Patterns of glimpsing windows affect release from energetic masking

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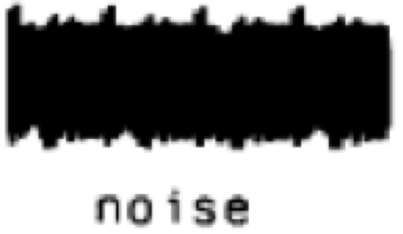
Question:

What role does rhythm play in speech perception in noise?

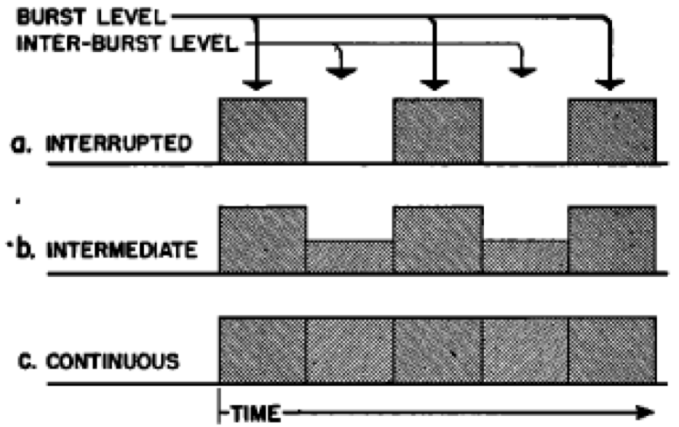
Previous Energetic Masking Work

- Steady-state masker



(Festen & Plomp, 1990)

- Periodic maskers, simple and variable noise power

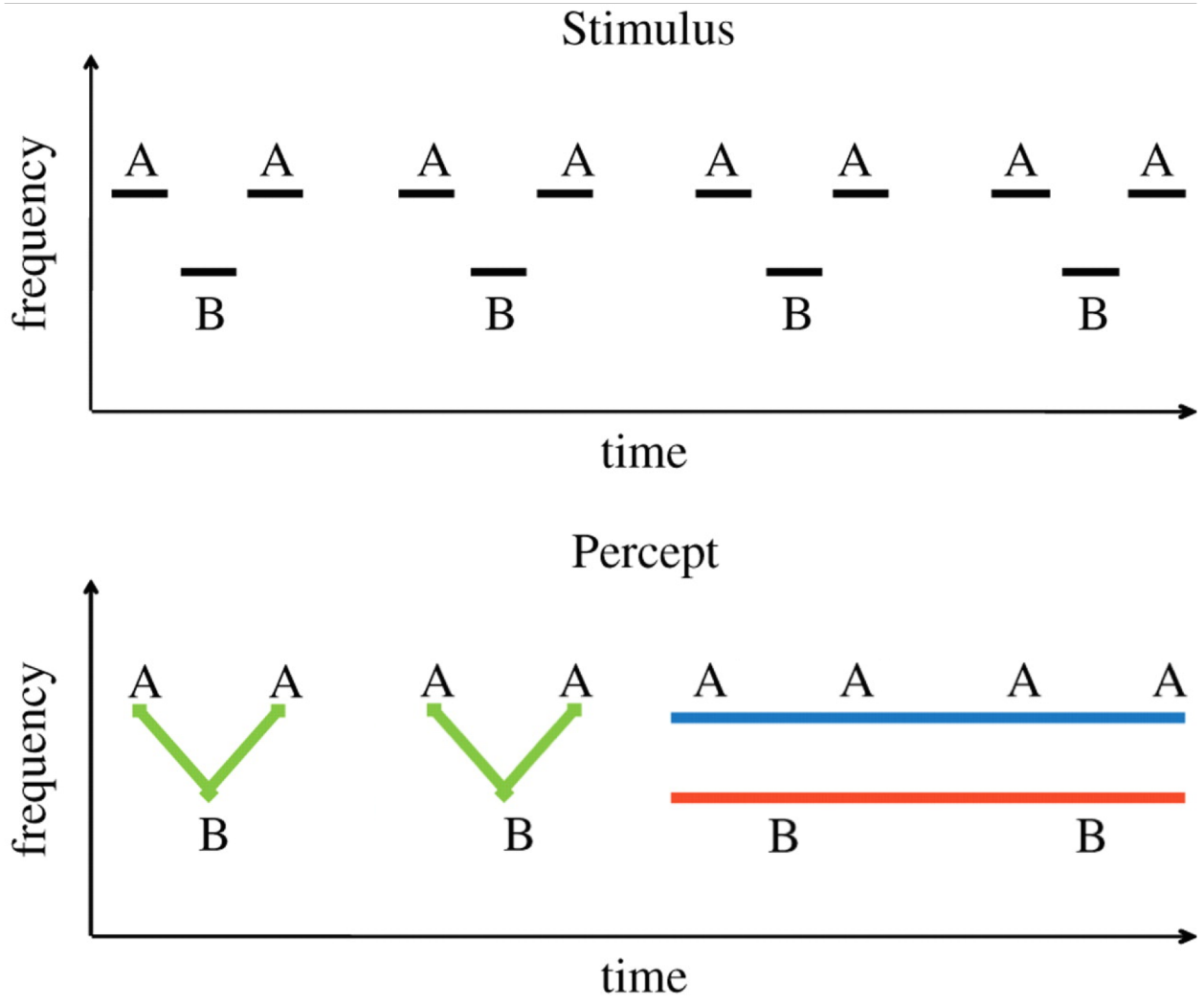


(Pollack, 1955)

