Effects of Perceived Gender on Prominence Perception

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Workshop de lancement du projet SIRL

Laboratoire Parole et Langage

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Overview

- Introduction
- Modifying Perceptual Gender
- Rapid Prosody Transcription
- Pilot Study
- Discussion

Perceived Speaker Identity and Perception of Sociophonetic Variables

- Gender: Johnson, Strand, and D'Imperio (1999)
- Region of Origin: Niedzielski (1999), Hay and Drager (2010)
  - And Labov (1963) for speech production
- Sexual Orientation: Mack and Munson (2010)
- Socio-economic Status: Hay, Warren, and Drager (2006)
  - And Eckert (1989) for speech production
- Age: Koops, Gentry, and Pantos (2008)

Implicit or Explicit?

- No evidence of implicit use of social information:
  - Sexual Orientation: Mack and Munson (2010)
- Evidence of implicit use of social information:
  - Gender: Johnson, Strand, and D'Imperio (1999)
  - Region of Origin: Hay and Drager (2010)
  - Age: Koops, Gentry, and Pantos (2008)

What sociophonetic variables can be influenced?

- Vowels:
  - Johnson, Strand, and D'Imperio (1999)
  - Niedzielski (1999)
  - Hay and Drager (2010)
  - Hay, Warren, and Drager (2006)
  - Koops, Gentry, and Pantos (2008)
- Consonants:
  - Mack and Munson (2010)
  - Strand and Johnson (1996)

What sociophonetic variables can be influenced?

- What about suprasegmental components?
  - Prosodic prominence?

Prosodic Prominence in English

- Words that are perceived as “prominent” are typically produced acoustically louder, longer, and bear a pitch accent, relative to words that are not prominent. (Cole et al 2008)
  - What causes words to be louder, longer, or carry a pitch accent?

Prosodic Prominence in English

- Each phrase contains at least one accent. If there are more, there is one particularly salient pitch accent, known as the nuclear accent.
  - Typically appears phrase finally.
- Focus Projection (Selkirk 1995); Focus-to-Accent (Ladd 1996)
  - Accents can appear on words to due to their information status (new to the discourse, contrastive, etc)

Prosodic Prominence in English

- Word predictability correlates with duration, intensity and f0 with intended meaning (Watson 2009)
  - But these things tend to co-occur
- Listeners use their expectations of where prominence should fall (Wagner (2005), Cole, Mo, Hasegawa-Johnson (2008))
- Listeners also use visual information to perceive prominence (Krahmer and Swerts 2007)

Non-Social Factors Influencing Prominence Production

- The emotional state of the speaker (Pell (2000))
- The information status of the word and other words in the utterance (Breen et al (2010))
- The accentability of a word, such as function word (Calhoun 2010)
- Location within an utterance (Breen et al (2010), Xu and Xu (2005), Cooper et al (1985))

Non-Social Factors Influencing Prominence Production

- Physical gesturing by the speaker (Krahmer and Swerts (2007))
- The presence of another person (Breen et al (2010); Bux-Lugo et al (2013))
- The level of engagement of other speakers (Rosa et al 2012)
- The presence of ambiguity (Snedeker and Trueswell (2002))

Prominence Perception and Perceived Gender

- Gussenhoven and Rietveld (1998)
  - Effect of gender on degree of prominence in speech synthesized for gender
  - But:
    - Is masculine speech perceived as more prominent than feminine speech (scaling)?
    - Or are prosodic events more likely to be perceived in male speech than female speech (linguistic)?

Research Questions

- In what way is the perception of prominence in English influenced by the perception of speaker gender?
  - Discrete or gradient?
  - Implicit or explicit association?

- To investigate these, we'll need:
  - Resynthesized speech
  - A method for collecting prosodic scores/annotations

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Resynthesizing for Gender

- Need to scale the formants while leaving other aspects of the speech alone.

Praat KlattGrid (Weenink 2009)

- Implementation of the Klaat Synthesizer (Klaat and Klaat 1990)
- Discrete parameterization of the speechwave
  - Powerful but complicated
- Workflow:
  - Extract KlattGrid parameters from source audio file
  - Conduct manipulation on KlattGrid
  - Resynthesize source audio with modified KlattGrid

Praat KlattGrid (Weenink 2009)

- My python interface to KlattGrid (praatIO) is available as a freely available resource
  - Allows for programmable manipulation of klattgrids.
  - https://github.com/timmahrt/praatIO

Original Audio

Formants increased 20%

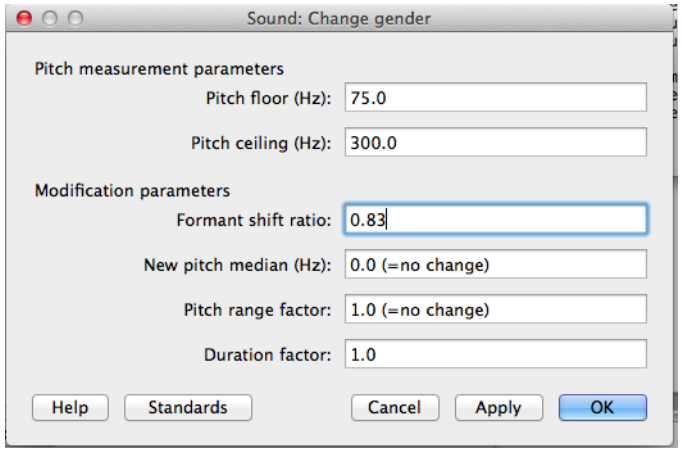
Formants Decreased 20%

Other Resynthesis Tools

- TANDEM-STRAIGHT (Kawahara et al 2008)
  - Powerful and feature rich, but also more complicated
- Audiosculpt (Centre Pompidou)

Praat “Change Gender”

- Easy to use; high-quality results.
- Formants are shifted by “manipulation of the sampling frequency”



Praat “Change Gender”

- Very good results can be obtained by manipulating both formants and mean pitch:

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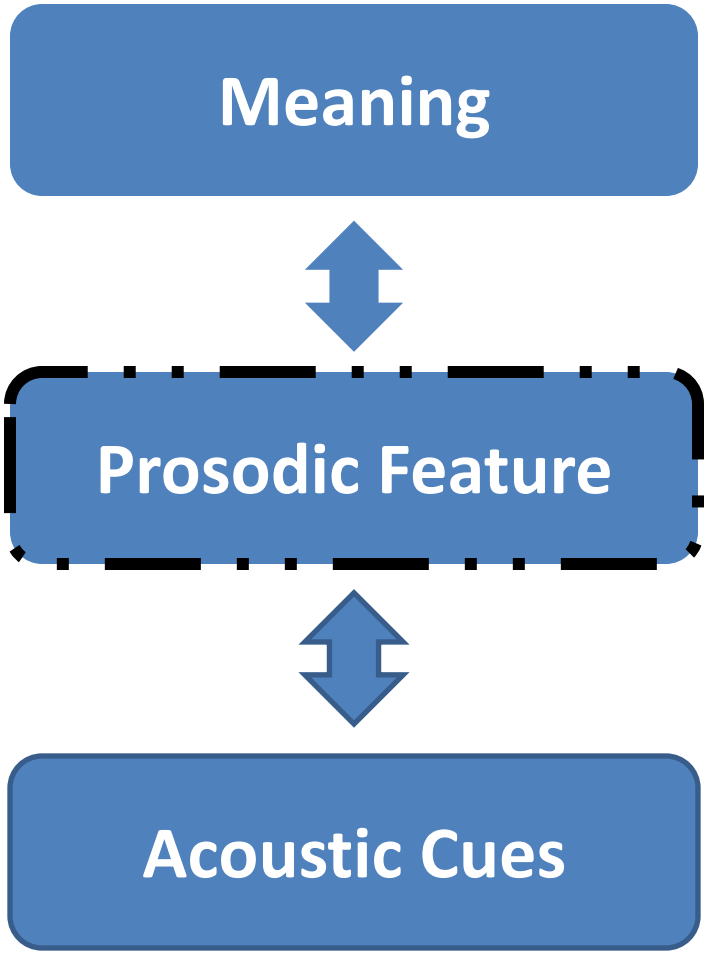
Prosodic annotation is (still) difficult: WHY?

