

# Listening effort in natural listening conditions

Esther Janse

# Global research question

How do native and nonnative listeners (learn to) understand speech in natural listening conditions?

# Natural listening conditions

- **Informal casual (fast) speech**  
containing reduced word pronunciation variants

*It was probably last Tuesday*

- **Foreign-accented speech**  
Containing (in) consistent substitutions of sounds
- **Quantify listening effort**

# Foreign-accented speech

Foreign-accented speech deviates from native speech

- Slower speech rate
- Possible rhythmic differences
- (in)consistent sound substitutions

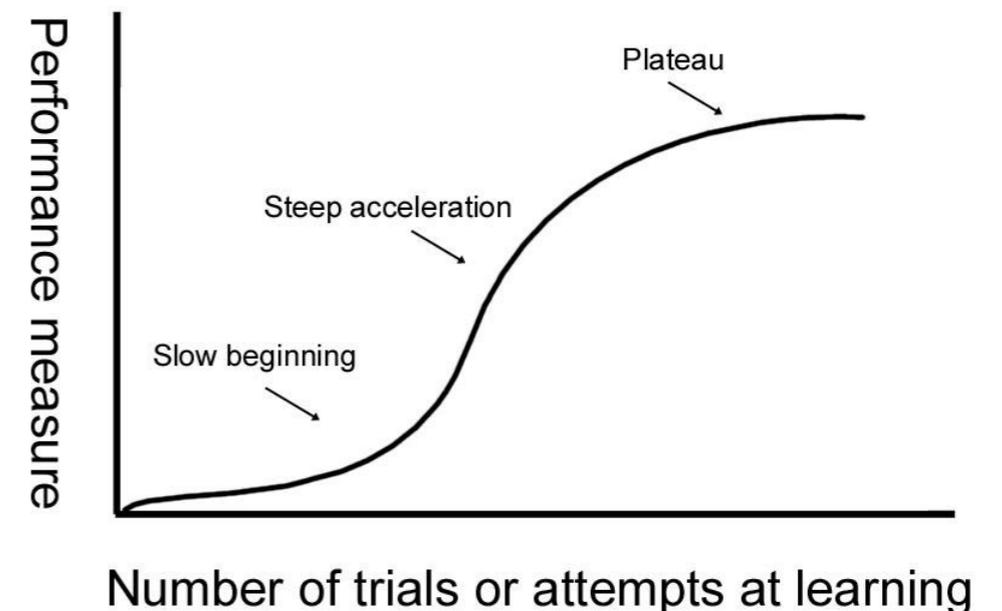
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Perceptual learning/adaptation  
Improvement with  
prolonged exposure

→ incorporate knowledge in reps



# Foreign-accented speech

## Research questions re aging

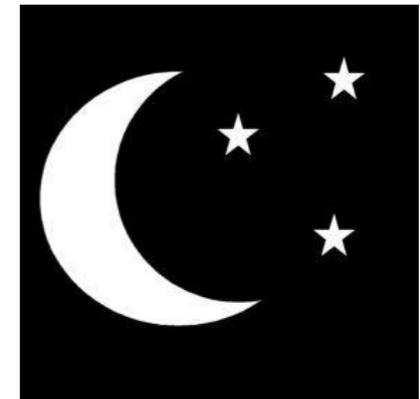
- Are older adults more impacted by a foreign accent than younger adults?
- Do older adults show less perceptual adaptation than younger adults?

# Foreign-accented speech

## Research questions re aging

1. Are older adults more impacted by a foreign accent than younger adults?
2. Do older adults show less perceptual adaptation than younger adults?

Unfamiliar accent of Dutch:  
Short → long vowels (and v.v.)  
Lexical confusion and poor mapping



*Quantify listening effort*

Speech in Noise performance: How much noise can listeners handle to get 50% correct → Speech Reception Threshold

# Foreign-accented speech and aging

(Adank & Janse, *Psychology and Aging*, 2010)

Negative SRT values (noise louder than speech) reflect good performance

## ACCENT IMPACT ON AGE GROUPS

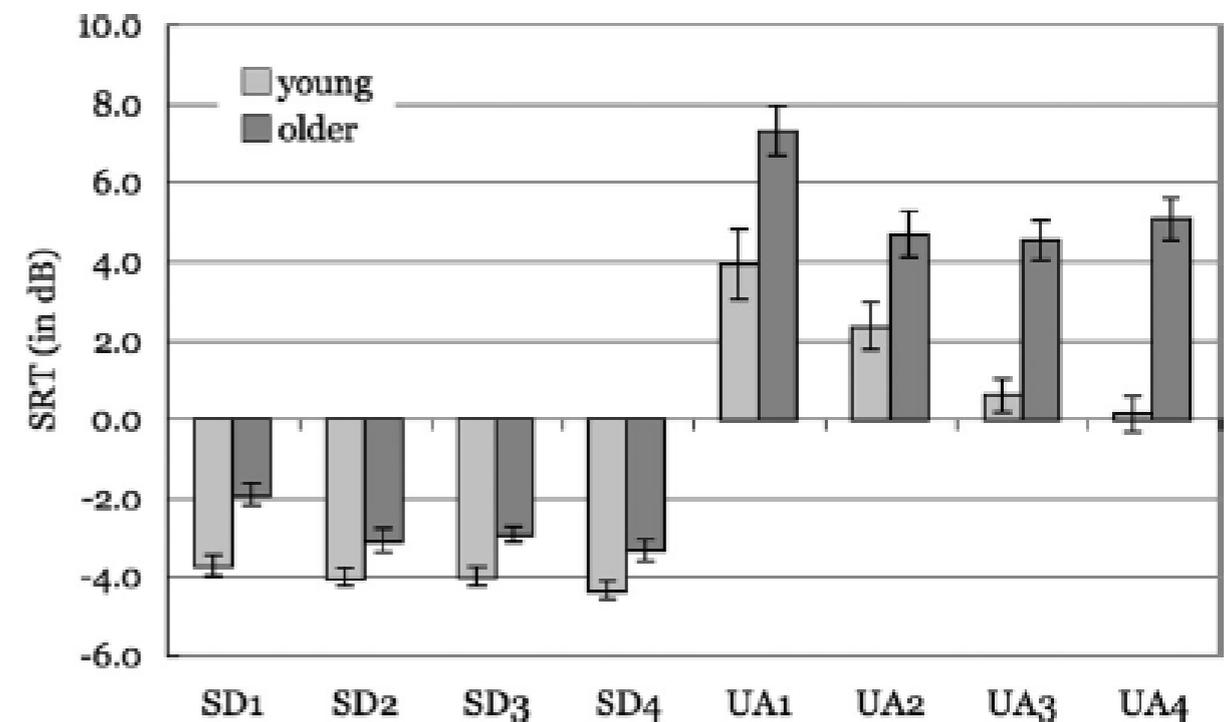
Age Group X Accent

Accent more detrimental for OA

## ADAPTATION OF AGE GROUPS

Equal amounts

But different in time course



# Foreign-accented speech

## Research questions re aging

1. Are older adults more impacted by a foreign accent than younger adults? **YES**
2. Do older adults show less perceptual adaptation than younger adults? **NOT REALLY**

*Quantify listening effort*

Speech Reception Threshold as performance measure  
... which is about *intelligibility*  
rather than *speech comprehension*

