

Rules of language?

Lecture 3

1

1

Summary of last class

- Two mechanisms for linguistic productivity:
 - Statistical associations
 - Rules
- The two mechanisms are distinct
 - Rules do not simply “emerge” from an *associationist* system
 - A system that is not endowed with the capacity to represent rules “innately”; note: this implies no innate rules!
 - *oftentimes, it’s hard to tell which one applies*
- Limitation: these conclusions obtain from artificial language

2

2

Rule or statistical association? It can be tricky...

- Hear: *bagaga, bailli, banunu*
test: *bakiki makiba*

rules

- ABB
- Abstract relation between variables
 - A=any syllable
 - B=any (other syllable)

Statistical learning

- Co-occurrence of specific *instances*
- #+ba (#=word boundary)
- Ba+ga
- Ga+ga

Note:

- Both mechanisms explain performance
- Both can *generalize*

3

3

Today's problem

- What about natural language:
 - Do rules rule?
- Can we rule out the statistical alternative?

4

4

Our goal here..

- Understand the issues
- A taste of the literature
 - Not a full review...
- Learn “how to fight the fight”
 - *Not necessarily decide the answer...*

5

5

Two cases of natural language

- Inflection
- Reduplication/identity

6

6

What learning mechanism?

Example 1: inflection

- *Hear:*
 - *Bag-bags*
 - *Cat-cats*
- Generalize: what is the better plural?
 - *Cags*
 - *cagd*
- *How?*
 - Two possible answers!

7

7

Two possibilities

Example 1: inflection

Rule (general)

- Plural $\rightarrow$ Noun_{singular}+S
 - Generalize by *structure*

Noun_{singular} s

- If $cag = \text{Noun}_{\text{singular}}$; then
- $Cag_{\text{noun}} \rightarrow Cag_{\text{noun}}s$

Statistical association (specific)

- Generalize by tracking association among *specific sounds* in singulars and plurals

	Plural
Train	b ags C ats
Test	c ags 🗣️ C ats 🗣️

8

8

What learning mechanism?

Example 2: XX

- *Hear:*
 - *Ba-baba*
 - *pa-papa*
- Generalize: what is the better output for *ma*?
 - *mama*
 - *mata*
- *How?*
 - Two possible answers!

9

9

Two possibilities Example 2: XX

Rule (general)

- $X \rightarrow XX$
 - Generalize by *structure*

Statistical association (specific)

- Generalize by tracking association among *specific sounds* in singulars and plurals

	ouput
Train	baba papa
Test	mama 🍌 mama 🍌

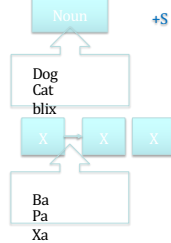
Labial onsets
Coronal onsets

10

10

Some characteristics of rules

- Operate on entire classes, not specific instances
 - Classes: (e.g., noun, syllable)
 - Instance: (e.g., *dog*, *ba*)
- Rules do not discriminate:
 - Apply to all members of the class alike, regardless of
 - Familiarity
 - Properties: their sound, meaning....
 - Form **equivalence classes**
- Rules operate on variables (e.g., N)
 - Noun plural=Noun singular+S
 - $X \rightarrow XX$
 - Blind to instances $\rightarrow$ generalize across the board



11

Two tests of associations

- Systematicity
 - Role of grammatical category (N, V)
 - structure sensitivity
 - *Big cup+Red up* $\rightarrow$ *big red cup*
- Scope of generalization
 - Do not depend on similarity
 - Across the board?

12

12

Competing predictions

Probe	diagnostic	Rules	Statistical association
Scope	Similarity to training items	<i>Can</i> ignore similarity	Similarity-driven
	Scope of generalization	<i>can</i> exceed the training space	Generalize only within the training space
Systematicity	Constituent structure/grammatical categories	Driven by grammatical categories/constituent structure	Insensitive to grammatical categories/constituent structure

13

13

Case study

Morphology: inflection

14

14

English inflection: two types

- Regular: stem+suffix
 - Plural: stem+s
 - Rat-rats
 - Past tense: verb+(e)d
 - Like-liked

Note:

- Different regular variants
 - Dogs, cats, cases
 - Liked, bagged, rated
- These changes are due to phonology, not morphology
- We ignore them here

- Irregular: Everything else

plural	
Change vowel	Goose-geese
Ending	Child-children
No change	Fish-fish

Past tense	
Change vowel	Bear-bore
No change	Hit-hit
Change all	Go-went

15

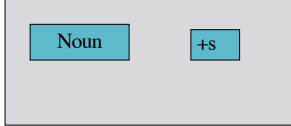
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Words & Rules theory (Pinker, 1999):

Two mechanisms

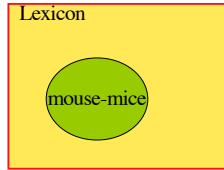
Regular inflection:
rule (grammar)

grammatical rules: regular



Regular inflection is formed by rules

Irregular inflection:
Associations (lexicon)



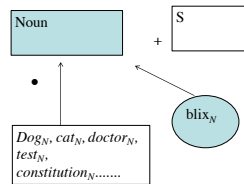
Irregular inflection is formed by lexical associations

16

16

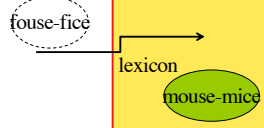
Generalizations (plurals)

Regulars: by rules



Rules can apply to any noun—familiar or novel

Irregulars: by analogy



- New words are associated with *similar* existing words (by *analogy*)
 - Mouse → bouse
- Generalization strictly depends on similarity

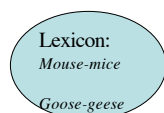
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Division of labor

When you encounter a new word...