- Cue weighting, Reduced or ambiguous cues
- Individual speaker differences
- Context effects (syntax, discourse); top-down processing
- Disfluency
- Uncertain contrast among labels

These factors are especially challenging in spontaneous speech, where communicative functions of prosody and phonetic reduction patterns are highly variable.



Disagreeing annotators

- Variable and ambiguous acoustic cues to prosody can yield different prosodic labels from different annotations of the same utterance.
- Disagreement = Noise
- Disagreements resolved through consensus, majority vote, or arbitration to produce a final annotation.

Noise = information

- Inter-annotator disagreement on a prosodic label can be informative, revealing ambiguities and other issues in need of further research.
- Multiple independent expert annotators as a standard?
- Problem: time, training, money

Crowdsourcing: “Labels for less”

Hasegawa-Johnson et al. (2015):

- Factor a difficult annotation task into a set of binary-coded “easy” questions that can be answered by anyone.
- Use crowd-sourcing, trade accuracy and specificity of annotations for efficiency and lower cost
- Scientific benefits: better modeling of form-function mapping are possible with larger labeled datasets

Crowdsourcing prosodic annotation

Rapid Prosodic Transcription (RPT), using

- Coarse-grained labels: Prominence, Boundary
- Real-time annotation
- Non-expert, untrained annotators
- Based on auditory impression- no visual speech display

RPT method

The annotator listens to speech sample of up to 1 minute duration, and follows along on a printed transcript with no punctuation or capitalization.

Round 1: boundaries	Select the location of boundaries that separate perceived chunks of speech:
	…it's gonna happen | that our society…

RPT method

The annotator listens to speech sample of up to 1 minute duration, and follows along on a printed transcript with no punctuation or capitalization.

Round 1: boundaries	Select the location of boundaries that separate perceived chunks of speech:
	…it's gonna happen | that our society…
Round 2: prominences	Selects words perceived as prominent:
	…it's gonna **happen** that **our** society…

Coding and pooling data

- Each annotator's annotations are coded on each word as a 0 or 1 for Prominence, and 0 or 1 for Boundary.
- Annotations are pooled over annotators

TOKEN	WORD
1	i
2	really
3	don't
4	know
5	i
6	think
7	in
8	today's
9	world
10	what
11	they
12	call
13	the
14	nineties
15	that
16	uh
17	it's
19	like

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15	that
16	uh
17	it's
19	like

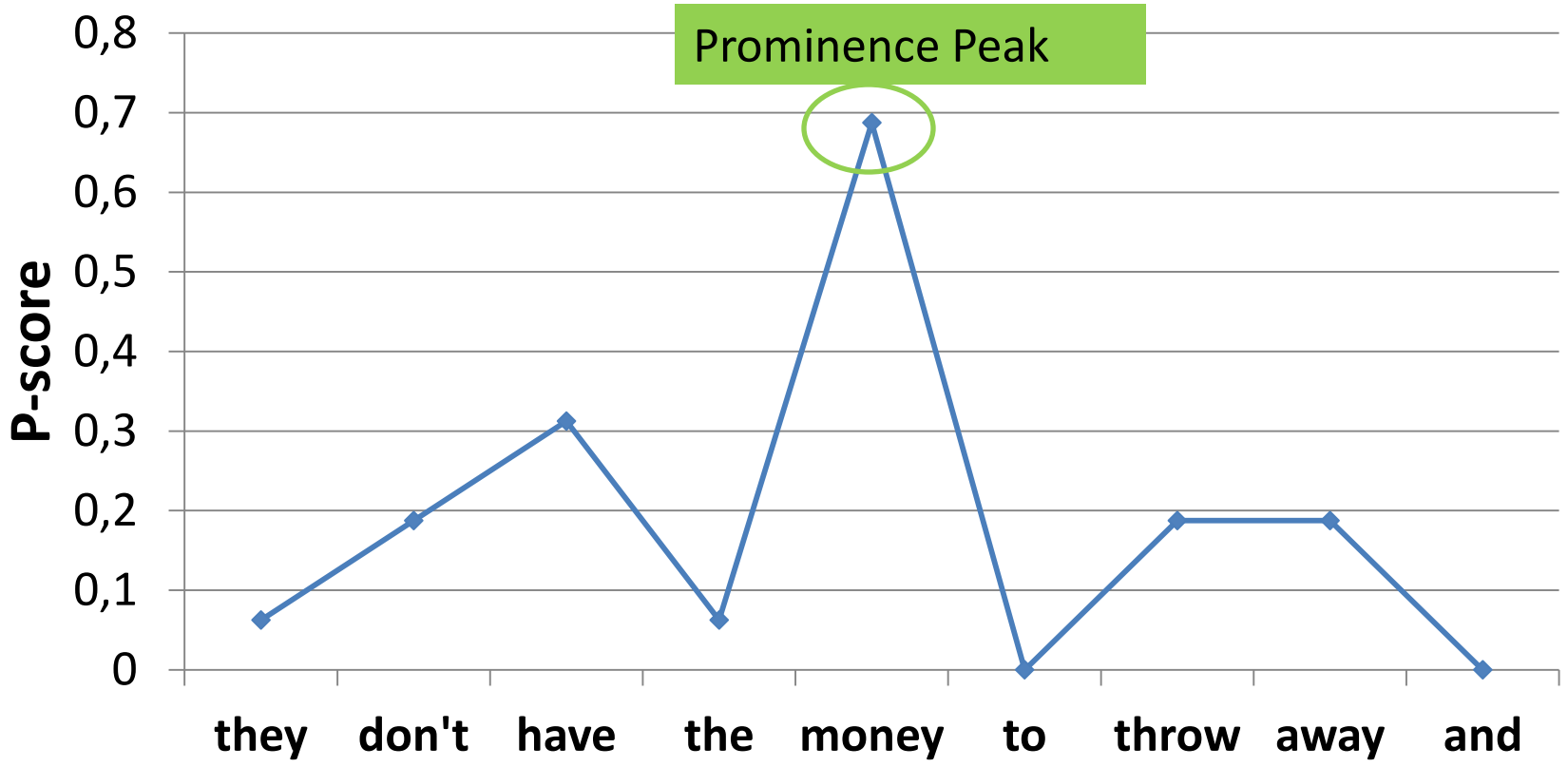
Boundary				Prominence				
A1	A2	A3	A4	A1	A2	A3	A4	…
0	0	0	0	0	0	0	0	
0	0	0	0	0	1	1	0	
0	0	0	0	0	0	0	0	
1	1	1	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	1	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	1	1	0	0	
1	1	1	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
1	1	1	0	1	0	0	1	
0	1	1	0	0	0	0	0	
1	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	

