بسم الله الرحمن الرحیم

علوم شناختی

جلسه ۱۹ (ج)

یادگیری زبان در شبکه‌های عصبی

Language Learning in Neural Networks

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http://courses.fouladi.ir/cogsci

PART 3:
APPLICATIONS

Chapter 10:
Models of Language Learning

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Chapter 10.3: Language learning in neural networks

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Overview

- Introduce physical symbol model of past tense learning
- Introduce neural network models of past tense learning
- Compare Rumelhart and McClelland's neural network model to Plunkett and Marchman's

Language Learning and PSSH

- Language is rule-governed
- Physical symbol systems are also rule-governed
- But rule-governed phenomena need not come from rule-governed information processing structures

Two Features of Past Tense Learning

1. Follow rules (e.g., add “-ed”)

2. Learn exceptions to the rules (e.g., “give” to “gave”)

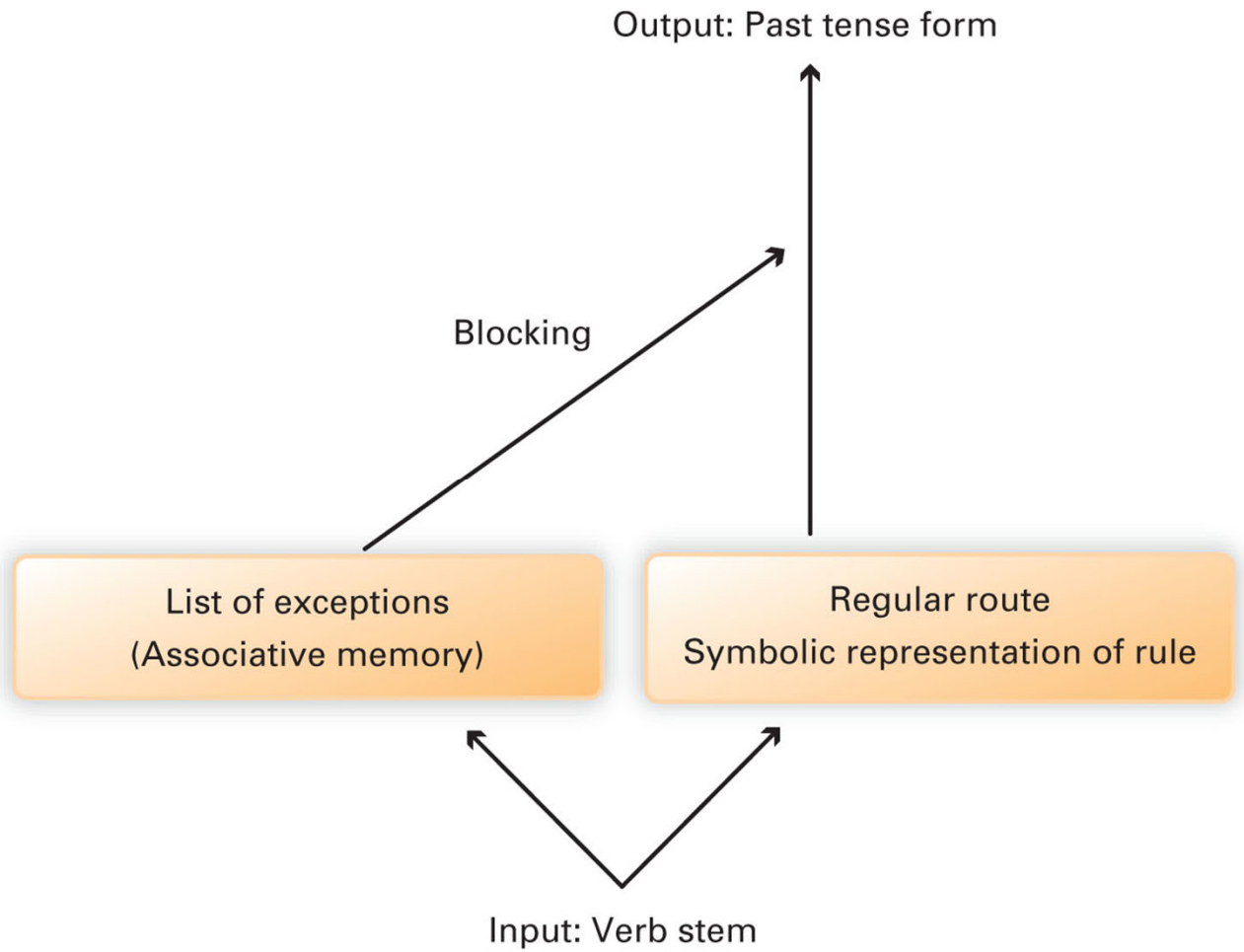
Past Tense Learning

The stages of past tense learning according to verb type

	STAGE 1	STAGE 2	STAGE 3
Early verbs	Correct	Over-regularization errors	Correct
Regular verbs		Correct	Correct
Irregular verbs		Over-regularization errors	Improvement with time

Seems to confirm the symbolic, rule-following model of past tense learning.

