The Traces of Inner Life

Lecture 06b (Analysis III)

Alessandro Vinciarelli

Outline

- A Probabilistic interpretation
- Biomarkers Revisited
- Conclusions

Outline

- A Probabilistic interpretation
- Biomarkers Revisited
- Conclusions

Cliff's Delta (I)

$$\delta = \frac{|\, n(x_i > y_j) - n(y_j > x_i) \,|}{N_x N_y}$$

- A set of values $\mathcal{X} = \{x_1, \ldots, x_{N_x}\}$ and a set of values $\mathcal{Y} = \{y_1, \ldots, y_{N_y}\}$;
- $n(x_i > y_j)$ is the number of times a value in $\mathcal{X}$ is greater than a value in $\mathcal{Y}$.

Social AI

University of Glasgow

Cliff's Delta (II)

$$p(x_i > y_j) = \frac{\delta + 1}{2}$$

- When $n(x_i > y_j) > n(y_j > x_i)$.

$$p(y_j > x_i) = \frac{\delta + 1}{2}$$

- When $n(x_i > y_j) < n(y_j > x_i)$.

Social AI

University of Glasgow

A Probabilistic Interpretation

- The Cliff's δ provides us with the probability that, if we take one depressed and one non-depressed speaker, the comparison between two bio-markers will have a certain direction;
- The closer the probability to 100%, the more the bio-marker helps one to discriminate between depressed and non-depressed speakers;
- Unfortunately, no bio-marker is known that separates clearly depressed and non-depressed speakers or, more generally, people affected by a pathology and others.

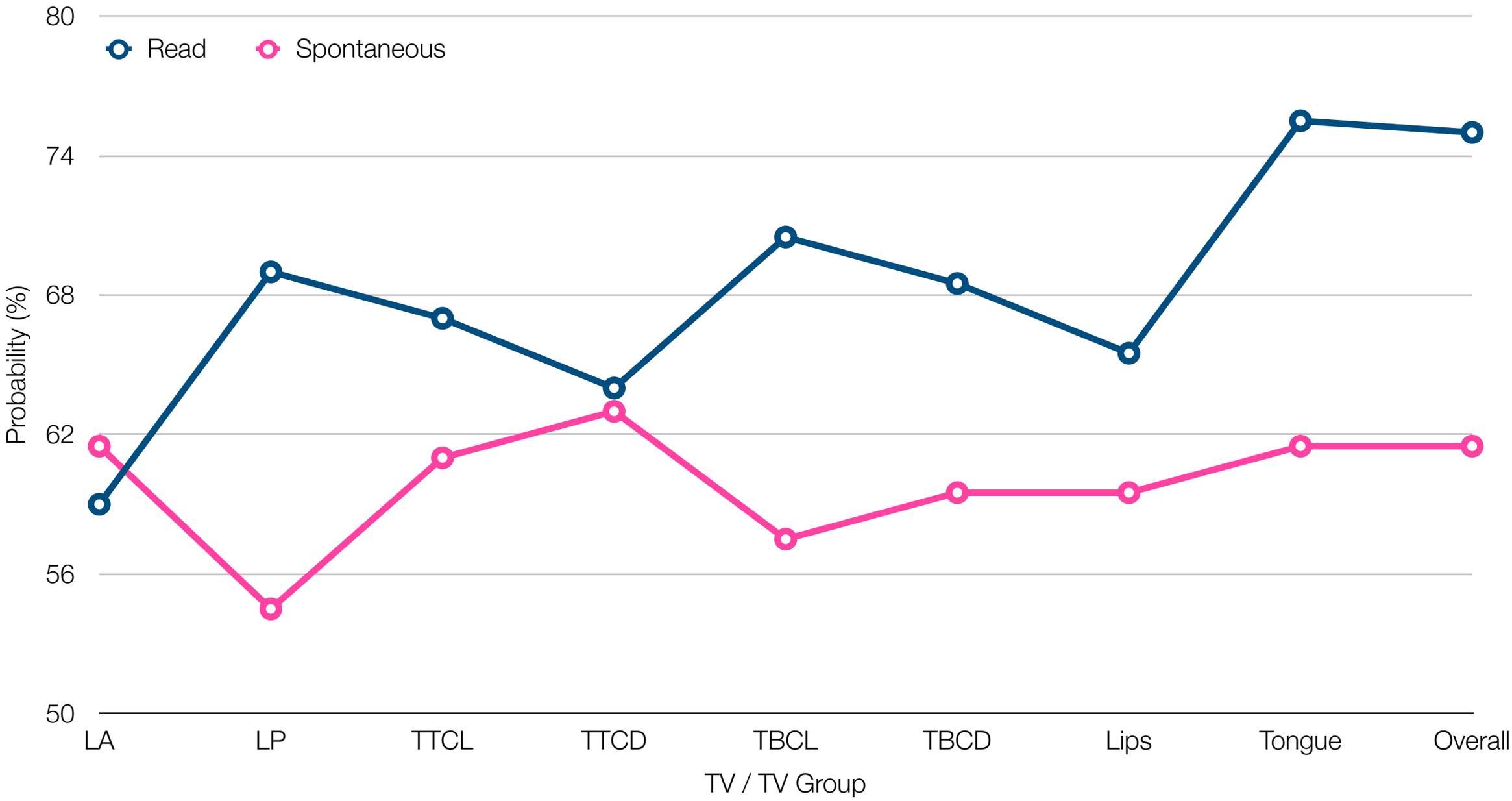
Social AI

University of Glasgow

Outline

- A Probabilistic interpretation
- Biomarkers Revisited
- Conclusions

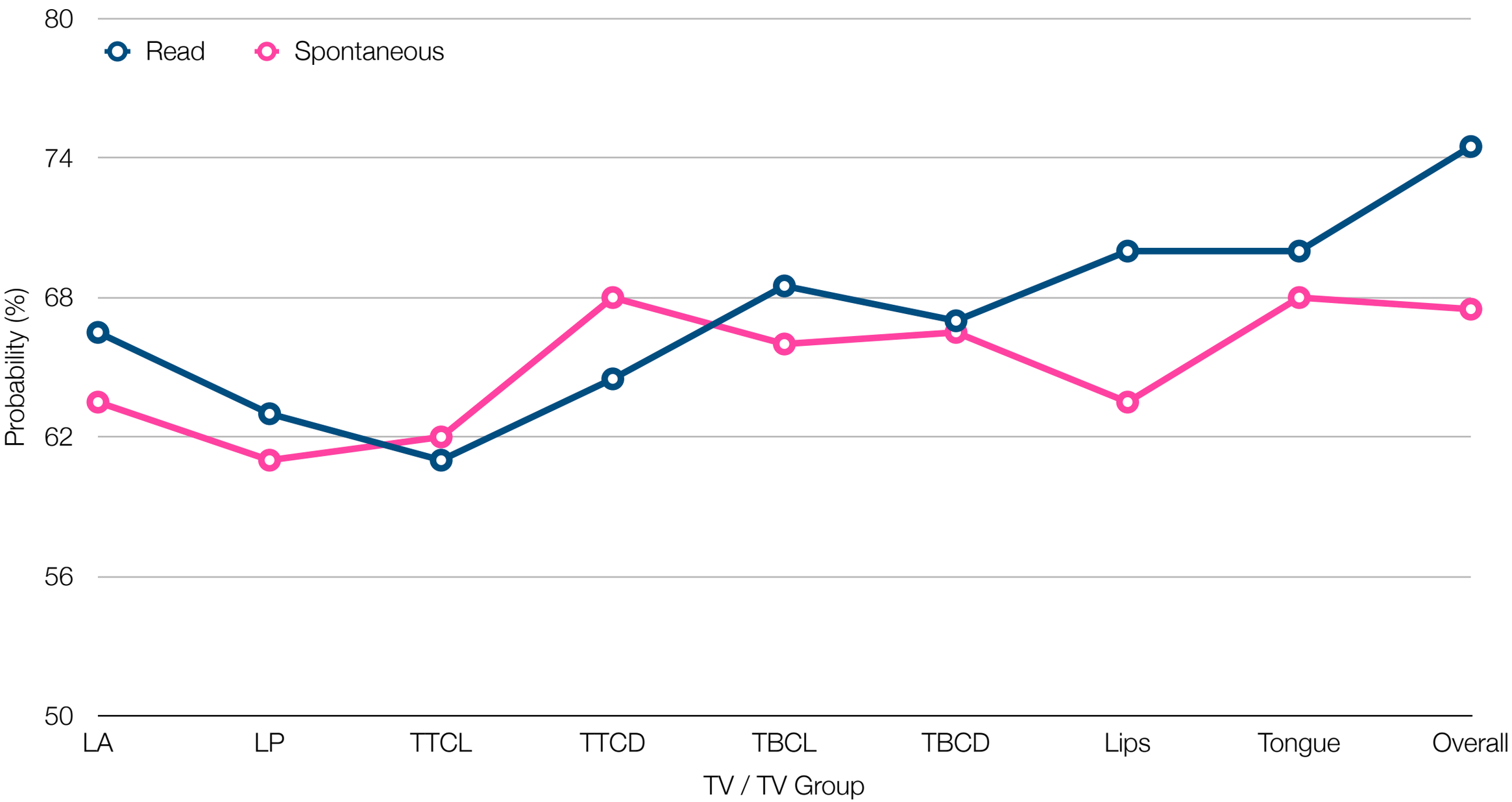
Probability of Outcome (LLE)



Social AI

University of Glasgow

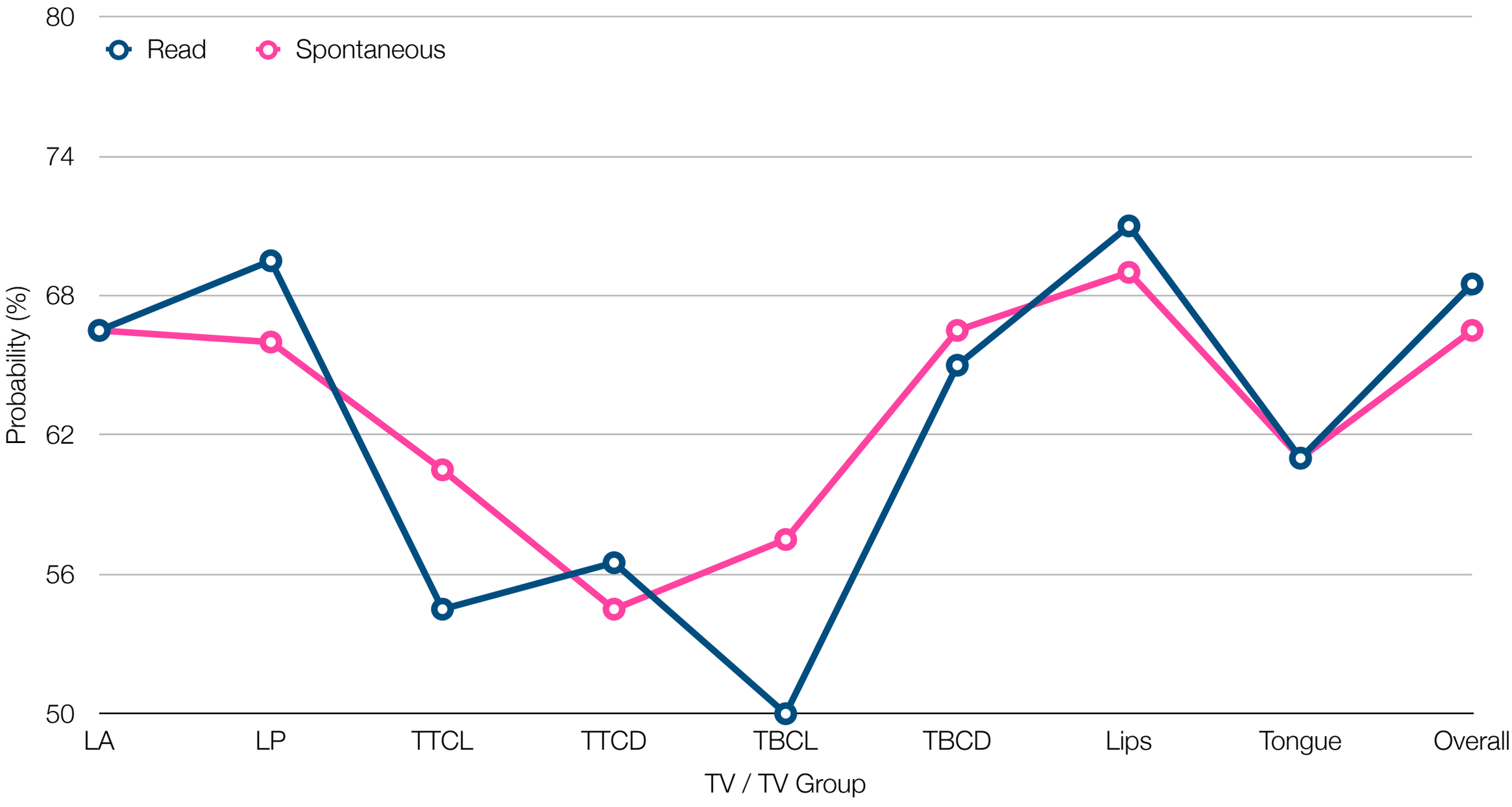
Probability of Outcome (CD)