- Complex structure, but no repeating rhythm

(Festen & Plomp, 1990)

Streaming and Rhythm



(Al Bregman's Lab)

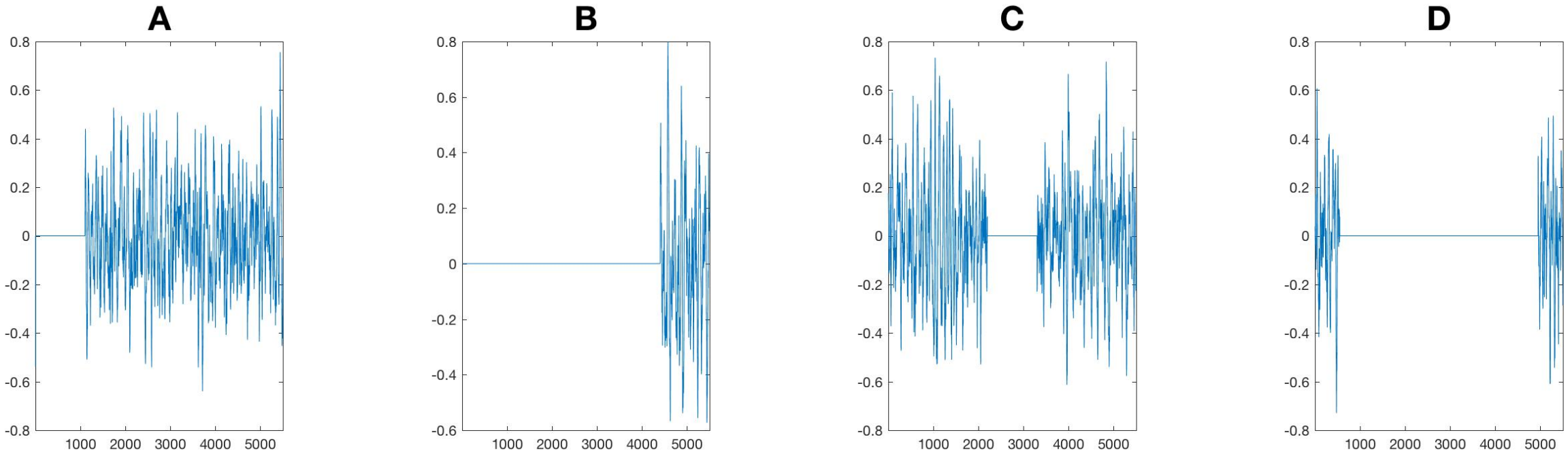
Motivation

- Energetic masking causes decreased intelligibility
- Auditory stream segregation separates auditory stimuli
- Can stream segregation-like processes aid in overcoming energetic masking?
- **Hypothesis: increased online rhythmic information will ease speech perception in noise**

Spoiler: It does

Our Energetic Maskers

- Speech shaped noise presented at an SNR of -10dB
- 8 periods of silence placed in the noise every second forming 125ms windows containing noise and silence

