

Introduction to Linguistics

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Linguistics

- study of language

branches: theoretical,

social, computational,

historical, psych-, neural

levels: phonology, morphology, syntax, semantics, phonetics, pragmatics

Theoretical Linguistics: language tests, native speaker's judgement

Psycholinguistics - how language is represented in the mind, processing, acquisition as 1st and 2nd language

(phonetics & phonology) ~ speech production & perception

◦ a lot of focus on production vs comprehension

◦ online vs offline measure: real-time measures vs results

Neurolinguistics - mind → brain. Neurological basis of language

◦ language impairments

◦ neuroimaging

Clinical Linguistics: assessment & treatment, diagnosis of deficits

& tailoring there

Introduction to language testing in awake surgery

Awake surgery - maximize lesion removed & minimize damage

4-5s, not many fars

1-6 ml

Mapping vs monitoring vs dual tasks

stimulate w/o stimulus ↓ combine with physical fars

Change representation: verb/noun dissociation

Speech vs Language

physical (vocal) manifestation ↗ whole cognitive system

production vs comprehension

Information theory in Psycholinguistics

language structure \sim mental functions, systems
complexity of an aspect of language

- linguistic descriptions: framework + systematization
- probability theory: frequency of language events + probabilities
- information theory

Information load - surprisal - $I_e = -\log_2 P(e)$

The less likely the event \rightarrow the more information it conveys
amount of information carried by a word in many forms

↳ entropy average uncertainty

max = equally probable outcomes $\log_2 N \quad H(e) = \sum P_x \log P_x$

Shannon equitability $\frac{H_p}{H_{max}}$

redundancy = $1 - \frac{H_p}{H_{max}}$

Distributional Semantic Models of Cognition

- Wittgenstein 1953 meaning \sim usage, context
- semantic space = multidimensional semantic space
similar meanings \rightarrow similar arrays
- instead of dimensions: lexical co-occurrence, vector-based semantic analysis

for ambiguous words - separate vectors for individual occurrences

Neural network resolution: count \rightarrow predict

polysemy \rightarrow transformer neural networks

Neurodevelopmental language disorders

Braen functions → symptoms begin to show early comprehension or production

Neurodevelopmental vs acquired

in the development of the child

genetic vs degenerative

DNA deterioration of a function

Classification

DSM, ICD. Expert, pathologist associations. Overlapping, unclear signs

ICF - functional goals-oriented

primary vs secondary condition: Developmental Language Disorder vs different condition disorder, not impairment

Difficulties in acquisition, use of language due to deficit in the comprehension or production of vocabulary, sentence structure and discourse

- over different mediums

- onset in early developmental period

- not caused by trauma

Exclusion criteria: normal variations, sensory impairments, intellectual disability, neurological disorder, language regression (seizures, epilepsy)

Complex speech, language and communication needs

Symptoms: problems retrieving words, organizing sentences, having conversations, telling stories, hard to understand words, do not remember what someone said, difficulty paying attention, reading and writing

Brain: fast auditory processes? basal ganglia? less white matter?

Specific learning disorder: difficulties in learning. Reading, spelling, writing

Specific → exclusion: cognitive deficits, economic disadvantage, neurological, motor, sensory disorders, poor or inadequate education

Secondary trait in genetic conditions

Informing Cognitive Models of Language with Language testing

TMs - causal neuroimaging

in Awake Neurosurgery

Can be used before awake surgery

New hypothesis - testing with tasks that differentiate centers

First language acquisition

Language levels: phonetic & phonology, morphology, syntax, lexicography

Phonological development: speech perception, speech production, isolate the sounds of speech, decide the language input

Milestones phonological

- Birth: discriminate between languages, cannot syllables (vowels), perceive accent
- 1 month: discriminate between consonants
- 6-8 months: babble, sensitive to phonological properties of L1
- 8-10 month: vowel quality influenced by the ambient language, sensitivity to foreign consonantal contrasts starts to decline
- 10-12 month: cannot discriminate foreign consonants contrasts, use repertoire of consonants during babbling influenced by F1

Early vocalizations: reflexive crying (0-1 month), differentiating crying (1-4 m), cooing (2 m →), marginalized babbling (4-6 m), deduplicated babbling (6-8 m), varied babbling, proto-words

Milestones lexical:

- Birth: prosody, boundaries
- 6-8 m: phrasal coherence, lots of bi-phasic from L1 preferred

- 8 m: Distributive (regularly), recognizing
- 20-24m: Vocabulary spurt, multiword utterances, syntactic information to infer words meaning

Morpho-syntactic: parse sentences, build structural representations, categorize words, grammatical functions.