- Search for a stored association
- If none is found, apply the rule
- Rule=default
 - Fall back mechanism: Applied when lexical search fails

Grammar: rule
Noun+s



18

18

Division of labor: *examples*

- *Fouse?*
 - Activate *mouse*
 - generate *fice* (by lexical association)
- *Xag*
 - Go to lexicon → no analogy found
 - Apply the rule (by default) → *xags*

Grammar: rule
Noun+s

Lexicon:
Mouse-mice
Goose-geese

19

19

Summary: two accounts of inflection

Pinker's words and rules

- Two mechanisms:
 - Regulars: generated by rule
 - Irregulars: by lexical analogies
- Order of application:
 - Rule applies by default
 - Elsewhere: lexical associations

Connectionist alternative

- A single associationist mechanisms for both
- regulars and irregulars

20

20

How the two accounts differ?

- Irregulars:
 - Mostly agree
- Regulars: here the two theories differ!

21

21

How the two accounts differ?

	Words and rules	Associations
What is "regular"?	Generated by rule	- Frequent association - Preserves the base
How generalizations emerge?	Operation on variables	Associations between specific word instances
Similarity to training set matters?	Not necessarily	Yes
What determines well-formedness?	structure	frequency

22

22

Tests of these predictions

- Role of similarity/frequency
- Role of grammatical categories
- Dissociations:
 - Neurological
 - Grammatical

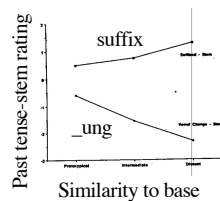
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23

Role of similarity

Goal: systematically manipulate similarity to base

Similarity	Irregulars	Regulars
similar	Spling	Plip
intermediate	Fring	Brilth
distant	Nist	Frlig



- *Prediction* (W&R): selective similarity effects to irregulars, not regulars

Prasada, S., & Pinker, S. (1993). Generalization of regular and irregular morphological patterns. *Language and Cognitive Processes*, 8, 1-55.
 Berent, I., Pinker, S., & Shimron, J. (1999). Default nominal inflection in Hebrew: Evidence for men

24

24

Limitations

- The critical prediction to regulars is based on a *null effect*
 - Similarity *doesn't* affect regulars
- The predictions of W&R are weak:
 - People *may* store regulars and analogize to them
 - Regulars may not be immune to similarity *even if* rules rule
- “big data” may further mask the effects of similarity for regulars even in associationist systems

25

25

Tests of these predictions

- Role of similarity/frequency
- Role of grammatical categories
- Dissociations:
 - Neurological
 - Grammatical

26

26

Julia child and her husband

One day, John told his wife, Mary, that he was inviting some new friends over for dinner. The two couples had a great time. As the guests were leaving, Mary asked them for their full name. It turns Mary has just fed Julia Child and her husband. Yet the _____ were gracious guests, and said the food was great!



- Children
- Childs

Marcus, G. F., Brinkmann, U., Clahsen, H., Wiese, R., & Pinker, S. (1995). German inflection: the exception that proves the rule. *Cognitive Psychology*, 29(3), 189-256.

27

Role of grammatical categories

What determines generalization?

Association

- similarity
- Prediction:
 - The *Children*

W&R

- Constituent structure of grammatical categories
- Names (Julia Child): rootless
- Block lexical association
 - Rule applies by default
- Prediction: default suffix and faithful base
 - *Childs*
 - *Neharim*
- Experimental results support this prediction

28

28

Role of grammatical categories

משפחת נהר

יוסי ועירית נהר גרים בקומה מעלי. הם לא מפסיקים להרעיש בלילה והם מעירים אותי משנתי. ה— — — — — הם שכנים מעצבנים.
נהרים
נהרים
נהרות
נהרות

משפחת תמר

יוסי ועירית תמר גרים בקומה מעלי. הם לא מפסיקים להרעיש בלילה והם מעירים אותי משנתי. ה— — — — — הם שכנים מעצבנים.
תמרים
תמרים
תמרות
תמרות

Berent, I., Pinker, S., & Shimon, J. (2002). The nature of Regularity and Irregularity: Evidence from Hebrew Nominal Inflection. *Journal of Psycholinguistic Research*, 31(5), 459-502.

29

Tests of these predictions

- ✓ Role of similarity/frequency
- ✓ Role of grammatical categories
- Dissociations:
 - Neurological
 - Grammatical

30

30

The logic of dissociations

- If two cognitive systems, A & B (e.g., reg. vs. irreg) are distinct, then they should selectively dissociate
 - Some manipulations will affect A, not B
 - Other manipulations will affect B, not A

	System A	System B
Manipulation A	Impaired	Intact
Manipulation B	Intact	Impaired

- This logic is central to cognitive neuropsychology

31

31

Evidence from dissociations

- Pinker et al. have identified *neurological* conditions (congenital & acquired) that selectively affect reg. & irreg inflection

	Regulars	Irregulars
SLI	Impaired	Intact
Williams'	Intact	Impaired

- Challenges
 - Neurological dissociations are usually not entirely selective
 - Differences could be due to other factors (e.g., sensorimotor)