# Foreign-accented speech

Follow-up study with speeded sentence verification

*Rats have teeth*



*Otters wear clothes*

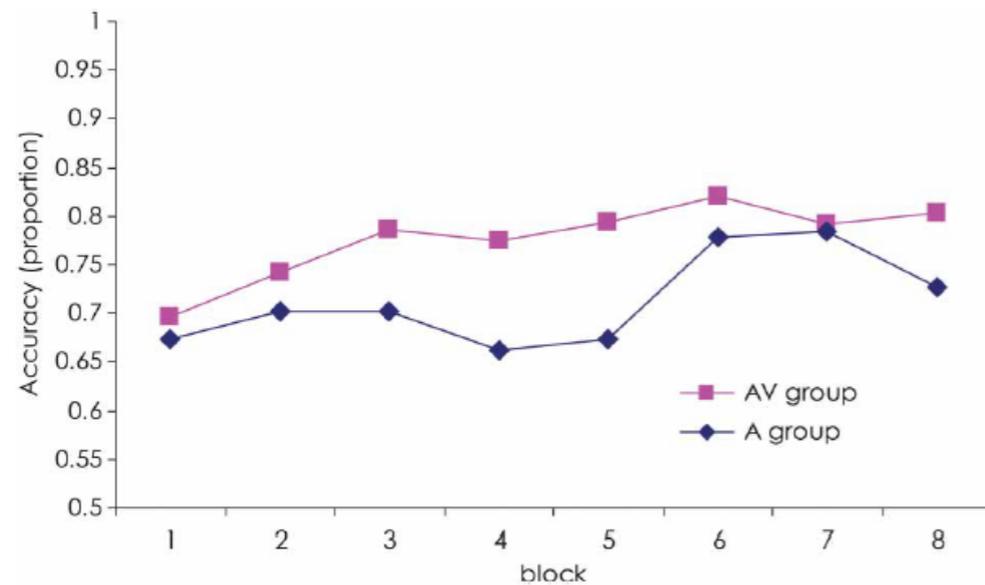
Research questions re perceptual adaptation

1. Does audiovisual presentation of accented speech enhance perceptual adaptation compared to audio-only?
2. Among older adults, do hearing and cognitive skills predict amount of perceptual adaptation?