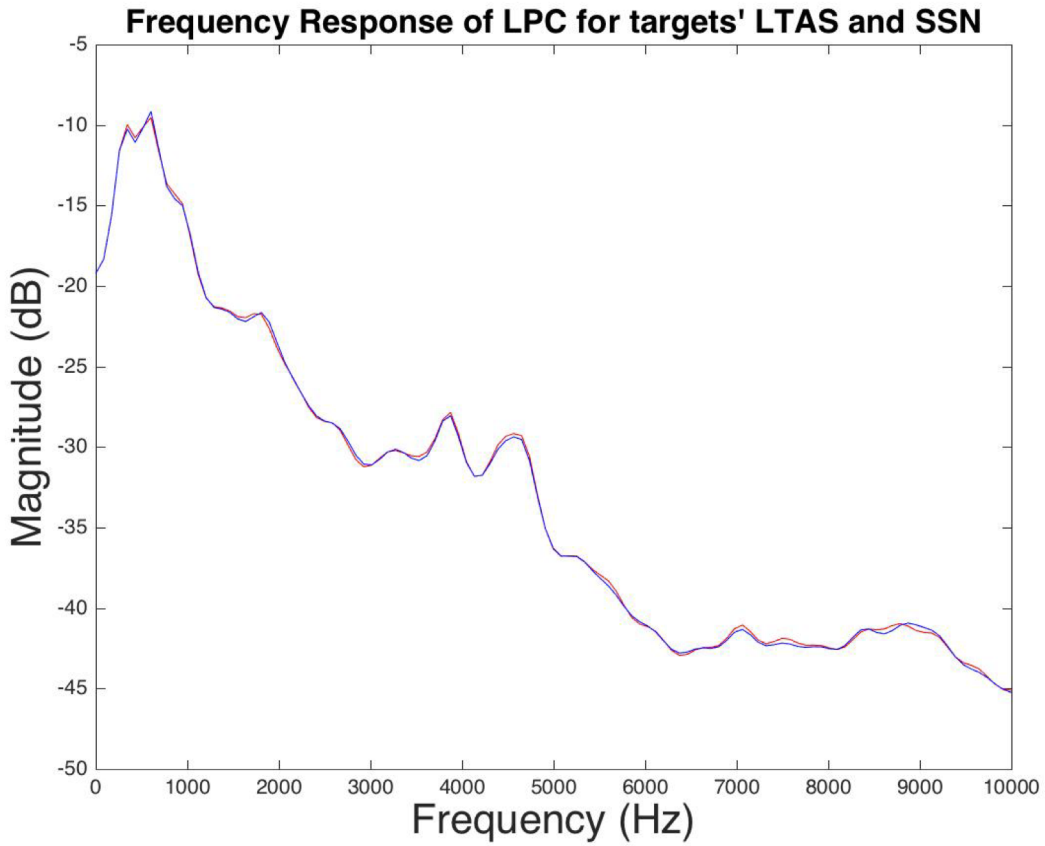


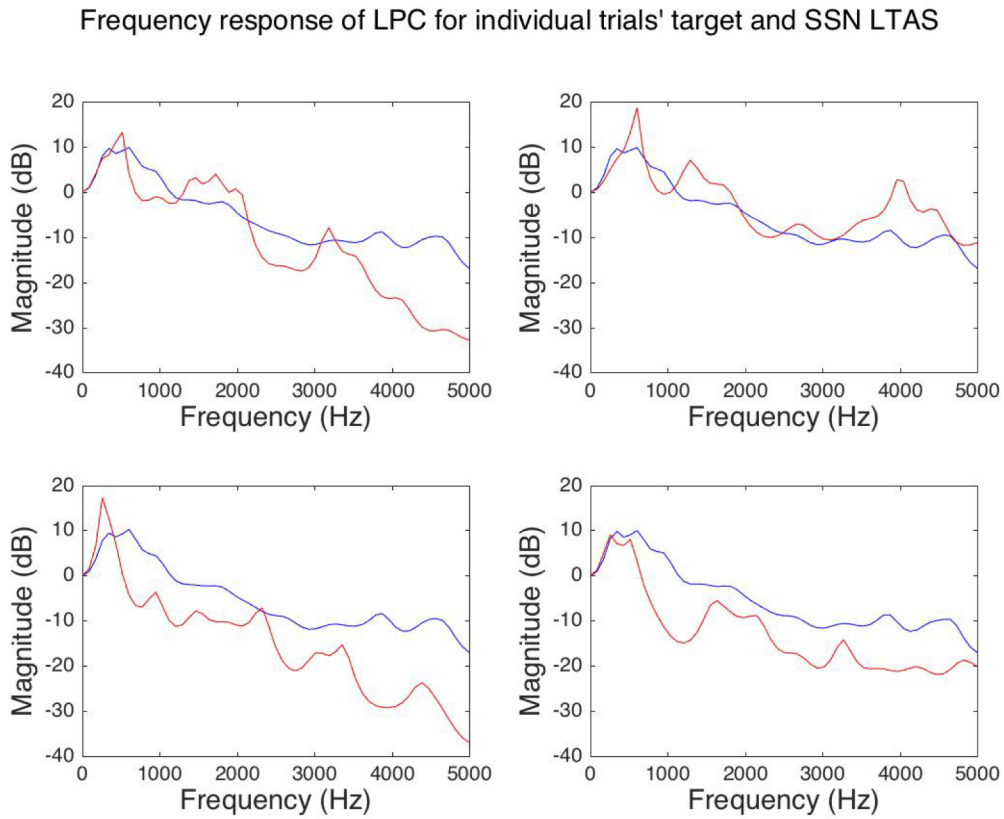
Durations Between Window Onsets

Second Window

First Window	Left-ruled	Centered Long	Centered Short
Left-ruled	125ms	137.5ms	175ms
Centered Long	112.5ms	125ms	162.5ms
Centered Short	75ms	87.5ms	125ms