1 annotator's labels

				Boundary				Prominence				
TOKEN	WORD	B-SCORE	P-SCORE	A1	A2	A3	A4	A1	A2	A3	A4	…
1	i	0	0	0	0	0	0	0	0	0	0	
2	really	0	0.56	0	0	0	0	0	1	1	0	
3	don't	0	0.25	0	0	0	0	0	0	0	0	
4	know	0.81	0.44	1	1	1	0	0	0	0	0	
5	i	0	0	0	0	0	0	0	0	0	0	
6	think	0.31	0.44	0	0	0	0	0	1	0	0	
7	in	0	0	0	0	0	0	0	0	0	0	
8	today's	0	0.81	0	0	0	0	1	1	0	0	
9	world	0.81	0.44	1	1	1	0	0	0	0	0	
10	what	0	0	0	0	0	0	0	0	0	0	
11	they	0	0	0	0	0	0	0	0	0	0	
12	call	0	0	0	0	0	0	0	0	0	0	
13	the	0	0	0	0	0	0	0	0	0	0	
14	nineties	0.81	0.5	1	1	1	0	1	0	0	1	
15	that	0.5	0.13	0	1	1	0	0	0	0	0	
16	uh	0.38	0	1	0	0	0	0	0	0	0	
17	it's	0	0	0	0	0	0	0	0	0	0	
19	like	0	0.06	0	0	0	0	0	0	0	0	

Prominences and Boundaries coded as counts or proportions

Prominence scores (proportions) plotted for each word in an (partial) utterance.



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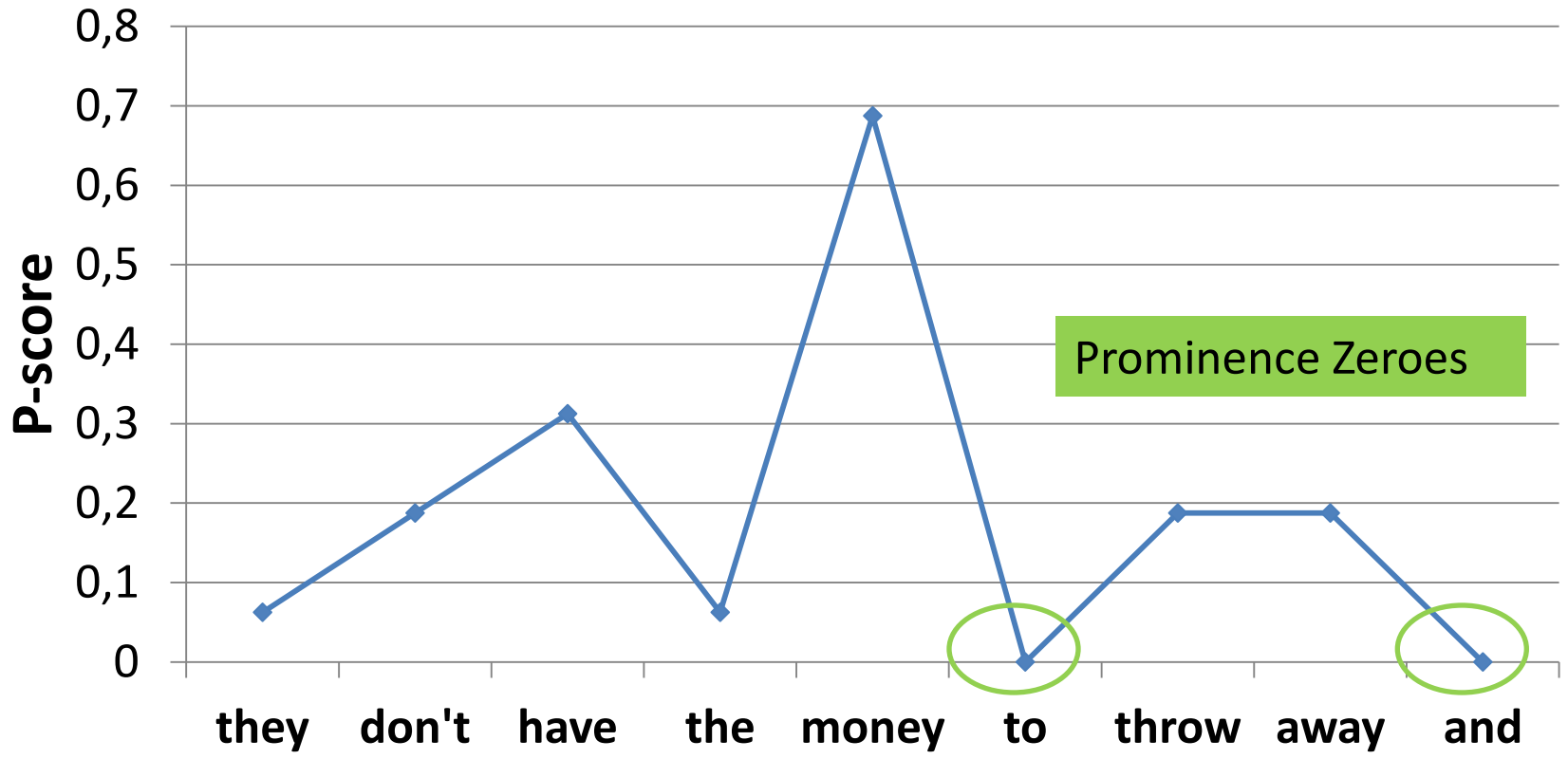