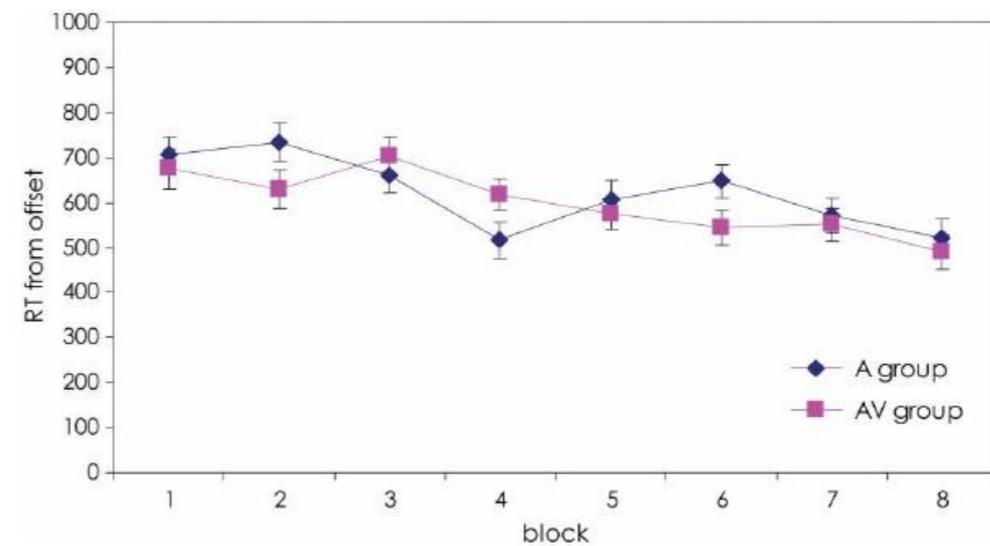
# Foreign-accented speech

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Accuracy

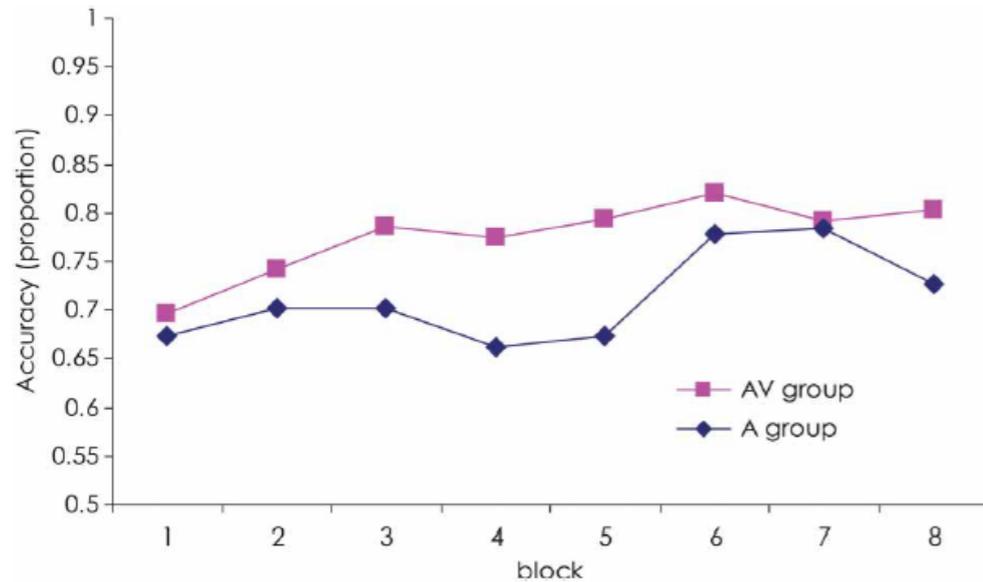


Response Time

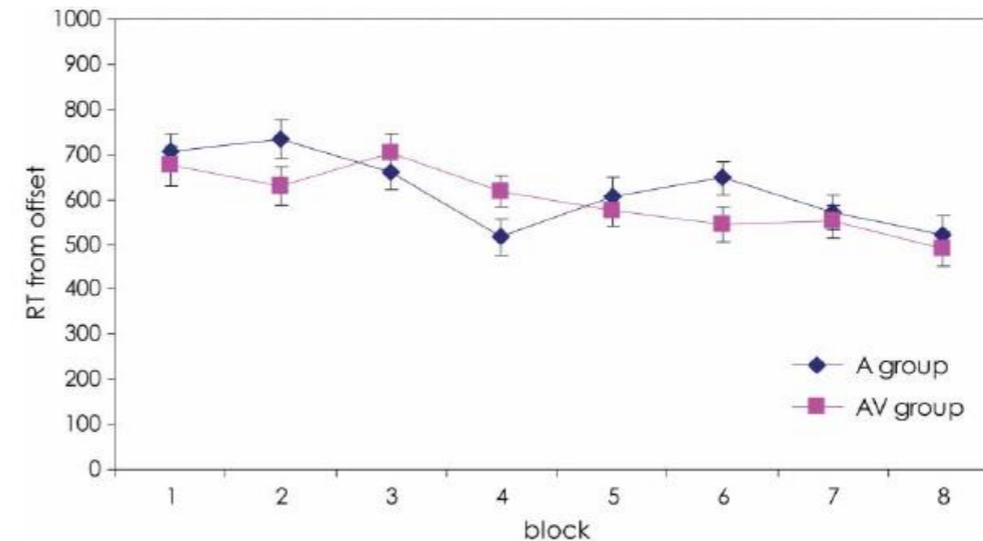


# Foreign-accented speech

## Accuracy



## Response Time



### Predictors of general performance

Hearing and memory measures

Hearing, age, vocabulary  
Attentional measure (?)