Pinker and Prince



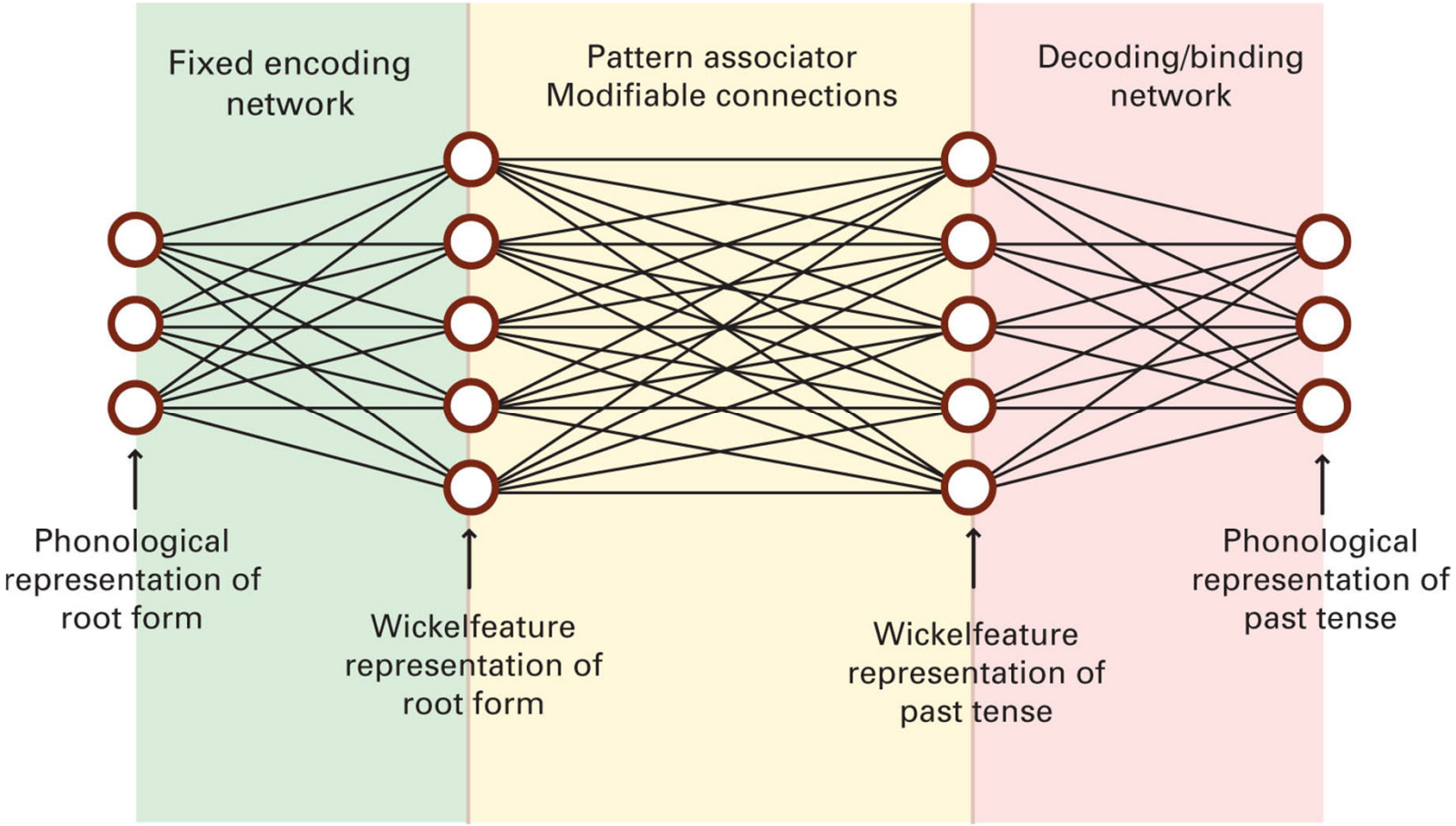
Neural network models

Attempt to replicate rule-governed linguistic behavior without the rules being explicitly taught

Rumelhart and McClelland

- Phoneme detection network
- Capable of comparing words according to their phonetic structure
- Trained on high- and medium-frequency verbs

Rumelhart and McClelland

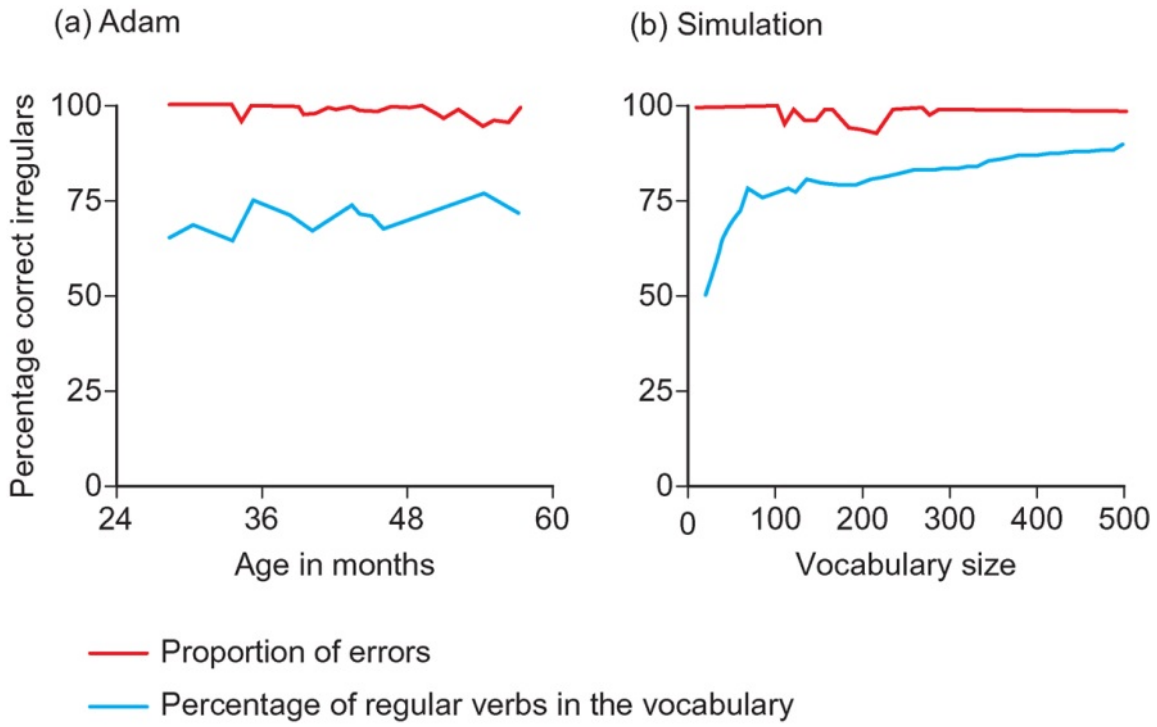


Plunkett and Marchman 1993

- Reproduced over-regularization error
  - More regular than irregular verbs, just like real children
  - Characteristic mistakes (e.g., adding "-ed" to every verb)
  - Gradual change in performance, just like real children