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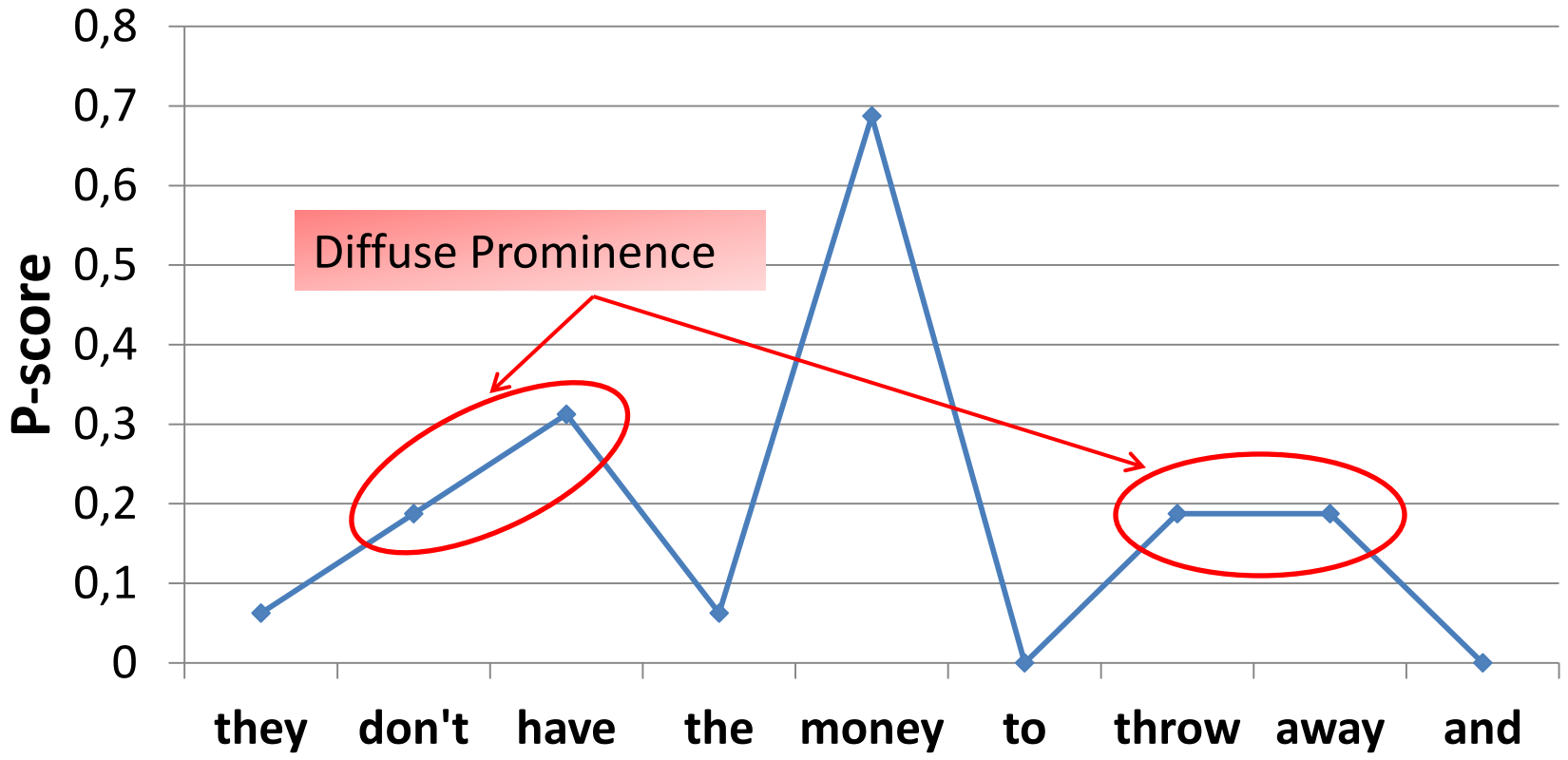
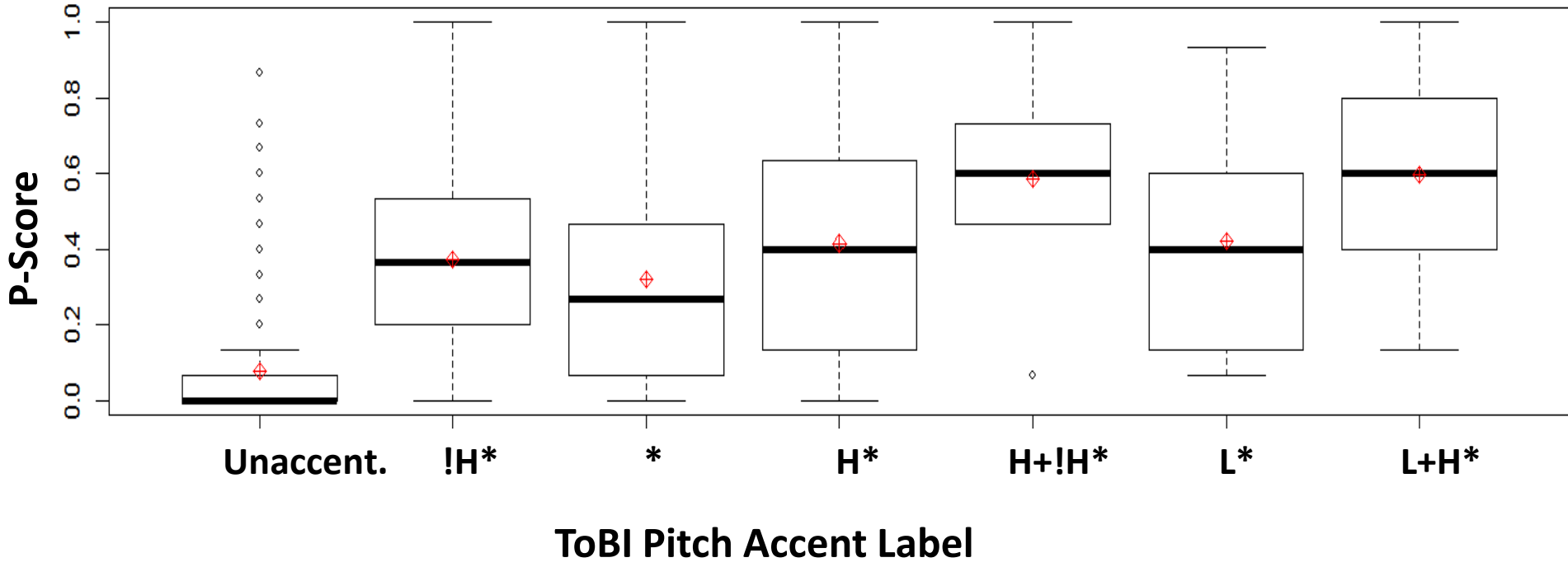
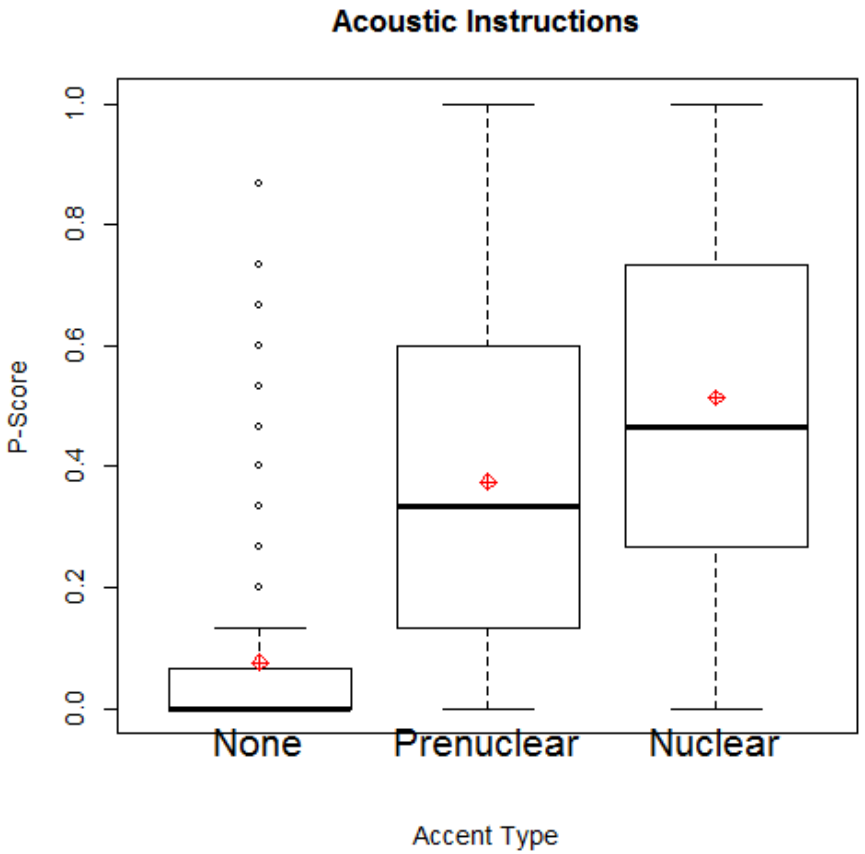


Prominence ratings by ToBI pitch accent type (American English)



Prominence ratings by ToBI pitch accent type (American English)



Overview

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Research Question

- In what way is the perception of prominence in English influenced by the perception of speaker gender?
  - Hypotheses?