### Predictors of adaptation (improvement over trials)

vocabulary and attentional measure

none

# Foreign-accented speech

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NOT REALLY

1. Among older adults, do hearing and cognitive skills predict amount of perceptual adaptation?

HEARING AND MEMORY PREDICT GENERAL PERFORMANCE;  
VOCAB AND ATTENTION PREDICT PERCEPTUAL LEARNING

Speeded sentence verification yields accuracy & RT

But RT not necessarily most telling in terms of explaining individual differences

# Casual speech and reduced word pronunciation variants

- Function and content words reduce
- Reduction is highly frequent
- Reduction makes words deviate from stored representation (unless ...)
- Time-compressed speech less effortful to process than naturally fast variant (Janse, 2004)
- Phoneme monitoring (e.g., press button for “b”)
- *“He should the batch have destroyed”*
- Faster word recognition for t-c speech

# Casual speech and reduced word pronunciation variants

In order to fully understand spoken language processing, we need to know

- The characteristics of reduced word forms
- When they occur

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- The characteristics of reduced word forms
- When they occur
- How talkers produce them
- How listeners understand them

# Restoring reduced forms from acoustic context information

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- The characteristics of reduced word forms
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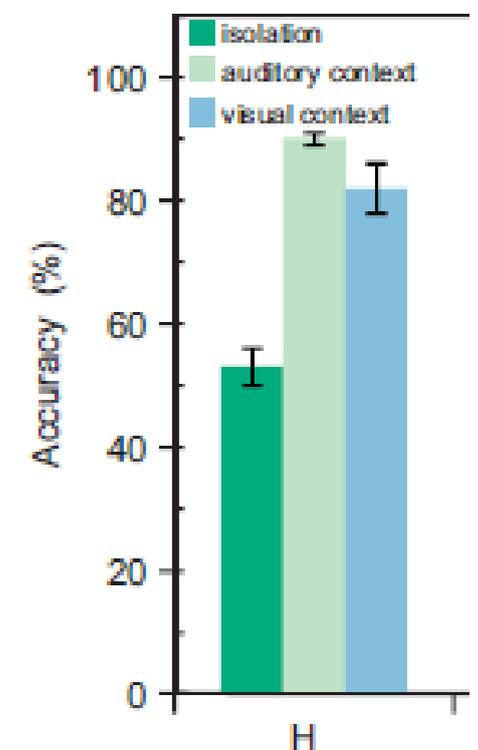


The roles of bottom-up and top-down information in the recognition of reduced speech: Evidence from listeners with normal and impaired hearing

Esther Janse<sup>a,b,\*</sup>, Mirjam Ernestus<sup>b,c</sup>

# Restoring reduced forms from acoustic context information

- Highly reduced words ('yeshay' for *yesterday*) often found in casual speech
- Such words can hardly be recognised if isolated from context
- Context is partly semantic
- So could be provided via orthographic transcriptions
- But spoken context also contains acoustic cues



# Restoring reduced forms from acoustic context information

- Spoken context contains semantic and acoustic cues
- How does (simulated) hearing loss affect the use of context?

## RESULTS

Hearing loss not only modulates word recognition  
But also amount of benefit from contextual cues  
(to restore reduced forms).

*..... But: performance measure to index LE*

# Conversational speech and speech rate (Koch & Janse, JASA, 2016)

Conversational speech more variable in rate than  
lab speech

(How) can we quantify the effect of this natural  
rate variation on listening effort?

Increased speech rate more detrimental for middle-  
aged and/or older adults than younger adults?