LTAS Forms for trials & in total



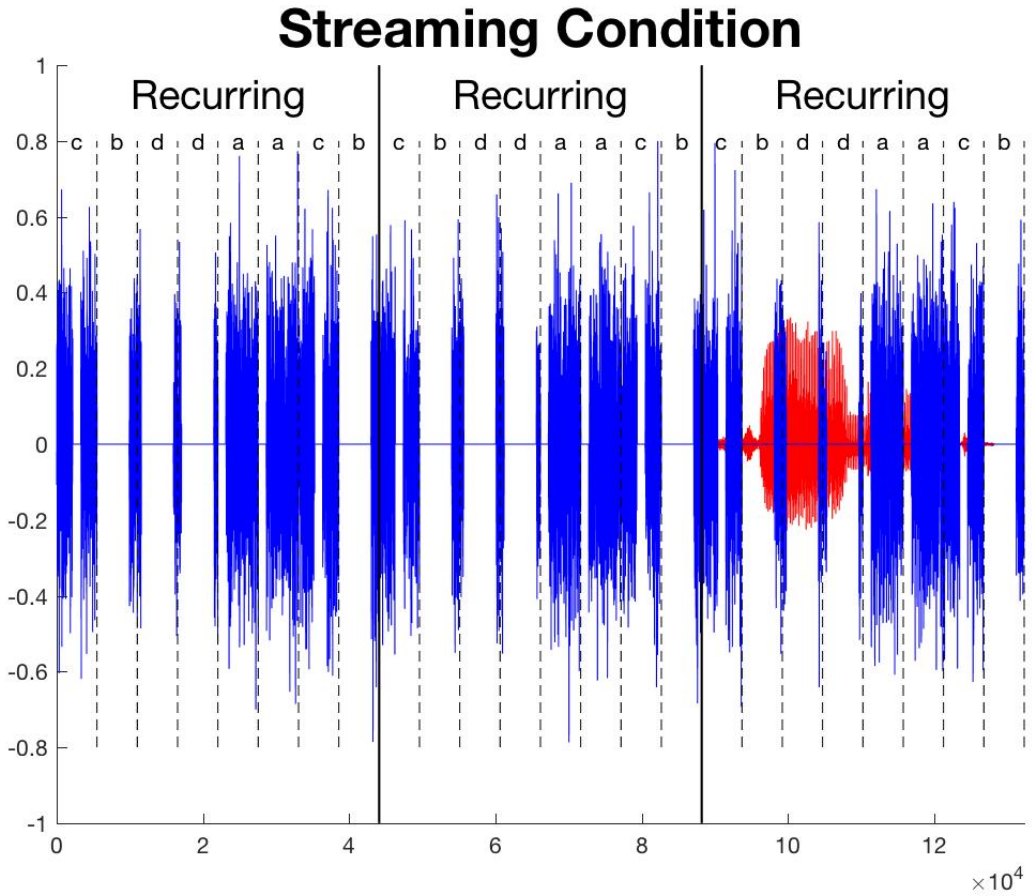


Trial Conditions

- 3 patterns occurred in each 3 second trial
  - First two were preamble patterns
  - Third pattern masked the target
- Streaming Condition: The recurring pattern repeated 3 times
- Learning Condition: 2 random patterns, then the recurring pattern masking
- Random Condition: 3 random patterns

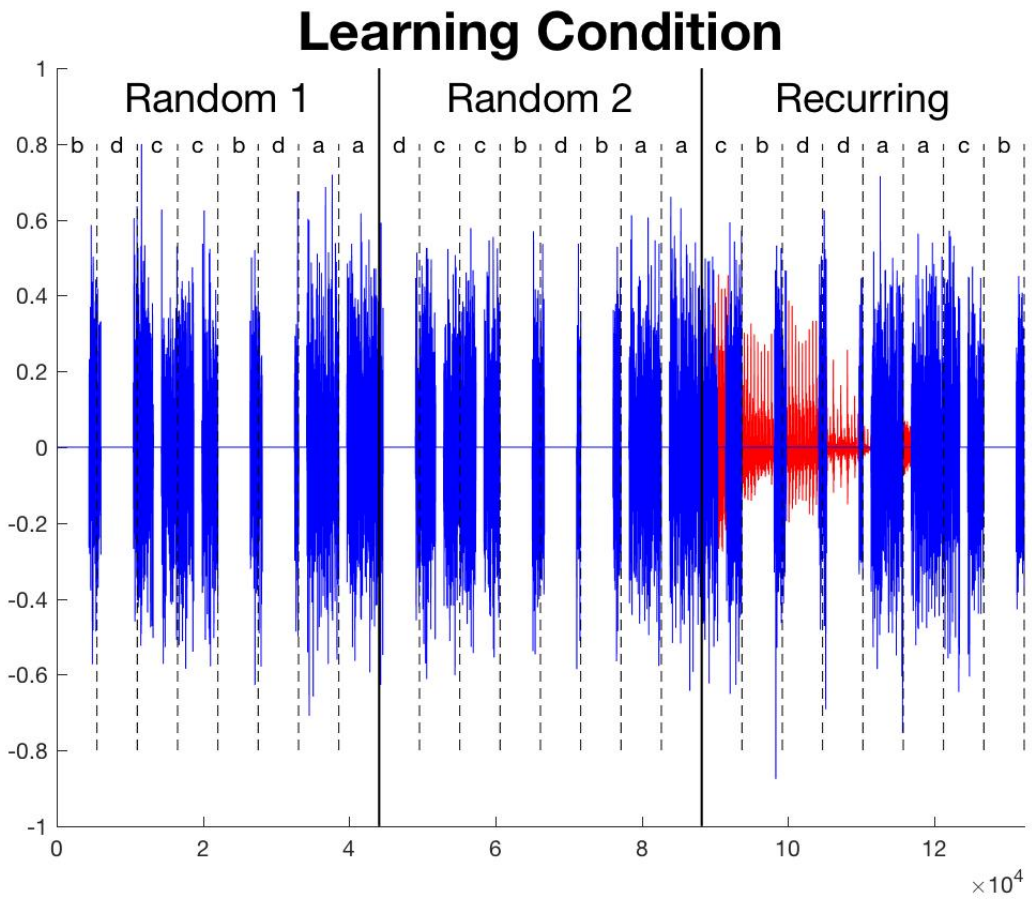
Streaming Condition (#1)

