

Course outline

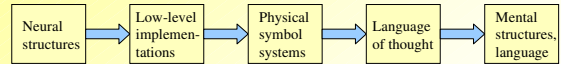
Introduction to the field, administrative details, talk planning
Neuronal learning and the biological concepts of language
Chomsky, Universal Grammar and the "poverty of stimulus"
Acquisition of morphology and early lexis
Acquisition of words and concepts
The emergence of grammar from the lexicon
Acquisition of syntax
Acquisition of semantics
Acquisition of concepts of space and time
Becoming a bilingual
Bilingual mental representation
Lexis of bilingual speakers
Processes in L2 acquisition
L2 learning hypotheses
Wrap-up

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Neurophilosophical trends in acquisition research

Cognitive functioning (incl. language): reduced to neural functioning (Churchland)
• reductionist approach that eliminates psychological explanations for language processing
• emphasis on relevance of neuronal measurements



Lenneberg (*Toward a biological theory of language development*) gives 5 biological premises:

1. cognitive function is species-specific
- cerebral functions mediate between sensory input and motor output
- cerebral functions correspond with cognitive functions

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Lenneberg's biological premises for language development

2. specific properties of cognitive function are replicated in *every member* of the species (form/function invariance)
3. cognitive processes/capacities are differentiated spontaneously with *maturation*
Lenneberg voluntarily disregards environment
• environment has status of delivering "building blocks" and primarily energy for differentiation
4. at birth, humans are *immature*, certain cognitive aspects emerge during infancy, some require *extra-organismic stimuli*:
• for development of visual perception it needs "properly illuminated objects"
5. social phenomena come about via spontaneous adaptation of behavior

Language is the manifestation of species-specific cognitive propensities

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Epigenesis and the relevance of input for language

Neville (1991): competition between inputs
• input deprivation leads to: *reduction* of responsive neurons therefore: early experience influences neural development

- a. neuron growth (size, number)
- b. dendritic branching increases
- c. myelination
- d. synapse number increase
→ mature values are reached at age 15

• in course of competition: important variable is the *temporal patterning* of the input: neurons that are active together tend to migrate + *aggregate*

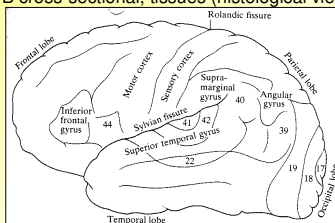
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Organization of language in the brain

Structures: Cortex and processing in dominant/non-dominant hemispheres (Garman 1990)
Structural aspects of the Cortex

A surface, convoluted (topographical view)
B cross-sectional, tissues (histological view)



A: surface is folded in *gyri*: small (*sulci*) + large (*fissures*)
Fissures:

1. longitudinal (divides hemispheres)
2. central/Rolandic (divides frontal and parietal lobe)
3. Sylvian (divides temporal and frontal/parietal lobe)
4. Superior temporal (divides upper and lower temporal)

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Functional aspects of language in the brain

Two hemispheres → parallelism of functions but also separation

Hemisphere asymmetry: *contralateral* control

Left: dominance; controls handedness, language aspects

- Occipital: vision
- Parietal: body-surface sense, spatial orientation
- Temporal: hearing, time
- Front of central fissure: motor

Broca's area: marked by inferior frontal gyrus

- important for *speech output*
- no specific cell characteristics
- controls articulators and oral tract functions *related to speech*

Wernicke's area: angular gyrus on temporal lobe

- is larger in dominant hemisphere than in the other
- suggests evolutionary adaptation to language
- close to auditory area and to visual cortex

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Neurobiology of cognitive learning

Information coding in brain: impulse sequences between neurons code in *temporal patterns*, parallel architecture
 Spine synapses: have synaptic contact *across synaptic cleft*

Learning = intense activity of a synapse that leads to potency increase of synaptic action (Eccles 1992)

- increased size/effectiveness of synapse and number growth
- granule cells discharge to activate *pyramidal cells*
- experimental evidence: after 4 stimuli: EPSP (*excitatory postsynaptic potential*) shows doubly strengthened synapses for 10 hrs
- provides model for memory, synapse "remembers" activation
- model is used in connectivist theories in semantics, AI research



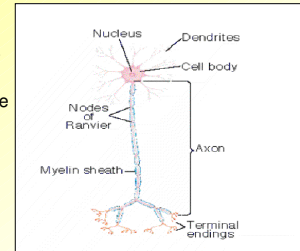
Architecture of a neuron

Dendrites: short branches projecting from cell body
 • receive messages from other neurons

Cell body (soma): contains the nucleus of the cell

Axon: a long tube which carries information from cell body to synaptic terminals

Synaptic terminals: secrete transmitter substance



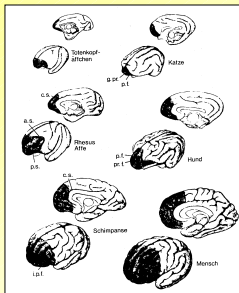
Neurotransmitters generate EPSPs

- control ionotropic receptors
- flux of ions across membranes depolarizes neuron („firing“)



Cognitive learning and memory processes

Role of hippocampus in memory: patient HM, loss of LTM



implicit vs. explicit memory (Popper)
implicit: not recognized as special memory event, cf. knowledge of language, moving limbs etc.,
 • HM still retained implicit learning
explicit: faces, objects, music...

Humans show *larger proportion* in prefrontal cortex than other species
 Humans: 29%,
 Chimps: 17%
 Macaques: 11-13%
 Dogs: 7% vs. Cats: 3,5%
 cf. Changeux/Connes



Chomsky's argument of a "poverty of stimulus"

APS: **under-determination of theory by data**

The facts:

- child perceives finite # of sentences, acquires comprehension for sentences drawn from infinite #
- Chomsky 1980 uses "poverty of stimulus"
- 1. children acquire language rapidly and uniformly
- 2. children are only exposed to a finite amount of data
- 3. children appear to converge on a grammar capable of interpreting unfamiliar sentences
- **conclusion:** some aspect of grammar must be *innate* (Marcus 2001:660)
- dependence on parental correction of errors is ruled out
- plausible errors never occur, cf.
- The dog is barking* → *Is the dog barking?*
- The dog that is barking is black* → **Is the dog that is barking is black?*



Innateness and the LAD

→ Information from the environment: not rich enough to transform language input (I) into grammar (G)

- any decision on a mental rule could be made with **almost infinite** possible logical generalizations
- cf. almost identical surface structures
- John is eager to please*
- John is easy to please*

but: choice is determined by *innate learning mechanisms*

LAD: Language Acquisition Device,
 = a mental organ on basis of the UG
 • excludes systematically regular plurals from compound
 cf. plural + compounding: *mice-infested* vs. **rats-infested*

Controversy: Exist constraints to other cognitive faculties?



Universal Grammar: Levels of evidence

1. crosslinguistic investigations
 - similarity of languages around the world, even languages without contact and features without conceptual motivation
 - property in one language is also found in unrelated languages
 2. Rapid and uniform acquisition of **all** children without instruction
 3. modularity and language
- IF fact can be informationally encapsulated
 IF fact of an individual speaker is a fact in all known languages and
 IF fact is not acquired as imitation of input data
 → evidence that fact comes from specific feature of UG
UG: the study of the common grammatical properties shared by all natural languages and of the parameters of variation between the languages



Universal Grammar: Examples and application

cf. Thematic roles: e.g. AGENT, INSTRUMENT, found in all lang.
= reflects language-independent categorization schemes

- language-independent categories are mapped into specific syntactic positions (e.g. AGENT → subject position)
- principle of UG, mapping is innate
- research focuses on phenomena where functional explanation is least likely

example: dysfunctional aspect in *Wh*-questions (cross-linguistic)
UG allows for language variation, it limits range of variation e.g. position of the finite verb

UG defines parameters of possible variation

- acquisition = setting of parameters
- only **real** variation: in the lexicon

Controversy: Is UG at the core a default grammar?


- Some evidence from isolated acq. and bird songs



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Acquisition of early lexis: object properties

Acquisition: across domains (language, objects, space, time)
→ supports domain specificity in cognitive development

- suggests that domains are coordinated from a **unified level**
- children: have context-specific knowledge in word learning
- connection object – noun is established
- act of learning of a 2-year old: underdetermined ("turtle") 
- one learning episode: sufficient to categorize
- knowledge of one instance = knowledge of full category
- experiment: object with name/without name
shape-similar, texture-similar, color-similar objects

- with name: dominance of
- with name: dominance of



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Acquisition of boundedness and countability

Shape experiments: suggests that N stand for shaped categories

- other dependencies: *object has eyes* → shape and texture dominates

object is unbounded ("sugar") → color and texture dominate
split:

count N	mass N
syntactic context: "This is a X"	syntactic context: "This is Y"
morphol. context: plural	morphol. context: no plural
shape dominance	texture, color dominance

- suggests that same lexical meaning is *pre-conditioned* before acquisition



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Acquisition of morphology

= acquisition of structural makeup of words
involves difference content words/function words
morphemes: phonologically realized as allomorphs
inflectional: grammatical realization of same words
derivational: a different word

- order of acquisition: depends on linguistic complexity
- does not depend on frequency of use (Brown),
-ing, -ed, -s, number/earliness, is/are/was/were
- index MLU (mean length of utterance), measures linguistic complexity
- inflectional morphemes:
allomorphs are
- phonologically determined (*rats, tags, judges*)
- morphologically determined: *ox, mouse*



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Acquisition of inflectional and derivational morphemes

→ pluralization of nonsense words (Berko)
order: progressive – plural – possessive – 3rd-Person-s

- irregular inflection: often overgeneralized
- rules are invented to cover full spectrum
eated → *ated* → *ate*; *feet* → *foots* → *feet*

Derivational morphemes:

- less productive than inflectional morphemes

A.) -er (Agentive, Instrumental)

B.) -ie/y (Diminutive)

C.) -ly (Adverbial)

D.) -y (Adjectival)

E.) compounds

(order: - - - -)



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Acquisition of words and concepts

Approaches in word learning

1. constraint theory (Markman et al.)
 - existence of domain-specific constraints for word mapping
 - innatist, compatible with UG
2. domain-general approach (Smith et al.)
 - inference ability develops
 - constructivist, related to "nurture"
3. social-pragmatic theory (Tomasello et al.)
 - conversation partners (e.g. parents) provide clues for mapping (gestures, eye-gaze)

Golinkoff et al.: hybrid model of 1-3

- establish set of 6 principles
- words are used to **refer** (principle of reference)



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Principles of early word learning 1

Basis principles:

- Central relationship:
 - object + symbol: a "goes with" - relation
 - symbol + object: a "stands for" - relation
 - **principle of reference**
- Memory limitations enforce categorization
 - **principle of extendibility**
- Objects* in contrast to *actions/events* AND *objects* in contrast to *parts of objects*
 - **principle of object scope**

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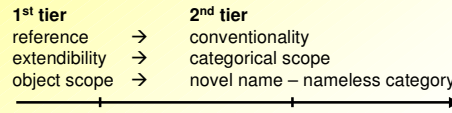


Principles of early word learning 2

Evolution of the basic principles:

→ must be consistent with social environment

- (**principle of conventionality**)
- extendibility evolves as the categorical basis is confirmed
- (**principle of categorical scope**)
- nameless objects are deliberately identified
- (**principle of novel name – nameless category**)



year 1 (adapted from Golinkoff et al. 1999)

year 2

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Concept acquisition: Innatism vs. Constructivism

Compromise between innatism (Chomsky) and constructivism (Piaget): existence of **cognitive primitives**

- common root: pool of general-purpose computational abilities
- genetic setup allows for computational primitives (Papert)

Fodor: advocates most extreme innatist position

- there is "nothing new to be acquired"
- growth of language + knowledge: unfolding of predetermined developmental stages
- involves specialization and restriction of competence
- general learning mechanism does not exist

Therefore: **Learning is inductive extrapolation**

→ from sets of beliefs about experiences to general beliefs involves hypothesis formation and confirmation

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The emergence of grammar from the lexicon

Empiricists (Aristotle, behaviorists) vs. Nativists (Plato, Chomsky)

- non-nativists focus on interactionism, strong forms: constructivism (Piaget) and emergentism

Emergentism:

- outcome is not predictable from individual inputs
 - logic and knowledge emerge from successive interaction of perceptual activity and a structured world
 - grammar emerges when a rich set of meanings is mapped onto narrow speech channel
- emergentists acknowledge that a general problem-solving faculty is innate
 - propose "language-facilitating mechanisms"
 - grammar = class of possible solutions to mapping between high-dimensional meaning space with universal properties and low-dimensional channel that unfolds in time**

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Vocabulary size and mean grammatical complexity

Bickerton et al: single word stage and before: **pre-linguistic**
 Locke: rule mechanism starts after collecting a **critical mass-number of utterances: morphosyntactic "burst"** (24-30)

lexicon	grammar
finite	infinite
language-specific	universals exist
inductively acquired	deductively acquired

→ discrete jump in development suggest: grammar and lexicon are **separate**
 strong lexicalization: grammar + lexicon are acquired and handled by the **same mental mechanisms**

Bates/Goodman: measure similar function between complexity and vocabulary size

Grammar = a function of vocabulary size

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Acquisition of syntax: Principles and parameters

Chomsky 1986: Knowledge of language/*principles and parameters*
 • grammatical variation across languages is result of limited variation on universal principles

- parameters are set by children via simple positive evidence
- acquisition of grammar = determining correct values for parameters**
- input: only trigger, not used for induction/analysis

Example: **parameter of optionality of overt subjects**

A tensed sentences must have overt subjects, cf. English and German (*I go to the movies*)

B null-subjects are possible in Spanish, Italian (*Soy alemán*)

→ **parameter setting = determining optionality of subjects**

• arguably, the same parameter controls expletive subjects as in *It is raining*

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Null-subjects phenomenon: Parameter explanations

Utterances like *Writing book*, *See running* in telegraphic phase

explanation 1: children know subjects are obligatory but omit them for performance reasons (Bloom et al.)

- difficulty of producing long strings of morphemes

I play in bed → *Play bed*

- performance limitation, **MLU (mean length of utterance): 2**
- corpus studies: 2-year olds drop 55% of all subjects, 9% of all objects

explanation 2: child grammar **differs** from adult's grammar

- resembles Italian-like grammar (subject dropping) or Chinese-like grammar (topic-dropping)
- both makes them **temporarily insensitive** for triggers

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Inflectional elements and the Null-subjects phenomenon

Early theories: children ignore inflectional elements

I am not going → *Me no going*

- **current** tool of research: correlation of word order and morphology up to 3 years of age

- children know morphosyntactic properties of finiteness even though they use finite and non-finite verbs **alternatively**

→ **optional infinitive (OI) stage** (Wexler)

- very early parameter setting (VEPS), set at very early age, 2;0 or even 1;6

- Poeppel/Wexler on subject-verb agreement in German:

either correct inflection or uninflected form is used

English: never errors like **I likes candy*

- hypothesized that very early parameter setting occurs for which

-s means 3rd person

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Null-subjects phenomenon: Morphosyntactic explanations

Hyams on use of Null-subjects: *Baking cookies*

- Hyams' interpretation: children **wrongly** set this parameter
- new evidence suggests: Null-subject is used in all languages by children

Explanation: Wexler sees evidence that children consider any language as a null-subject language at an early age

→ **null-subject is grammatical for children**

Indicator: use in *Wh*-questions only when without tense

e.g. *Where going?* But never **Where is going?*

→ if English was a Null-subject language it would be used with tense

→ also indicator that theories employing only general mechanisms of learning are ruled out

- also argues for delayed A (Argument)-chaining (passives)

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Principles and parameters: Problems and clues

1. P&P: reduced to inflection or for many grammatical principles?
2. What kinds/amounts of primary linguistic data (PLD) are used by the learner for assigning settings to particular parameters?
3. How does the triggering in 2. work?