# Conversational speech and speech rate

visual world paradigm

Click which (if any) out of four pictures occurred  
in fragment

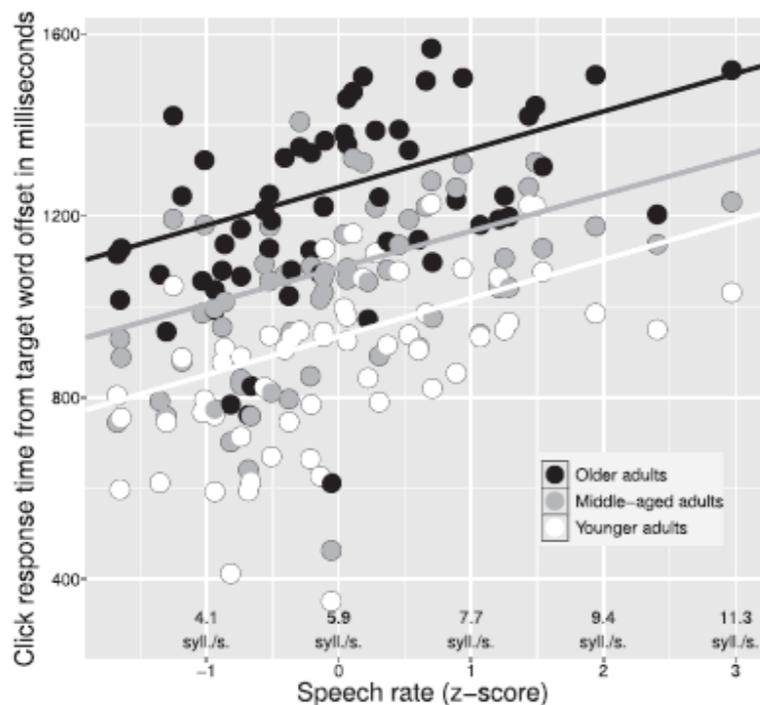
Fragments selected to differ in speech rate

Click RTs, eye-gaze data, pupil size

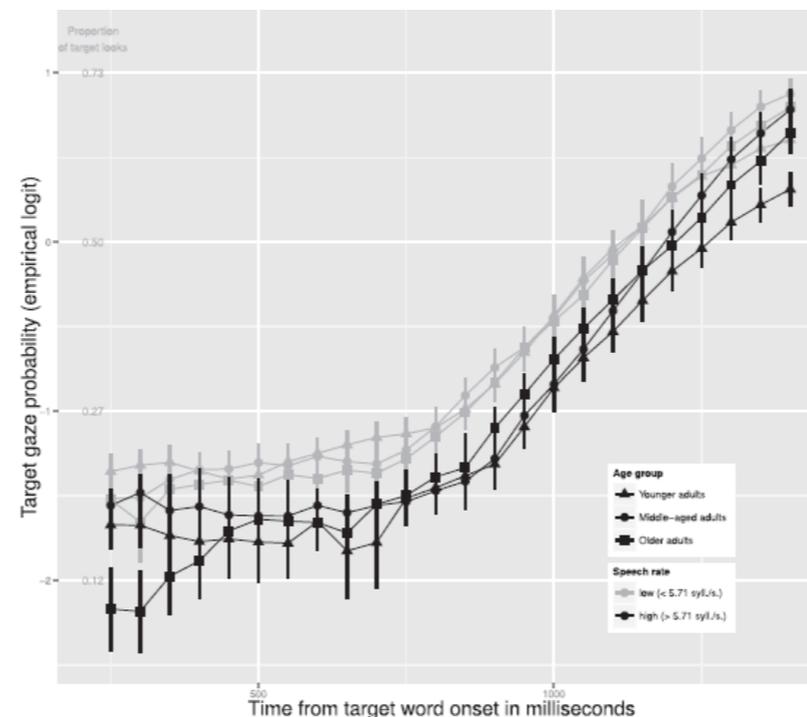
# Conversational speech and speech rate

## RESULTS

Longer click RTs for faster rates



Fewer (slower) gazes to target for faster rates (black lines)