- Condition 1: Online repetitive information available for streaming



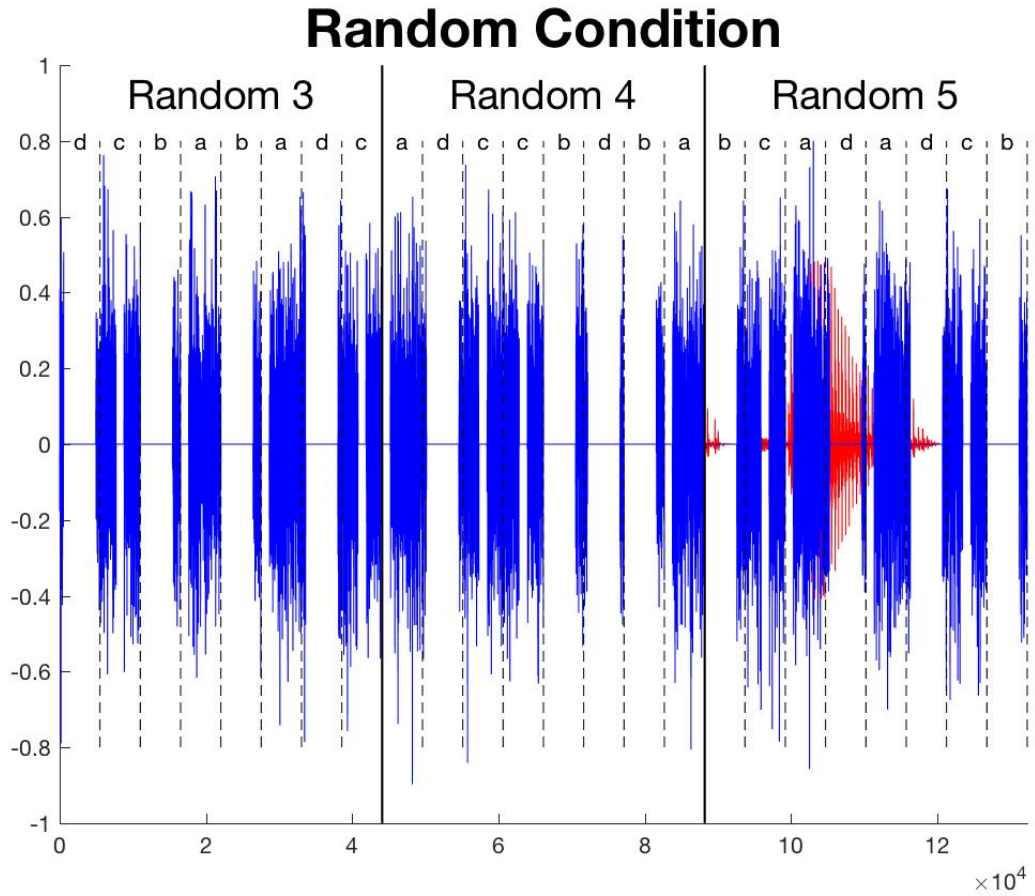
Learning Condition (#2)

- Condition 2: Offline information available for learning across trials



Random Condition (#3)