Stages-phases of language acquisition - same for all languages & children

Dynamics - depends on typological differences and individual factors influencing LA: innateness, caregiver, language input, and differences

Mechanisms: Innateness, imitation, analogy, reinforcement, association,

Major theoretical approaches: nativist, generativist motherese

vs constructivist, emergentist, socio-pragmatic, functionalist, usage-based

Gaze tracking

- pupil size, events (saccades, fixations)
- corneal reflection & pupil position ← calibration

Regressions - backward movement, 10-15°, sign of difficulty

Technical: distance from the screen, comfort of sitting so that people don't move

Areas of interest: should be of the same length, shouldn't be at the end, should be symmetrical-ish, style of images should be the same

Presentation programmes: from manufacturers or 3rd party
paradigm ~ research question + stimuli + population + equipment

* Preferred Preferred Looking Paradigm

- 2 images/stimuli + auditory stimulus, matching one of them

* Looking While Listening - different paradigms, frame by frame coding

* Visual World Paradigm - wdy 3 visual stimuli + auditory

- Blank Screen - after stimulus training anticipatory movements
- Self-paced reading - manually switch to show the next word only

Neuroanatomy for Linguists

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Sulci: longitudinal, lateral (frontal-temporal), central (Broca's, Wernicke's), parieto-occipital, transverse (from cerebellum)

Arteries: anterior (frontal), middle (fronto-temporal) & posterior (cerebral)



Representing the brain: glass brain,

inflated brain, anatomically correct

Cortex: 1.5mm - 5mm - unmyelinated cells, different layers (max 6)

Glia + +

Frontal lobe - decision-making, etc. Broca's area - linguistic production, primary motor cortex, emotions, behavior, self-awareness, problem-solving

Parietal - planning, orientation, visuospatial, attention, processing of sense

Temporal - Wernicke's area - language comprehension, primary auditory, object identification, learning & emotions

Occipital lobe - visual cortex

Right hemisphere - semantics, prosody, humor, ambiguity. Additional
Word meaning → general in right hemisphere ~ meaning
meaning in context left ~ metaphors

pSTG - posterior superior temporal gyrus

Area 44: prefrontal cortex, STG, superior temporal sulcus

Area 45: motor, somatosensory cortex

inferior Parietal cortex - semantics, domain-specific semantic WM capacity

OFC - adaptive learning, expectation

Left fusiform gyrus - letter recognition, face & body recognition

Posterior temporo-parietal cortex - on the right, self-other distinction, sense, semantic relakness, non-literal interpretation, orthography-to-phonology conversion

Posterior temporal cortex: phonology, semantics, object category, Zulu words, dorsal-living things. Lexical access.

STG: BA 41, 42, primary auditory cortex, semantics, morphology

Occipital lobe - visual cortex - luminosity, stimulus length, visual

Cortical anatomy: production vs comprehension, fluent vs non-fluent lessons

- affecting the anterior region of the central sulcus - spared comprehension even with severely impaired production, non-fluent patterns of speech
- posterior part: comprehension more damaged than production, fluent, agrammatism, paragrammatism

White matter

- myelinated, transmits information between grey matter points
- projected tracts (cortex to other regions, from the brain to other tissues), commissural (hemispheres), association (lobes)

Corpus callosum resection: right hemisphere can process language subnormally

Arcuate fasciculus: around the sylvian fissure or Wernicke-Geschwind posterior, long and anterior segments

Dorsal pathway - sound to motor \leftrightarrow speech repetition, complex syntactic means

Ventral pathway - sound to meaning \leftrightarrow basic syntactic, semantic

Subcortical structures

glutamatergic theory +
+ in the white matter

- Thalamus - relay for nerve impulses carrying sensory information, sleep disturbance of thalamus \rightarrow perseverations, erroneous words, thalamic aphasia

- Basal ganglia: voluntary movement, learning,
- Amygdala: emotion, memory
- Cerebellum: motor control, attention, language, emotional control
Cerebellar Cognitive Affective Disorder: agrammatism, motor, social, spatial
- Hippocampus: response inhibition, episodic memory, spatial cognition, speech feedback processing. Alzheimer, Down's syndrome, WS, Schizophrenia

Neuromodulation and neurotransmitters

- Dopaminergic system: FAS (foreign accent syndrome)
- Cholinergic - cues to reward, sensory attention, homeostasis. Recovery from post-stroke aphasia & apraxia

Applied Statistics

Cervical decision task: concreteness, emotional load, stimuli exposure
Measures: RT and accuracy

Variables: dependent/independent. Nominal, ordinal, interval, ratio

Factorial designs:

- comparing two groups; insignificant t-test for averaging over a different parameter to control; significant when testing the dep.var.
- More than 2 groups: independent measures one-way ANOVA
Interaction - two-way ANOVA

Mixed ANOVA ← independent & repeated measures

Correlational / designs

Mixed effects

Pre-processing: power

power at 0.2 - 80% explained Effect size - 0.5 - good. 0.2 - reasonable

Contrast coding: in independent variables at categorical levels at X: conditions (A, B, etc.)