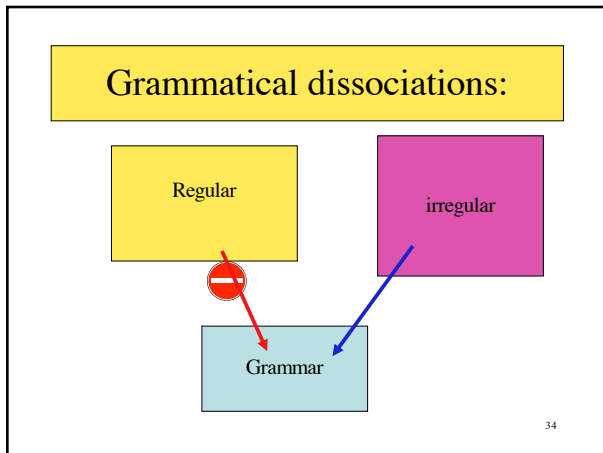
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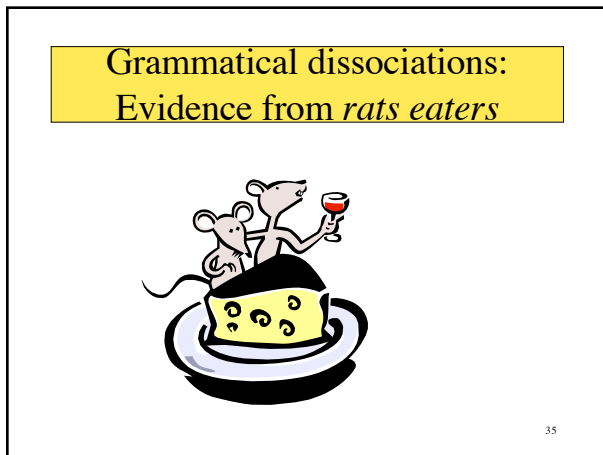
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Linguistic dissociations: compounds

33

33





Three monsters...

- This monster eats many rats
It is a
Rats eater
Rat eater
- This monster eats many mice. It is a
Mouse eater
Mice eater

36

- This monster eats both rats and mice. How would you call it?

Rats eater

Mice eater



37

37

The compounding facts

- All plurals are dispreferred
 - Semantic reasons
- Regular plurals are far worse than irregular plurals
 - *Rats eater* < *mice eater*
 - This preference is seen even in young children who rarely hear any compounds (3-5 years)

38

38

What's wrong with *rats-eater*?

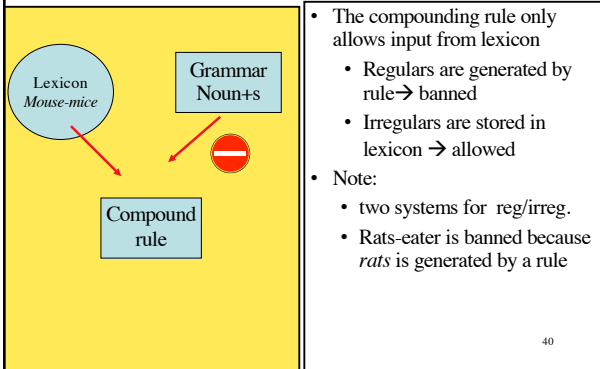
Two competing explanations

39

39

1. Word/Rules: rules matter

(Pinker, 1999)



- The compounding rule only allows input from lexicon
 - Regulars are generated by rule → banned
 - Irregulars are stored in lexicon → allowed
- Note:
 - two systems for reg/irreg.
 - Rats-eater is banned because *rats* is generated by a rule

40

40

2. Associative phonological explanation

(Haskell, MacDonald & Seidenberg, 2003)

- Regulars and irregulars are both formed by lexical association (one system)
- Regulars and irregulars differ *because of their infrequent sound pattern (phonology)*
 - Plurals end with Cs (*Rats, cats, dogz*)
 - Note: this has nothing to do with morphology!
 - Same explanation for *rats-eater* and *bpgnk*
 - These sound combinations rarely occur in compounds
 - Rare sound combinations are disliked

41

41

Why no “rats-eater”

Word/Rules

(Pinker, 1999)

- Rules vs. association
 - Regular plurals are banned in compounds
 - Rats eater banned because it *is* a regular plural (*formed by a rule*)

Phonological explanation

(Haskell, MacDonald & Seidenberg, 2003)

- Different phonological patterns
 - *Rats-eater* has an unusual sound combination
 - Rarely occurs in compounds
 - *Rat-s eater is banned because its sound-pattern (e.g., -ts) it sounds like regular plural*
 - This sound pattern is *rare* (in the context of a compound)

42

Test 1: Does merely “sounding” like a regular plural matter

(when morphology is controlled)?

- Consider *hose*
 - Sounds like regular plurals
 - Isn’t a plural
- Question: are singulars that only *sound* like regular plurals unacceptable in compounds?
 - *Hose-installer*
 - *Pipe-installer*

Berent, I. & Pinker, S. 2007. The Dislike of Regular Plurals in Compounds: Phonological Familiarity or Morphological Constraint? The Mental Lexicon, 2, 129-181.

43

43

Hose-pipe

John works for General Electric. His job is to install hoses on washing machines. His wife jokingly calls him the *hose-installer*.

John works for General Electric. His job is to install pipes on washing machines. His wife jokingly calls him the *pipe-installer*.

John works for General Electric. His job is to install hoses on washing machines. His wife jokingly calls him the *hoses-installer*.

John works for General Electric. His job is to install pipes on washing machines. His wife jokingly calls him the *pipes-installer*.

44

44

According to the *associationist* account

- People should dislike *hose-installer* because *hose* sounds like a regular plural
- People should prefer *hose-installer* because *hose* sounds like a regular plural
- People should give similar responses to *hose-installer* and *pipe-installer*

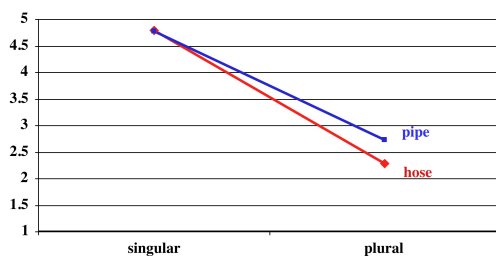
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According to the *Words and Rules account*

- A. People should dislike *hose-installer* because *hose* sounds like a regular plural
- B. People should prefer *hose-installer* because *hose* sounds like a regular plural
- C. People should give similar responses to *hose-installer* and *pipe-installer*

46

Results



47

Test 2: Morphology matters (when sound is controlled)!