Stimuli

- 5 utterances produced by males, where the formant resynthesis led to a different interpretation of their gender
  - 19-27 seconds long
  - 365 words total
- Taken from:
  - Buckeye Corpus (Pitt et al 2007)
  - CHAINS Corpus (Cummins et al 2006)
  - SBCSAE Corpus (DuBois et al 2000-2005)

Stimuli

- 15 utterances
  - 5 original utterances
  - 5 with formants increased 20%
  - 5 with formants decreased 17%
- Resynthesis performed using Praat's (Boersma and Weenink 2015) "Change Gender" function

Stimuli

Original

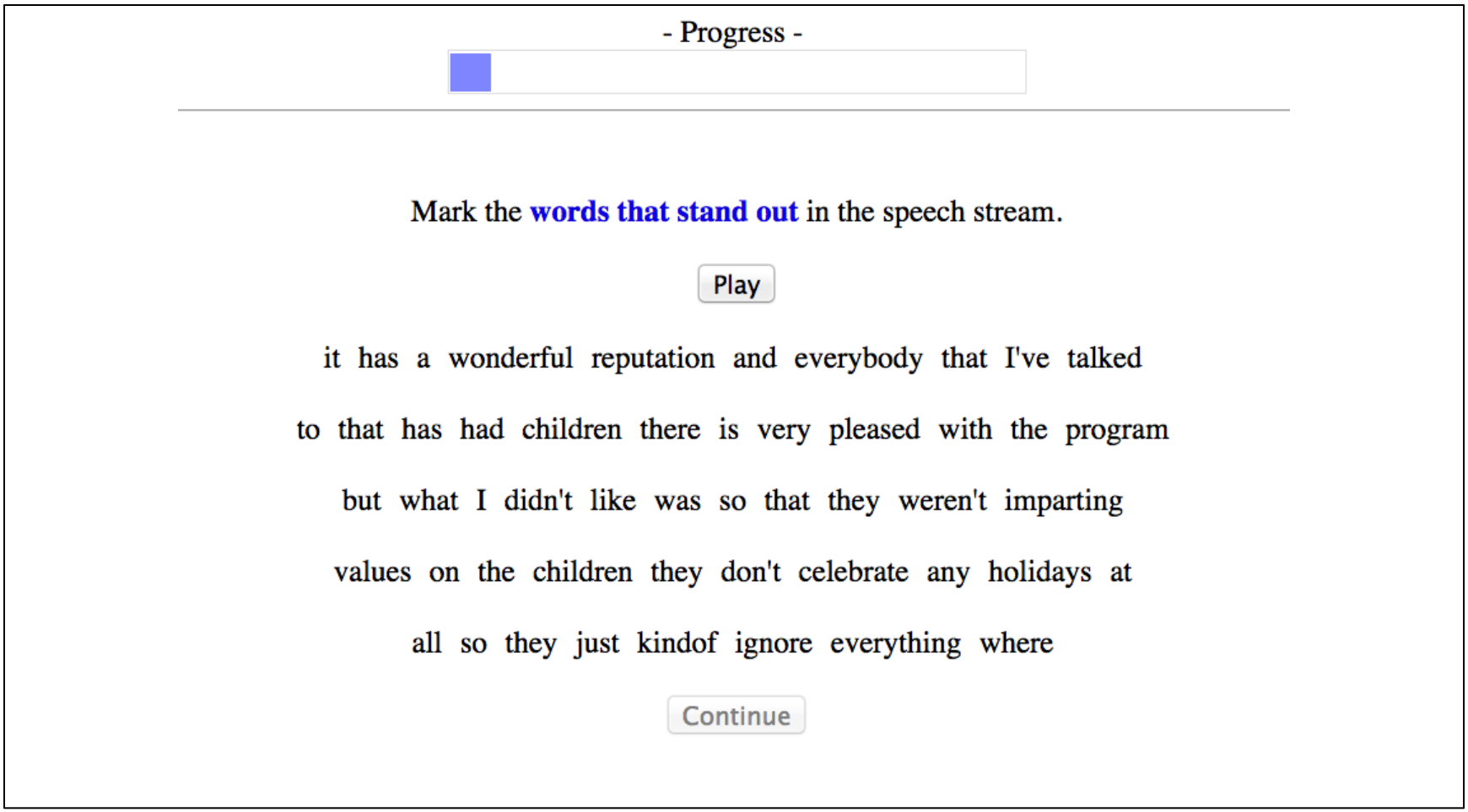
Increased formants

Decreased formants

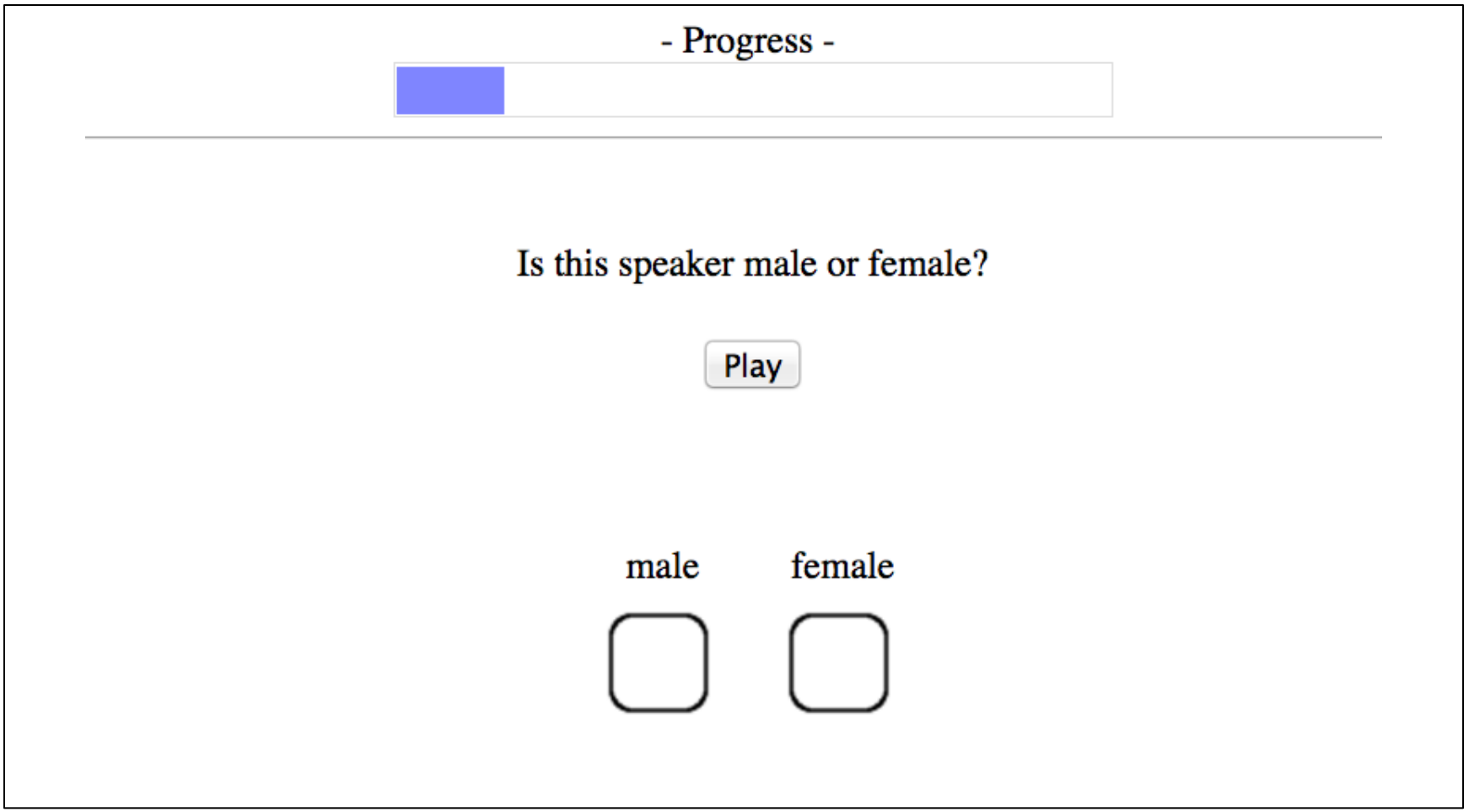
Participants

- 3 Groups
  - Original utterances
  - Increased formants
  - Decreased formants
- Recruited over Amazon Mechanical Turk
  - IP address limited to the United States
- Experiment administered over LMEDS (Mahrt 2015)
  - Download at: https://github.com/timmahrt/LMEDS

