05 - Morphological representation and processing

Nick Riches

Newcastle University

October 31, 2018

05 - Morphological representation and processing

Nick Riches

Introduction

The big debate

Evidence for comp sys.

- 1. Productive usag
- 2. Morph errors
- 3. Morpho-phon. parsing

4. Phonotactic evidence

Non-word roots

- 2 Multiple meanings
- Multiple meanings
 Psycholinguistic evidence
- A hybrid view
 Evidence for 2 sys.

Gradient pnenomena

Dual Route Mode

The model Evidence

- Crit. of DR model
- (1) Pseudo-regularity
- (2) The role of frequency

minute exercise

processing Nick Riches Introduction Introduction 1 Non-word roots

Proc vs Decl

Evidence for 2 sys.

05 - Morphological representation and

Crit of DR model

(2) The role of frequency

05 - Morphological representation and processing

Nick Riches

Introduction

- 1 Non-word roots
- Evidence for 2 sys.

- Crit. of DR model
- (2) The role of frequency

- Look at these examples. What does the suffix 'mouth' mean? How do you pronounce it in each word?
 - 1. Portsmouth
 - 2. Plymouth
 - 3. Tynemouth
 - 4. Grangemouth
 - 5. Cockermouth

processing Nick Riches The big debate The big debate 1 Non-word roots

Proc vs Decl

Evidence for 2 sys.

05 - Morphological representation and

Crit of DR model

(2) The role of frequency

Computational system versus lexical storage

05 - Morphological representation and processing

Nick Riches

ntroduction

The big debate

Comp. versus Lex.

Evidence for comp sys.

- Productive usa
- 2. Morph errors
- 3. Morpho-phon. parsing

4. Phonotactic evidence

Vhole-wd. storag

- 1. Non-word roots
- 2. Multiple me
 - B. Psycholinguistic evi

A hybrid view
Evidence for 2 sys.

Gradient phenomena

Dual Route Model

The model Evidence

- Crit. of DR model
- (1) Pseudo-regulari
- (2) The role of frequency

ninute exercise

1. A computational system

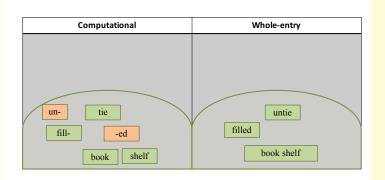
Words are generated by taking a root and adding an affix (combinatoric symbolic rule)

e.g. meaning of laughed is composed of two parts: LAUGH + PAST TENSE

2. A lexical system

Morphologically complex words are stored / processed as wholes in the **lexicon**

Computational system versus lexical storage



05 - Morphological representation and processing

Nick Riches

ntroduction

The big debate Comp. versus Lex.

Evidence for comp sys.

- 1. Productive usa
- 2. Morph errors
- 3. Morpho-phon. parsing
- 4. Phonotactic evidence

Whole-wd. stora

- 1. Non-word roots
- 2. Multiple meanings
- Psycholinguistic evidence

A hybrid view

Evidence for 2 sys.

Gradient phenomena

Dual Route Mode

Proc. vs. Decl. The model

- Evidence Crit. of DR model
- Crit. of DR model (1) Pseudo-regularity
- (2) The role of frequency

minute exercise

		processing
	ntroduction	Nick Riches
		Introduction
	The big debate	The big debate
		Comp. versus Lex.
ŀ	Evidence for a computational system	Evidence for comp. sys.
		Productive usage
	Evidence of the whole-word storage of	Morph errors Morpho-phon. parsing
r		4. Phonotactic evidence
		Whole-wd. storage
		Non-word roots Multiple meanings
		Psycholinguistic evidence
1	Morphology in language impairments - Ullman and Pinker's	A hybrid view
	Dual Route model	Evidence for 2 sys.
		Gradient phenomena
		Dual Route Model