Social AI

University of Glasgow

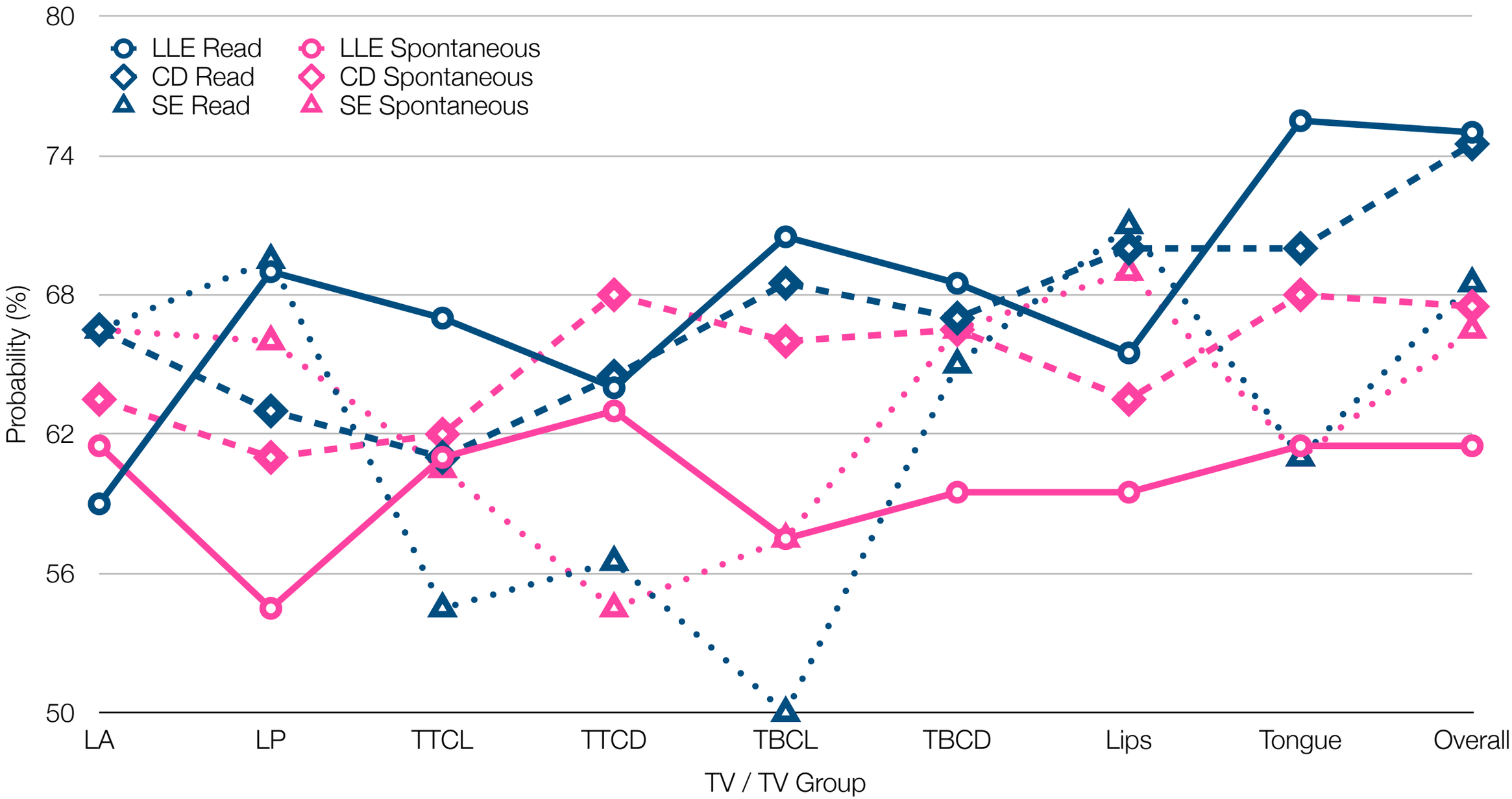
Probability of Outcome (SE)



Social AI

University of Glasgow

Probability of Comparison Outcome



Social AI

University of Glasgow

Key-Findings

- Overall, bio-markers appear to work better on read speech than on spontaneous speech;
- One possible explanation is that read speech eliminates the variance due to the content (e.g., differences in tone, rhythm, emotions, etc.);
- Another explanation is that reading does not involve the cognitive efforts required to plan what to say next it is only about producing speech;
- The bio-markers capture the population aspects of depression, spontaneous speech is more likely to capture individual dimensions.

Social AI

University of Glasgow

Outline

- A Probabilistic interpretation
- Biomarkers Revisited
- Conclusions

Conclusions

- LLE, CD and SE can be used as depression biomarkers, that is, they can be used to discriminate between depressed and non-depressed speakers;
- The Cliff's δ, originally designed to estimate the size effect, provides a probabilistic indication of how effective the bio-markers can be;
- Read speech provides indications at the population level (what all depressed speakers have in common), while spontaneous speech conveys information about individuals (crucial for therapy);
- The complementarity above is an ideal ground for interdisciplinary collaboration.

Social AI

University of Glasgow

Thank You!

Social AI

University of Glasgow