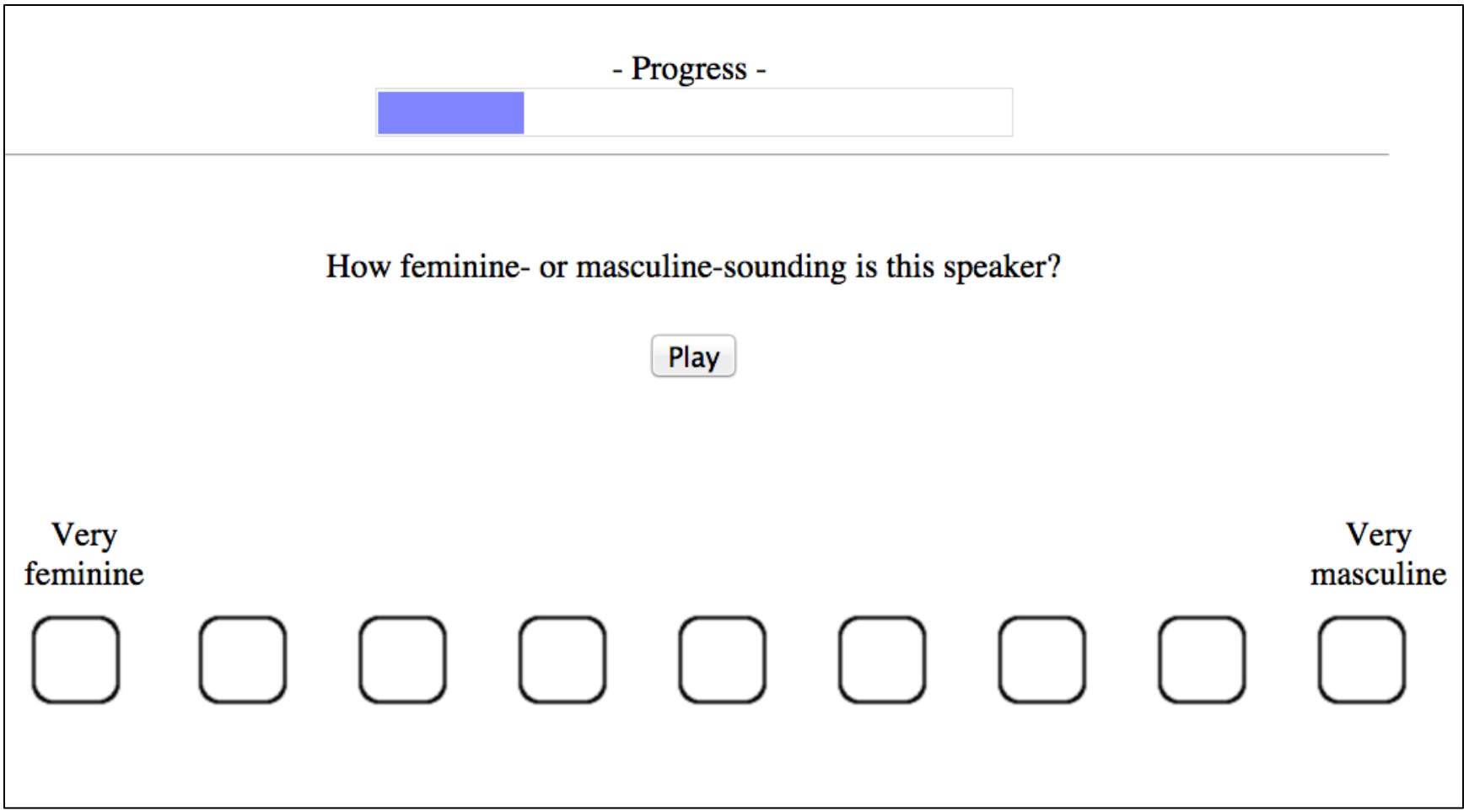
Task 1

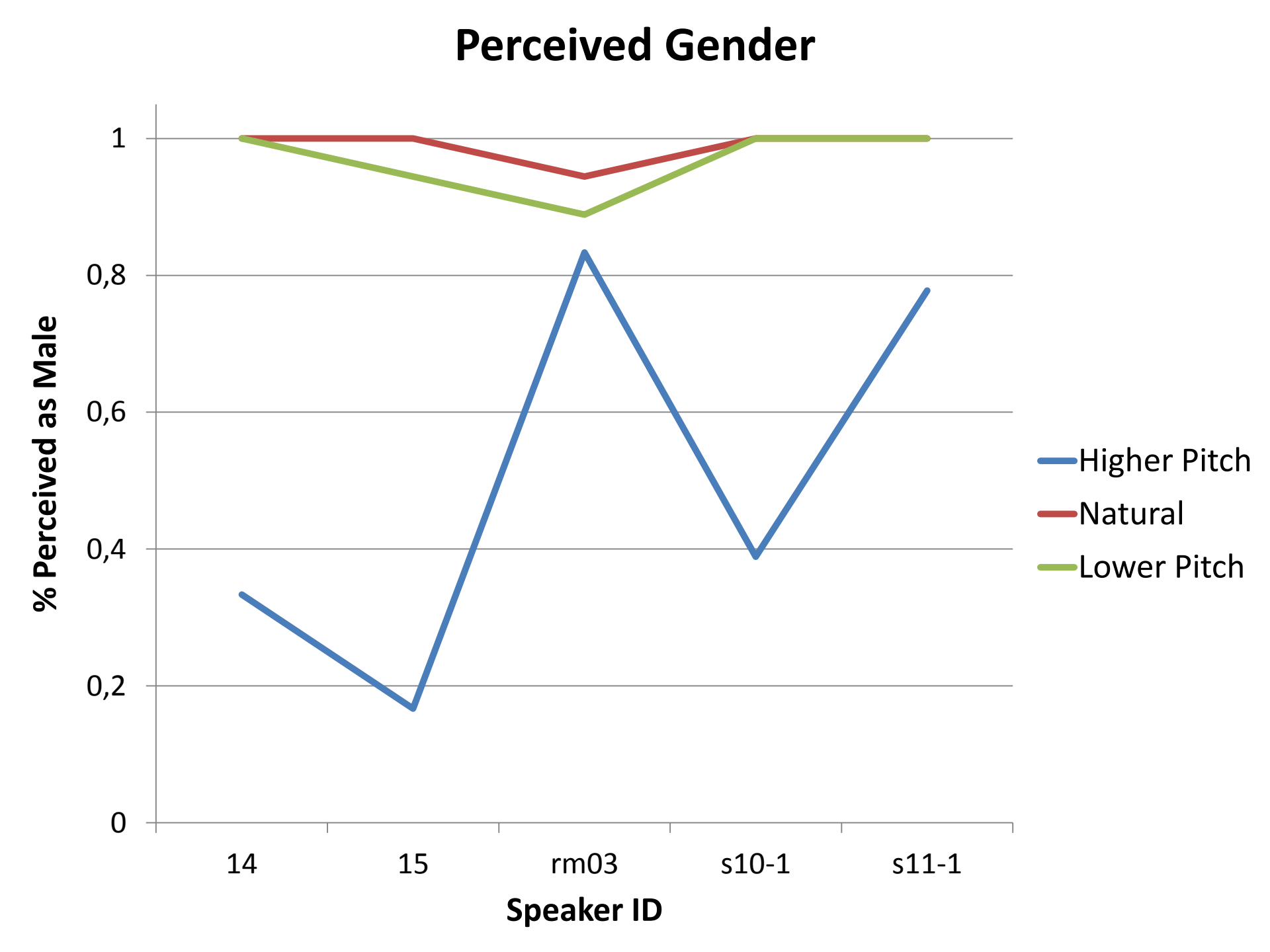

- Progress -
Mark the words that stand out in the speech stream.
Play
it has a wonderful reputation and everybody that I've talked
to that has had children there is very pleased with the program
but what I didn't like was so that they weren't imparting
values on the children they don't celebrate any holidays at
all so they just kindof ignore everything where
Continue