(2) The role of frequency
5-minute exercise

Proc. vs. Decl.
The model
Evidence
Crit. of DR model
(1) Pseudo-regularity

05 - Morphological representation and

1. Productive usage

3. There are two wug-s

4. Look! The dog is meek-ing 5. The dog was un-meek-able

1. He merengu-ed his way onto the dance floor

2. She was so angry that she crutch-ed her boyfriend

05 - Morphological representation and processing

Nick Riches

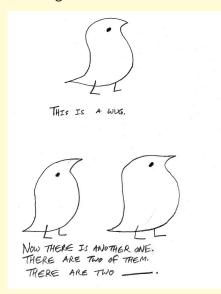
- 1. Productive usage

- 1 Non-word roots

- Crit. of DR model
- (2) The role of frequency

1. Productive usage

Berko-Gleason's 'Wug test'



05 - Morphological representation and processing

Nick Riches

Introduction

The big debate

Comp. versus Lex.

Evidence for comp sys.

Productive usage

- 2. Morp
- 3. Morpho-phon. parsin
- 4. Phonotactic evidence

Whole-wd. stora

- 1. Non-word roots
- 2. Multiple
 - 3. Psycholinguistic evidence

A hybrid view Evidence for 2 sys.

Gradient phenom

Dual Route Model

Proc. vs. Decl. The model

Evidence Crit. of DR model

- (1) Pseudo-regularity
- (2) The role of frequency

5-minute exercise

2. Morphological movement, stranding and substitution errors

- 05 Morphological representation and processing Nick Riches
 - NICK RICHES

Introduction

The big debate

Evidence for comp sys.

- . Productive us
- 2. Morph errors
 - Morpho phon pag
- 4. Phonotactic evidence
- Whole-wd storage
- 1. Non-word roots
- . Multiple meanings
- hybrid view

Gradient phenomena

Dual Route Model

he model vidence

- Crit. of DR model
 - 1) Pseudo-regularity
- (2) The role of frequency
 - inute exercise

- 1. She wash upp-ed the dishes.
- 2. I'd forgot about-en that
- 3. We have a lot of church-es in our minister
- 4. She always pack-s a keep
- 5. He gave me some good **de**-vice

representation and processing

Nick Riches

05 - Morphological

Introduction

The big debate
Comp. versus Lex.

Evidence for comp sys.

Productive usage

Morph errors
 Morpho-phon, parsing

4. Phonotactic evidence

Non-word roots

Multiple meanings
 Psycholinguistic eviden

A hybrid view Evidence for 2 sys.

radient phenomena

oc. vs. Decl.

Evidence Crit. of DR model

rit. of DR model

1) Pseudo-regularity

(1) Pseudo-regularity
(2) The role of frequency

minute exercise

Туре	Example	RT
Real infl.	Fill ed -fill	
Pseudo infl.	Mil d -mile	
Novel infl.	Nill ed -nill	
No infl.	Bel t -bell	

representation and processing

Nick Riches

05 - Morphological

ntroduction

he big debate

Evidence for comp sys.

Productive usage
 Morph errors

Morpho-phon, parsing

4. Phonotactic evidence

Non-word roots

. Multiple meanings . Psycholinguistic evidenc

A hybrid view
Evidence for 2 sys.

Gradient phenomena

The model
Evidence

Crit. of DR model

(1) Pseudo-regularity
(2) The role of frequency

minute exercise

8/30

Туре	Example	RT
Real infl. Pseudo infl. Novel infl. No infl.	Fill ed -fill Mil d -mile Nill ed -nill Bel t -bell	949

representation and processing

Nick Riches

05 - Morphological

Introduction

The big debate
Comp. versus Lex.

Evidence for comp sys.

Productive usage

Morph errors
 Morpho-phon, parsing

Phonotactic evidence

Whole-wd. storago 1. Non-word roots

Multiple meanings
 Psycholinguistic eviden

A hybrid view Evidence for 2 sys.

Gradient phenomena

ual Route Model

The model Evidence

Crit. of DR model

(1) Pseudo-regularity
(2) The role of frequency

ne role of frequency

Example	RT
Fill ed -fill	949
Mil d -mile	932
Nill ed -nill	
Bel t -bell	
	Fill ed -fill Mil d -mile Nill ed -nill

05 - Morphological representation and processing Nick Riches

ntroduction

The big debate

Evidence for comp sys.