- *Breeks tea*
 - (regular plural of *breek*)
- *Breex tea*
 - (irregular plural of *broox*)
- Finding: regular plurals are banned
 - Even when spoken (no spelling)

48

materials

Breek is a flower used to make tea that cures headaches. It usually takes three brees to make a cup of tea. Mary's headaches are so bad she makes her tea using six _____.

This wonderful tea is often called the headache tea, but its formal name is

brees-tea _____

breek-tea _____

Broox is a flower used to make tea that cures headaches. It usually takes three breex to make a cup of tea. Mary's headaches are so bad she makes her tea using six _____.

This wonderful tea is often called the headache tea, but its formal name is

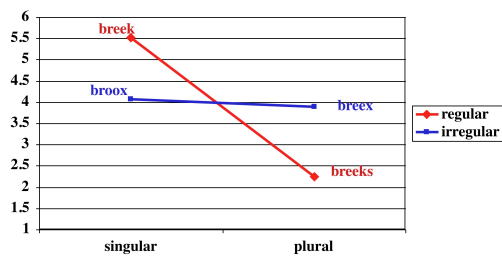
breex-tea _____

broox-tea _____

49

49

Results: rating in compound



50

50

Summary: double dissociation

	Sounds like a plural?	Is a regular plural?	OK?
Hose-installer	Yes	no	Yes
Pipe-installer			
brees tea (breek)	No	yes	No
Breex tea (broox)			

- Sounding like a regular plural doesn't matter
- Being a regular plural does!

51

51

Conclusion

- Regular plurals are banned in compounds
- The ban concerns morphological structure, not phonology (sound)
- Support for Words and Rules

52

52

What is “regular”?

- English regulars tend to be
 - Most frequent type
 - Preserve the base (*rat-rats*)
- This is not always the case!
 - German: regulars are **least** frequent (Marcus et al., 1995)
 - » +n, +e, +er, no change, +s
 - Hebrew: regulars and irregulars can both preserve the base (Berent et al., 2002)
 - Regular: Shir-shirim 'songs'
 - Irregulars: Kir-kirot 'walls'
- Conclusion: regular forms are ones *generated by a rule*
 - Not necessarily frequent or one that preserves the base

53

53

General conclusions: three tests of regulars

- Role of similarity/frequency
 - Regular inflection does not necessarily depend on frequency
 - Problem: it *might*...it's a nuanced argument
- Role of grammatical categories
 - Generalizations to rootless forms (e.g., names) depend on their grammatical category, not similarity
- Dissociations:
 - Neurological: several have been observed, but they are rarely complete
 - Grammatical: compounds dissociate regulars from irregulars!

54

54

Reduplication/Identity

Case 1

55

55

Identity/reduplication restrictions: how are they represented?

- Algebraic operations over variables?
- Non-algebraic accounts
 - Associations
 - *Test case: the Semitic stem*
 - Sensorimotor constraints
 - *Test case: the double identity of doubling...*

56

56

Semitic stems: the fact...

- Like other Semitic languages, Hebrew bans the position of identity
 - *ABB
 - AAB

57

57

Why *ssm/smm?

Algebraic rule

*   

Associative alternative

acceptability ~ identity
(constituent structure)

Bat-El, O. (2006). Consonant identity and consonant copy: the segmental and prosodic structure of Hebrew reduplication. *Linguistic Inquiry*, 37, 179-210.

Hebrew lexicon
{dmm, zmm, xmm, tmm, smm, ?mm, qmm, rmm}

Acceptability ~ frequency

58

58

How to adjudicate between these accounts?

- Test the role of association
 - (partly) control for statistical structure of ABB/ABC

59

59

Lexical decision

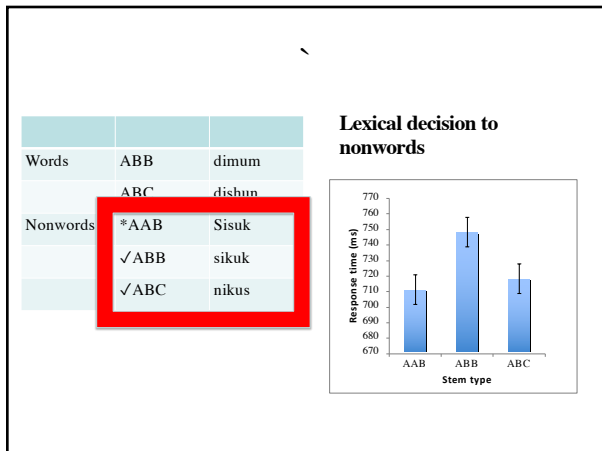
Words	ABB	dimum
	ABC	dishun
Nonword	*AAB	Sisuk
	✓ABB	sikuk
	✓ABC	nikus




word nw

60

60



61

Rule application is automatic

- If reading is automatic, then the properties of printed words (meaning) should interfere with color naming
 - And it does...
- What about grammatical properties?

“Classical” Stroop task

62

Rule application is automatic

Modified Stroop task

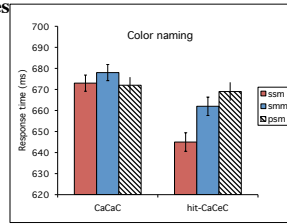
Nonwords		
	*AAB	Sisuk
	✓ABB	sikuk
	✓ABC	Nikus

63

Rule application is automatic

Can grammatical properties
elicit Stroop?

