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Measuring Variations of Mimicry by Means of Prosodic Cues in Task-Based Scenarios and Conversational Speech

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Measuring variations of mimicry by means of prosodic cues

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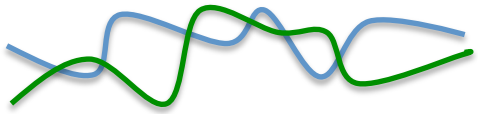
Mimicry in speech

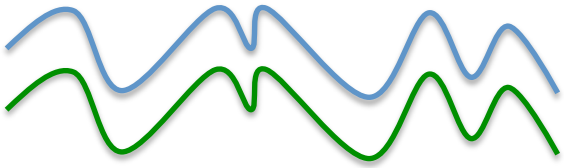
Speakers imitate each other's speech mannerisms in terms of sounds, syntax, lexicon, prosody

… *accommodation, alignment, convergence, entrainment, synchrony*…

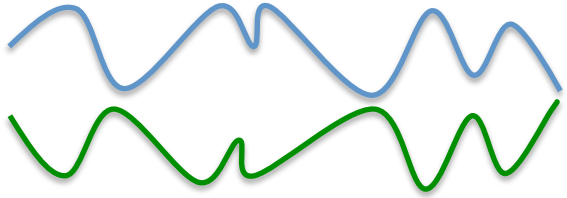
Non-Mimicry: random

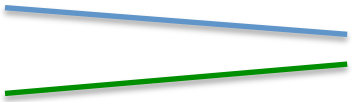


Mimicry: parallel patterns

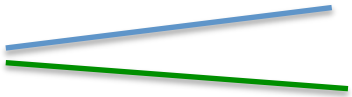


Anti-mimicry: mirror patterns





Convergence: converge towards a common point



Divergence: move apart towards different points

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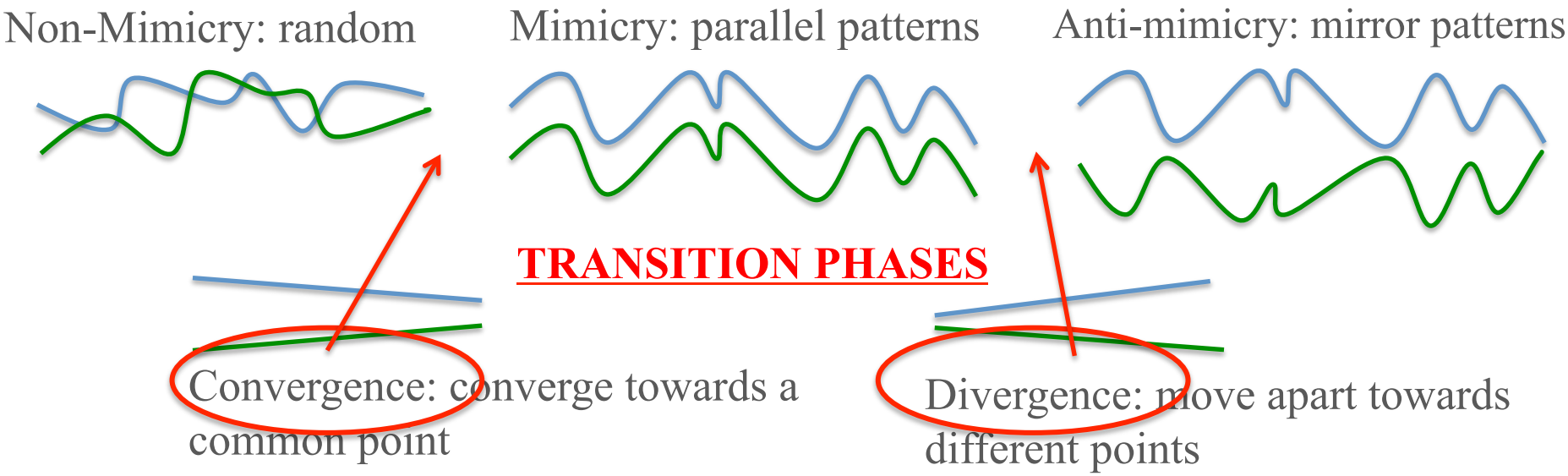

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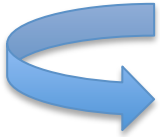
Mimicry in speech

*The situation where the observed behaviours of two inter-actants although dissimilar at the start of the interaction are moving towards behavioral matching (*Burgoon et al 1995)



Speakers tend to imitate over the course of the interaction?

Phases of mimicry and non-mimicry

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Mimicry measurements

Metrics developed may not capture the temporal dynamics of mimicry (except Jaffe et al, 2001; Edlund et al 2009)

Mimicry strength measured

- on the whole interaction
- on parts of the interaction

Data

- Task-based scenarios: Co-operation between 2 participants to complete an imaginary shipwreck scenario. Time, score and functional constraints.

  8 dialogues, 10 minutes. Male & Female, but not mixed.

- Spontaneous speech:

  D64 corpus (Oertel et al, 2010)

  Two interactions (S1/S2 & S1/S3)

  2M & 1F

  30 min each

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Mimicry measurements

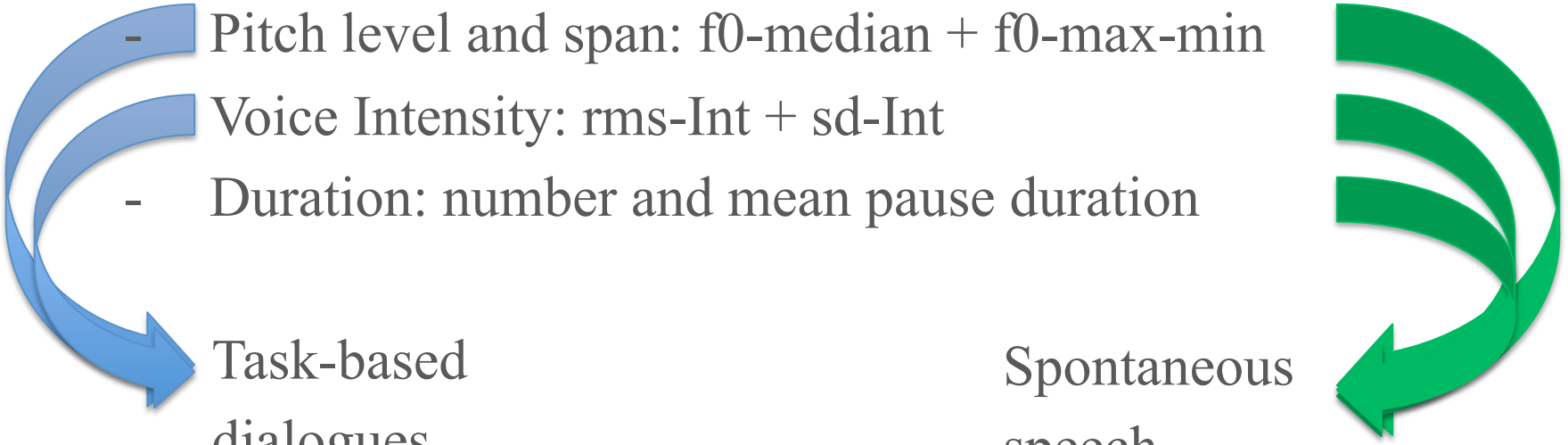
Prosodic cues:

- Pitch level and span: f0-average + f0-max-min
- Voice Intensity: rms-Int + sd-Int
- Duration: number and mean pause duration

Mimicry measurements

Prosodic cues:

- Pitch level and span: f0-median + f0-max-min
- Voice Intensity: rms-Int + sd-Int
- Duration: number and mean pause duration



Task-based dialogues

Spontaneous speech

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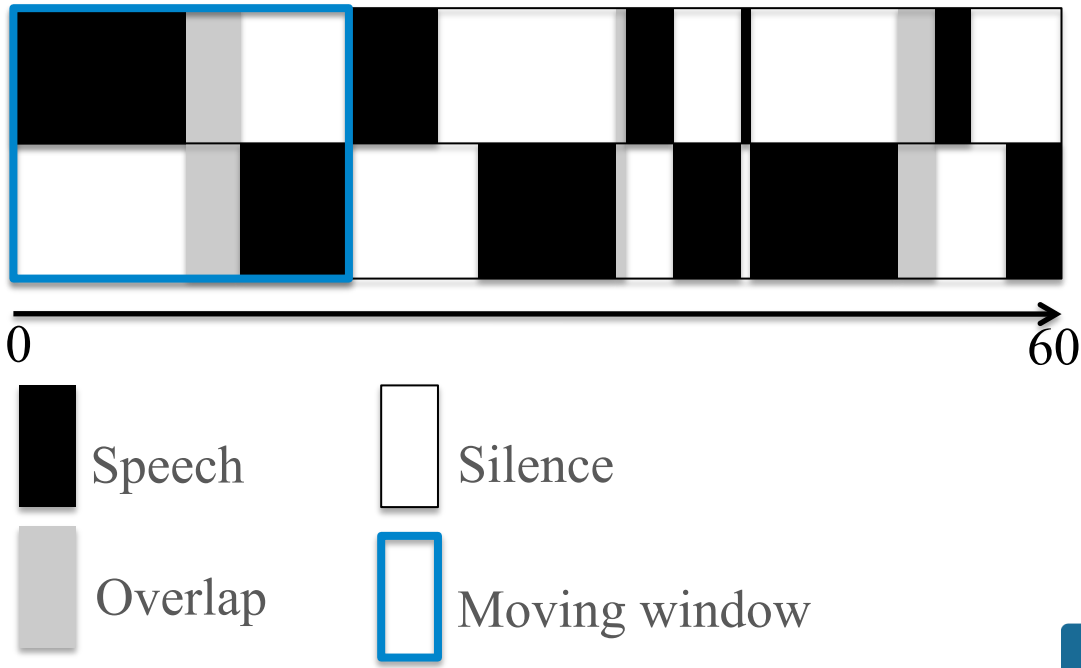
Mimicry measurements

Methods:

- Prosodic cues extraction: a series of overlapping windows (length = 20 sec; time step = 10 sec) (Kousidis et al, 2008; Edlund et al, 2009)

Figure 1: Conversation Chart



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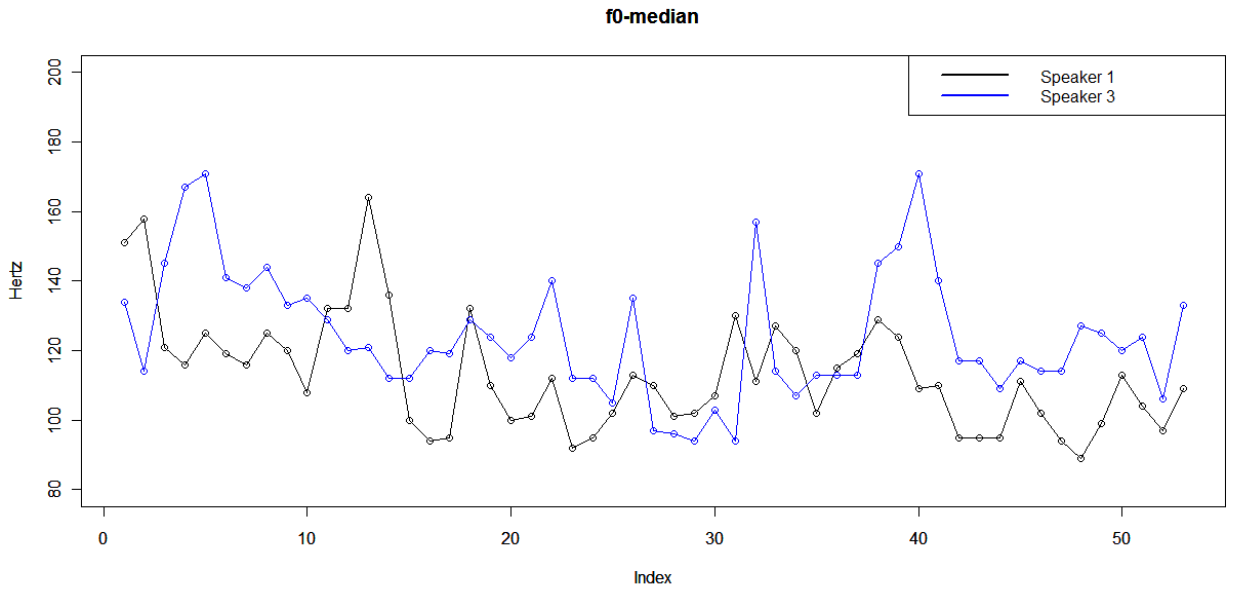
Mimicry measurements

Methods:

- Mimicry strength measurement: Pearson's correlation coefficient of the two speakers' time series (use of moving windows for temporal variations)

Figure 2



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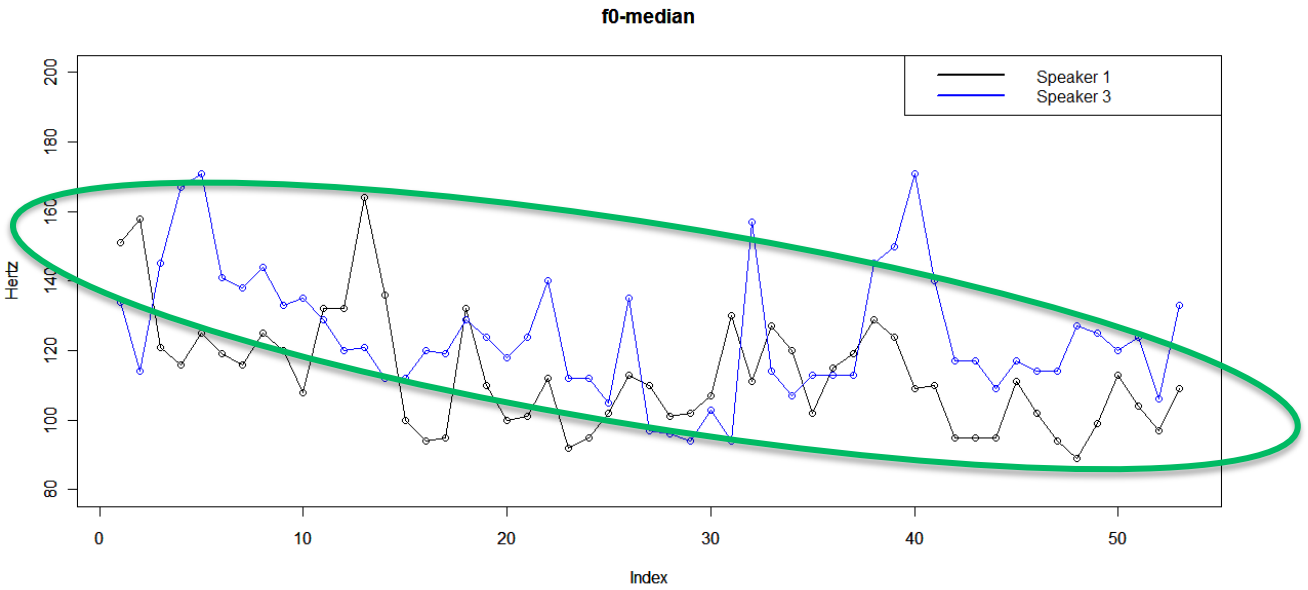

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Mimicry measurements

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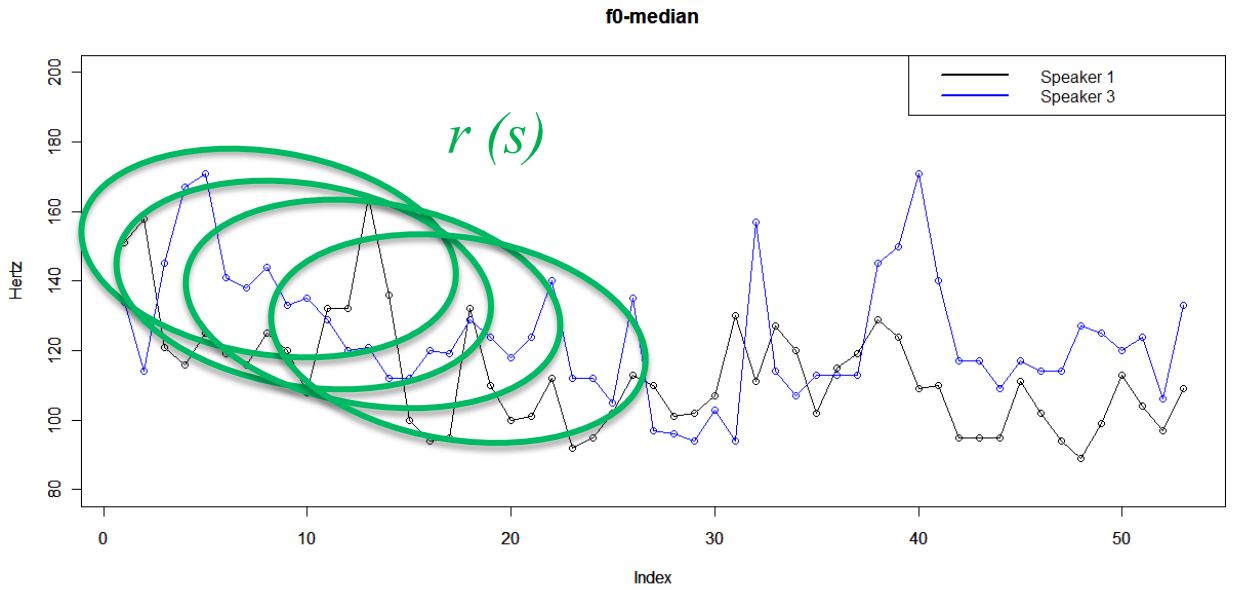

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Mimicry measurements

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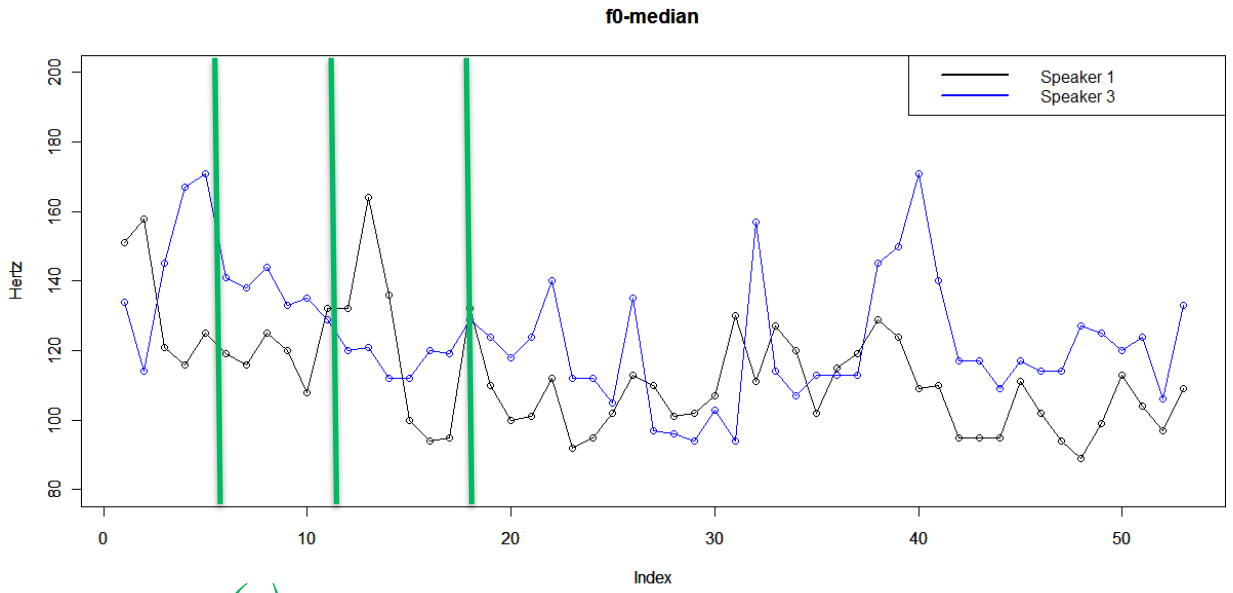

r (s)

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Mimicry - functions

Mimicry plays an important role in social interaction

- express deference, speakers seek each other's approval
- its absence: maintain social distance with each other?
- signal agreement?

→ Level of agreement (DAMSL:5-point scale) in task-based dialogues.

→ Degree of involvement (scale 0-10) in spontaneous speech.

Results

Task-based dialogues

Whole interaction

- D1: Weak for mean pitch, pitch range, intensity
- D2: Stronger for pitch, pitch range, max pitch, mean intensity

Windowed correlation

D1 & D2: Change in some of the values in either direction.

Results

Task-based dialogues

D1 Overall:

- Mean Pitch:
  r=0.377
- Pitch Range (Semi-Tones)
  r=0.11
- Min pitch:
  r=0.044
- Max pitch:
  r=0.073
- Mean intensity:
  r=-0.83
- Intensity range:
  r=0.273
- Agreement: ☹

D2 Overall:

- Mean Pitch:
  r= 0.711
- Pitch Range (Semi-Tones)
  r= 0.433
- Min pitch:
  r=0.254
- Max pitch:
  r=0.712
- Mean intensity:
  r=0.795
- Intensity range:
  r=0.752
- Agreement: ☹?

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Results

Task-based dialogues: Change of values with windowed correlation (10 points:200 seconds).

D1 windowed correlation.

1-10: Pitch range, r=0.444

10-20: Max pitch, r=0.814

20-30: Mean pitch, r=657

30-40: Mean pitch, r=0.448

40-50: Mean Pitch, r=0.575

Min pitch, r=0.666

50-60: Mean intensity, r= - 0.602

60-66: Mean pitch, r=0.690

Min pitch, r= - 0.741

Intensity, r= - 0.786

D2 windowed correlation

1-10: Max pitch, r=0.531

10-20: Mean intensity, r= 0.905

Intensity range, r=0.899

20-30: Mean intensity, r=0.899

Intensity range, r=0.875

30-40: Max pitch, r=0.753

Pitch range ST, r=0.758

40-50: Pitch range St, r=0.868

50-61: Intensity range, r= 0.837

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Results

Mimicry and levels of agreement

In task-based dialogues

Mimicry when agreement AND disagreement. E.g. Mean pitch

Movement is in either direction: increase AND decrease. E.g Mean pitch.

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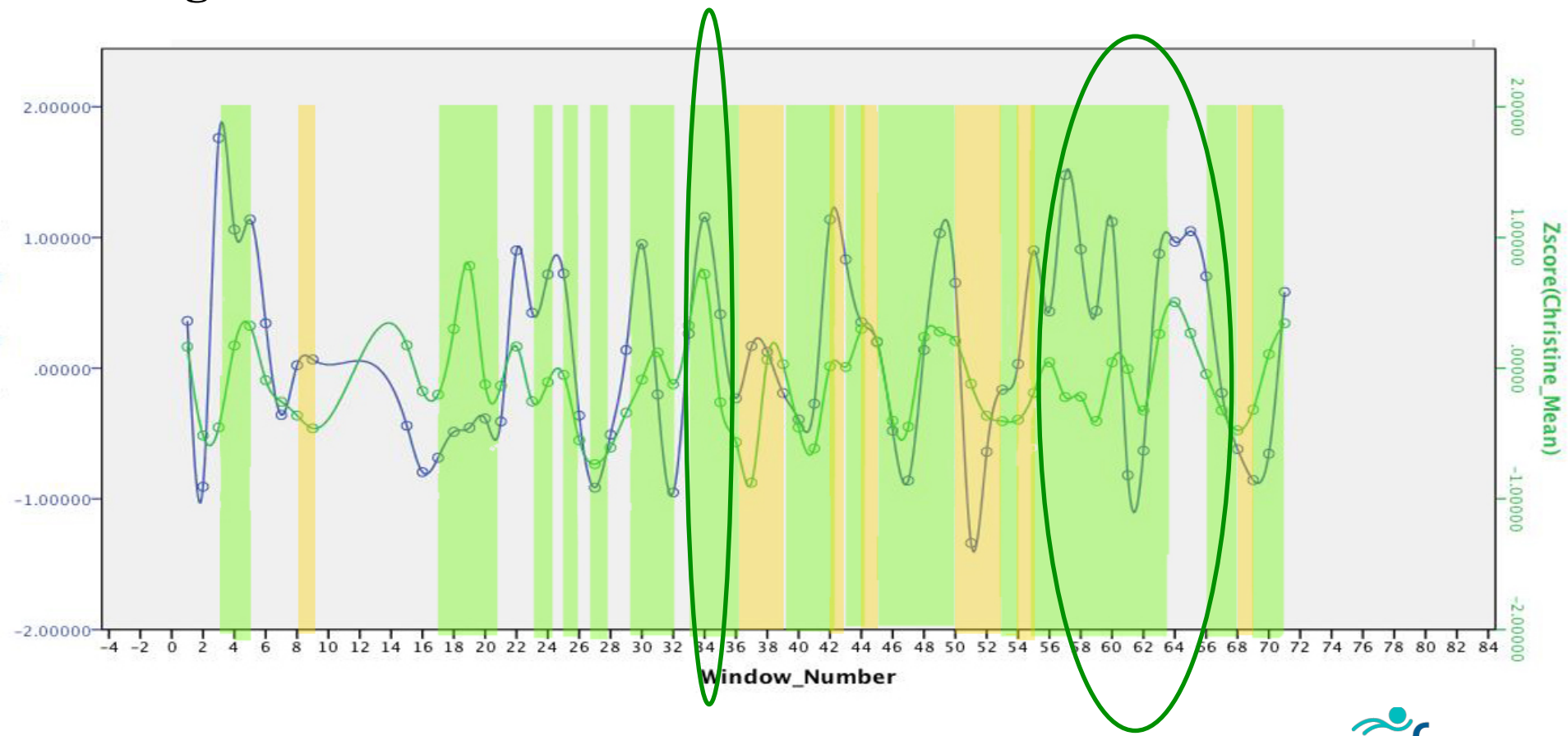
Results

Task-based dialogues

D1 Agreement.



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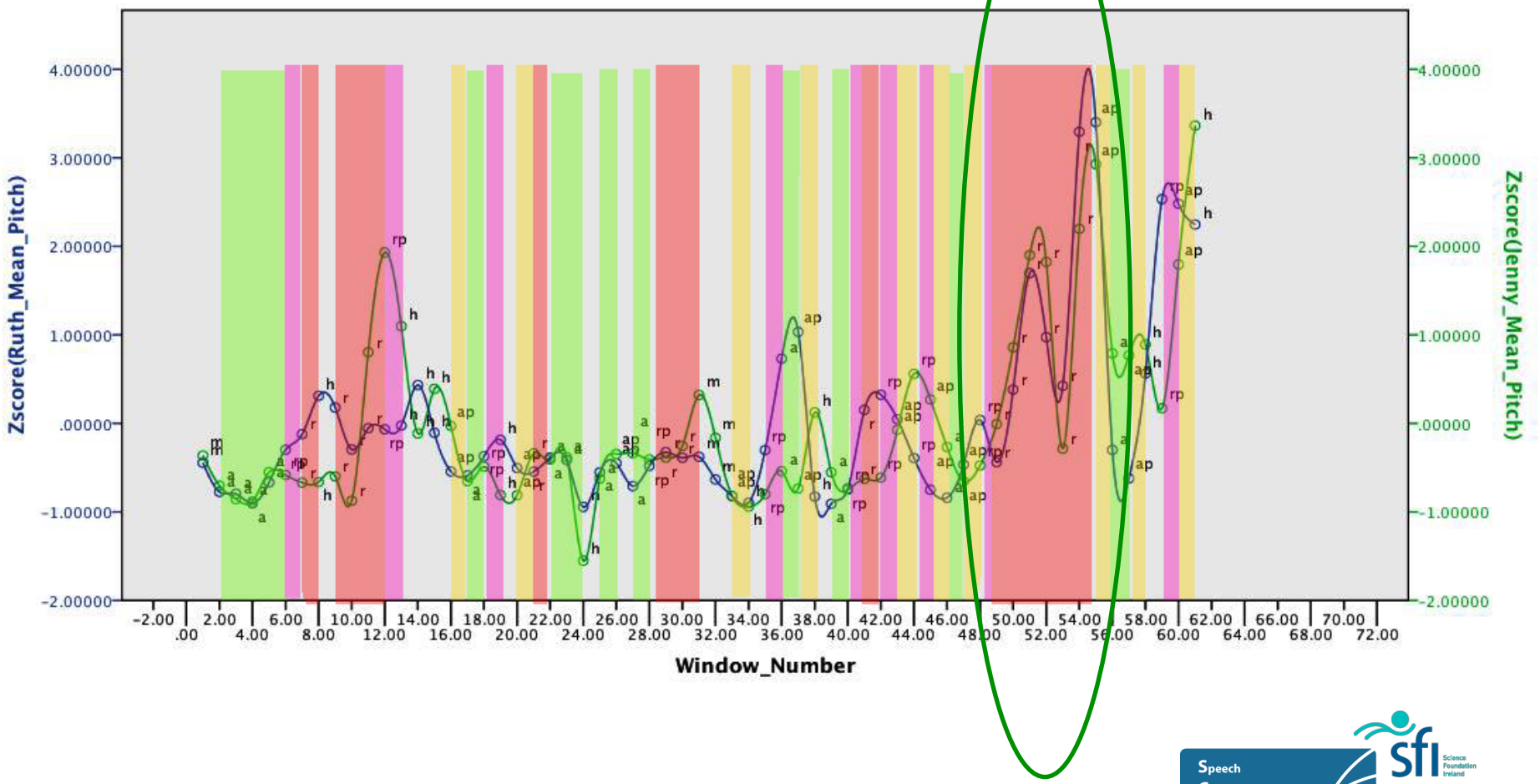
Results

Task-based dialogues

D2 Agreement.



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Results

Spontaneous speech

On the whole interaction

- S1/S2: No mimicry
- S1/S3: Mimicry in voice intensity level, variation
  pitch range ceiling
  mean pauses duration

Temporal variations of mimicry

-S1/S2: Mimicry in voice intensity level

- S1/S3: Mimicry in pitch range ceiling
  mean pauses duration

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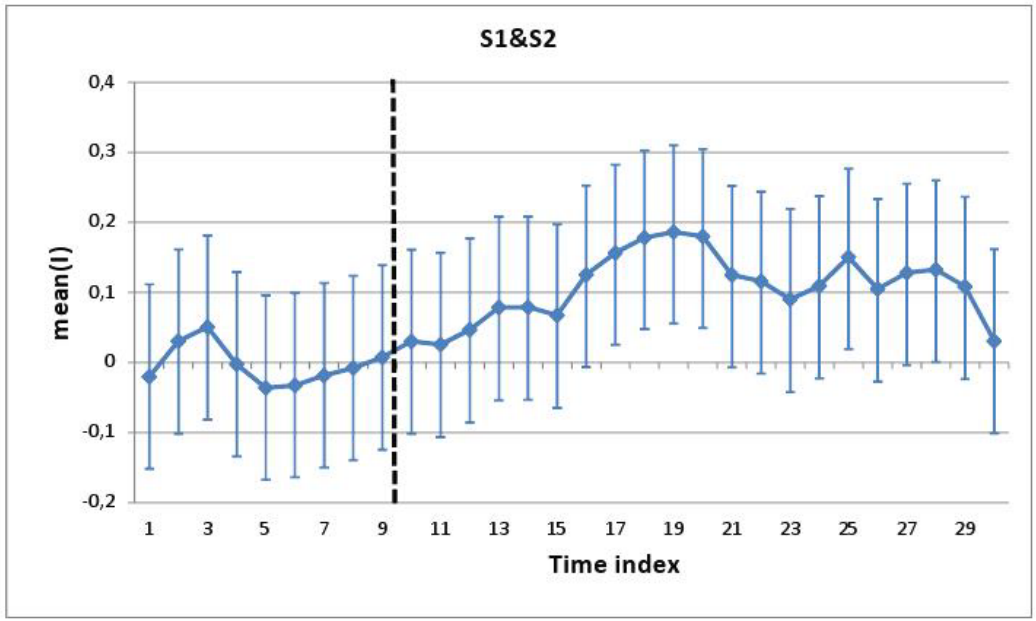
Results

Mimicry and degrees of involvement

In spontaneous speech (S1/S2)

- Mean(I) = calculated from the set of 8 prosodic cues



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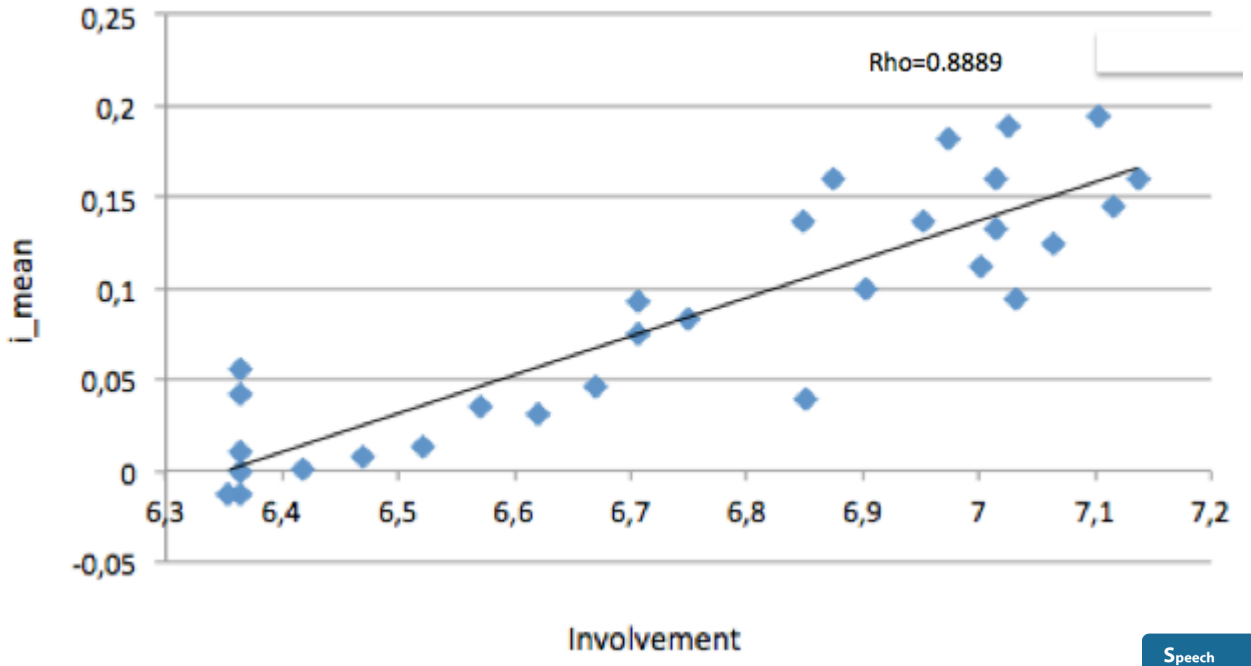
Results

Mimicry and degrees of involvement

In spontaneous speech (S1/S2)

-Strong correlation:

The higher the degree of involvement, the stronger the mimicry



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Results

Mimicry and degrees of involvement

In spontaneous speech (S1/S2)

-Strong correlation:

The higher the degree of involvement, the stronger the mimicry

In terms of

-Rms_Intensity (r=0.89)

-Mean_pause_dur (r=0.89)

-Number_pauses (r=0.59)

-F0-min (r=0.55)

-F0-span (r=0.51)

-F0-median (r=0.42)

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Conclusion

- Mimicry can be measured by means of prosodic cues
- A non-linear phenomenon
- Temporal dynamics of mimicry as strong cues for predicting involvement
- Mimicry at points of agreement and disagreement.

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Discussion

- Mimicry: task-dependent?
  Not necessarily a linear phenomenon
  In spontaneous speech: dynamics of mimicry

- Mimicry or use of the same prosodic parameters to convey the same functions (e.g. discourse, attitudinal)?

- Z-score transformations for detecting mimicry but not convergence?

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Future work

- Methodology:
  - -Capture smaller variations of mimicry
  - -Measure anti-mimicry, convergence and divergence phases
  - -Measure who mimics whom?
  - -Improve/increase annotation of agreement
- Correlation between temporal variations of mimicry and discourse structure (e.g. topic changes)
- ….

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Thanks!


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