Productive usage

Morph errors
 Morpho-phon, parsing

Phonotactic evidence

Whole-wd. storag

Multiple meanings
 Psycholinguistic evid

A hybrid view

Gradient phenomena

oc. vs. Decl.

Evidence Crit. of DR model

1) Pseudo-regularity

(2) The role of frequency

Туре	Example	RT
Real infl.	Fill ed -fill	949
Pseudo infl.	Mil d -mile	932
Novel infl.	Nill ed -nill	908
No infl.	Bel t -bell	

05 - Morphological representation and processing Nick Riches

Introduction

The big debate

Evidence for comp sys.

1. Productive usage

Morph errors
 Morpho-phon, parsing

Wiorpho-phon. parsing
 Phonotactic evidence

Whole-wd. storage

Nultiple meanings

A hybrid view

Evidence for 2 sys.

Gradient phenomena

ual Route Model

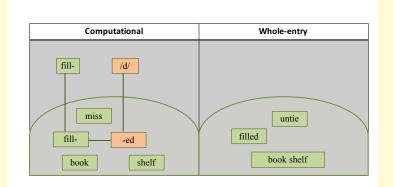
The model Evidence

Crit. of DR model

(1) Pseudo-regularity
(2) The role of frequency

ninuto oversise

Туре	Example	RT
Real infl.	Fill ed -fill	949
Pseudo infl.	Mil d -mile	932
Novel infl.	Nill ed -nill	908
No infl.	Bel t -bell	806



05 - Morphological representation and processing

Nick Riches

Introduction

The big debate

Comp. versus Lex.

Evidence for comp. sys.

- 1. Productive usage
- 2. Morph errors
- 3. Morpho-phon, parsing
- 4. Phonotactic evidence

hole-wd. storage

- 1. Non-word roots
- . Multiple meanings
- 3. Psycholinguistic evidence

A hybrid view Evidence for 2 sys.

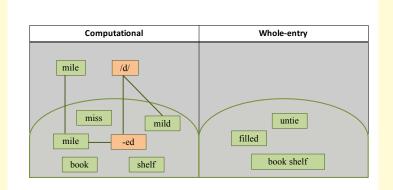
Gradient phenomena

Dual Route Model

The model Evidence

- Crit. of DR model
- Crit. of DR model (1) Pseudo-regularity
- (2) The role of frequency

minute exercise



05 - Morphological representation and processing

Nick Riches

Introduction

The big debate

Comp. versus Lex.

Evidence for comp. sys.

- 1. Productive usage
- 2. Morph errors
- 3. Morpho-phon, parsing
- 4. Phonotactic evidence

Whole-wd. storag

- 1. Non-word roots
 - Multiple meanings
- 3. Psycholinguistic evidence

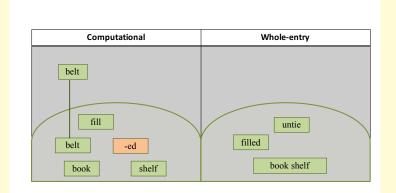
A hybrid view Evidence for 2 sys.

Dual Route Mode

Proc. vs. Decl. The model

- Evidence Crit of DR model
- Crit. of DR model
 (1) Pseudo-regularity
- (2) The role of frequency
 -) The role of freque

minute exercise



05 - Morphological representation and processing

Nick Riches

Introduction

The big debate

Comp. versus Lex.

Evidence for compa

- 1. Productive usage
- 2. Morph errors
- 3. Morpho-phon. parsing
- 4. Phonotactic evidence

/hole-wd. storage

- 1. Non-word roots
 - Multiple meanings
- 3. Psycholinguistic evidence

A hybrid view Evidence for 2 sys.

Qual Route Mode

Dual Route Model

The model

- Crit. of DR model
- Crit. of DR model (1) Pseudo-regularity
- (2) The role of frequency

ninute exercise

4 Phonotactic evidence

lost \rightarrow frost, accost, riposte swam \rightarrow dam, tram, ham turn**ed** \rightarrow spurn-**ed**, learn-**ed**, earn-**ed** 05 - Morphological representation and processing

Nick Riches

- 4 Phonotactic evidence

- 1 Non-word roots

Evidence for 2 sys.

Evidence

- Crit. of DR model
- (1) Pseudo-regularity
- (2) The role of frequency

05 - Morphological representation and processing Nick Riches

Evidence of the whole-word storage of morphologically-complex words

Whole-wd. storage 1. Non-word roots

Evidence for 2 sys.

Proc. vs. Decl.

Crit of DR model

(2) The role of frequency

1. Non-word roots

Un-re-mitt-ing-ly
 It's in-evit-able

3. The food supplies were de-**plet**-ed

05 - Morphological representation and processing

Nick Riches

ntroduction

The big debate
Comp. versus Lex.

Evidence for comp sys.

- 1. Productive usage
- 2. Morph errors
- 3. Morpho-phon. parsir
- 4. Phonotaction

iole-wd. storage

Non-word roots

2. Multiple meanings

Psycholinguistic eviden

A hybrid view
Evidence for 2 sys.

Jual Route Model

Proc. vs. Decl. The model

Evidence Crit of DR model

Crit. of DR model

(1) Pseudo-regularity

(2) The role of frequency

ninute exercise

2. Multiple meanings

Agent / instrument ambiguity

Stripp**er** Garden**er**

Cooker

05 - Morphological representation and processing Nick Riches

1. Non-word roots

2. Multiple meanings

A hybrid view

Evidence for 2 sys.

Proc. vs. Decl.

Evidence

Crit. of DR model

(1) Pseudo-regularity

(2) The role of frequency

3. Psycholinguistic evidence

Losiewicz (1995) $laps \longrightarrow lapse \rightarrow$

 $hovered \longrightarrow covered \rightarrow$ nee**ded** \longrightarrow knea**ded** \rightarrow

05 - Morphological representation and processing

Nick Riches

1 Non-word roots

3. Psycholinguistic evidence

Evidence for 2 sys.

Proc vs Decl

Crit. of DR model

(1) Pseudo-regularity

(2) The role of frequency

3. Psycholinguistic evidence

05 - Morphological representation and processing

Nick Riches

1 Non-word roots

3. Psycholinguistic evidence

Crit. of DR model

(2) The role of frequency

13 / 30

Losiewicz (1995)

 $laps \longrightarrow lapse \rightarrow$

 $hovered \longrightarrow covered \rightarrow$

 $needed \longrightarrow kneaded \rightarrow$

Alegre & Gordon (1999)

Relation between speed of lexicality judgement and frequency of inflected form only when inflected form exceeds a specific frequency threshold (1 word per 7 million)

processing Nick Riches 1. Non-word roots A hybrid view A hybrid view

Evidence for 2 sys.

05 - Morphological representation and

Proc vs Decl

Crit of DR model

(2) The role of frequency

Strong evidence for two systems

Novel inflected forms, e.g. meek-ed

Non-word roots, e.g. un-remitt-ing-ly

05 - Morphological representation and processing

Nick Riches

1. Non-word roots

Evidence for 2 sys.

Evidence

Crit. of DR model

(2) The role of frequency

Strong evidence for two systems

processing \Leftrightarrow expressivity

ems 05 - Morphological representation and processing

Nick Riches

ntroduction

The big debate

Evidence for com

1. Productive usage

2. Morph errors

Morpho-phon. parsing

Phonotactic evidence

Whole-wd. storag

1. Non-word roots

Non-word roots Multiple meanings

Psycholinguistic evide

A hybrid view Evidence for 2 sys.

radient phenomena

ual Route Model

roc. vs. Decl.

Evidence Crit of DR model

(1) Pseudo-regular

(1) Pseudo-regularity

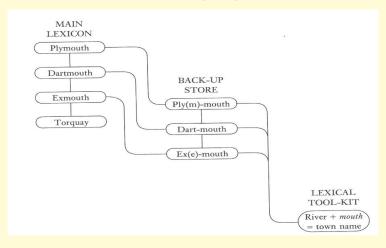
(2) The role of frequency

5-minute exercise

3ib 15 / 30

Gradient phenomena

Aitchison, 'Words in the Mind' (2002)



05 - Morphological representation and processing

Nick Riches

- 1 Non-word roots

A hybrid view Evidence for 2 sys.

Gradient phenomena

Evidence

- Crit. of DR model
- (2) The role of frequency

Gradient phenomena

*Chicken***less** *nuggets* ⇒ A careless person \Rightarrow A gormless/ruthless person



05 - Morphological representation and processing

Nick Riches

- 1. Non-word roots

A hybrid view Evidence for 2 sys.

Gradient phenomena

- Evidence Crit. of DR model
- (2) The role of frequency

representation and processing Nick Riches

Morphology in language impairments - Ullman and Pinker's Dual Route model

05 - Morphological

1 Non-word roots

Evidence for 2 sys.

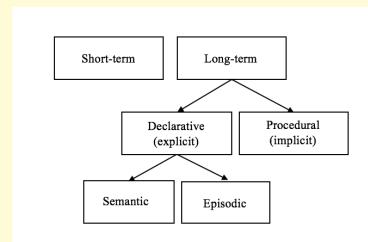
Dual Route Model

Crit of DR model

(2) The role of frequency

Procedural versus Declarative memory

Tulving's Memory model



05 - Morphological representation and processing

Nick Riches

Introduction

The big debate

Evidence for comp

- 1. Productive usag
- 2. Morph errors
- 3. Morpho-phon. parsing

Vhole-wd. stora

- 1. Non-word roots
- 2. Multiple meanings
- Psycholinguistic evidenc

A hybrid view
Evidence for 2 sys.

Dual Route Model

Proc. vs. Decl.

The mode Evidence

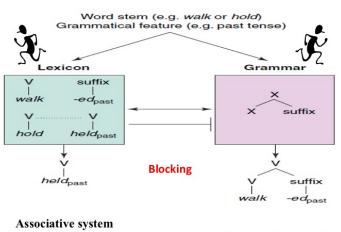
- Crit. of DR model
- (1) Describe assets
- (2) The role of frequency

minute exercise

The model

Analogy-based

Frequency dependent



Computational system
Not frequency dependent

05 - Morphological representation and processing

Nick Riches

ntroduction

The big debate Comp. versus Lex.

Evidence for comp sys.

- 1. Productive usa
- 2. Morph errors
- 3. Morpho-phon. parsir

Phonotactic evidence

- /Vhole-wd. stor
- Multiple meaning
- 3. Psycholinguistic evide

A hybrid view
Evidence for 2 sys.
Gradient phenomena

Dual Route Model

Proc. vs. Decl.

The model

- Crit. of DR model
- Crit. of DR model
- (2) The role of frequency

minute exercise

minute exercise

05 - Morphological representation and processing

Nick Riches

ntroduction

The big debate

Comp. versus Lex.

Evidence for comp sys.

- Productive usag
 - 2. Morph errors
- 3. Morpho-phon. parsin

Whole wid stores

/Vhole-wd. storag

- Non-word n
 Multiple me
- 2. Multiple me
- Psycholinguistic evi

A hybrid view Evidence for 2 sys.

Gradient phenomena

roc. vs. Decl.

Evidence

- Crit. of DR model
 - 1) Pseudo-regular
- (2) The role of frequency

ninute exercise

Pinker & Ullman (2002) - Frequency effects are only found in the irregular system

1. Children's overregularisation errors, e.g. she swammed are determined by the density of the irregular neighbourhood

e.g. [$swim \rightarrow swam$, $sing \rightarrow sang$] versus [$bring \rightarrow brought$, $buy \rightarrow bought$, $seek \rightarrow sought$, $teach \rightarrow taught$, $fight \rightarrow fought$]

2. Adult generation of inflected form is affected by input frequency only in the irregular system.

Analogy = the mapping of relationships

What is the past tense of *tring*?