Novel stems	
*AAB	Sisuk
✓ABB	sikuk
✓ABC	Nikus



Berent, I., Bish, U. & Tatlow, J. (2006). The automatic computation of linguistic structure in reading: Evidence from the Stroop task. *The Mental Lexicon* 11(2), 201-230.

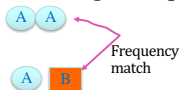
Prediction: ill-formed words should be easier to ignore →
faster color naming

64

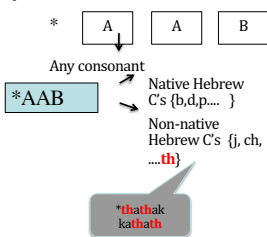
How to adjudicate between rules and associations?

Show structure sensitivity

(while controlling for frequency) Across the board generalization



- Limitation: These generalizations fall *within* the training space
- Can be attained by connectionist systems

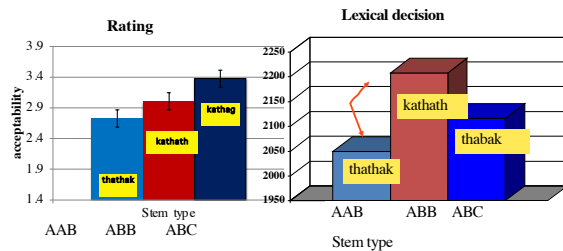


Evidence from the frequency generalization. *Journal of Memory and Language*, 44, 444-465.
Marcus, S. (2002). Identity sensitivity in the Hebrew lexicon: Implications for the debate on the role of word formation. *Brain and Language*, 81, 324-341.
Marcus, S., & Shimon, J. (2003). Generalization to novel words: Is it automatic? *Journal of Memory and Language*, 49, 31-55.
Marcus, S., Farkas, V., & Shimon, J. (2004). Does a theory of language need a grammar? Evidence from Hebrew root structure. *Brain and Language*, 90, 170-182.
Marcus, S., Farkas, V., & Shimon, J. (2007). Root, stem, and the universality of lexical representations: Evidence from Hebrew. *Cognition*, 104, 214-236.

65

65

Generalizations to novel features (th)

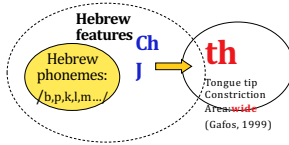


Berent, I., Marcus, G. F., Shimon, J., & Gafos, A. I. (2002). The scope of linguistic generalizations: evidence from Hebrew word formation. *Cognition*, 83, 113-139.

66

Phonological generalizations are powerful!

- Phonological generalizations are **consistent** with rules: extend generalizes across the board, to
 - Novel phonemes
 - Novel feature values
- Such generalizations are **unattainable** by various systems that do not encode algebraic rules (e.g., operate on variables)
 - (Spoken) phonology is an **algebraic** system, endowed with the principled capacity for discrete infinity



*Berent, L., Wilson, C., Marcus, G., & Remis, D. (2012). On the role of variables in phonology: Remarks on Hayes and Wilson. *Linguistic Inquiry*, 43, 97-119.
 *Marcus, G. F. (1998). Rethinking eliminative connectionism. *Cognitive Psychology*, 37, 243-282.

67

67

How to adjudicate between these accounts?

- ✓ The role of association
 - (partly) control for statistical structure of ABB/ABC
 - Generalization beyond their training space
- The role of sensorimotor constraints

68

68

Two accounts of language of phonology

Abstraction
 Phonology is governed by abstract algebraic operations (rules/constraints)

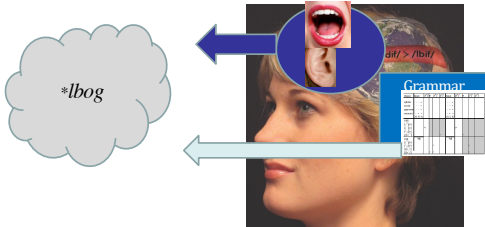


Embodiment
 Phonological patterns are governed by the sensorimotor system



69

What is the *direct cause* of a speaker's (synchronic) intuitions?



70

How to tell?

- Strategy 1: does phonology survive insults to the phonetic channel
 - Via TMS/mechanical suppression
 - Congenitally, in dyslexia



Berent, I., Brown, A.-R., Zhao, X., Seidenberg, P., Pica, M., & Spitsberg, J. (2015). Role of the motor system in language knowledge. *Proceedings of the National Academy of Sciences*, 112, 1969-1978. doi: 10.1073/pnas.1408051112

Berent, I., Volante-Nashum, V., Balaban, E., & Galaburda, A. (2013). Phonological generalizations in dyslexia: the phonological grammar may not be impaired. *Cognitive neuropsychology*, 30(12), 285-310. doi: 10.1080/03044949.2013.800382

Berent, I., Volante-Nashum, V., Balaban, E., & Galaburda, A. M. (2012). Dyslexia impairs speech recognition but can spare phonological competence. *PLoS One*, 7(9), e44875. doi: 10.1371/journal.pone.0044875

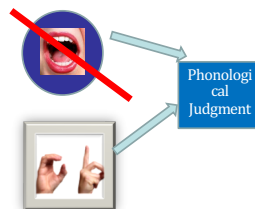
Berent, I., Zhao, X., Balaban, E., & Galaburda, A. M. (2014). Phonology and phonetics dissociate in dyslexia: Evidence from adult English speakers. *Language, Cognition and Neuroscience*, 29(9), 1170-1182

Zhao, X., & Berent, I. (2014). Universal Restrictions on Syllabic Structure: Evidence From Mandarin Chinese. *Journal of Psycholinguistic Research*, 43, 795-811. doi: 10.1007/s10936-015-9379-1

71

How to tell?

- Strategy 1: does phonology survive insults to the phonetic channel
 - Via TMS/mechanical suppression
 - Congenitally, in dyslexia
- Strategy 2: can phonology emerge in a new channel?



Adrian, G., Bao, D., Brown, R., & Berent, I. (2010). DISCRETE is needed: Evidence from a signed language. *Cognition*, 116, 279-285. doi: 10.1016/j.cognition.2010.07.016

Berent, I., Bao, D., Brown, R., Brown, R., & Volante-Nashum, V. (2011). Are all phonology? *Journal of Linguistics*, 47, 499-528. doi: 10.1017/S0022268110000498

Berent, I., Bao, D., Brown, R., Brown, R., & Volante-Nashum, V. (2011). The double identity of linguistic doubling. *Proceedings of the National Academy of Sciences*, 108(18), 12760-12767. doi: 10.1073/pnas.1017401108

Berent, I., Bao, D., Brown, R., & Pica, M. (2010). Knowledge of language transfers from speech to sign: Evidence from doubling. *Cognitive Science*, 34(1), 1-11. doi: 10.1111/j.1365-0299.2009.00379.x

Berent, I., Bao, D., & Volante-Nashum, V. (2010). The double identity of linguistic doubling: Evidence from the phonological competence study. *Cognition*, 116, 279-285.

72

A simple question

- If you (sign-naïve) speakers were to see signs in ASL, how would you perceive them:
 - As pantomime
 - As structured linguistic representations?



Can spoken phonology apply in a new modality—manual signs?

73

Amodal phonology

Hypothesis

- Phonology is distinct from its bodily channel: it is neither speech nor sign. Rather, it is an abstract algebraic system

Consequences

- Grammatical principles could apply across language modalities
- Speakers can spontaneously project *grammatical* phonological principles cross-modally
 - Spoken L1 → Signed L2
 - Signed L2 → Spoken L1

74

One stone, two birds...

Cross modal transfer simultaneously tests

- Sensorimotor explanations
 - Different modalities, different sensorimotor constraints
 - Cross modal generalizations challenge sensorimotor explanations
- Scope of linguistic generalizations
 - Signed and spoken features do not overlap
 - Generalization across modality offers evidence for variables



75

75

Thank you Outi!



76

Evidence from a grammatical
illusion



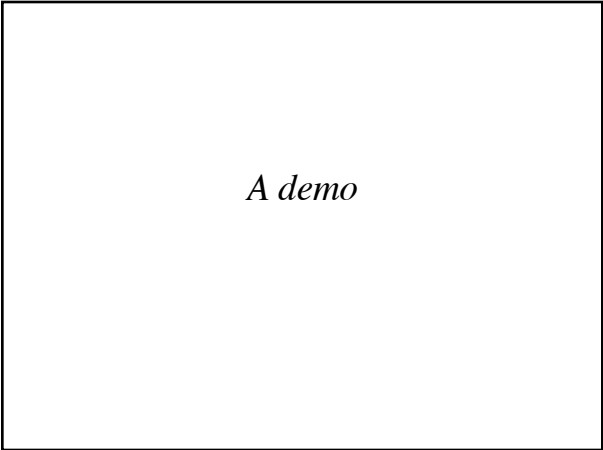
77

The double life of linguistic
doubling

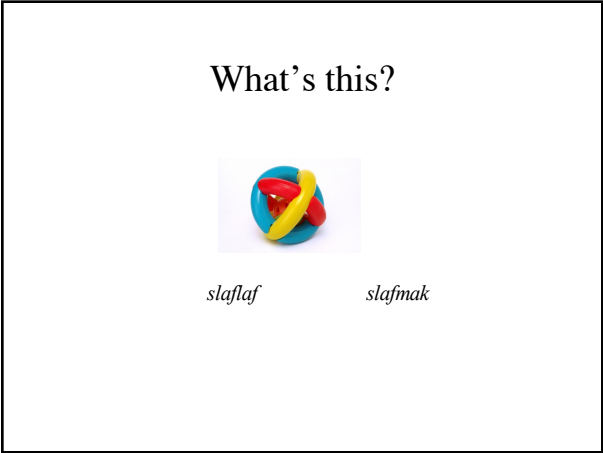


Photo credit: Diane Arbus, *Identical Twins* (1967)

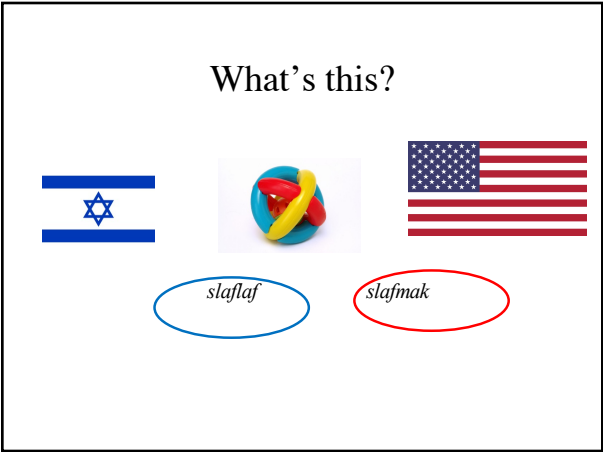
78



79



80



81

What's going on?