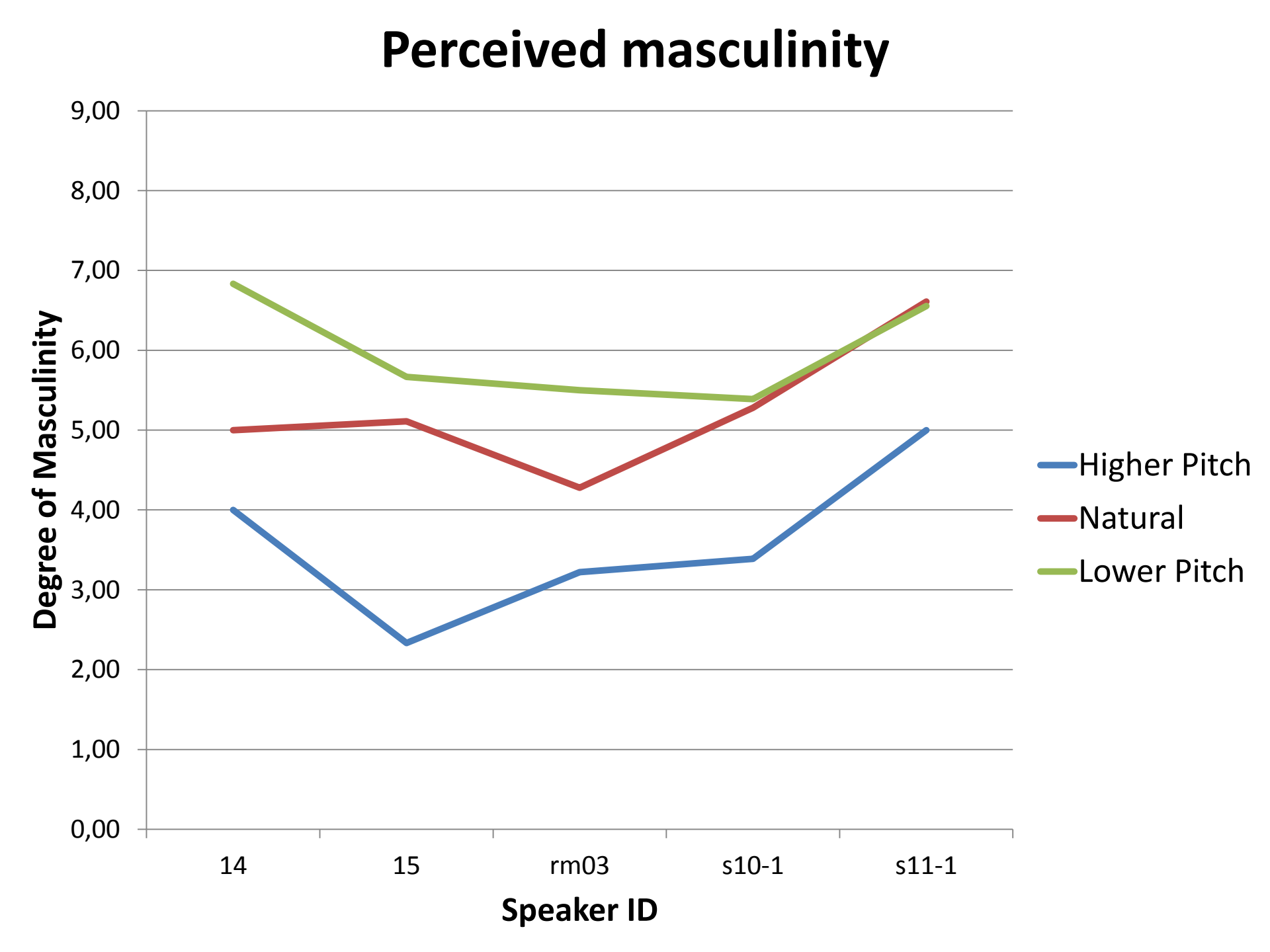
Task 2

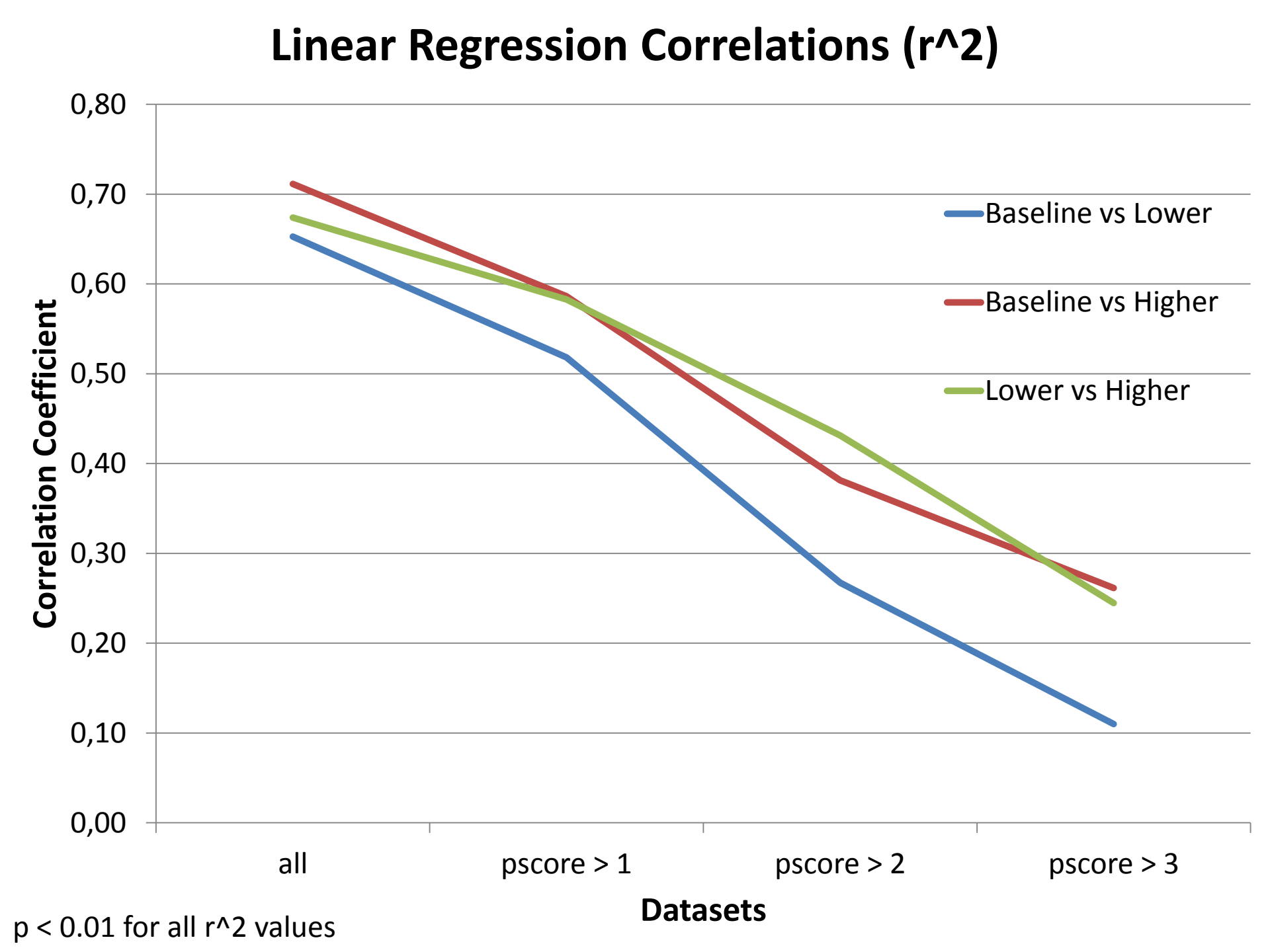


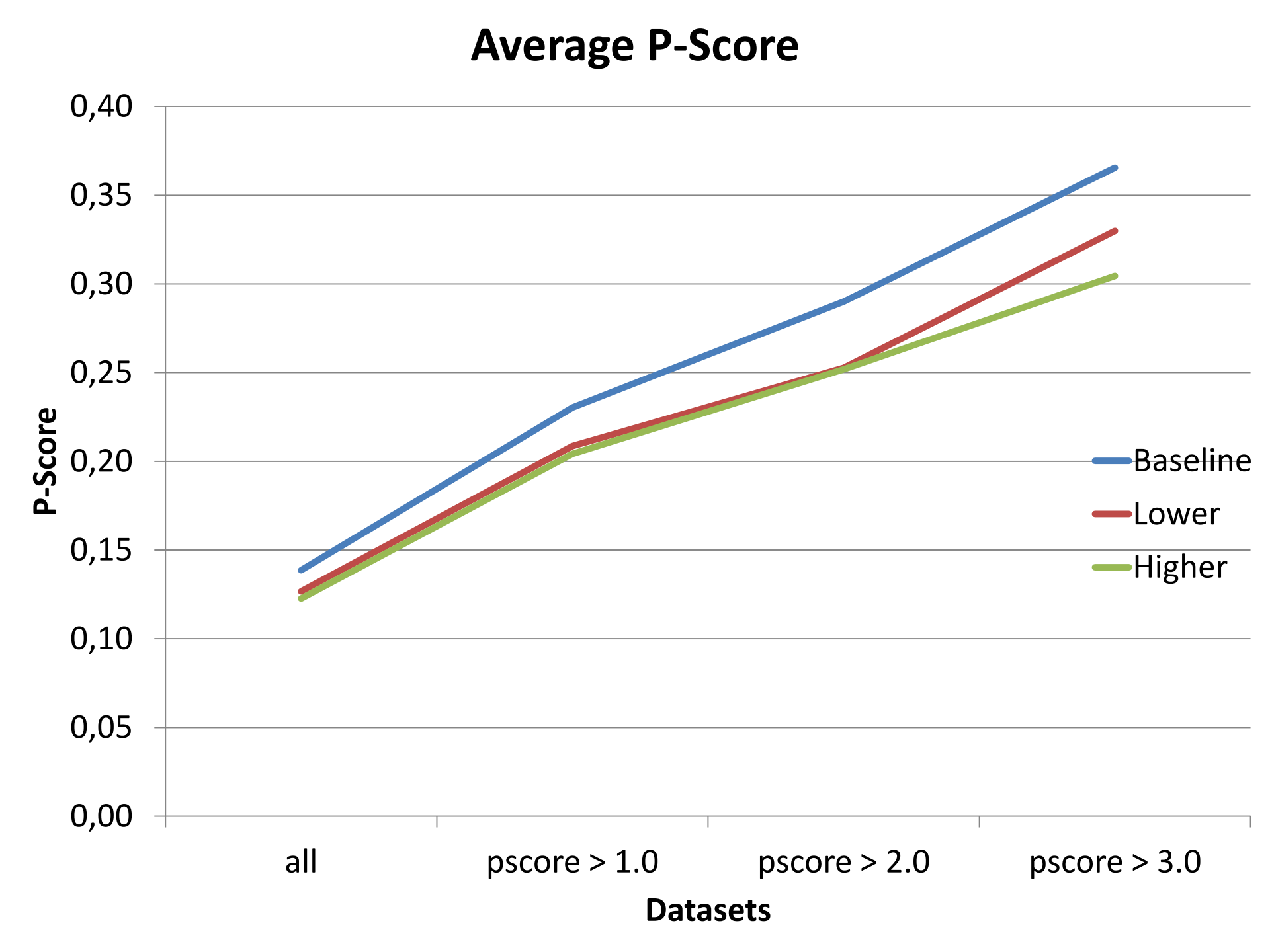
Task 3


- Progress -
How feminine- or masculine-sounding is this speaker?
Play
Very feminine
Very masculine


Perceived Gender
% Perceived as Male
1
0,8
0,6
0,4
0,2
0
14
15
rm03
s10-1
s11-1
Speaker ID
Higher Pitch
Natural
Lower Pitch


Perceived masculinity
9,00
8,00
7,00
6,00
5,00
4,00
3,00
2,00
1,00
0,00
Degree of Masculinity
14
15
rm03
s10-1
s11-1
Speaker ID
Higher Pitch
Natural
Lower Pitch


Linear Regression Correlations (r^2)
0,80
0,70
0,60
0,50
0,40
0,30
0,20
0,10
0,00
Correlation Coefficient
Baseline vs Lower
Baseline vs Higher
Lower vs Higher
all
pscore > 1
pscore > 2
pscore > 3
Datasets
p < 0.01 for all r^2 values


Average P-Score
0,40
0,35
0,30
0,25
0,20
0,15
0,10
0,05
0,00
P-Score
Baseline
Lower
Higher
all
pscore > 1.0
pscore > 2.0
pscore > 3.0
Datasets

Findings

- Increased formants lead to a greater chance of a man being perceived as female. (But only for certain speakers (why?))
- Formant height may be inversely correlated with masculinity
- Increased formants p-scores are more similar to the baseline than the decreased formants p-scores. But p-scores are higher for the baseline than the manipulated results.

Discussion

- Why a different result from Gussenhoven and Rietveld 1998?
  - They used male and female speakers with only resynthesized pitch.
  - Perhaps this lends evidence to the idea that although there are differences in the degree of prominence—prominent words are still perceived as prominent.

Developing the Study Further

- Add more speakers—more masculine male speakers and feminine and masculine female speakers
- New task—repetition of Gussenhoven and Rietveld 1998.
- New stimuli with pitch and formants manipulated?

Comments?
Questions?

Thank you for listening