The TRACE Model of Speech Perception

Presented by A. Brian Davis

- Introduction
- Specifics
- Experiments
- Limitations

Introduction

- Insufficiency acoustic information
  - Context Sensitivity (adjacent phonemes)
- Distributed processing
  - Individual units as hypotheses
- Psychological vs Computational model performance

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Specifics

- Input Features
  - Consonantal, vocalic (obvious), diffuseness (spread out), acuteness, voicing, Power, Amplitude of “burst of noise” (discriminating stops)
  - Discretized, chosen

TABLE I
Phoneme Feature Values Used in TRACE II

Phoneme	Power	Vocalic	Diffuse	Acute	Cons.	Voiced	Burst
p	4	1	7	2	8	1	8
b	4	1	7	2	8	7	7
t	4	1	7	7	8	1	6
d	4	1	7	7	8	7	5
k	4	1	2	3	8	1	4
g	4	1	2	3	8	7	3
s	6	4	7	8	5	1	—
S	6	4	6	4	5	1	—
r	7	7	1	2	3	8	—
l	7	7	2	4	3	8	—
a	8	8	2	1	1	8	—
i	8	8	8	8	1	8	—
u	8	8	6	2	1	8	—
^	7	8	5	1	1	8	—

Specifics

- Input Features
  - Consonantal, vocalic (obvious), diffuseness (spread out), acuteness, voicing, Power, Amplitude of “burst of noise” (discriminating stops)
  - Discretized, chosen
    - Correlated

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g	4	1	2	3	8	7	3
s	6	4	7	8	5	1	—
S	6	4	6	4	5	1	—
r	7	7	1	2	3	8	—
l	7	7	2	4	3	8	—
a	8	8	2	1	1	8	—
i	8	8	8	8	1	8	—
u	8	8	6	2	1	8	—
^	7	8	5	1	1	8	—

TRACE 2

- Time discretized
- 3 logical levels
  - Features, Phonemes, Words
    - Time (1,3,6); overlap
    - Node excitation is hypothesis
      - Probabilistic: $p(R_i)=\frac{S_i}{\sum_j S_j}$, $S_i=e^{ka_i}$
  - {Between,Within}-level excitation, inhibition (Neural network)
    - Features excite phoneme nodes
    - Phonemes excite word nodes
    - Competition

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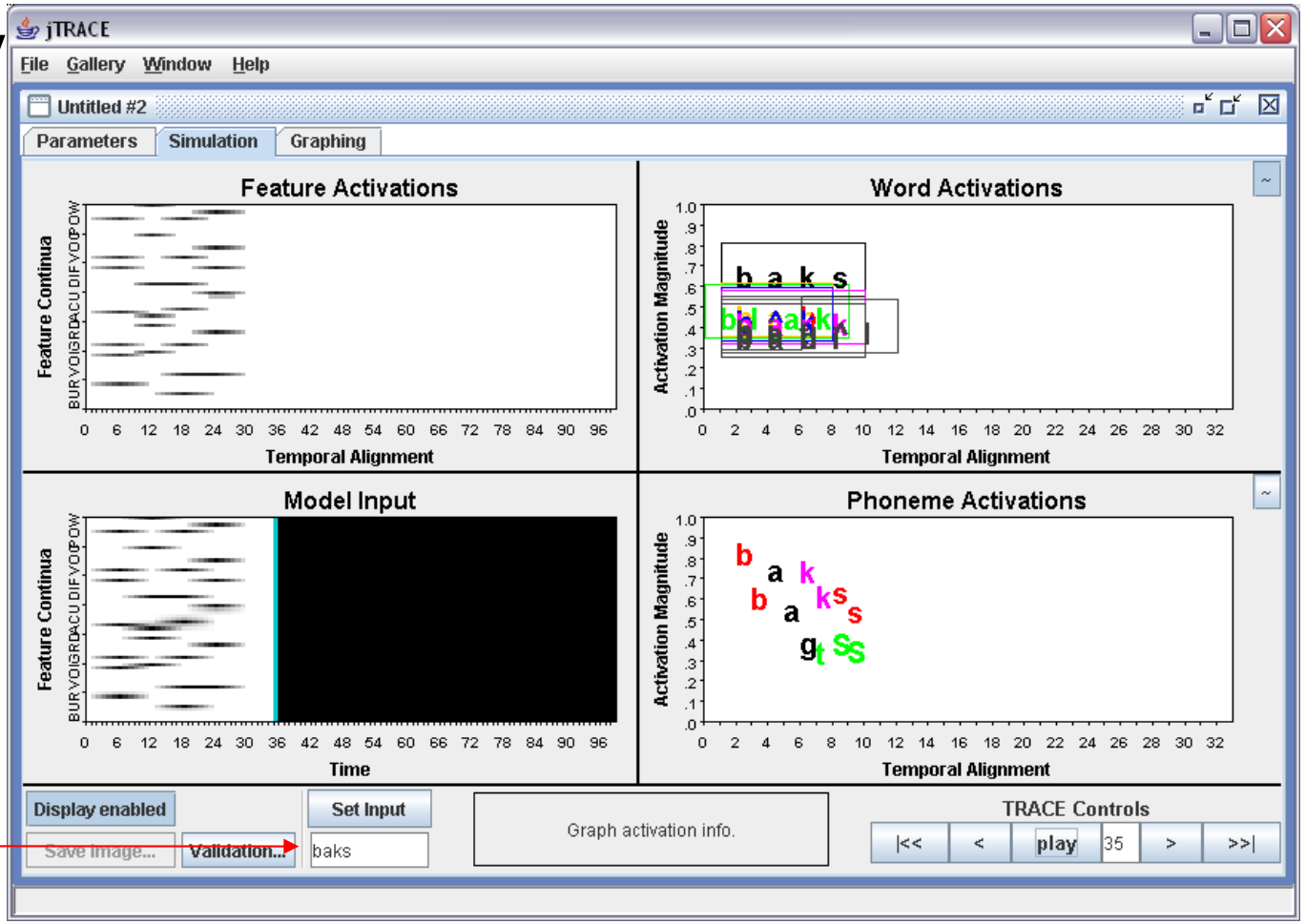
jTRACE

- Java implementation TRACE
- Thanks to Daniel Felps for the link

jTRACE

- Java implementation TRACE
- Thanks to Daniel Felps for the link
- Somewhat faulty
  - Experiments



Input phonemes

Lexical Effects

- Correct misspoken phoneme
  - Word feedback (Ex: Trust/Tlust)
- Mechanical / Psychological
- Reaction times (Phonotactic effect)
  - End of words (secret, guldut)

Word Segmentation

- Ambiguous word breaks
  - Humans easily disambiguate (usually)
    - secant/she can't
  - TRACE words inhibit other words overlapping time
    - Shorter words preferred, then longer
  - Words vs non-words, break decision speed
    - {Possible, pagusle} target

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Deficiencies

- Learning mechanism (none)

TABLE 3
Parameters of TRACE II

Parameter	Value
Feature–phoneme excitation	.02
Phoneme–word excitation	.05
Word–phoneme excitation	.03
Phoneme–feature excitation	.00
Feature-level inhibition	.04
Phoneme-level inhibition[a]	.04
Word-level inhibition[a]	.03
Feature-level decay	.01
Phoneme-level decay	.03
Word-level decay	.05

[a] Per three time-slices of overlap.

- Context
- Size