05 - Morphological representation and processing

Nick Riches

- 1. Non-word roots

Evidence

- Crit. of DR model (1) Pseudo-regularity
- (2) The role of frequency

05 - Morphological representation and processing

Nick Riches

- 1 Non-word roots

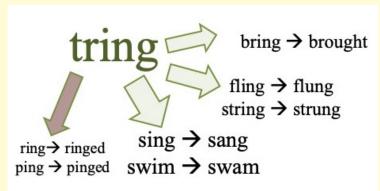
Evidence for 2 sys.

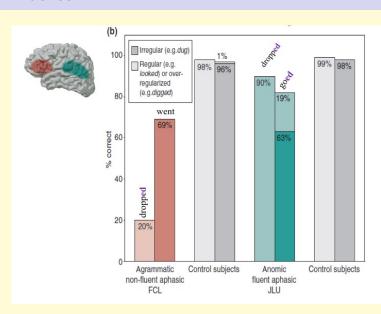
Evidence

- Crit. of DR model
- (2) The role of frequency

Analogy = the mapping of relationships

What is the past tense of *tring*?





05 - Morphological representation and processing

Nick Riches

- 1. Non-word roots

A hybrid view

Evidence for 2 sys.

Proc. vs. Decl.

Evidence

- Crit. of DR model
- (1) Pseudo-regularity
- (2) The role of frequency

05 - Morphological representation and processing

Nick Riches

1 Non-word roots

2. Multiple meanings

Evidence for 2 sys.

Evidence

Crit. of DR model

(2) The role of frequency

23 / 30

Alzheimmers

Declarative memory affected REG. >better than >IRREG.

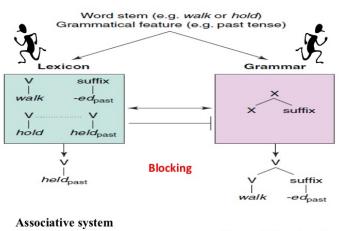
Wernicke's type aphasia

IRREG. >better than >REG.

Procedural memory affected

Dev. Lang. Disorder **Parkinsons**

Broca's type aphasia



Associative system
Analogy-based
Frequency dependent

Computational system Not frequency dependent 05 - Morphological representation and processing

Nick Riches

ntroduction

The big debate Comp. versus Lex.

Evidence for comp sys.

- 1. Productive usag
- 2. Morph errors
- 3. Morpho-phon. parsis
- 4. Phonotactic evidence

Whole-wd. stora

- 1. Non-word roots
- Multiple meaning
 Psycholinguistic a
- 3. Psycholinguistic evi

A hybrid view
Evidence for 2 sys.
Gradient phenomena

Dual Route Model

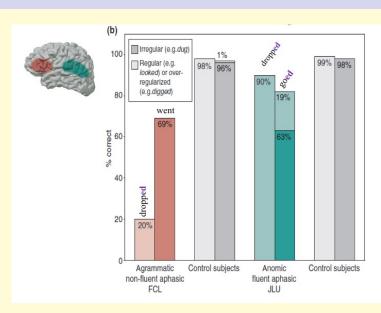
Proc. vs. Decl. The model

Evidence

- Crit. of DR model
- (1) D
- (2) The role of frequency

minute exercise

illitute exercise



05 - Morphological representation and processing

Nick Riches

ntroduction

The big debate

Evidence for companys.

- 1. Productive usa
- 2. Worph errors
- Niorpno-pnon. parsin

Whole-wd. sto

- 1. Non-word roots
- 2. Multiple meanings
- Psycholinguistic eviden

A hybrid view

Evidence for 2 sys.

Dual Route Mode

Proc. vs. Decl.

Evidence

- Crit. of DR model
- (1) Pseudo-regularity
- (2) The role of frequency

minute exercise

illitute exercise

Criticism of the dual route model

Joanisse & Seidenberg, 1999. Irregular system shows characteristics of regular system $meet \rightarrow met$, $let \rightarrow let$, $put \rightarrow put$, $shut \rightarrow shut$ $goose \rightarrow geese, mouse \rightarrow mice, moose \rightarrow moose.$

05 - Morphological representation and processing

Nick Riches

1 Non-word roots

- Crit. of DR model
- (1) Pseudo-regularity
- (2) The role of frequency

Criticism of the dual route model

Frequency **does** play a role in regular morphology.

e.g. Losiewicz and Alegre & Gordon studies cited above

05 - Morphological representation and processing

Nick Riches

ntroduction

The big debate

Evidence for comp sys.