82

The double life of linguistic doubling

Phonology



Photo credit: Diane Arbus, *Identical Twins* (1967)

Morphology



83

83

The double life of linguistic doubling

Phonology



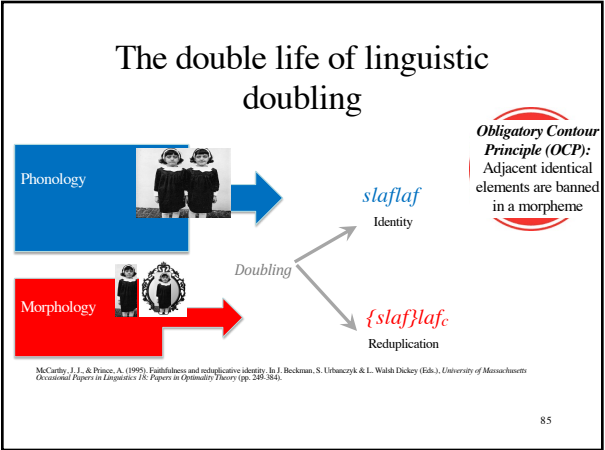
slaflaf
Identity

**Obligatory Contour
Principle (OCP):**
Adjacent identical
elements are banned
in a morpheme

Leben, W. (1973). *Suprasegmental phonology*. Cambridge, MA: MIT press.
McCarthy, J. J. (1981). A prosodic theory of nonconcatenative morphology. *Linguistic Inquiry*, 12, 373-418.

84

84



85

A linguistic analysis: bare forms

		Parse	OCP	DEP
Phonology	<i>slaflaf</i>	XX	*	← English
	<i>slafmat</i>	XY	✓	
Morphology	<i>slaflaf</i>	{X}X _c	✓	← Hebrew
	<i>slafmat</i>	XY		*

86

86

Hypothesis: bare phonological forms

- Speakers spontaneously project their grammar to novel non native-like stimuli
- Projections to bare forms depend on L1 experience
 - English: XX
 - Hebrew {X}X_c

87

87

Can English speakers see the morphological light?



88



The double identity of linguistic doubling

Iris Berent^{a,1}, Outi Bat-El^b, Diane Brentari^c, Amanda Dupuis^a, and Vered Vaknin-Nusbaum^{d,*}

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Edited by Barbara H. Partee, University of Massachusetts at Amherst, Amherst, MA, and approved October 14, 2016 (received for review August 18, 2016)

Does knowledge of language consist of abstract principles, or is it fully embodied in the sensorimotor system? To address this question, we investigate the double identity of doubling (e.g., *slaf*/*flaf*, or generally, *XX*, where *X* stands for a phonological constituent). Across languages, doubling is known to elicit conflicting preferences at different levels of linguistic analysis (phonology vs. morphology). And because a single stimulus can elicit different representations whereas different stimuli can be mapped to a single representation to a stimulus (e.g., its acceptability) and its sensorimotor demands could doubly dissociate. That is, a single stimulus could elicit conflicting responses, whereas distinct stimuli that contrast on their sensorimotor demands could give rise to conflicting responses.



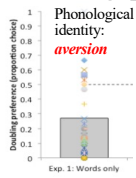
89

Which one sounds better?

*slaf**flaf**slaf**mak*

90

Doubling preferences: novel words



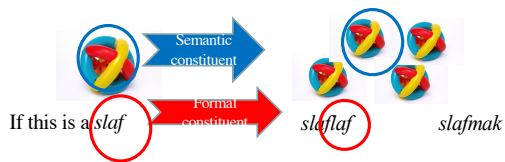
Exp.	1. Words only
Step 1	
Step 2	? ... slafslafslafmak

Berent, Bat-El, Brentari, Dupuis & Vikain-Nusbaum (2016). *Proceedings of the National Academy of Sciences*.

91

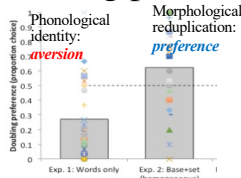
How about now?

What do you call these ones?



92

Doubling preferences: novel words

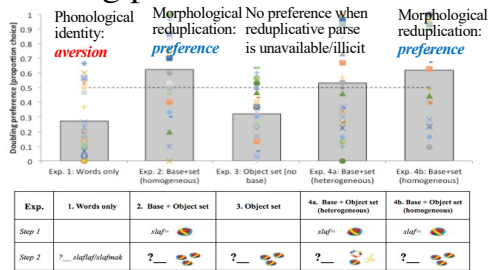


Exp.	1. Words only	2. Base + Object set
Step 1		<i>slaf</i> = [object]
Step 2	? ... slafslafslafmak	? ... [object] [object] [object]

Berent, Bat-El, Brentari, Dupuis & Vikain-Nusbaum (2016). *Proceedings of the National Academy of Sciences*.

93

Doubling preferences: novel words



Bever, Bat-El, Brentari, Dupuis & Yekutieli-Nusbaum (2016). *Proceedings of the National Academy of Sciences*.

94

Result summary: doubling preference English speakers; novel words

Speakers	Bare nouns	Licit Plurals
English	-	+
Hebrew	+	

(-)=aversion ~ XX
(+)=preference ~ {X}Xc

95

The double identity of doubling

- Acceptability *dissociates* from sensorimotor demands: must be distinct!



97

What about generalizations across language modalities?

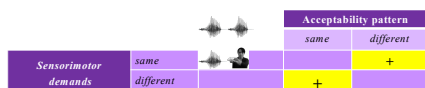
Will speakers who are sign-native spontaneously project their knowledge of spoken L1 to ASL signs?

98

98

The double identity of doubling

- Acceptability *dissociates* from sensorimotor demands: must be distinct!



99

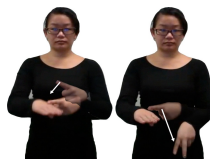
What's this?



XX



XY

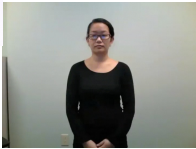


100

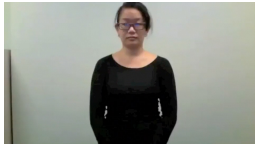
What's this?



XX

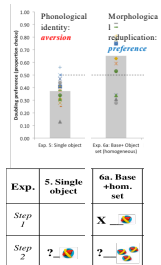


XY



101

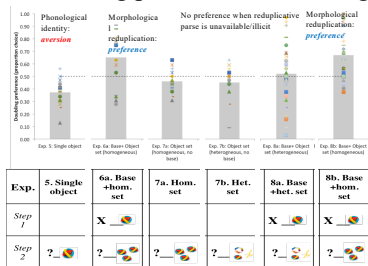
Doubling preferences: novel signs



Berent, Bat-El, Brentari, Dapuis & Yavuz-Nisabaum (2016). *Proceedings of the National Academy of Sciences*.

102

Doubling preferences: novel signs



Berent, Bat-El, Brentari, Dapuis & Yavuz-Nisabaum (2016). *Proceedings of the National Academy of Sciences*.

103

Who's boss?

Strong embodiment

Language



Does the analysis of *signs* depend on the structure of *spoken* language (L1)?

104

Cross modal projections

- Projections can be similar across modality
 - E.g., English speakers
- Projections depend to signs depend on L1 morphophonology

105

105

English speakers

	Bare nouns	Plurals
Spoken words	Iden	Red
ASL Signs	Iden	Red

106

Cross modal projections

- Projections can be similar across modality
 - E.g., English speakers
- Projections depend to signs depend on L1 morphophonology

107

107

Reduplicative projections depend on L1 grammar

- Obtain only if L1 has productive morphology

	L1 plural morphology	Red. Projections (signs).
English	✓	✓
Malayalam	✓	✓
Mandarin	X	X

Berent, I., Bat-El, O., Andon, Q., Brentari, D., & Vaknin-Nusbaum, V. (2021). Amodal phonology. *Journal of Linguistics*, 57, 199-529. doi: 10.1017/S0022267200000296

Berent, I., Bat-El, O., Brentari, D., Dupuis, A., & Vaknin-Nusbaum, V. (2016). The double identity of linguistic doubling. *Proceedings of the National Academy of Sciences*, 113(48), 13702-13707. doi: 10.1073/pnas.1613749113

Berent, I., Bat-El, O., Brentari, D., & Plam, M. (2020). Knowledge of language transfers from speech to sign: Evidence from doubling. *Cognitive Science*(44), 1. doi: 10.1111/cogs.12809

108

Some constraints on the projection of a reduplicative parse in a new modality

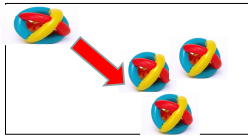
- Projections to plurals (unmarked):
 - only if L1 marks the relevant grammatical category morphologically (not necessarily by reduplication)
- Projections to diminution (marked)
 - Only if L1 marks diminution on the relevant lexical category by *reduplication*

109

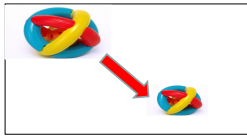
109

Two morphological interpretations of doubling

Plurals



Diminutives



Does the morphological interpretations of *signs* depends on *spoken* morphology: English vs. Hebrew?

110

Will doubling take a morphological analysis?

	Plurality 	Diminutives 
English	+	—
Hebrew	—	+

Kelev 'dog'
Klavlav 'puppy'

111

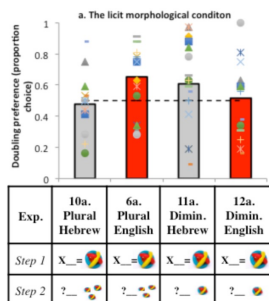
Will doubling take a morphological analysis?

	Plurality 	Diminutives 
English	+	—
Hebrew	—	+

Kelev 'dog'
Klavlav 'puppy'

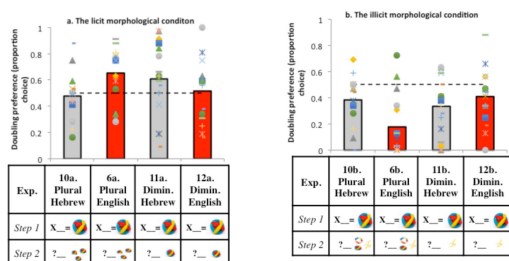
112

Doubling preferences for novel *signs* depend on
spoken language



113

Doubling preferences for novel *signs* depend on
spoken language



114

Morphological analysis of signs
depends on (spoken) L1 morphology

	Plurality	Diminutives
English	+	-
Hebrew	-	+

115

Conclusions (doubling)

- Speakers who are sign-native spontaneously transfer their knowledge of spoken L1 to signs
- Implications
 - This knowledge must be algebraic, not sensorimotor
 - Linguistic principles are partly *amodal*

116

116

General conclusions

- Rules or associations?
 - It's not easy to tell!
 - It's not impossible...
- Several strategies
 - Test for the effects of similarity/familiarity
 - Test for the role of *grammatical categories* by probing for dissociations

117

117

General Conclusions (Con'd): Three types of dissociations...

- Neurological:
 - neurological conditions that selectively affect one system
- Linguistic
 - Linguistic constraints that selectively apply to a single system
- Modality: cross modal transfer shows that linguistic knowledge
 - Is defined by grammatical categories
 - Is impervious to sensorimotor channel

118

118
