Explaining the Pseudohomophone Effect in Lexical Decision

Hedderik van Rijn
&
John R. Anderson

Carnegie Mellon University

What is Lexical Decision?

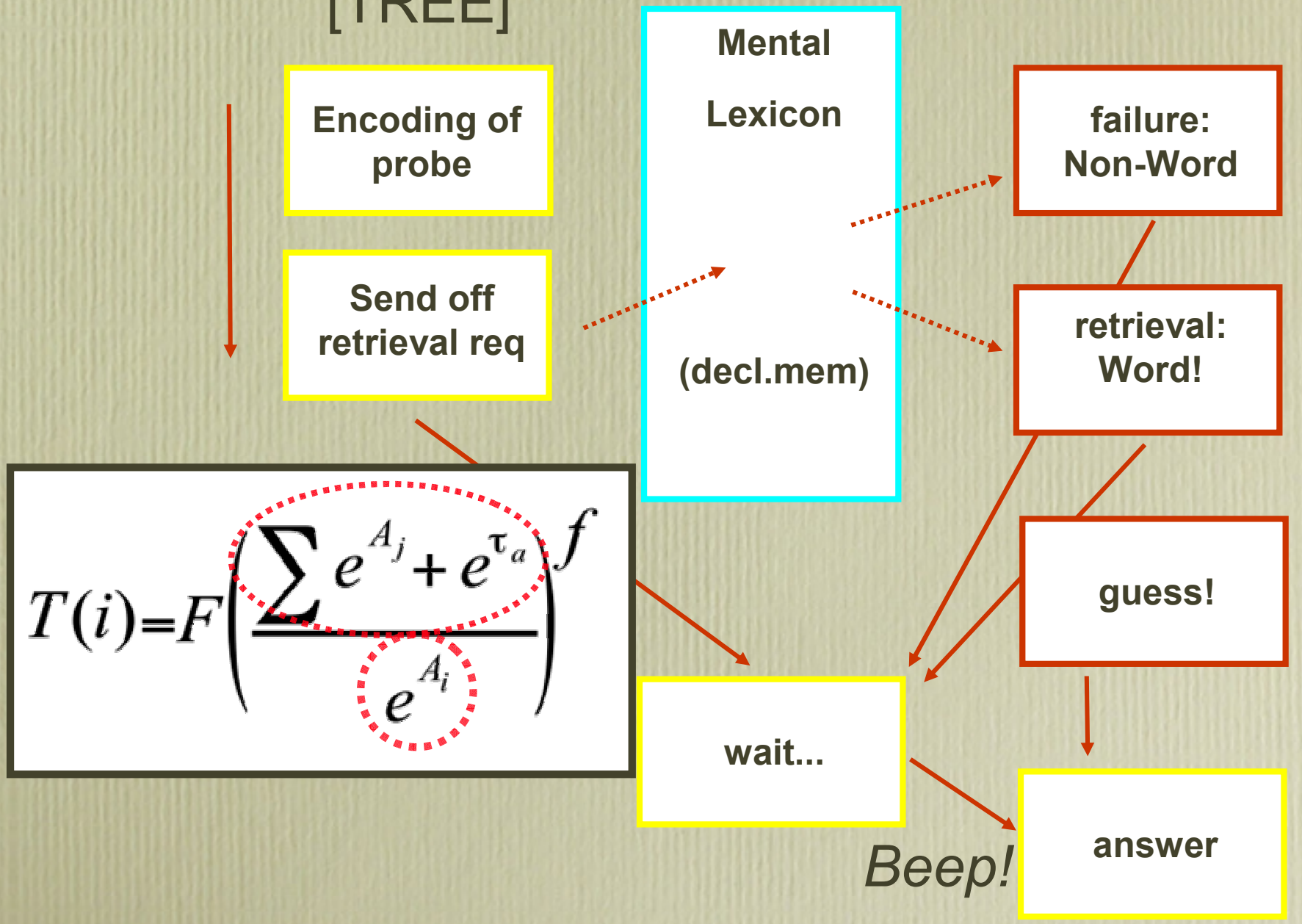
Typical Results

- High frequent words are responded to more accurately than low frequent words:
  - HOUSE vs CHUTE
  - GIRL vs LIME

- Word-like nonwords are responded to less accurately than nonwords that are less word-like.
  - BALN *(ball, balm)* vs YEBE

ICCM ACT-R LD model

[TREE]



What are Pseudohomophones?

- Pseudohomophones (PsHs) are nonwords that are, when pronounced, similar to a word
  - brane → */brain/* → brain
  - focks → */foks/* → fox

- Isn't it just another group of nonwords with just slightly worse performance?

- There is something special about PsHs:
  - the baseword ("fox" for "focks") frequency influences the performance on the PsH in a unintuitive way

Frequency Prediction

- Given the previously presented flowchart:
- PsH is presented → retrieval request
- Baseword is a high frequency (HF) word:
  Retrieve baseword quickly, answer incorrect
- Baseword is a low frequency (LF) word:
  Retrieval threshold: answer correct

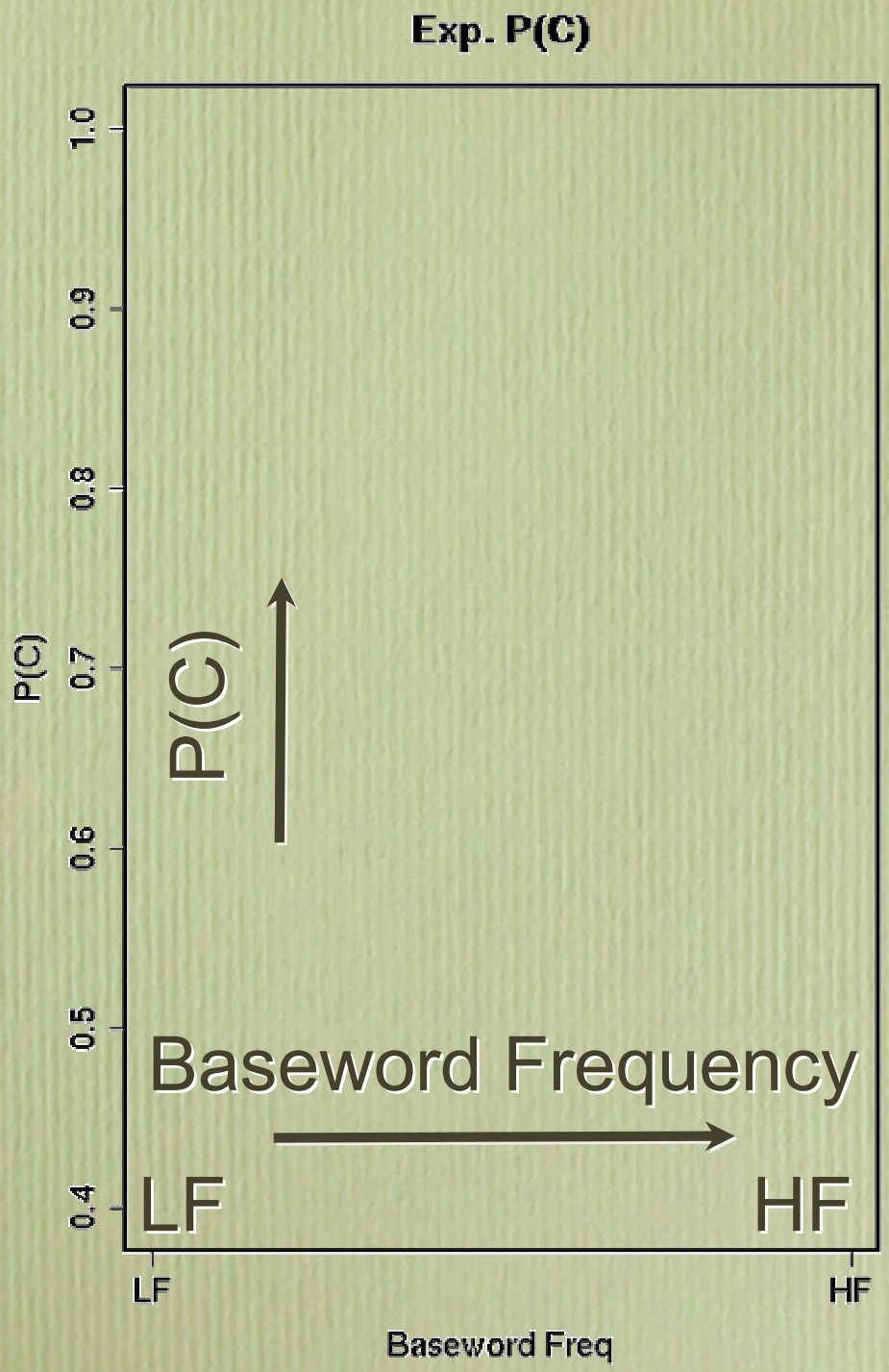
- HF P(C) < LF P(C)