- 1. Productive usa
- 2. Morph errors
- 3. Morpho-phon. parsi

4. Phonotactic evidence

Phonotactic evidence

iole-wd. storage

Non-word roots
 Multiple meanings

Multiple meanings

Psycholinguistic evidence

A hybrid view Evidence for 2 sys.

ual Route Model

The model

Crit. of DR model

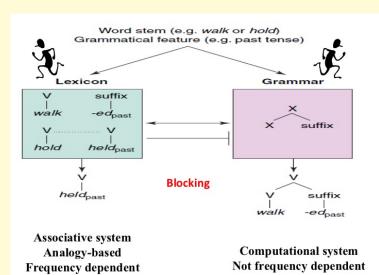
rit. of DR model (1) Pseudo-regulari

(2) The role of frequency

inute evercice

illitute exercise

Criticism of the dual route model



05 - Morphological representation and processing

Nick Riches

1 Non-word roots

Evidence for 2 sys.

- Crit. of DR model
- (2) The role of frequency

	05 - Morphological representation and processing
Introduction	Nick Riches
The big debate	Introduction The big debate
Evidence for a computational system	Comp. versus Lex. Evidence for comp. sys.
Evidence of the whole-word storage of morphologically-complex words	1. Productive usage 2. Morph errors 3. Morpho-phon. parsing 4. Phonotactic evidence
A hybrid view	Whole-wd. storage 1. Non-word roots 2. Multiple meanings
Morphology in language impairments - Ullman and Pinker's Dual Route model	Psycholinguistic evidence A hybrid view Evidence for 2 sys. Gradient phenomena
5-minute exercise	Dual Route Model Proc. vs. Decl.
	The model Evidence
Bibliography	Crit. of DR model (1) Pseudo-regularity

5-minute exercise

(2) The role of frequency

Bib

05 - Morphological representation and processing Nick Riches

Which one of these sentences did Yoda say in the Star Wars

trilogy? Can you explain the reasons behind your choice?

- 1. Have become powerful you. You the dark side I sense in.
- 2. Powerful you have become. The dark side I sense in you.
- Become powerful you have. The dark I sense in you side.

1 Non-word roots

Evidence for 2 sys.

- Crit. of DR model
- (2) The role of frequency

5-minute exercise

05 - Morphological representation and processing Nick Riches 1. Non-word roots Evidence for 2 sys.

Bibliography

Proc vs Decl

Crit of DR model

Rih

(2) The role of frequency

05 - Morphological representation and processing Nick Riches

Aitchison, J. (2002). Words in the Mind: An Introduction to the Mental Lexicon (3rd Edition). Wiley-Blackwell.

Alegre, M., & Gordon, P. (1999). Frequency effects and the representational status of regular inflections. Journal of Memory and Language, 40, 41-61.

Joanisse, M. F., & Seidenberg, M. S. (1999). Impairments in verb morphology after brain injury: A connectionist model. Proceedings of the National Academy of Sciences of the United States of America, 96(13), 7592.

Losiewicz, B. L. (1992). The effect of frequency on linguistic morphology. University of Texas at Austin.

Pinker, S., & Ullman, M. T. (2002). The past and future of the past tense debate. Trends in Cognitive Sciences, 6(11), 456-463.

Post, B., Marslen-Wilson, W. D., Randall, B., & Tyler, L. K. (2008). The processing of English regular inflections: Phonological cues to morphological structure. Cognition, 109(1), 1-17. https://doi.org/10.1016/j.cognition.2008.06.011

Ullman, M. T., & Pierpont, E. I. (2005). Specific language impairment is not specific to language: the procedural deficit hypothesis. Cortex, 41(3), 399-433.

- 1. Productive usage

1 Non-word roots

Evidence for 2 sys.

Proc vs Decl

- Crit. of DR model

Rib

- (2) The role of frequency