ALTMANN LAB

Department of Psychological Sciences

Overall Question

How does the brain process and encode the meanings of sentences?

Specific Questions

How do we encode events, in which objects act on one another, causing the affected objects to change?

E.g. "*the squirrel cracked an acorn*"

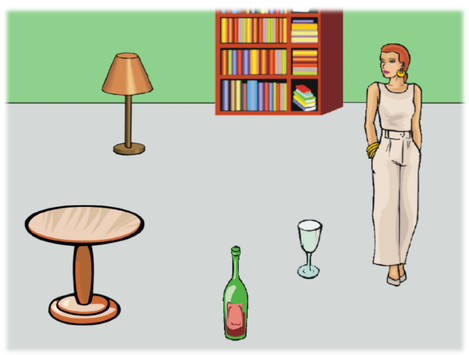
(The acorn was first intact, and then became cracked)

The Issue and its challenges

- Understanding sentences requires:
  - access to knowledge of the objects around us (e.g. the *class of acorns*)
  - instantiation of individual tokens of those objects (e.g. *a specific, mentioned acorn*), and
  - instantiation across time of the distinct states in which those tokens exist (e.g. *intact, then cracked*).
- How does the brain distinguish between **TYPES** (acorns in general), **TOKENS** (a specific acorn), and **TOKEN-STATES** (the specific acorn as intact or cracked)?
  - cf "semantic" vs. "episodic" memory
- How do different **memory systems** interact during language / event comprehension?
  - How does the brain control activation of one token-state rather than another?

Current empirical methods

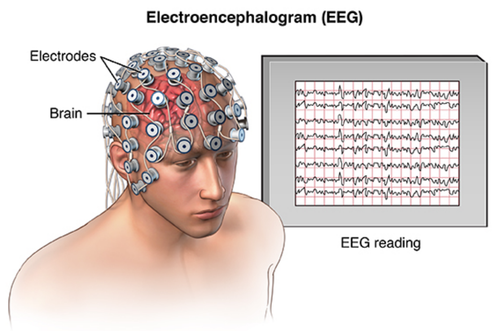
- Psycholinguistic studies of which representations activate, and when, during sentence processing.



The woman will move the glass onto the table…

Eye movements are monitored as subjects hear the sentence

- EEG and fMRI studies of sentence comprehension showing activation of distinct brain areas involved in selective attention (cognitive control), memory, and object representation



Current Empirical Challenges

- To combine high density EEG with fMRI to obtain high spatiotemporal resolution dynamics of brain networks involved in event comprehension.

  Collaborators: Kevin Brown / Sabato Santaniello (BME), Pete Molfese (BIRC), David Gow (MGH, Boston)
- To track the time-course of representational change; and the extent to which different memory representations may interfere with each other.

Future Challenges

- Can we build animal models of the Type/Token/Token-state distinction, and explore the genetic underpinnings of this sensitivity? **Collaborators**: Holly Fitch (Murine Behavioral Neurogenetics Facility)
- Can we build dynamical models of event comprehension in which the Type/Token/Token-state distinction emerges through learning and experience?
- How does the need to selectively attend to different token-states impact on language production (e.g. planning the utterance "the squirrel cracked that acorn")? **Collaborators:** Vic Ferreira (UCSD), Johannes Gerwien (Heidelberg)
- What are the implications for real-time language processing of the distinct ways in which different languages encode verbs such as "crack" (in Chinese, verbs explicitly encode the resultant state of an event)? **Collaborators**: Heeju Hwang (Hong Kong University); Elsi Kaiser (USC).