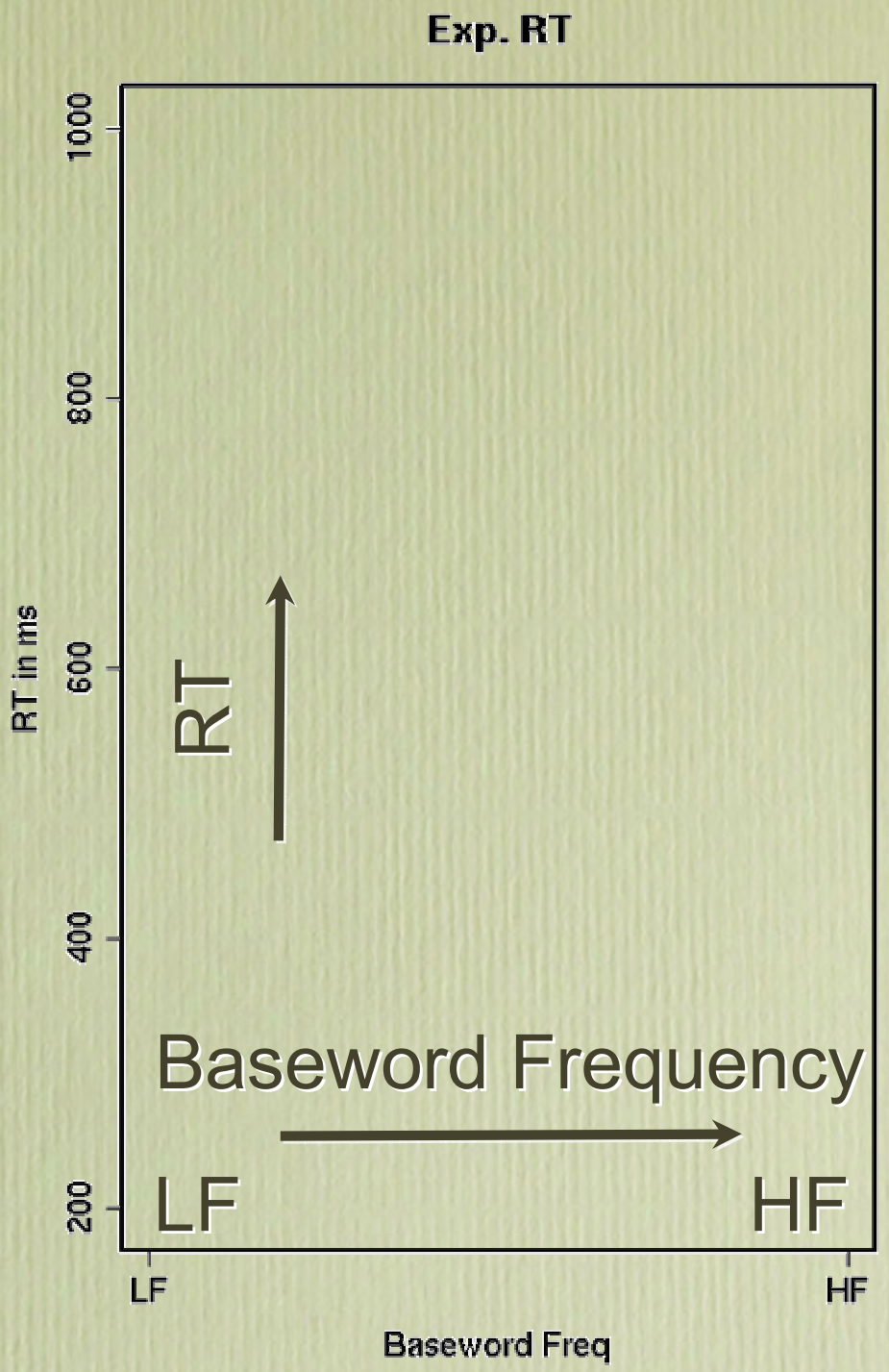
However...

- Ziegler, Jacobs, & Klueppel, (2001) Pseudohomophone Effects in Lexical Decision: Still a Challenge for Current Word Recognition Models, *Journal of Experimental Psychology: Human Perception and Performance*, 27(3), 547-559

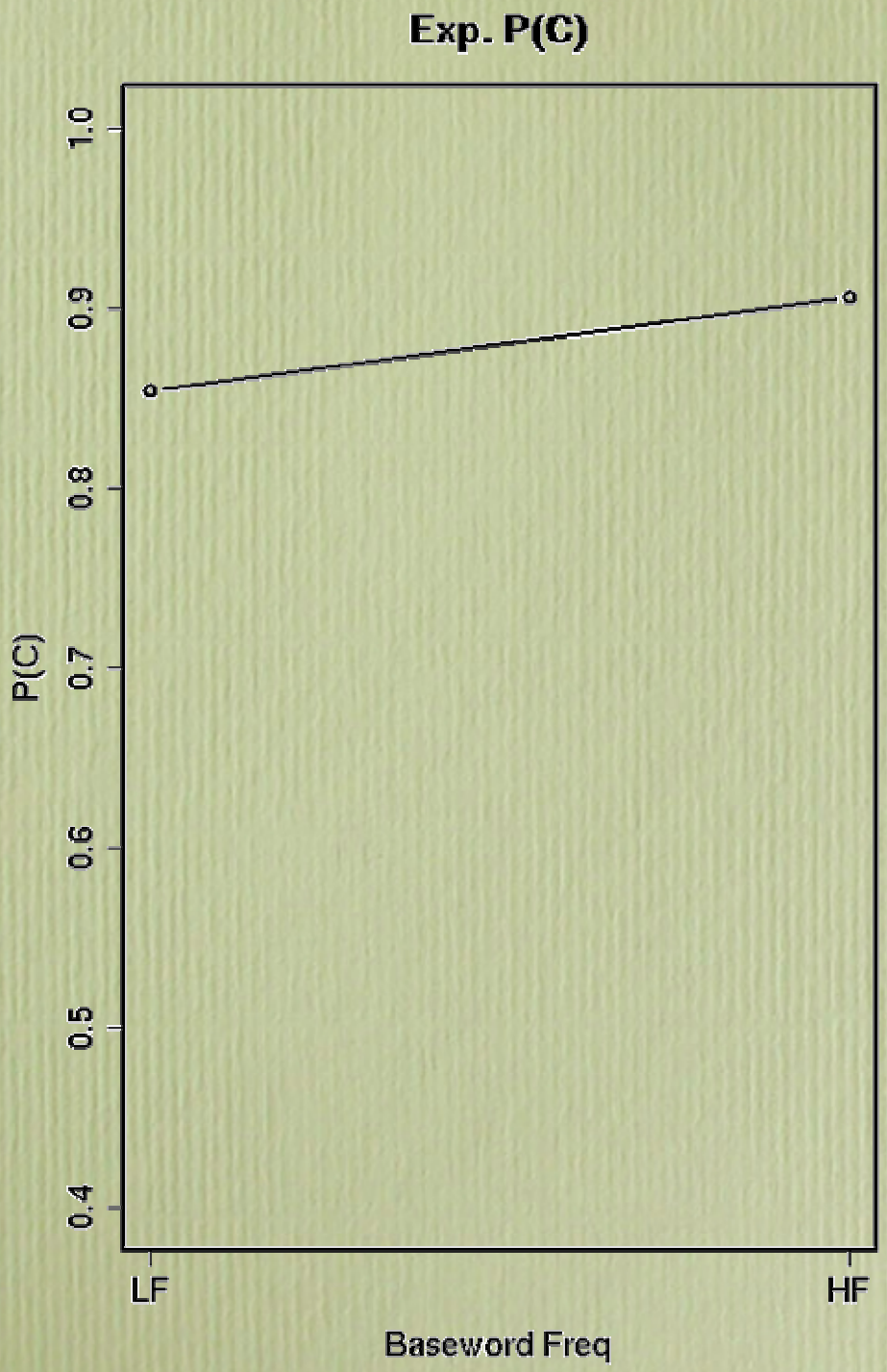
- Showed that PsHs derived from high frequency words are responded to ***more*** *accurately*!

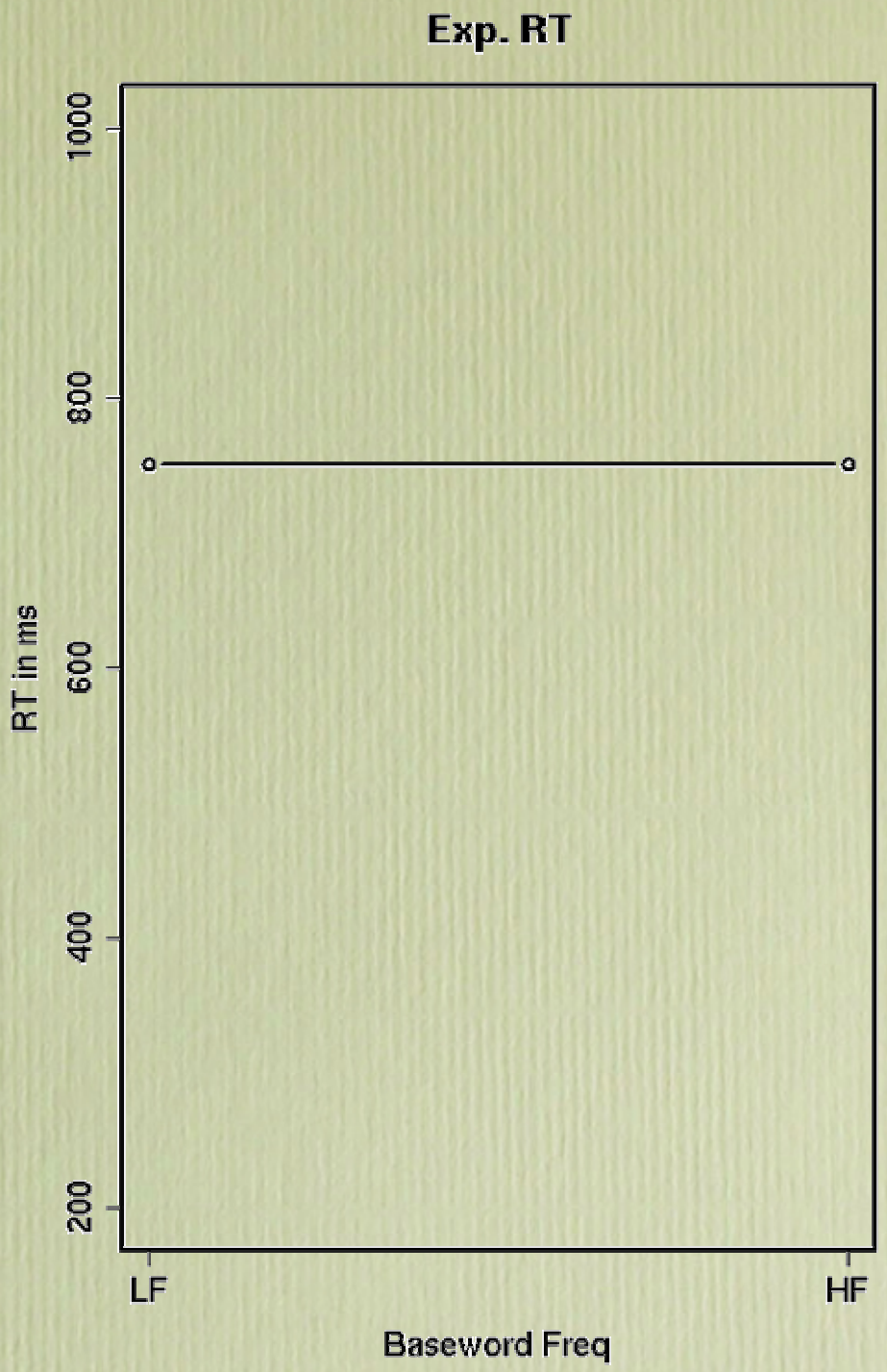
However: the experiment was run in German





Zeelenberg, Van Rijn, Wagenmakers (in prep.


Exp. P(C)
P(C)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
LF
HF
Baseword Freq

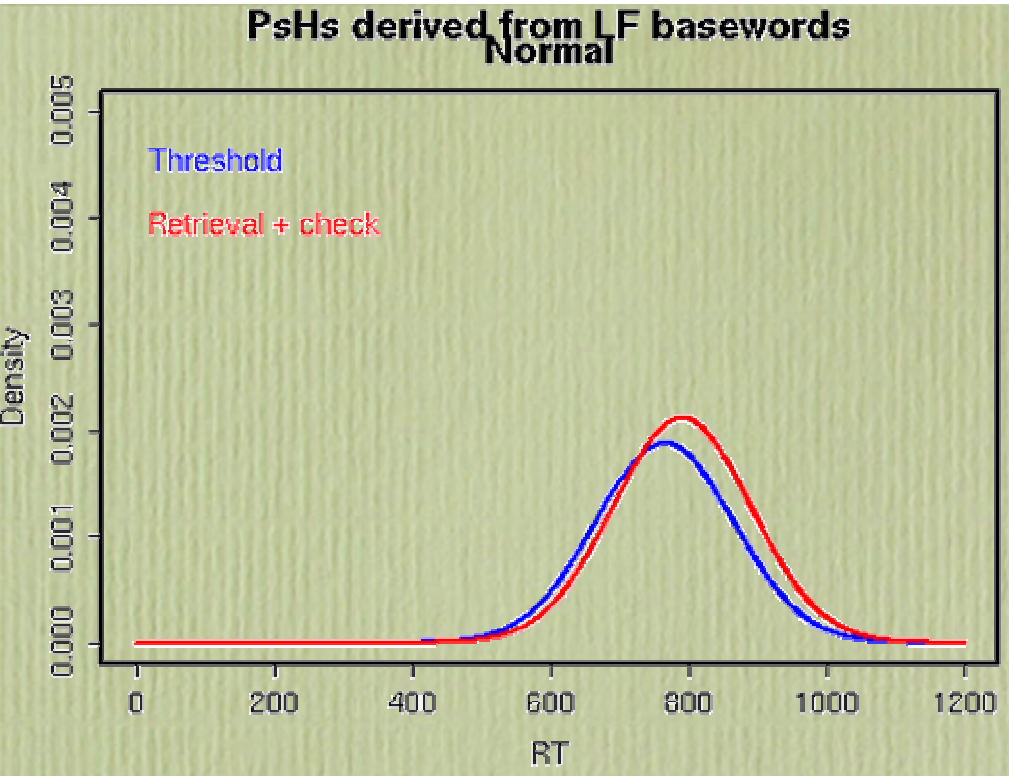

Exp. RT
RT in ms
1000
800
600
400
200
LF
HF
Baseword Freq

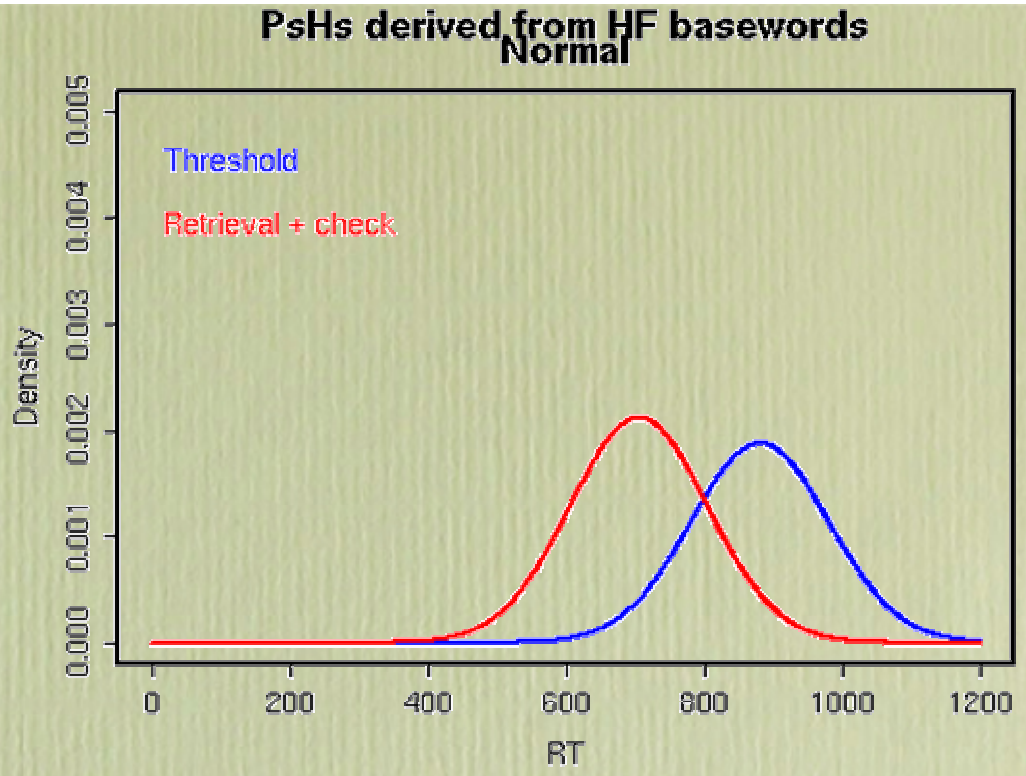
Frequency Prediction Revised

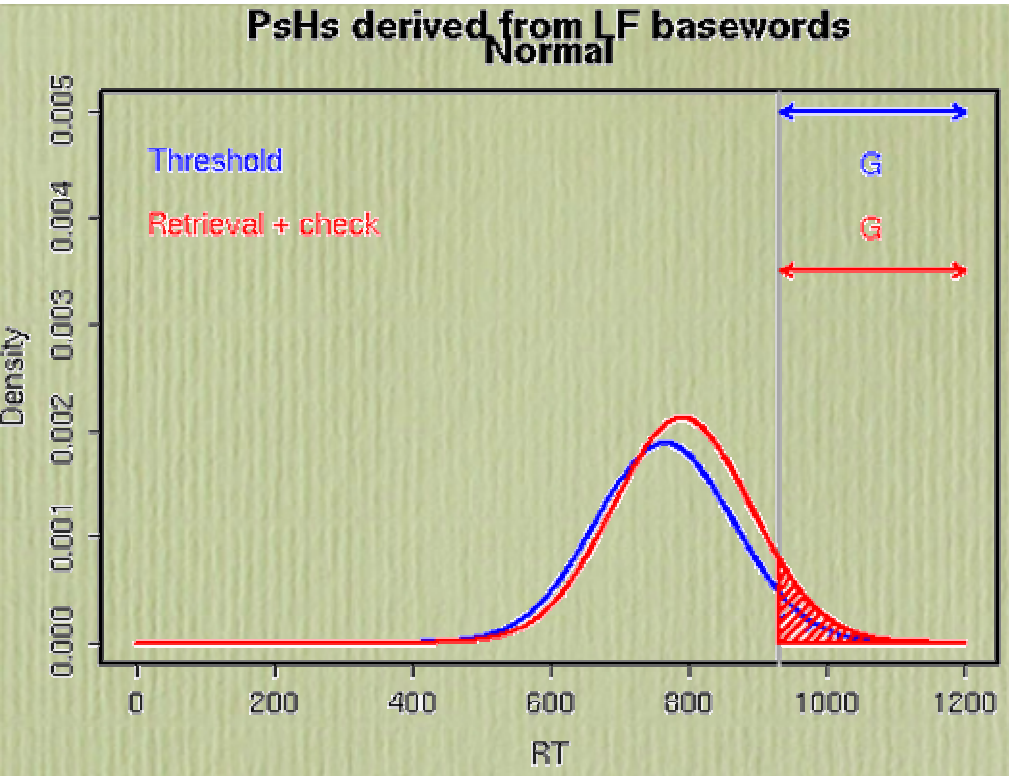
- Given the previously presented flowchart:
- PsH is presented → retrieval request
- Baseword is a high frequency (HF) word:
  Retrieve baseword quickly, answer incorrect
  check retrieval → answer correct
- Baseword is a low frequency (LF) word:
  Retrieval threshold: answer correct

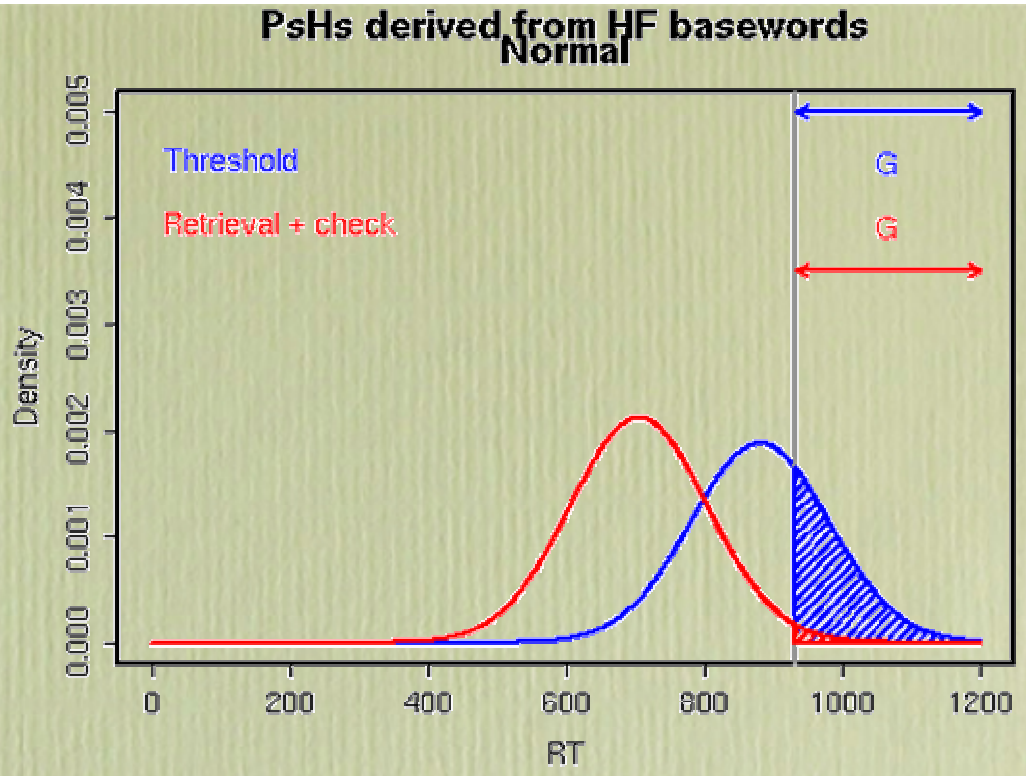
- HF P(C) < LF P(C) → *HF P(C) > LF P(C)*

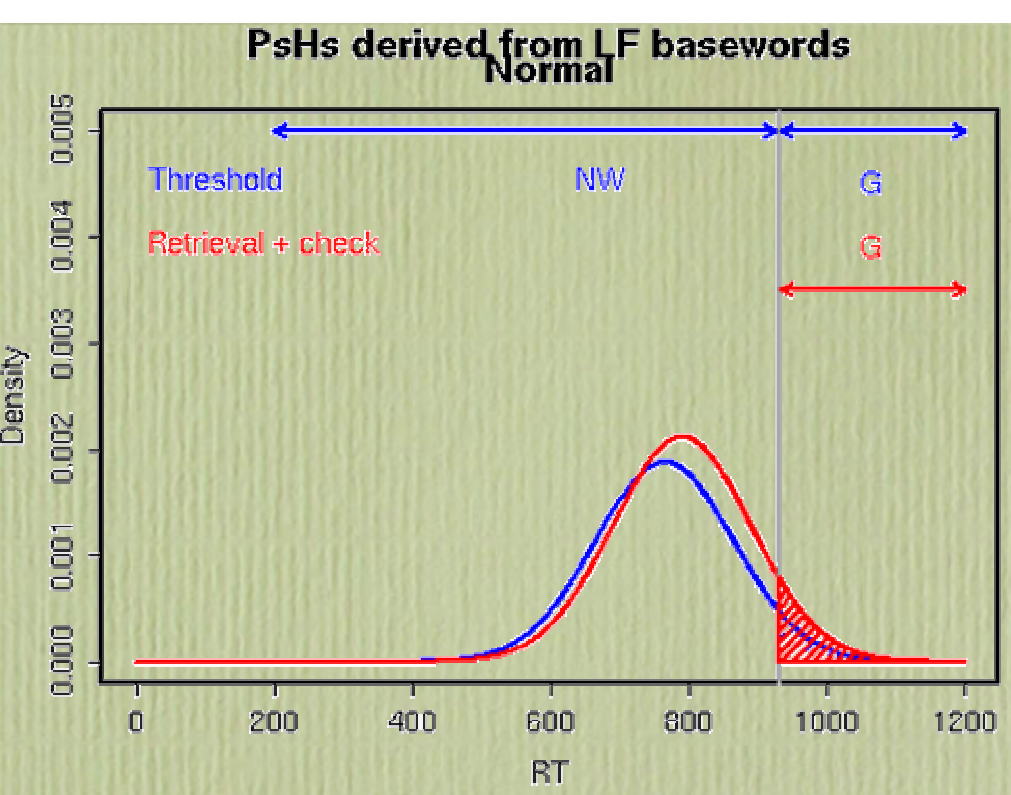
Verification Mechanism, Ziegler et al (2001)

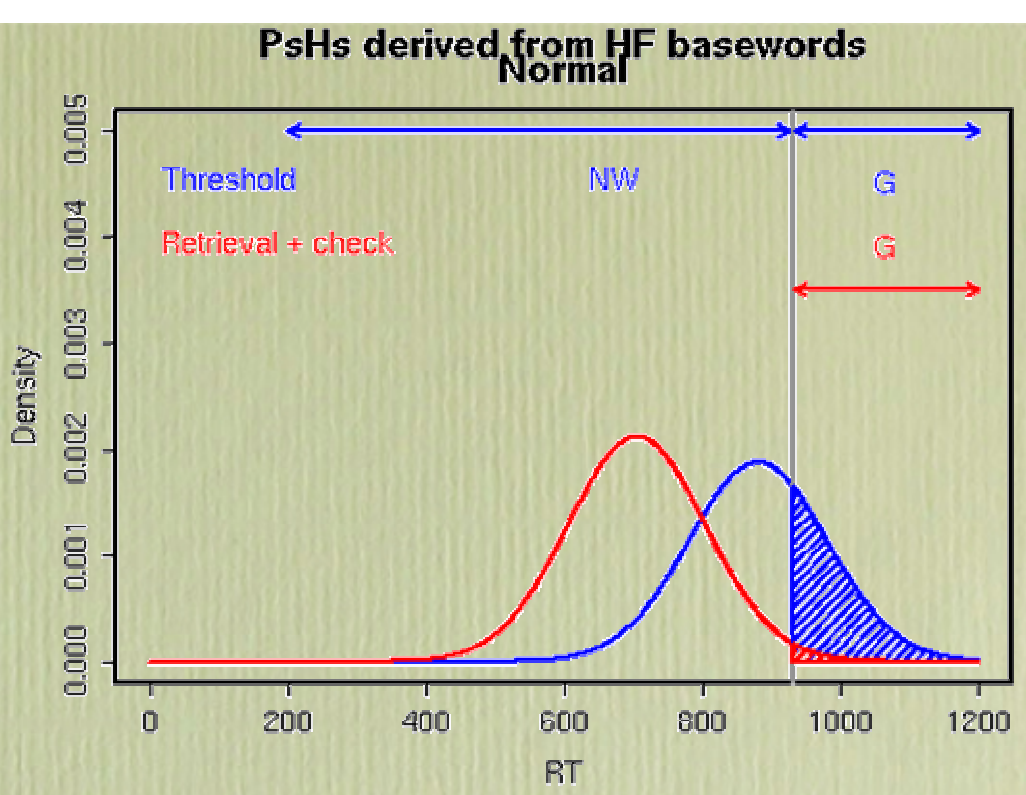

PsHs derived from LF basewords
Normal
Threshold
Retrieval + check
Density
0.000
0.001
0.002
0.003
0.004
0.005
0
200
400
600
800
1000
1200
RT

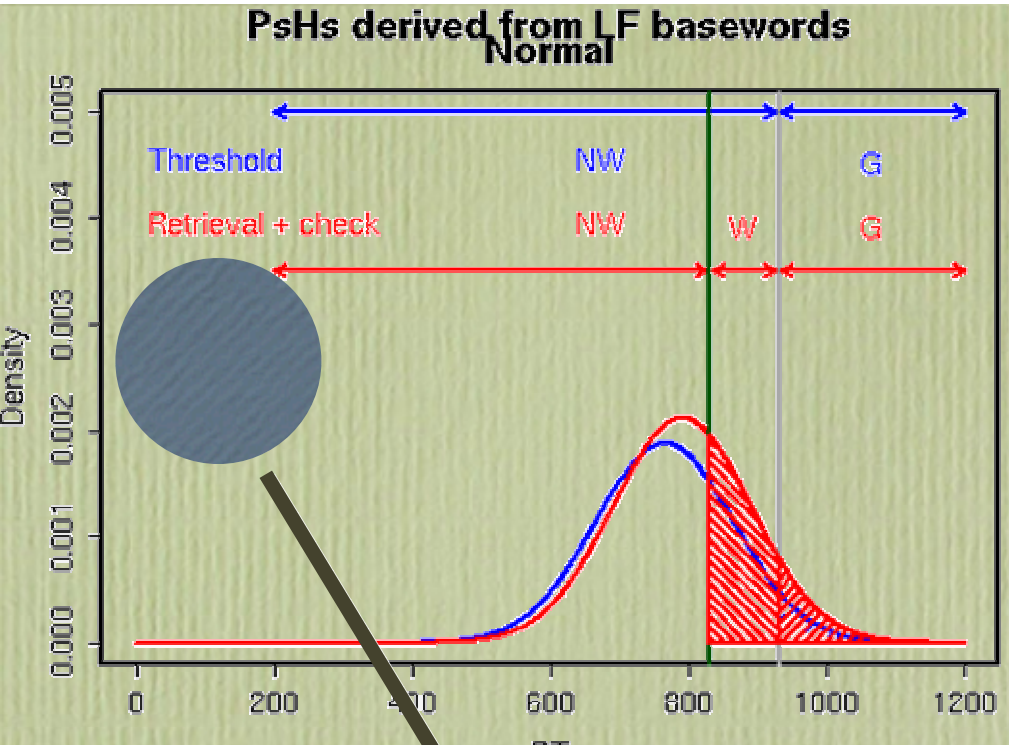

PsHs derived from HF basewords
Normal
Threshold
Retrieval + check
Density
0.000
0.001
0.002
0.003
0.004
0.005
0
200
400
600
800
1000
1200
RT

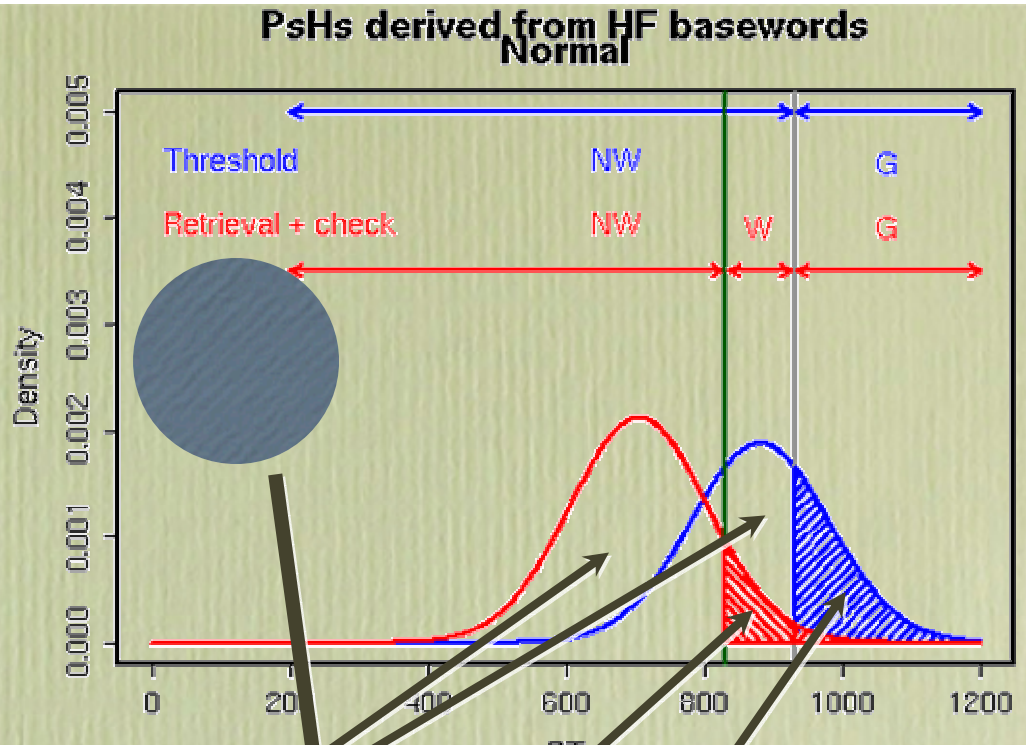

PsHs derived from LF basewords
Normal
Threshold
Retrieval + check
G
G
Density
0.000
0.001
0.002
0.003
0.004
0.005
0
200
400
600
800
1000
1200
RT


PsHs derived from HF basewords
Normal
Threshold
Retrieval + check
G
G
Density
0.000
0.001
0.002
0.003
0.004
0.005
0
200
400
600
800
1000
1200
RT


PsHs derived from LF basewords
Normal
Threshold
NW
G
Retrieval + check
G
Density
0.000
0.001
0.002
0.003
0.004
0.005
0
200
400
600
800
1000
1200
RT


PsHs derived from HF basewords
Normal
Threshold
NW
G
Retrieval + check
G
Density
0.000
0.001
0.002
0.003
0.004
0.005
0
200
400
600
800
1000
1200
RT





Nonword

RT: 789 ms
P(C): 0.85

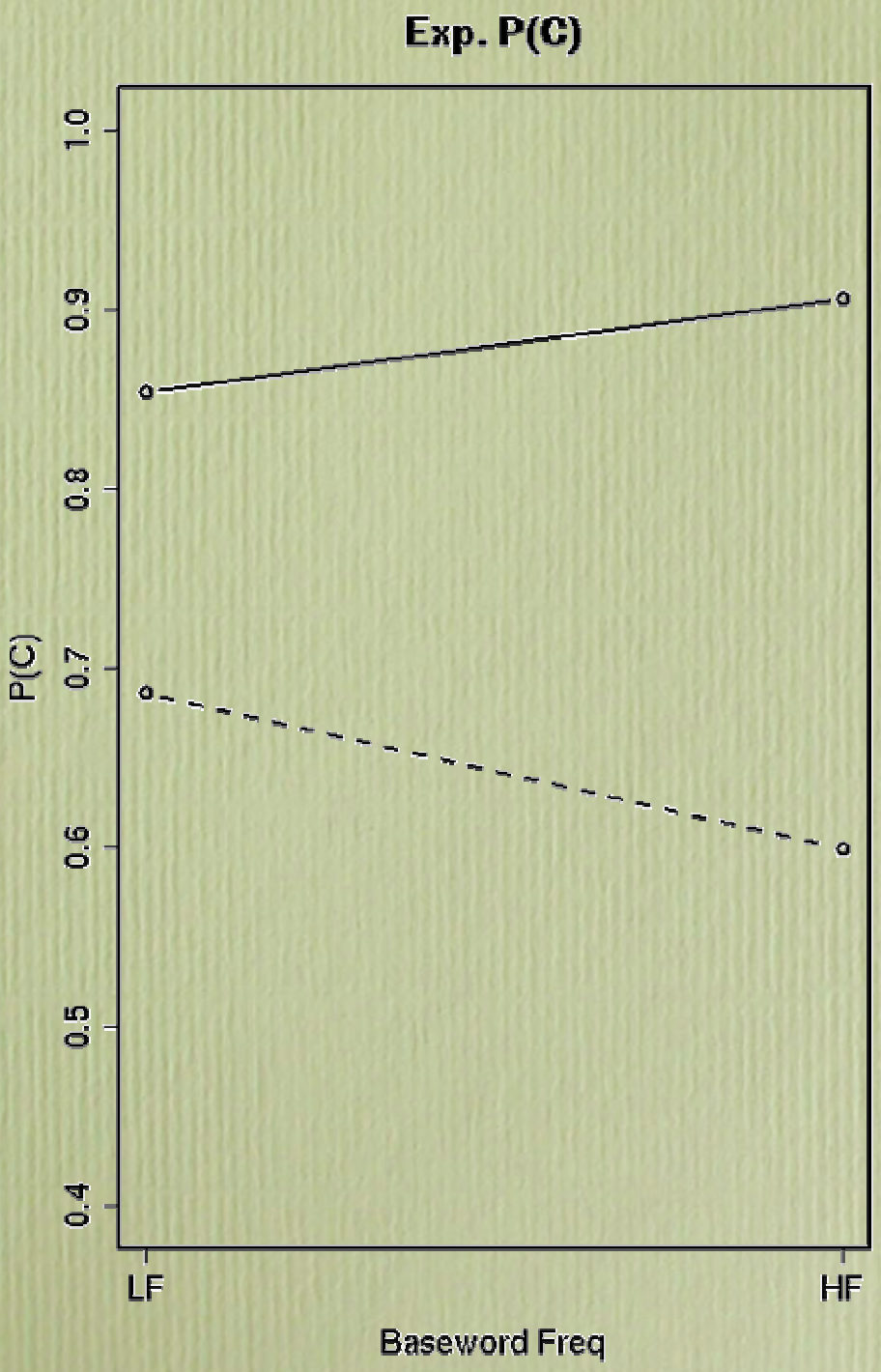
Word

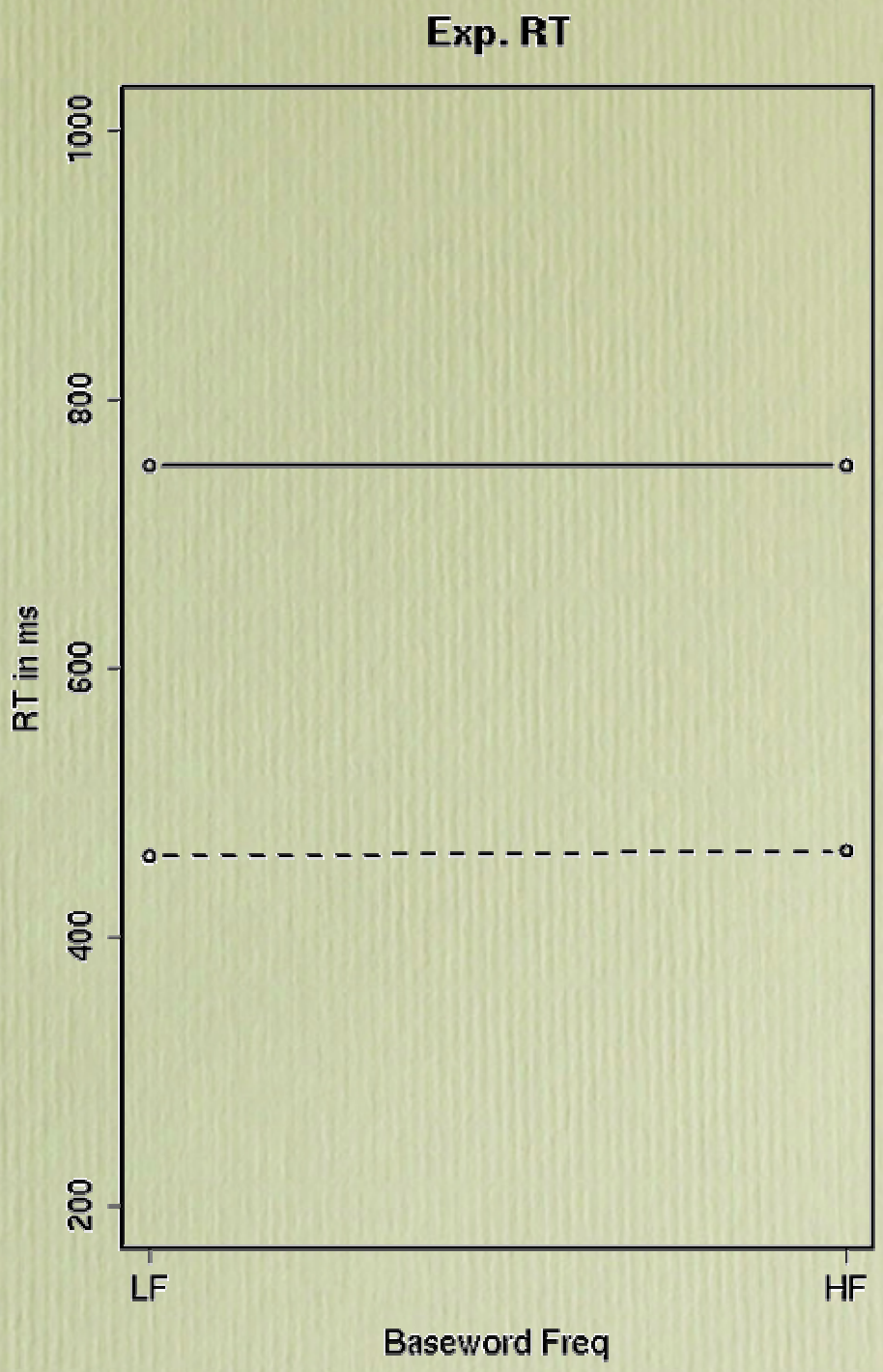
RT: 788 ms
P(C): 0.93

Guess

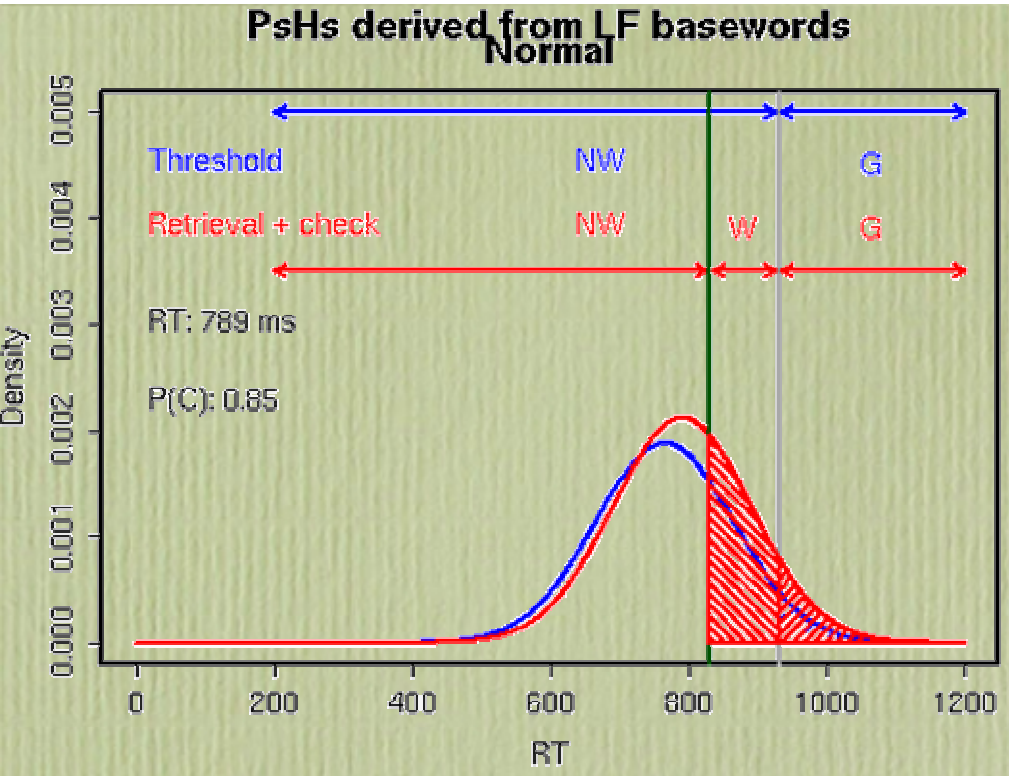
Verification when speeded?

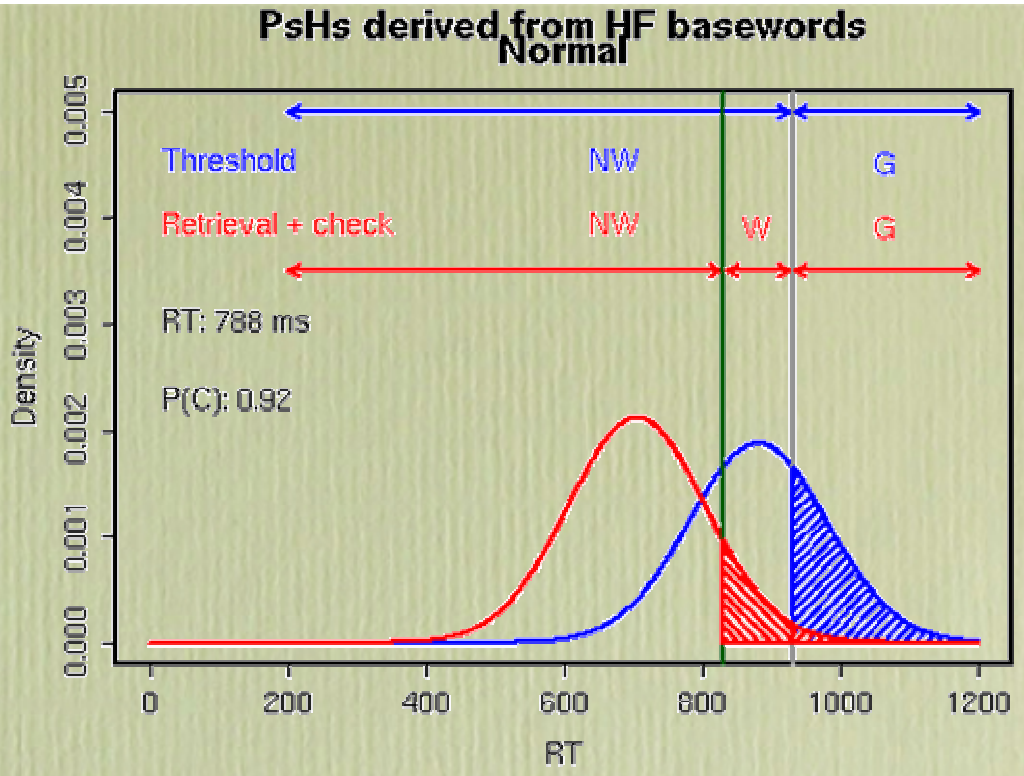
- When speeded, HF words are still retrieved faster, but ***no time for verification,*** yielding low P(C).
- When speeded, LF words aren't retrieved at all, so guesses determine performance.
- Therefore: HF P(C) < LF P(C)

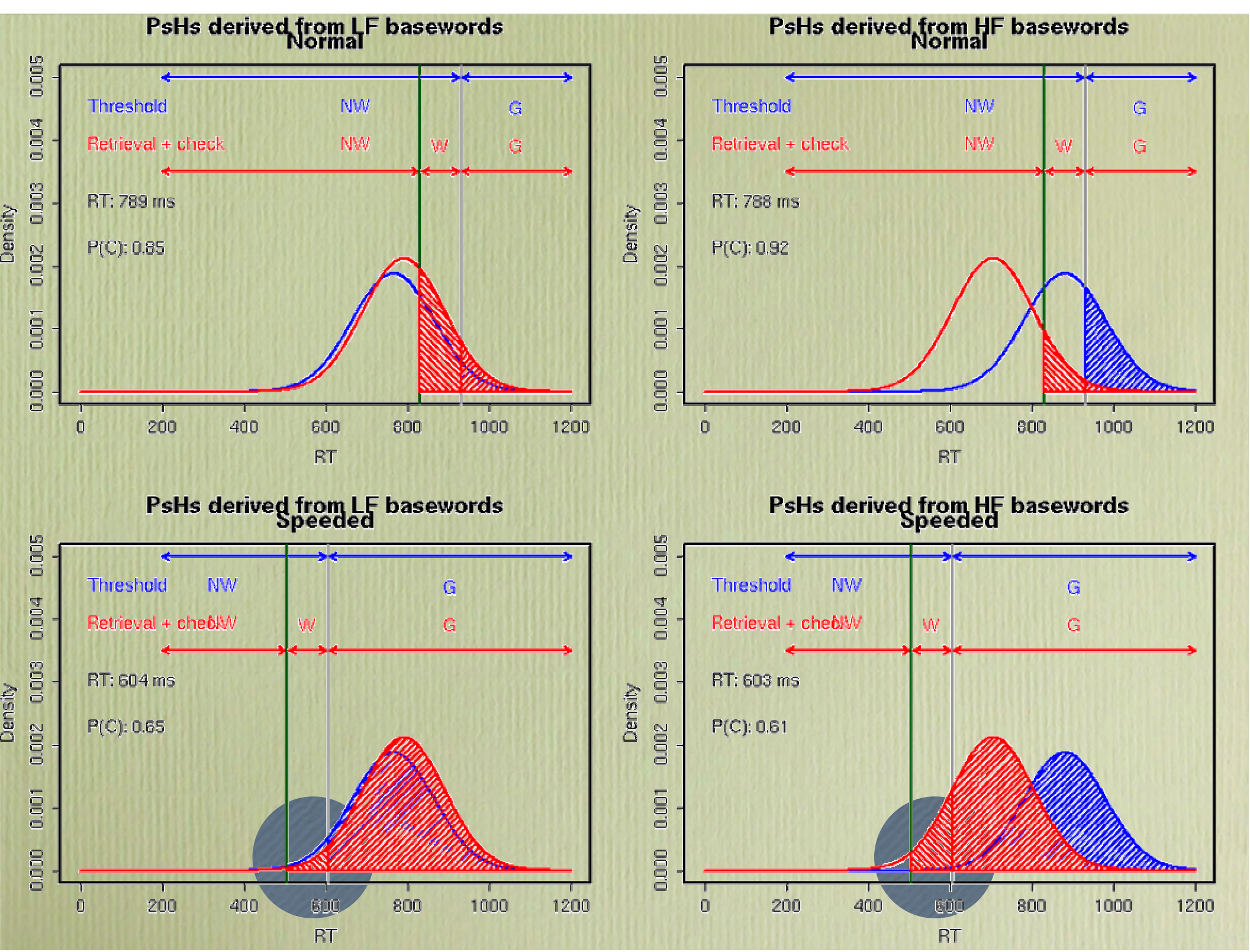




Zeelenberg, Van Rijn, Wagenmakers (in prep.)

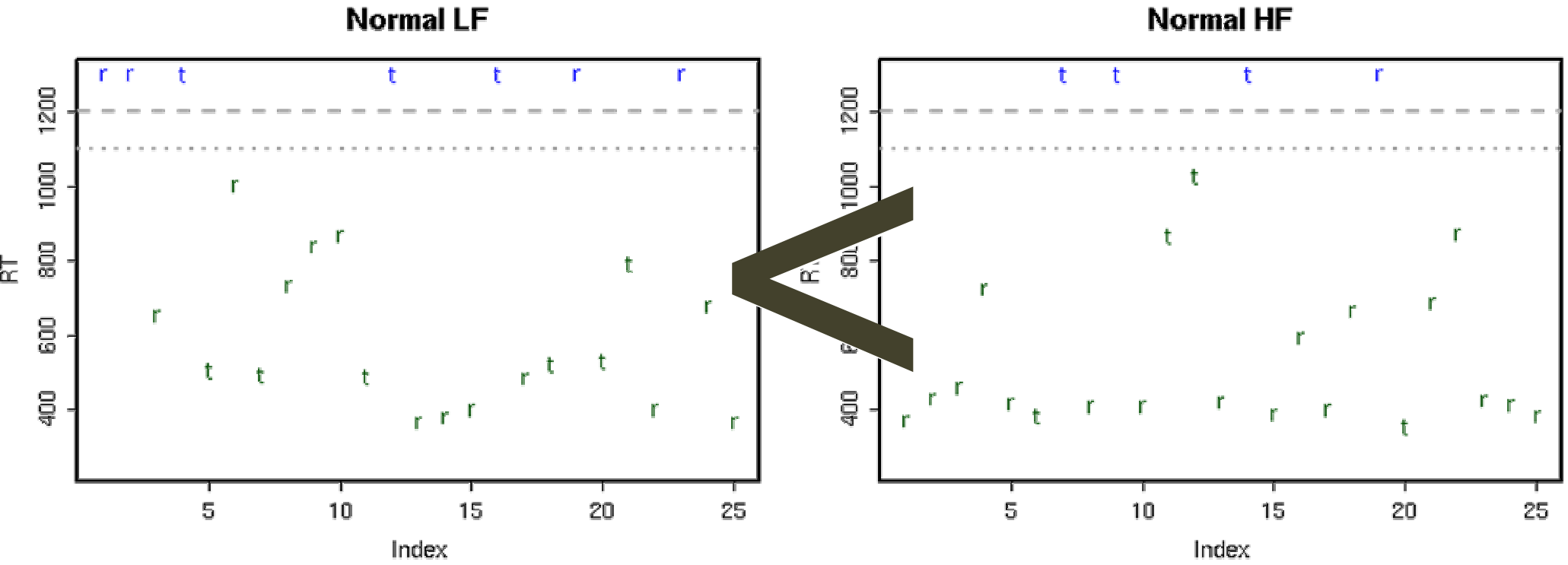

PsHs derived from LF basewords
Normal
Threshold
NW
G
Retrieval + check
NW
W
G
RT: 789 ms
P(C): 0.85
Density
0.000
0.001
0.002
0.003
0.004
0.005
0
200
400
600
800
1000
1200
RT

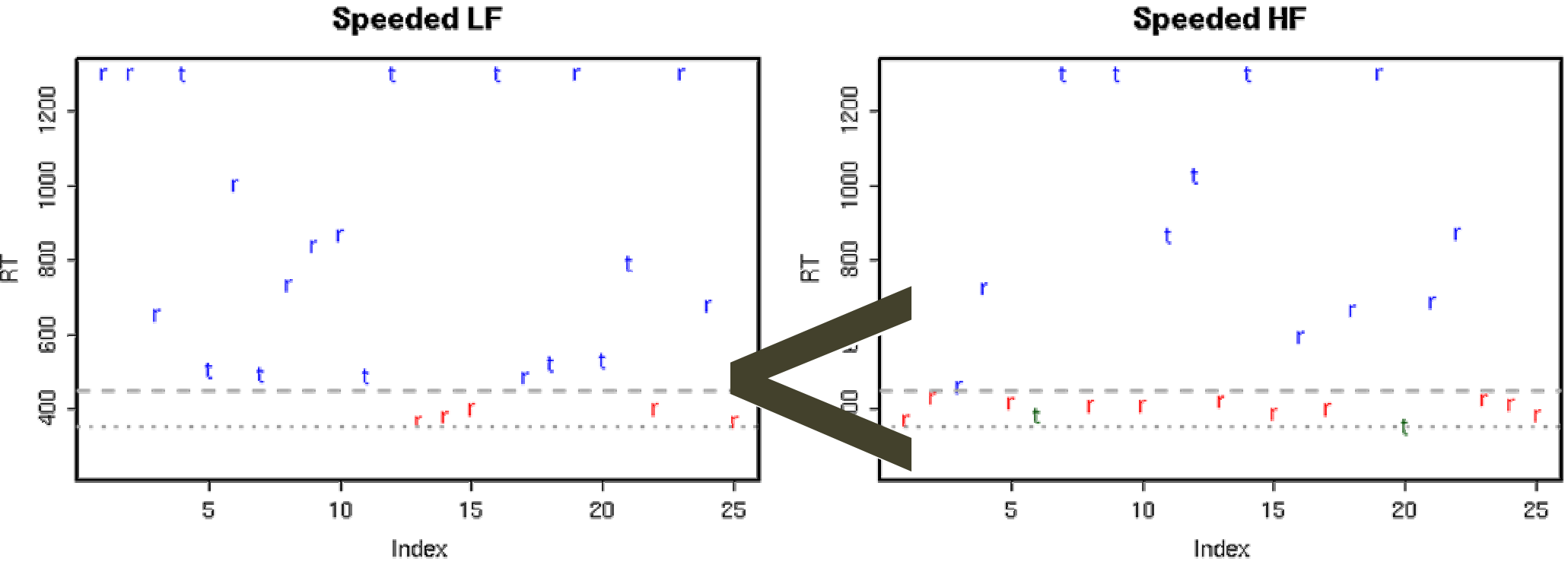

PsHs derived from HF basewords
Normal
Threshold
NW
G
Retrieval + check
NW
W
G
RT: 788 ms
P(C): 0.92
Density
0.000
0.001
0.002
0.003
0.004
0.005
0
200
400
600
800
1000
1200
RT

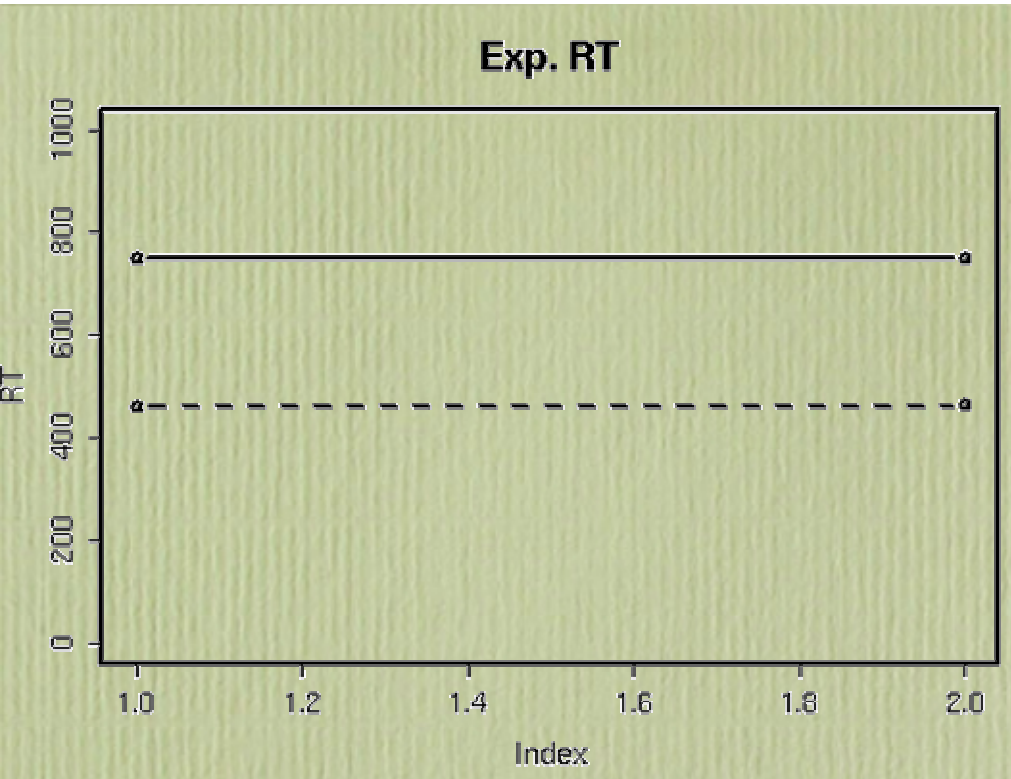

PsHs derived from LF basewords
Normal
Threshold
NW
G
Retrieval + check
NW
W
G
RT: 789 ms
P(C): 0.85
Density
RT
PsHs derived from HF basewords
Normal
Threshold
NW
G
Retrieval + check
NW
W
G
RT: 788 ms
P(C): 0.92
Density
RT
PsHs derived from LF basewords
Speeded
Threshold
NW
G
Retrieval + check
NW
W
G
RT: 604 ms
P(C): 0.65
Density
RT
PsHs derived from HF basewords
Speeded
Threshold
NW
G
Retrieval + check
NW
W
G
RT: 603 ms
P(C): 0.61
Density
RT

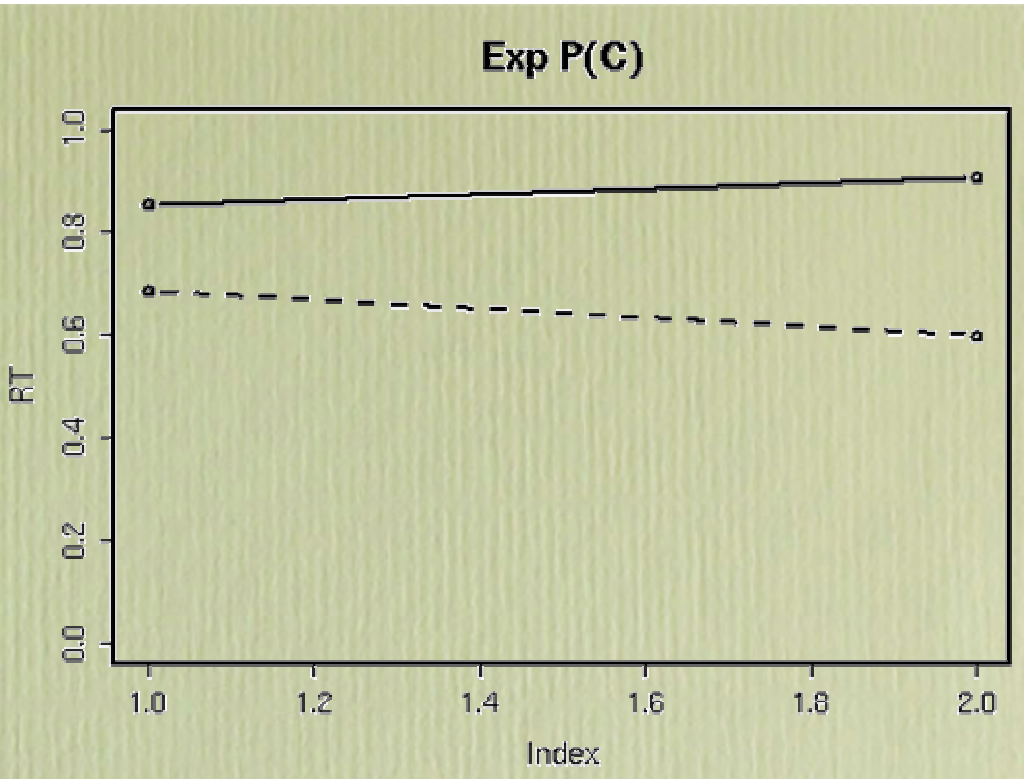
An Updated ACT-R LD Model

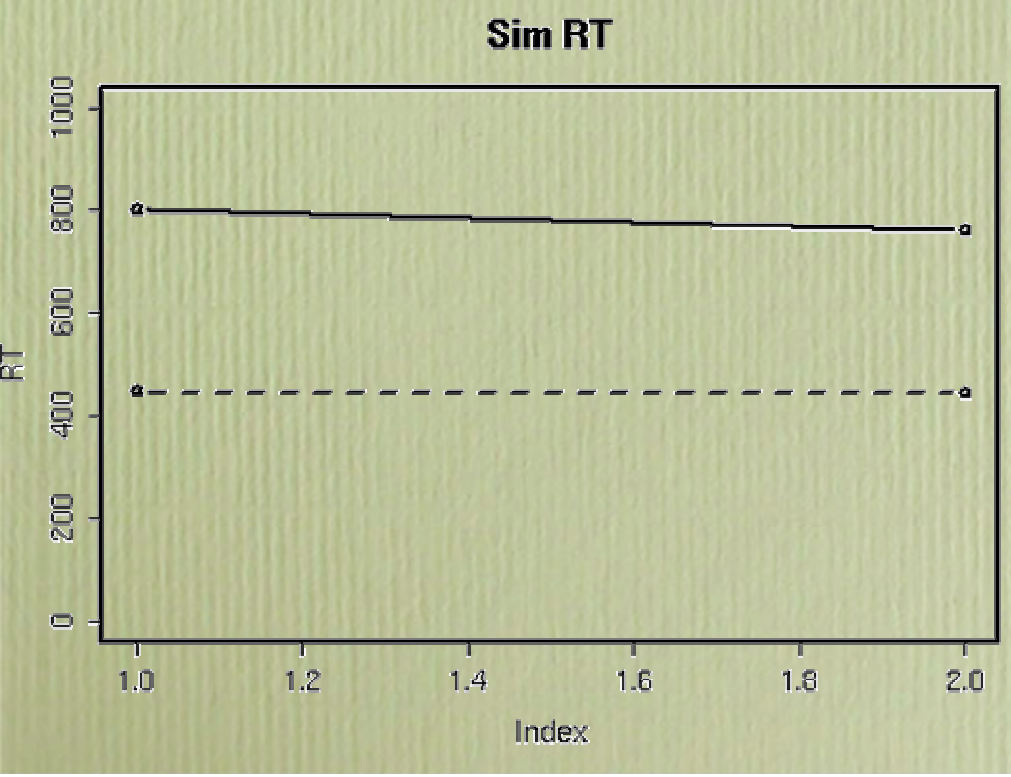
- Similar to the model presented at the ICCM in Bamberg:
  - Competitive Latency
  - One DM sample
  - Actual stimuli
  - Internal “clock”, signaling a deadline
- After sampling *and* given sufficient time, base answer on verification process
- Word chunks are revised:
  - From: BRAIN → [B,R,A,I,N]
  - To: BRAIN → [“BR”,“AI”,“N”, */br/*, */ain/*]

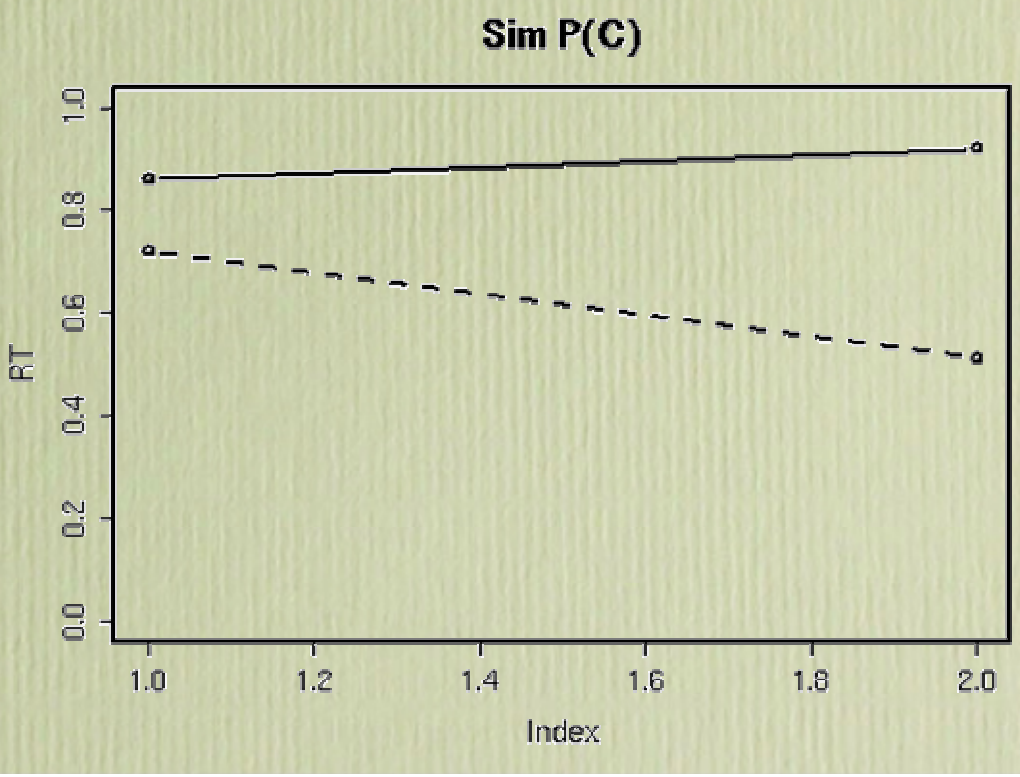

Normal LF
Normal HF
RT
Index
400
600
800
1000
1200
5
10
15
20
25


Speeded LF
Speeded HF
RT
Index
400
600
800
1000
1200
5
10
15
20
25


Exp. RT
RT
0
200
400
600
800
1000
1.0
1.2
1.4
1.6
1.8
2.0
Index


Exp P(C)
RT
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.2
1.4
1.6
1.8
2.0
Index


Sim RT
RT
0
200
400
600
800
1000
1.0
1.2
1.4
1.6
1.8
2.0
Index


Sim P(C)
RT
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.2
1.4
1.6
1.8
2.0
Index

To be continued…

Word condition in PsH experiments

Go back to the Signal-to-Respond data (ICCM)

Ziegler, Jacobs, & Klueppel, (2001) Pseudohomophone Effects in Lexical Decision: **Still a Challen… Current Word Recognition Models,**
Journal of Experimental Psychology: Human Perception and Performance, 27(3), 547-559

Other