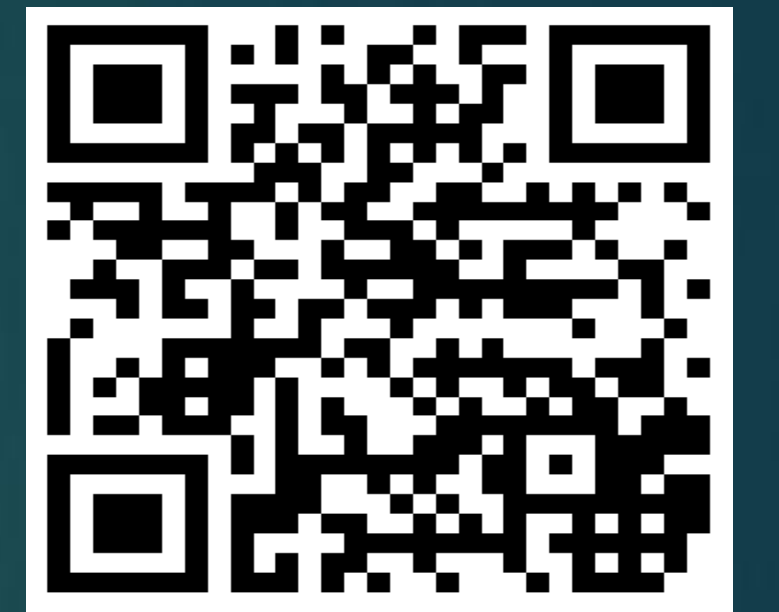


Harnessing Cognitive Features for Sarcasm Detection

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<http://www.cfilt.iitb.ac.in/cognitive-nlp>

Overview

- **Background:** Detecting textual sarcasm is a difficult task and traditional NLP techniques have limited capabilities (Joshi et al. 2016).
Example: "This is the kind of movie you watch because the theater has air conditioning."
- **Objective:** We aim to bolster traditional "feature based" sarcasm detectors by **augmenting** textual features with **cognitive features** derived from the **eye-movement patterns** of readers reading sarcastic text.
- **Results:** Augmented feature-set helps achieve significantly improved results (with a maximum of 3.7% improvement) across multiple sarcasm classifiers. Our feature significance analysis also reveals that, cognitive features are indeed helpful for sarcasm detection.

Hypothesis, Method & Observations

Hypothesis:

- Sarcasm is often traced to *incongruity*-
I will always cherish the original misconception I had of you
- Textual incongruity, if not expected beforehand, elicits distinctive eye movement patterns while reading, compared to literal texts.
- Extracting features from the eye movement patterns may, thus, be useful to tackle incongruity better than traditional textual features.

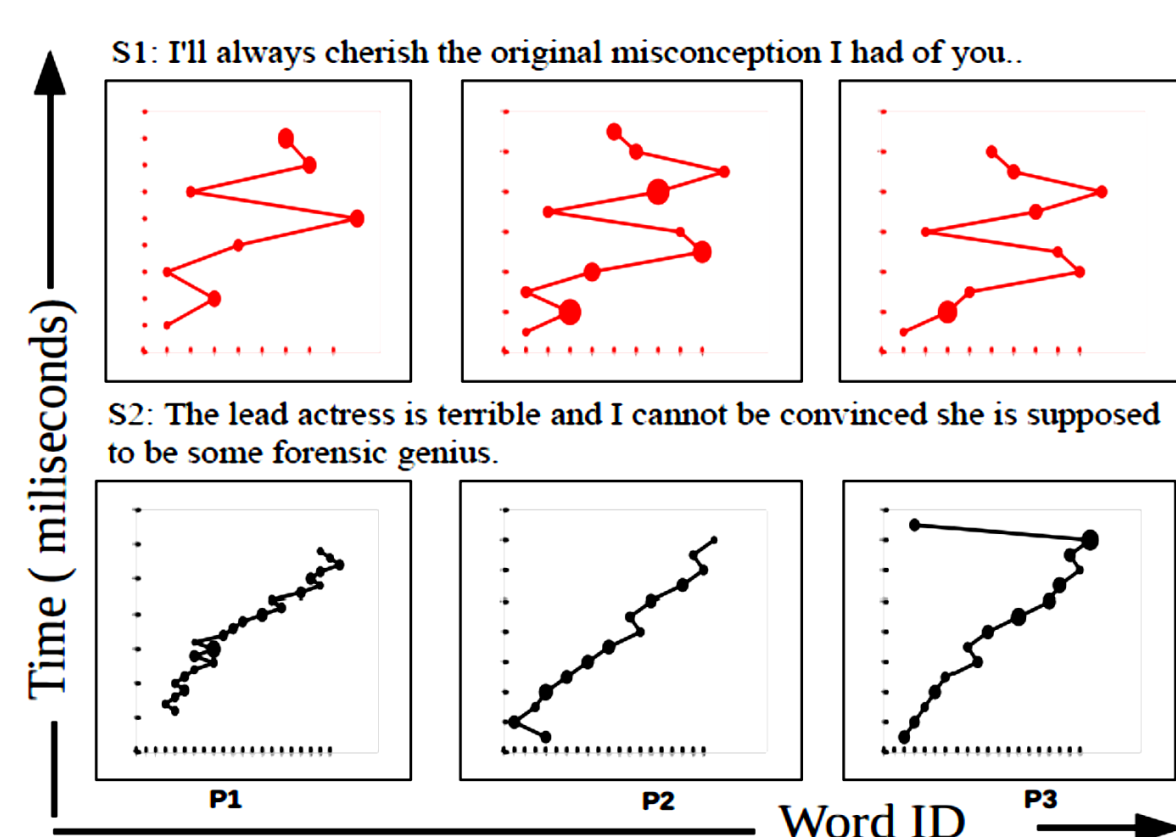
Method:

- A dataset consisting of **994** snippets (**350** sarcastic and **644** non sarcastic) of movie reviews, tweets and sarcastic quotes are collected and read by **7** participants.
- Eye movement data is recorded in terms of scanpaths (comprising *fixations* and *saccades*).



Observations:

- Fixations Duration is significantly higher on sarcastic texts than non-sarcastic ones ($p < 0.01$) and more regressive saccades are observed between the incongruous phrases.

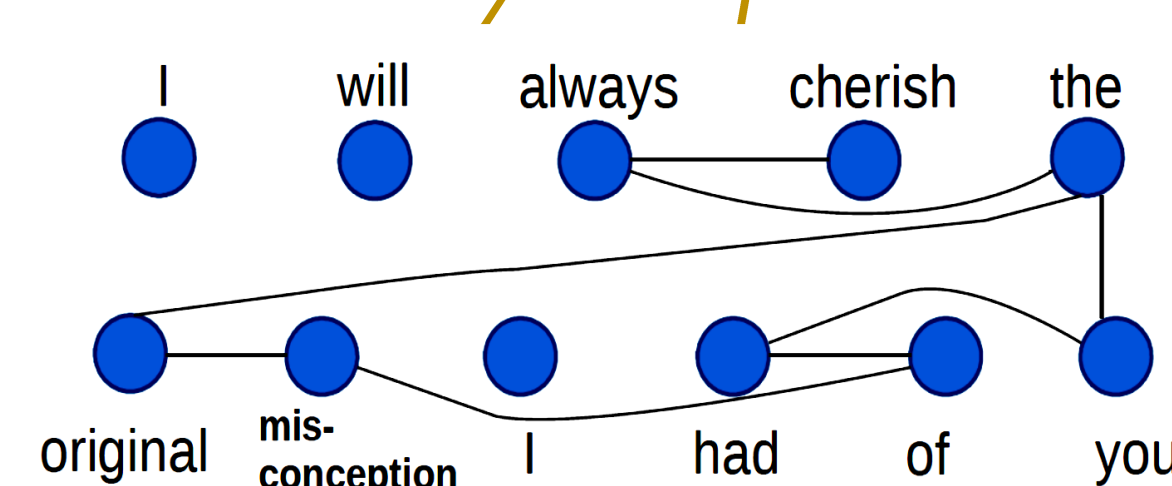


Cognitive Features for Sarcasm

Cognitive features:

- **Simple Gaze based Features:** Computed directly from the eye-movement data through statistical aggregation.
 - (1) Average Fixation Duration, (2) Average Fixation Count, (3) Average Saccade Length, (4) Regression Count, (5) Number of words skipped, (6) Regressions from second half to first half, (7) Position of the word from which the largest regression starts

- **Complex Gaze based Features:** Computed from the "Gaze Saliency Graph".



- (1) Edge density,
- (2) Highest weighted degree,
- (3) Second Highest weighted degree

We derive multiple edge weights using fixation duration, saccade counts, and saccade distance at a node.

Textual Features: Used in reading (psycholinguistics) and computational sarcasm literature.

- (1) Unigrams (2) Punctuations (3) Implicit incongruity (4) Explicit Incongruity (5) Largest +ve/-ve subsequences (6) +ve/-ve word count (7) Lexical Polarity (8) Flesch Readability Ease, (9) Word count

Experiment & Results

- 10-Fold cross validation with three single instance (NB, SVM, MLP) and one multi instance (MI-Logistic Regression) classifiers.
- Feature combinations tried: (1) Only Unigrams (**Uni**), (2) Textual (**Sar**), Textual+ Cognitive (**All**)
- Compared with Joshi et al., 2015 and Riloff et al., 2013.

	NB	MLP	SVM	MI
Uni	59.5	66.8	69.6	-
Sar	60.5	69.9	72	-
Gaze	71.9	71.8	72.2	73.1
All	61.2	70.9	74	75.7

Riloff
47.0
Joshi
64.2

Discussion & Conclusion

Analysis of results:

- Difference in F-scores between our systems (with gaze features) and traditional systems are statistically significant. ($p < 0.02$)
- Improvement of gain in F-scores with cognitive features over is consistent across different training data size.
- Feature significance analysis thorough *Chi-squared* and *Info-gain* tests reveal that **16** out of top **20** most powerful predictors of sarcasm are **gaze features**.

Conclusion:

- First of its kind to augment cognitive features with textual features for any text classification task.
- Availability of inexpensive eye-tracking machinery makes our work feasible and practicable (e.g., <http://www.sencogi.com>).

References:

- Aditya Joshi, Pushpak Bhattacharyya, and Mark James Carman. 2016. Automatic sarcasm detection: A survey. CoRR, abs/1602.03426.
- Aditya Joshi, