What is Language
What is Language?

- A type of communication
- but not just any type of communication
- Language involves *symbolic reference*
Indicative vs. Symbolic Reference

- **Indicative reference** involves responding distinctively to stimuli in the presence of an observer.

- Vervet monkeys make distinctive calls depending on whether the predator is a leopard, eagle, or snake; for the other monkeys, these calls indicate the presence of a certain predator.
Vervet alarm calls

Leopard

Eagle

Snake

8 kHz

1 kHz

0.5 s
Indicative vs. Symbolic Reference

Symbolic reference involves an arbitrary sign that stands for a class of objects that may or may not be present.

A boy can say “wolf” to refer to one wolf (“help! wolf!”), several wolves (“observe the wolf in his natural habitat”), or no wolves (“Yup, I’m a wolf scout”).
Language:

a visual/auditory code for combining referential symbols
B.F. Skinner was confident that language could be explained by reference to just those principles of behavior formulated on the basis of results with animal subjects.

For example, if a reinforcer is delivered frequently with high intensity it should increase the likelihood of behavior.
Chomsky: To say that each bit of verbal behaviour is under stimulus control is a scientifically empty claim, because some stimulus can be posited to occasion any response.
Stimulus

“Nice! Nice! Nice! Nice!”

“[long pause] nice”

“crooked, isn’t it?”

“Do you remember our camping trip”

Response
The Language Acquisition Device

- **Chomsky:**
  - Grammatical rules are aspects of the human mind that link spoken sentences to the mind’s system for representing meanings.
  - All grammars are based on these fundamental rules that are innate properties of the human mind.
  - The Language Acquisition Device (LAD) was Chomsky’s shorthand for universal grammatical rules and for the inborn mechanisms that guide children’s learning of the unique rules of their culture’s language.
Morphology (rules for forming complex words, including regulars)

Phonology (rules that define the sound pattern of a language)

Lexicon (stored entries for words, including irregulars)

Semantics (meanings expressed through language)

Syntax (rules for forming phrases and structures)

Beliefs & Desires

Mouth & Ears
Evidence of Grammatical Rules
Rule for regulars: “The past tense of a verb may be formed from the verb followed by the suffix -ed”
## Inflectional Morphology

- Rules versus stimulus-stimulus associations (Prasada & Pinker, 1993)

<table>
<thead>
<tr>
<th>Verb</th>
<th>Human Production</th>
<th>Connectionist Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>mail</td>
<td>mailed</td>
<td>membled</td>
</tr>
<tr>
<td>conflict</td>
<td>conflicted</td>
<td>conflafted</td>
</tr>
<tr>
<td>wink</td>
<td>winked</td>
<td>wok</td>
</tr>
<tr>
<td>quiver</td>
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<td>satisfy</td>
<td>satisfied</td>
<td>sedderded</td>
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<td>smairf</td>
<td>smairfed</td>
<td>sprurice</td>
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<tr>
<td>trilb</td>
<td>trilbed</td>
<td>treelit</td>
</tr>
<tr>
<td>smeej</td>
<td>smeejed</td>
<td>leefloag</td>
</tr>
<tr>
<td>frilg</td>
<td>frilged</td>
<td>freezled</td>
</tr>
</tbody>
</table>
Support for Chomsky’s theory

1. Genetic disorders affect specific aspects of language.
2. Specific aspects of language are also disrupted by specific brain damage.
3. Language learning goes through a **universal sequence of development**.
4. Young *children invent grammar* when it is lacking in the environment.
5. Language, like many other innate abilities, seems to go through a “**critical period**”.
6. Only humans are capable of acquiring language.
Genetic Evidence

- **Specific Language Impairment** (Gopnik & Crago, 1991)
  - “Carol is cry in the church”; difficulty with productive inflectional morphology
  - Among 31 members of the KE family spanning 3 generations, 50% were impaired (as if the syndrome were controlled by one dominant gene or string of genes sitting next to each other on the chromosome)
  - In 1998, blood samples from 27 family members were taken a stretch of genes on chromosome 7 (SPCH1) correlated perfectly with existence of impairment
  - SPCH1 known to affect axon pathfinding, production of kinases, and growth and differentiation
Genetic Evidence

- **Williams Syndrome**
  - deletion of about ten adjacent genes on chromosome 7
  - very low IQ, but high social skills and very high language ability*
  - Exceptional (if odd) vocabulary: high in low-frequency words; *evacuate the glass*, birds: *shrike* and *spearhawk*
  - Hyper-overregularize: overregularize irregulars (e.g., *catched* and *slepted*), pass Wug test, but do terribly at guessing new genders (e.g., *bicron* as masculine, *faldine* as feminine)
Genetic Evidence

A possible generalization:

- Language is a specialization of the brain that depends on generative rules that allow computation of regular forms.
- Genes of one group (SLI) impair their grammar and ability to regularize but not their IQ; genes of another (Williams) impair their IQ but not their grammar and ability to regularize.
Neurological Evidence

• **Anomia versus Agrammatism**
  • Damage to the posterior LH (Wernicke’s area) typically results in *anomia*, a difficulty in retrieving words despite otherwise fluent speech
    • “She wikses a zen from me.”
    • “He mivs in a love-beautiful home”
    • “Waitresses. Waitrixies. A backland and another bank. For bandicks er bandicks I think they are, I believe their zandicks, I’m sorry, but they’re called flitters landocks.” [attempting to name a box of matches]
    • Fine at inflecting novel verbs like *plam* and often overregularize (like *digged*)
Neurological Evidence

- **Anomia versus Agrammatism** (Ullman et al., 1997)
  - Damage to the anterior LH (Broca’s area) typically results in *agrammatism*, a difficulty in producing fluent speech despite otherwise intact vocabulary
    - “Son..university..smart...boy..good...good”
    - “Lower falls..Maine...Paper. Four hundred tons a day!”
  - Misread smile as “smiled” or wanted as “wanting” but do not commit similar errors for irregulars
  - Incapable of inflecting novel words (e.g., *plam*) and never overregularize irregulars (e.g., *digged*)
  - *Walk* does not prime *walked*, but *found* primes *find* and *goose* primes *swan*
Neurological Evidence

- A possible generalization
  - Anomics have preserved mental machinery for producing grammar and regular words; agrammatics have preserved mental machinery for memorized words (including irregulars) but impaired machinery for following rules
Universal Sequence of Language Development

1. Phonological Development
2. Semantic Development
3. Syntactic Development
Phonological Development

- **Influence of Perceptual Learning**
  - *Perceiving the mother’s voice*:
    - As early as 3 days old, infants prefer to listen to human speech rather than music.
    - Infants as young as 2 hours old prefer to hear the sound of their mother’s voice to that of another woman.
  - *Perceiving the mother tongue*:
    - Babies under 6 months can hear the difference between any 2 phonemes in any of the world’s languages
    - After that they can only perceive the differences used in their native language.
• **Early use of phonemic recombination**
  – In the first 8 weeks, infants just cry, burp, cough, and sneeze.
  – Between 8-20 weeks, they playfully draw out their vowels (oooooooh-oooooooh) in *cooing*.
  – Between 16-30 weeks, they produce single distinctive syllables (*vocal play*), and between 25-50 weeks, they repeat strings of alternative vowels and consonants (*reduplicative babbling*).
  – Finally, between 9 to 18 months, reduplicative babbling takes on a variety of stress and intonational patterns in a sort of *expressive jargon*.

• **First Words**
  – Early words seem to consist of many performatives, which are wordlike sounds that accompany very specific actions. For example, one child used the word *nenene* only for scolding and *tt* when calling squirrels (Leopold, 1949).
  – Later these sounds may be used simply for describing the world.
Semantic Development: Word Reference

- Quine: The Problem of Indeterminacy (or the Gavagai problem)
Semantic Development: Word Reference

Words refer to kinds of things. “Ball” refers to all balls that ever have existed, now exist, and will ever exist. So when Plato says that a ball is a perfect shape, I know what he means just as well as when a toddler points to the left and says “Ball!”

How do children learn the meanings of words?
Errors that children do make:

- **Overextensions**: using a term more broadly than adult usage would allow. For example, extending ball to oranges, planets, and plates.

- **Underextensions**: using a term more narrowly than adult usage would allow. For example, extending up only to being taken up into a parent’s arms, rather than as a general spatial term.
Semantic Development: Strategies for Learning Words

• **Whole Object Assumption**: Toddlers assume that novel labels refer to the whole object and not to its parts, substance, or other properties.
  
  – For example, Soja, Carey, and Spelke (1991) introduced toddlers to a novel object made of a novel distinctive substance, saying, “This is my blicket.” Then the children were shown an object of the same shape but different material and pieces of an object made of the original material. When asked to find the *blicket*, the toddlers consistently chose the whole object.
• **Taxonomic Assumption:** When toddlers learn new words, they focus on taxonomic rather than thematic relations.
  
  – Markman and Hutchinson (1984) presented toddlers with two taxonomically related objects, such as a dog and a cat, and a third object that was thematically related, such as dog food.
  
  – When simply asked to find two objects that are alike, most toddlers selected the dog and dog food.
  
  – When the dog was labeled with the new word *dax* and children were asked to find another *dax*, they reliably selected the cat.
• **Mutual Exclusivity Assumption**: Toddlers prefer one label per object.
  – Liittschwager and Markman (1994) taught 16-month-olds a novel label for either an object that already had a known name or for one that did not: the babies learned the first labels but not the second.
  – Markman and Wasow (1999) placed objects with well known labels (e.g., spoons) on a table, and asked 16-month-olds, “Can you show me the *mido*?” Rather than picking up the spoon, they spontaneously looked around the room for the *mido*.
Are these “assumptions” necessary for word learning?

- **Smith**: Word learning comes about from domain-general associative processes, such as learning to associate noun tokens with distinct shapes.

- **Tomasello**: Word learning comes about from using social-pragmatic information.

- **Gelman & Bloom**: Word learning is so opportunistic that neither shape-biases nor social-pragmatic information alone provide necessary and sufficient conditions for word learning.
Syntactic Development

- **Telegraphic Speech** (18-24 months) consists of simple two-word combinations (Brown, 1973).
  - For example, *Mommy fix, Mommy sock, Baby table*
  - Although these sentences do not appear grammatical on the surface (as in *Mother gave John lunch in the kitchen*), children’s two-word utterances do preserve grammatical order.

<table>
<thead>
<tr>
<th>AGENT</th>
<th>ACTION</th>
<th>RECIPIENT</th>
<th>OBJECT</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother</td>
<td>gave</td>
<td>John</td>
<td>lunch</td>
<td>in the kitchen</td>
</tr>
<tr>
<td>Mommy</td>
<td>fix</td>
<td>[my toy]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mommy</td>
<td>[look]</td>
<td>[at the] sock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[The] Baby</td>
<td>[is]</td>
<td></td>
<td></td>
<td>[on the] table.</td>
</tr>
</tbody>
</table>
Babies who spoke in only single words were seated in front of two television screens, each of which featured a pair of adults dressed up as Cookie Monster and Big Bird.

One screen showed Cookie Monster tickling Big Bird; the other the opposite.

Meanwhile, the children heard a voiceover, “OH LOOK!!! BIG BIRD IS TICKLING COOKIE MONSTER!! FIND BIG BIRD TICKLING COOKIE MONSTER!!” (or vice versa).

Babies reliably looked at the screen that depicted the sentence they heard, suggesting they understood word order before they were producing linguistically sophisticated utterances.
Consider these sentences from a little boy called Adam over the course of a year:

- 2;4: See marching bear go? Screw part machine. That busy bulldozer truck.
- 2;5: Now put boots on. Mommy talking bout lady. What that paper clip doing?
- 2;6: Write a piece of paper. I lost a shoe. No, I don’t want to sit seat.
- 2;7: Where a piece a paper go? Ursula has a boot on. Shadow has hat just like that.
- 2;8: Let me get down with the boots on. Don’t be afraid a horses.
- 2;9: Where Mommy keep her pocket book? Show you something funny.
- 2;10: Look at that train Ursula brought. I simply don’t want put in chair.
- 2;11: Do want some pie on your face? I finish drinking all up down my throat.
- 3;0: I going wear that to wedding. They are going sleep in wintertime.
- 3;1: I like to play with something else. You know how to put it back together. You want to give me some carrots and some beans?
- 3;2: I’m going to mail this so the letter can’t come off. Can I put my head in the mailbox so the mailman can know where I are and put me in the mailbox? I want to have some espresso. Can I have some sugar? Can I keep the screwdriver just like a carpenter keep the screwdriver?
Syntactic Development: What Develops?

Bushier trees:

- The two-year-olds’ Big doggie (two-branch noun phrase) and Give doggie paper (three-branch verb phrase) becomes the three-year-olds’ Give big doggie paper (two-branch noun phrase embedded inside the middle branch of the three-branch verb phrase)

Acquisition of function words like of, the, on, and does

- By 3, children are using these function words more often than they omit them, many in more than 90% of the sentences that require them.
• Acquisition of inflections like -ed, -ing, and -s.
  – Inflections are not simply memorized, but are applied creatively.
  – Jean Berko (1958) showed children a funny shaped thing and told them “This is a wug.” Then she showed them two of the funny shaped things, and continued “Now there is another one. There are two of them. There are two ____.” The three-year-olds had no trouble inferring that there were two wugs.
• For the three-year-olds, errors such as mens, wents, Can you broke those?, What he can ride in?, and Button me the rest occur in only 0.1% to 8% of the opportunities for making them.
Syntactic Development: What Develops?

- Acquisition of auxiliaries like can, should, must, be, have, and do
  - There are about 24 billion billion logically possible combinations of auxiliaries (e.g., He have might eat; He did be eating), of which only a hundred are grammatical (He might have eaten; He has been eating).
  - Stromswold (1990) analyzed some of the errors that would be logical generalizations of the sentence patterns children heard from their parents. For example, adults turn He seems happy into Does he seem happy? Children might be tempted then to turn She could go into Does she could go? Or: I like going becomes He likes going, so I can go might be He cans go. Of 66,000 sentences Stromswold analyzed, she found no errors.
How do children acquire these grammatical rules?

1. Adam’s hypothesis: Imitating parents

2. Saffran: Detecting statistical regularities in the input

3. Marcus: Learning algebraic-like rules

4. MacWhinney: Rote-rule-analogy

5. Bickerton: There is no learning.
Father: Where is that big piece of paper I gave you yesterday?

Child: Remember? I writed on it.

Father: Oh, that’s right.

(Marcus, 1992)
Child: Nobody don’t like me.

Mother: No, say ‘nobody likes me.’

Child: Nobody don’t like me.

Mother: No, say ‘nobody likes me.’

Child: Nobody don’t like me.

Mother: No, say ‘nobody likes me.’

Child: Nobody don’t like me.

Mother: No, now listen carefully, say “NOBODY LIKES ME.”

Child: Oh! Nobody don’t likes me.
“For experimental purposes, I have occasionally made an extensive effort to change the syntax of my two children through correction. One case was use by my two-and-a-half daughter of other one as a noun modifier.

Over period of a few weeks, I repeatedly but fruitlessly tried to persuade her to substitute other+N for other one+N. With different nouns on different occasions, the interchanges went somewhat as follows:
C: Want other one spoon, Daddy
F: You mean, you want THE OTHER SPOON
C: Yes, I want other one spoon, please, Daddy
F: Can you say ‘the other spoon’?
C: Other...one...spoon
F: Say ‘other’
C: other
F: Spoon
C: Spoon
F: Other...spoon
C: Other...spoon. Now give me other one spoon?

Further tuition is ruled out by her protest, vigorously supported by my wife.” (Braine, 1971, p. 160-161)
Bickerton’s hypothesis

- Children do not learn grammar from their parents; they invent it themselves.

- Parents speak the same grammar as their kids because kids (fairly often) grow up to be parents themselves.
A Grammar-Deprivation Experiment

• Some communication systems, such as *pidgins*, have little in the way of grammar.
• *Pidgins* are choppy strings of words borrowed from overheard language.
  – For example, the Atlantic slave trade and indentured servitude in the South Pacific was supported in part by mixing laborers from different languages.
  – To carry out practical matters, the speaker of the different languages had to develop a make-shift jargon drawn from the speech of their masters.
A similar situation developed around the turn of the century in the booming Hawaiian sugar business, which had to import workers from China, Japan, Korea, Portugal, the Phillipines, and Puerto Rico, whereupon a pidgin quickly developed.

Bickerton (1984) studied this system and recorded such sentences as

- *Me cape buy, me check make.* (He bought my coffee; he made me out a check.)
- *Building--high place--will pat--time--nowtime--an’ den--a new tempecha eri time show you.* (a description of an electric sign that displayed time and temperature)
- *Good, dis one. Kaukau any-kin’ dis one. Pilipine islan’ no good. No mo money.* (It’s better here than in the Phillipines; here you can get all kinds of food, but over there there isn’t any money to buy food with.)
Children’s Invention of Grammar

- But pidgins can be converted to creoles, with a full range of grammatical rules, in one generation by the children who grow up hearing the grammarless pidgin. Examples from the Hawaiian Creole of a Japanese papaya grower born in Maui.
  - *Da firs japani came ran away from japan come.* (The first Japanese who arrived ran away from Japan to here.)
  - *Some filipino wok o’he-ah dey wen’ couple ye-ahs in filipin islan’.* (Some Filipinos who worked over here went back to the Phillipines for a couple of years.)
  - Thus, creoles come to possess standard word orders and grammatical markers that can be found neither in the pidgin of their parents nor in the language of the colonizers.

- The basic grammar of the creoles are very similar to the errors of English-speaking children
  - Why he is leaving?
  - Nobody don’t likes me.
  - I’m gonna full Angela’s bucket.
Children’s Invention of Grammar

- A similar pattern occurred when the communists took over Nicaragua.
- The Sandinistas assembled and forced deaf adults to lip-read Spanish (a policy that almost always fails).
- The adults adapted to the ineffective Sandinista policy by developing a *pidgin* sign language.
- As Bickerton would have predicted, the children of these adults converted the *pidgin* sign language into a true grammatical language, which is now the official sign language of Nicaragua.
Children learn many of the rules of language on their own and create ones that otherwise don’t exist.

What happens if children receive no language input at all?
Evidence for Critical Periods in Language Acquisition

- **Isabelle**
  - Discovered at the age of six, Isabelle was raised by a deaf single mother who was emotionally indifferent to Isabelle’s well-being.
  - Initially, no language; cognitive development below normal for a two-year-old.
  - Taken into foster care without exceptional training.
  - Within a 18 months, she learned to speak, her intelligence was tested as normal, and she joined a class of second graders who spoke about as well as she did.
  - “Why does the paste come out if one upsets the jar?”
  - “Do you go to Miss Mason’s school at the university?”
Evidence for Critical Periods in Language Acquisition

- **Genie**
  - Discovered at the age of 14, Genie had been tied to a chair since about 20 months old. She was frequently beaten and never spoken to (but sometimes barked at--her father said she was no more than a dog).
  - Initially, no language; cognitive development below normal for a two-year-old.
  - Taken into foster care, Genie was given focused one-on-one training and therapy by psychologists and linguists for seven years.
  - Genie never became a normal language user, never acquiring function words nor combining propositions together in elaborate sentences.
    - “Mike paint.”
    - “Applesauce buy store”
    - “Genie have Momma have baby grow up”
    - “I like elephant eat peanut”
• **Critical period in language acquisition.** Many congenitally deaf children have parents who refuse (like the Sandinistas) to allow their children access to ASL.

• Such children’s fist exposure, therefore, is often late in life.
  – Newport (1990) examined the language of these adults as a function of when they were first exposed to ASL. In short, although all could use ASL fairly fluently (after 30 years practice!), those who had been first exposed after 11 were consistently less fluent than those who had been first exposed at 4, who were less fluent than those who grew up with ASL.
Critical Period Effects in Second Language Learning: The Influence of Maturational State on the Acquisition of English as a Second Language

JACQUELINE S. JOHNSON AND ELISSA L. NEWPORT

**TABLE 1**
The Distribution of Early and Late Arrivals in Terms of the Number of Years They Lived in the U.S.

<table>
<thead>
<tr>
<th>Years in the U.S.</th>
<th>Age of arrival</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3-15</td>
</tr>
<tr>
<td>3-6</td>
<td>4</td>
</tr>
<tr>
<td>7-10</td>
<td>10</td>
</tr>
<tr>
<td>11-15</td>
<td>9</td>
</tr>
<tr>
<td>23-26</td>
<td>0</td>
</tr>
</tbody>
</table>

**TABLE 2**
12 Rule Types Tested in Grammaticality Judgment Task

1. Past tense 7. Particle movement
2. Plural 8. Subcategorization
3. Third person singular 9. Auxiliaries
4. Present progressive 10. Yes/no questions
5. Determiners 11. Wh-questions
6. Pronominalization 12. Word order
Fig. 1. The relationship between age of arrival in the United States and total score correct on the test of English grammar.
Language in Nonhumans?

Given that

1. human languages seem to share a universal structure
2. human language learning is characterized by a universal sequence and timing of acquisition
3. children are able to learn this structure even when it is absent from their environment
4. language acquisition appears to have a critical period,

humans seem to have an innate head start in learning language.
So what language abilities can animals learn?

- Early attempts to teach animals to learn involved raising a baby chimp along side a baby human.
- After seven years of treating both very similarly, the outcome was a mute chimp and normally speaking child.
- In 1966, Allen and Beatrix Gardner attempted to teach a young female chimp named Washoe a modified version of ASL.
- After four years, Washoe had learned about 130 signs for objects (banana, hand), actions (bite, tickle), and action modifiers (enough, more).
- During this same period a child learns about 10,000 words. (There are about 15,000 in all of Shakespeare’s collected works.)
- Washoe never learned to combine these signs syntactically.
Kanzi

- The most successful attempt has been made with Kanzi, a bonobo whose mother was being trained to use lexigrams for communication.
- Seeing what his mother could not do, Kanzi was eager to communicate using the lexigrams, and later used around 200 of them to announce his future intentions and to describe states of the world.
- However, no ape to date has acquired or invented a rule for distinguishing plural from singular nouns, for marking the tense of verbs, or for marking any words by grammatical class, which all 3 year old children do even when their parents do not.
Alternative Learning Theories
Fig. 1. A speech waveform of the sentence “Where are the silences between words?” The height of the bars indicates loudness, and the x-axis is time. This example illustrates the lack of consistent silences between word boundaries in fluent speech. The vertical gray lines represent quiet points in the speech stream, some of which do not correspond to word boundaries. Some sounds are represented twice in the transcription below the waveform because of their continued persistence over time.
### Inflectional Morphology


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<td>smairfed</td>
<td>sprurice</td>
</tr>
<tr>
<td>trilb</td>
<td>trilbed</td>
<td>treelit</td>
</tr>
<tr>
<td>smeej</td>
<td>smeejed</td>
<td>leefloag</td>
</tr>
<tr>
<td>frilg</td>
<td>frilged</td>
<td>freezled</td>
</tr>
</tbody>
</table>
Rule Learning

Figure 1a
Rote, Rule, and Analogy

Although the Competition Model was not originally designed to account for all aspects of second language learning and multilingualism, it has certain core concepts that fit well with a broader, fuller account. In particular, we can build on the core Competition Model insight that cue strength in the adult speaker is a direct function of cue validity. However, the unified account needs to supplement the theory of cue validity with additional theoretical constructs for dealing with cue cost and cue support.

Figure 1 represents the overall shape of the model that I will develop here.

Figure 1: The Unified Competition Model

This figure is not to be interpreted as a processing model. Rather, it is a logical decomposition of the general problem of language learning into a series of smaller, but interrelated structural and processing components.
Rote

- Child stores unanalyzed word forms in memory and produces them when meaning matches.

- Will fail to produce novel word forms: 1 Rug, 2 Rugs; 1 wug, 2 ???
Analogy

- Word forms are compared holistically and similar transformations are applied to similar words forms

- E.g., 1 rug, 2 rugs::1 wug, 2 wugs; 1 ox, 2 oxen:: 1 wug, 2 wugen*
Chomsky on Analogy
Rules

Word forms are coded by parts of speech and morphological units

\[ V_{\text{past}} \]

- \[ V \text{ suffix} \]
  - walk -ed
  - wug -ed
Stages of Rule-Formation

1. Pure rote: generation of correct adult plurals, and no plurals for nonsense words

2. Superimposition: comparing lexical items on both phonological and semantic levels to achieve optimal fit. Correct plurals for regulars; incorrect plurals for similar irregulars.
Stages of Rule-Formation

3. Free rules applying regardless of situation. Irregulars are always* overregularized

4. Unification: Patterns of irregulars are identified to avoid categories of overregularization

5. Adult state: regular and irregular forms are computed correctly regardless of novelty
**Test: a wug test in Hungarian**

<table>
<thead>
<tr>
<th>Conventional word</th>
<th>Meaning</th>
<th>Nonsense word</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) hajó</td>
<td>boat</td>
<td>(2) fajó</td>
<td>space-man</td>
</tr>
<tr>
<td>(3) pipa</td>
<td>pipe</td>
<td>(4) piga</td>
<td>totem pole</td>
</tr>
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<td>(6) szésze</td>
<td>rattle</td>
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<tr>
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<td>flower</td>
<td>(8) źirág</td>
<td>furry creature</td>
</tr>
<tr>
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<td>book</td>
<td>(10) önyv</td>
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<tr>
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<td>penguin</td>
<td>(14) gvin</td>
<td>plastic arrow</td>
</tr>
<tr>
<td>(15) hal</td>
<td>fish</td>
<td>(16) gal</td>
<td>spider/octopus</td>
</tr>
<tr>
<td>(17) kenyér</td>
<td>bread</td>
<td>(18) kepér</td>
<td>ear-plug</td>
</tr>
<tr>
<td>(19) kosár</td>
<td>basket</td>
<td>(20) mosár</td>
<td>conical shape</td>
</tr>
<tr>
<td>(21) tehén</td>
<td>cow</td>
<td>(22) pehén</td>
<td>yellow creature</td>
</tr>
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<td>mirror</td>
<td>(24) źükör</td>
<td>concentric circles</td>
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<td>(25) majom</td>
<td>monkey</td>
<td>(26) kajom</td>
<td>space-man/spaceship</td>
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<td>crane</td>
<td>(28) taru</td>
<td>rocket/shuttlecock</td>
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<tr>
<td>(29) ló</td>
<td>horse</td>
<td>(30) gó</td>
<td>bow (archery)</td>
</tr>
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<td>Item</td>
<td>Adult plural</td>
<td>%</td>
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</table>

* Twelve of the fifteen adults examined generalized the bound rule of vowel shortening to these roots. Generalizations of other bound rules, such as V-INSERTION in lovák to produce gowék, were obtained in only two or three subjects per item.
Conclusions

- Although stimuli were stacked in favor of analogy and rote, children’s responses overwhelmingly applied some form of rule-usage