Some clues found in **Creolization**

- parameter setting is hierarchically organized

- Bickerton: **bioprogram hypothesis:**

learner manifests parameters with primary linguistic data mostly absent

→ indicates that parameters are **accessible without triggers**

Evidence: structural **similarities across Creoles**

- also supports that inflectional data is overrated

- field research observes discontinuities

→ result is a divergence of target grammar and final grammar

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Acquisition of spatial semantic categories: Problems

1. Is non-linguistic spatial perception implicitly categorized?
2. Is spatial perception organized in perceptual primitives?
3. → Is space divided according to language?

- Whorf: language shapes the understanding of the world

Counterevidence:

- Piaget shows cognitive pre-linguistic development
- Rosch, prototypes: language categories are less arbitrary, more "given" by nature;

children categorize before they have names for objects

- Berlin/Kay: colors have stable conceptualization across cultures

Cognitive hypothesis: spatial acquisition bases on pre-linguistic cognitive achievements

- children acquire morphemes to express spatial concepts they already have (through perception)

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Parameters and evidence of the Cognitive hypothesis

- a.) children know much about space before they talk
- b.) linguistic and non-linguistic structuring of space is related; biology imposes constraints like top-bottom, front-back asymmetry and gravity etc.

- **P-space (perceptual space) is isomorphic with L-space (language space)** (Clark)

- c.) acquisition of spatial words is preceded by the **unfolding of non-linguistic spatial knowledge** (Bowerman)

Evidence:

A. children communicate spatial relationships without morphemes:

towel bed;

on, in; first PREPs that are missed are the first PREPs acquired

- earlier acquired: postnominal marker (Japanese),

- later acquired: prenominal marker (English, German)

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More evidence for the Cognitive hypothesis

B. Order of prepositions is universal

1. Functional-topological (*in*)
2. Support and continuity (*on*)
3. Occlusion (*under*)
4. Proximity (*behind, beside, between*)
5. Projective order (*in front of*)

C. nonlinguistic/linguistic asymmetry

- front/back can be distinguished before words (*before/behind*) are acquired
- containment/support can be distinguished before words (*in/on*) are acquired

→ **hypothesis 1: Morphemes are mapped onto pre-linguistic knowledge (Bowerman 1999:149)**

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Bowerman's argument for language-depend. spatial relations

Spatial relationships vary from language to language

a.) *in* → containment (*apple* → *bowl*)

b.) *on* → support (*cup* → *table*)

English: a.) extends to c.) *cassette* → *case*

b.) extends to d.) *lid* → *bowl*

grouping: a.) + c.) and b.) + d.)

Korean:

grouping: a.) + b.) and c.) + d.)

different conceptualization: fitting of two objects together

English *on*: objects are in contact, o_1 supports o_2 but does not contain it

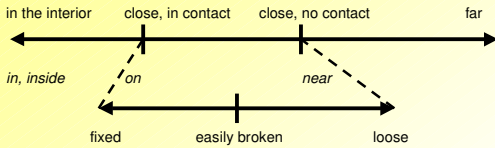
cf. *handle on pan, fly on wall, diaper on baby*

• captured in figure-ground/ "relative distance" relationships

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The continuum of relative distance (Landau/Jackendoff)



→ children learning different languages: attend to different spatial relationships (Bowerman)

• English, German, Dutch, Finnish: ignore shape of figure/ground

• Mesoamerican languages: categorize according to shape

hypothesis 2: children discover grammatical marking according to their own categories

• **so-called primitives are influenced by language of those who pose these primitives**

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