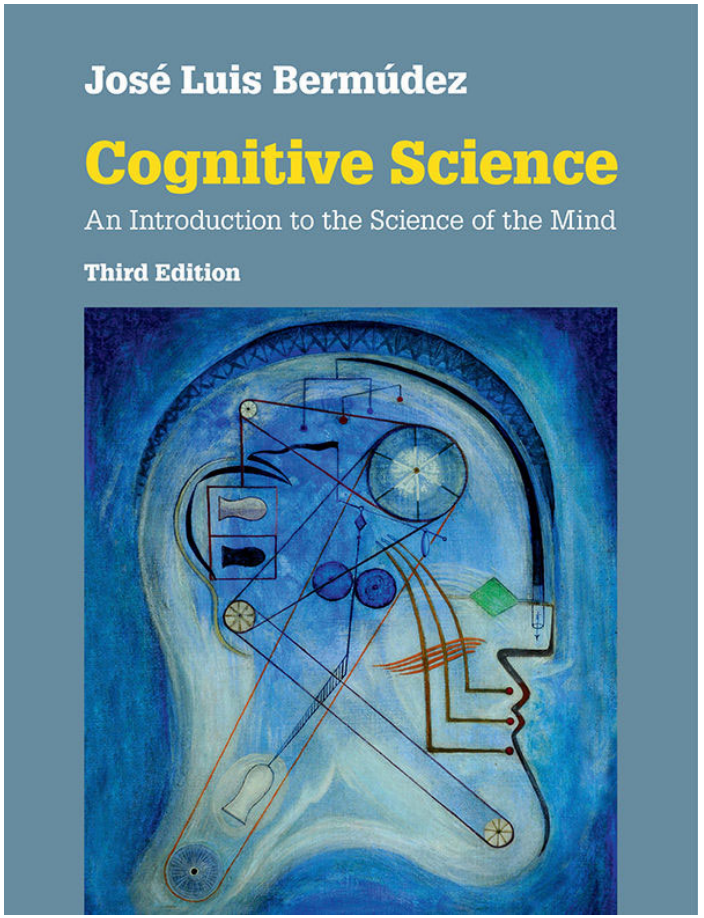
- Trained the network on both regular and irregular verbs
  - More like how real children learn verbs