- Condition 3: Task performance, SNR, and glimpsing duration baseline



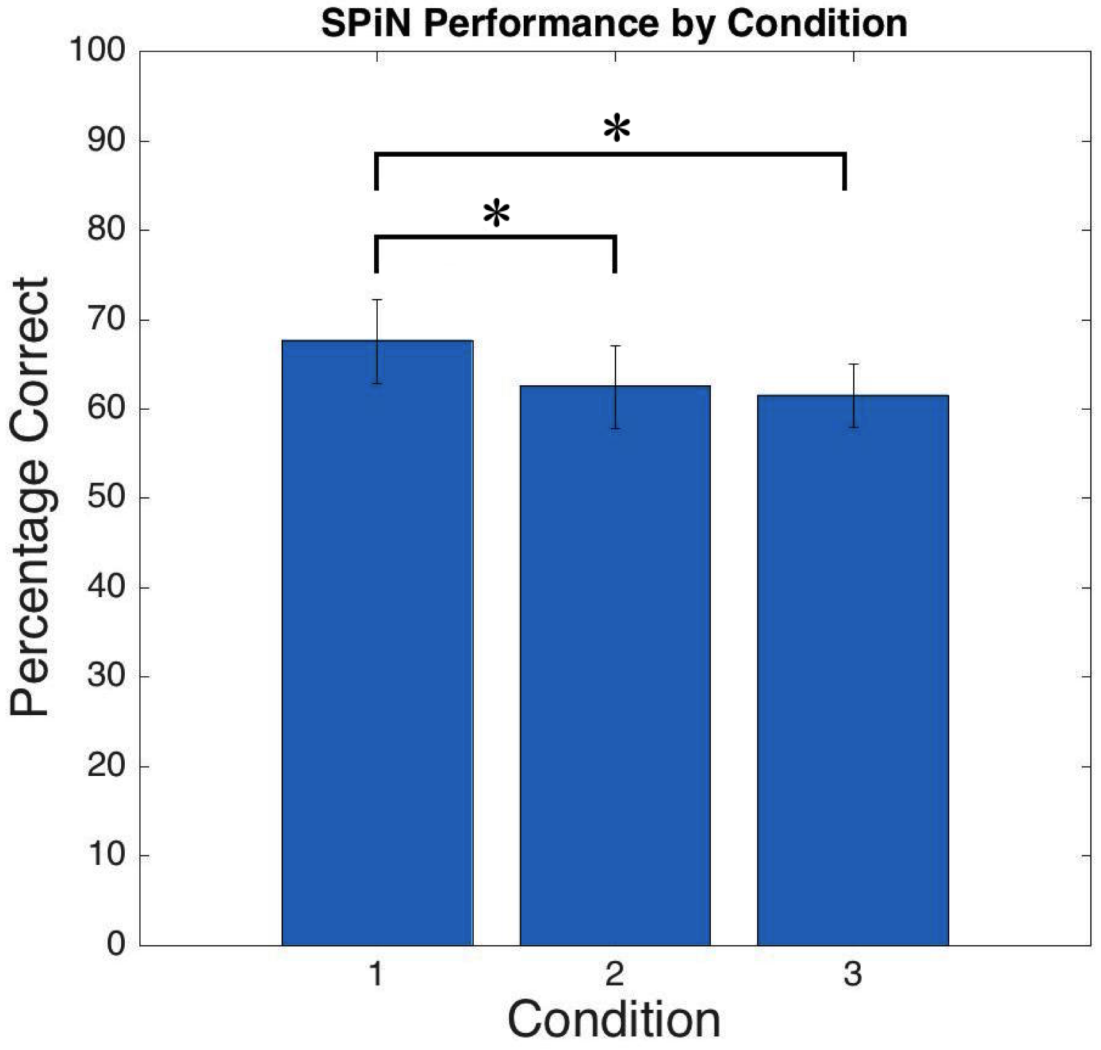
Predictions

- Streaming Condition: 3 repetitions of the recurring patterns
  - Ryhthmic structure may allow streaming, and participants may learn the pattern
  - Maximum advantage for intelligibility
- Learning Condition: 2 random, 1 recurring pattern
  - Participants may be learning the masking pattern
  - Possible advantage over base levels
- Random Condition: 3 random patterns
  - Without repetitive or re-occurring information, participants should perform at base speech perception in noise levels

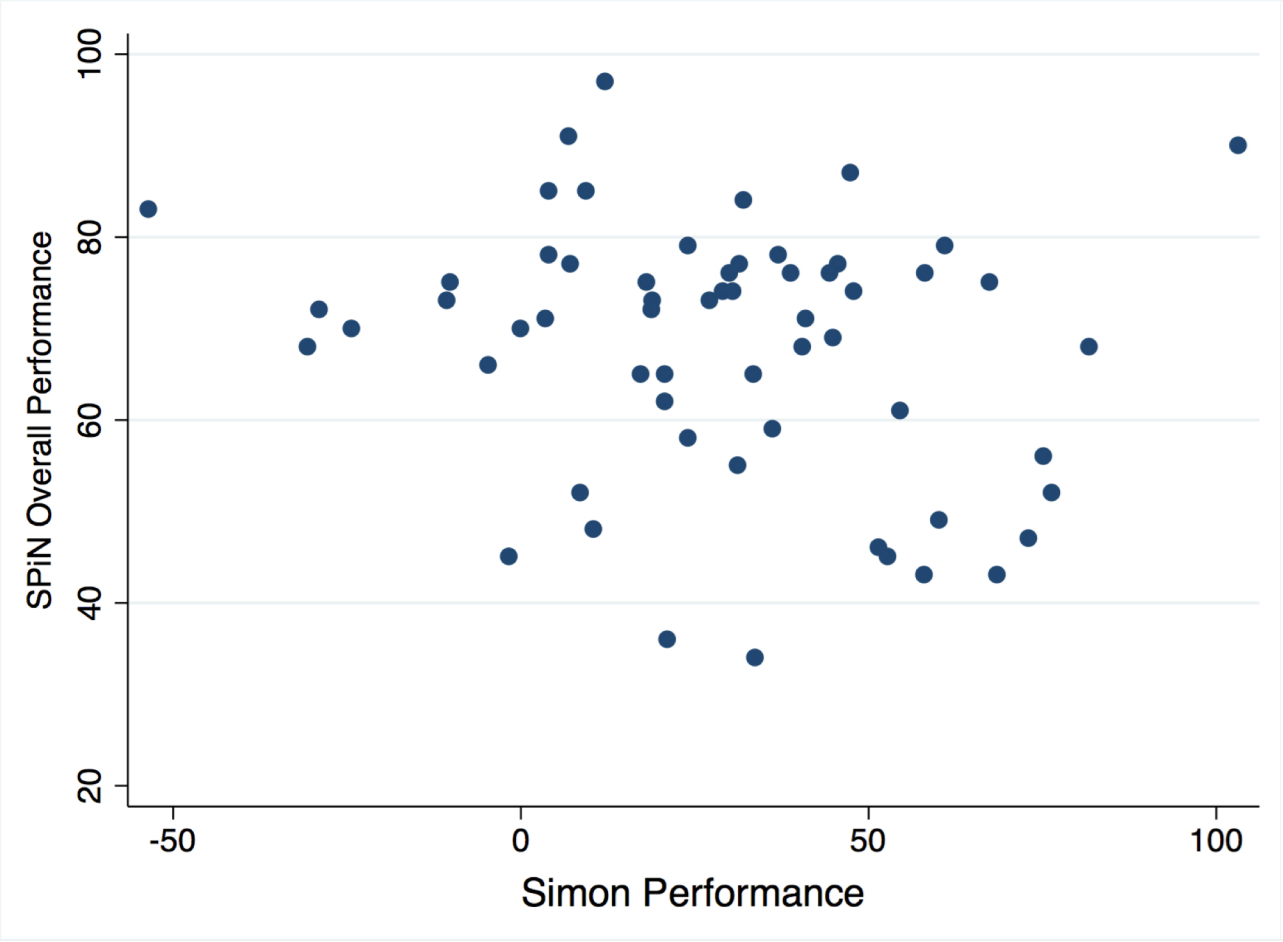
Experiment Format

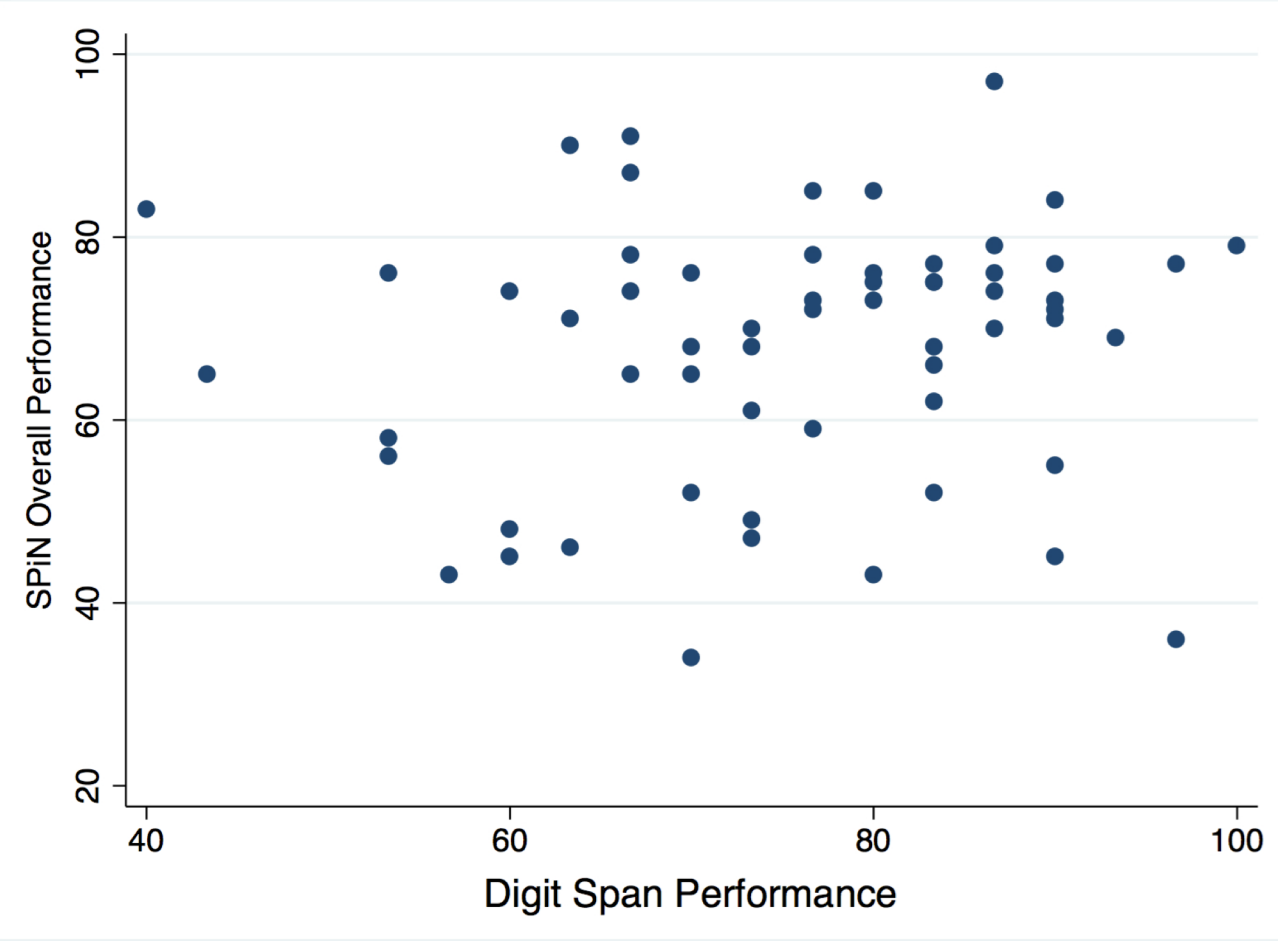
- Open-set word-recognition task
- Used 108 multisyllabic words as targets
- 60 Undergraduates at USC (n = 60)
- Executive function and working memory tasks followed

Results


SPiN Performance by Condition
Percentage Correct
100
90
80
70
60
50
40
30
20
10
0
*
*
1
2
3
Condition

Executive Function & Working Memory tasks





What have we found evidence for?

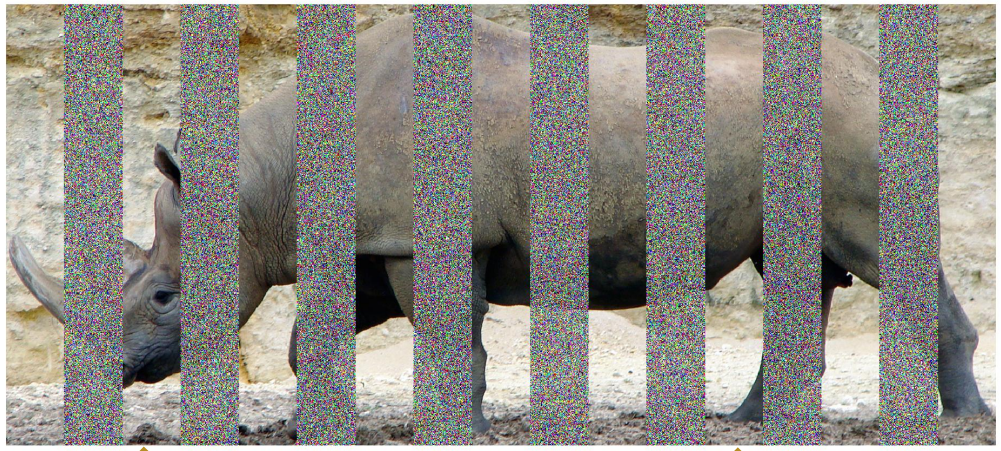
- What mechanism(s) underlies the streaming condition advantage?

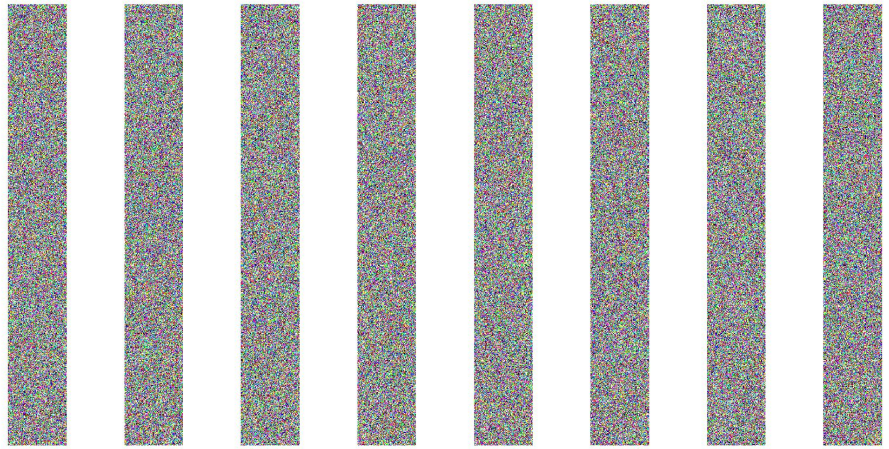
A couple accounts are plausible:

- The first is segregating the target stream from the noise stream
- The second is a prediction of glimpsing opportunities

How can we use their properties to uncover which it is?

Streaming vs. Glimpsing: Streaming





Streaming vs. Glimpsing: Glimpsing

Future manipulations

- Frequency manipulation
  - Spectrally fluctuating maskers
- Inter-pattern gap
  - Insert silence between patterns
    - Should not affect timing calculations
    - Should defeat streaming
- Auditory attention manipulation
  - Manipulate attended stream

THANK YOU!

SHOUTOUT TO ZEVIN LAB AND THE R.A.S! AND THE PARTICIPANTS WHOSE DATA ENABLED THIS RESEARCH!

References

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