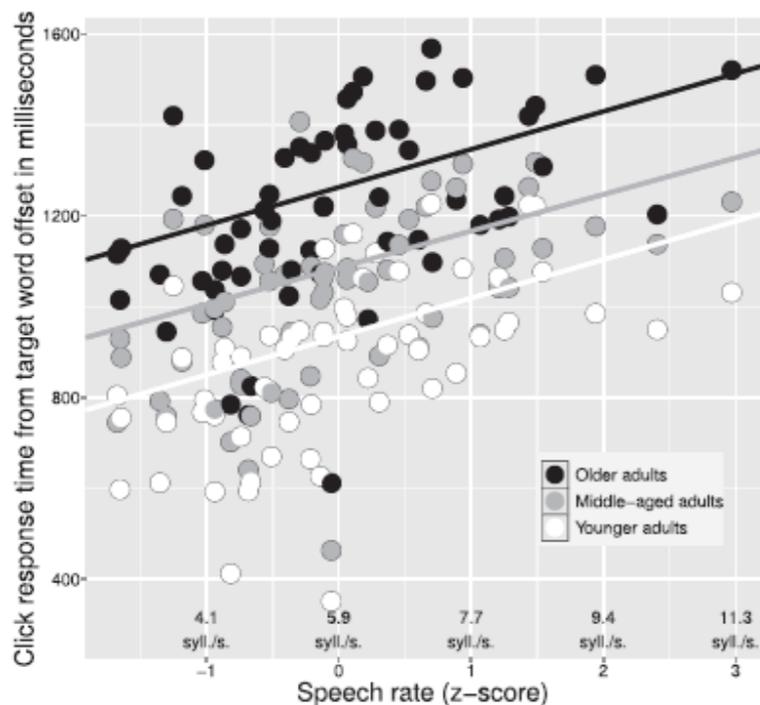


Pupil size no rate effect

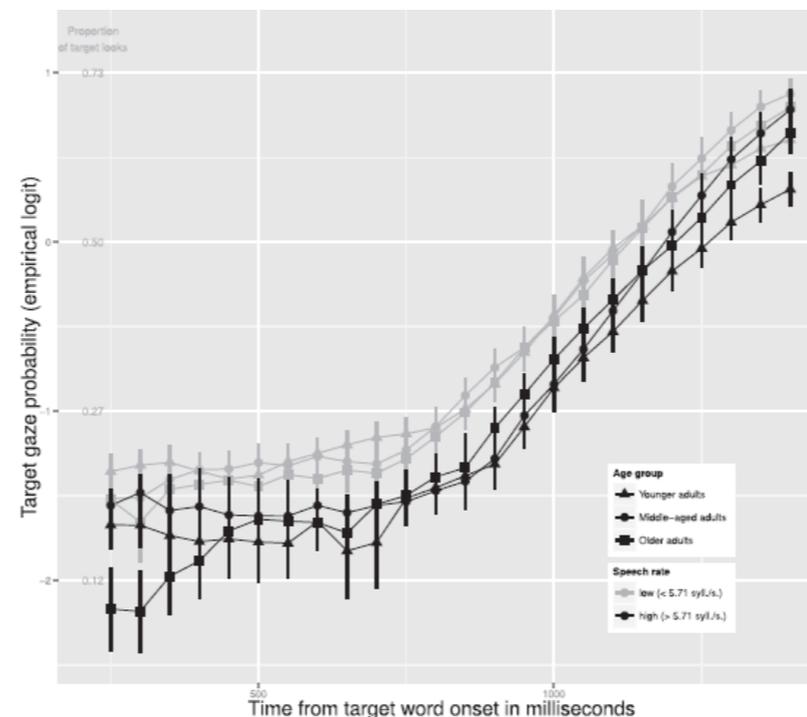
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*YES: rate effect on click RTs and eye gaze data*

*NO: no rate effect on pupil size*

Increased speech rate more detrimental for middle-  
aged and/or older adults than younger adults?

*NO, for none of the dependent measures*

• How listeners understand them

# Conversational speech and speech rate

(How) can we quantify the effect of this natural  
rate variation on listening effort?

*YES: rate effect on click RTs and eye gaze data*

*NO: no rate effect on pupil size*

Which of the measures related to individual hearing  
or cognitive skills (across age groups)?

*Click RT ~ Age, Processing Speed, Vocab*

*Pupil peak latency ~ Age, Processing Speed*

• How listeners understand them

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*Restoring what has been reduced can be effortful for those with hearing impairment and non-natives*

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*Effortful for all, but learning decreases effort*

- **Quantify listening effort**

*Speeded measures offer more data*

*Not all measures equally sensitive to speech or listener effects*