Plunkett and Marchman 1993

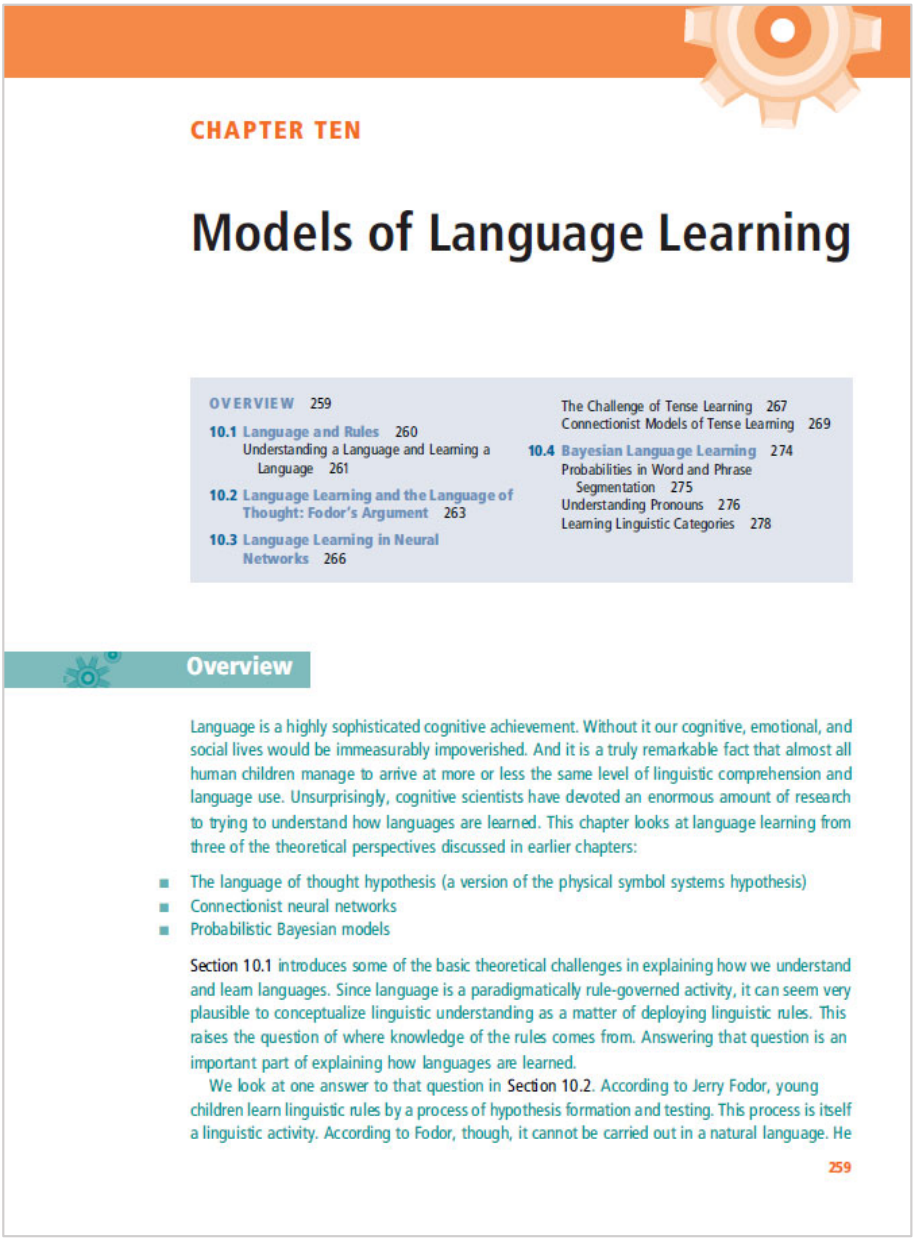


A comparison of the errors made by Adam, a child studied by the psychologist Gary Marcus, and the Plunkett–Marchman neural network model of tense learning. (Adapted from McLeod, Plunkett, and Rolls 1998)

منبع اصلی



José Luis Bermúdez,
Cognitive Science:
An Introduction to the Science of the Mind,
3rd ed., Cambridge University Press, 2020.
Chapter 10 (Section 10.3)



CHAPTER TEN

Models of Language Learning

Overview

Language is a highly sophisticated cognitive achievement. Without it our cognitive, emotional, and social lives would be immeasurably impoverished. And it is a truly remarkable fact that almost all human children manage to arrive at more or less the same level of linguistic comprehension and language use. Unsurprisingly, cognitive scientists have devoted an enormous amount of research to trying to understand how languages are learned. This chapter looks at language learning from three of the theoretical perspectives discussed in earlier chapters:

- The language of thought hypothesis (a version of the physical symbol systems hypothesis)
- Connectionist neural networks
- Probabilistic Bayesian models

Section 10.1 introduces some of the basic theoretical challenges in explaining how we understand and learn languages. Since language is a paradigmatically rule-governed activity, it can seem very plausible to conceptualize linguistic understanding as a matter of deploying linguistic rules. This raises the question of where knowledge of the rules comes from. Answering that question is an important part of explaining how languages are learned.

We look at one answer to that question in Section 10.2. According to Jerry Fodor, young children learn linguistic rules by a process of hypothesis formation and testing. This process is itself a linguistic activity. According to Fodor, though, it cannot be carried out in a natural language. He

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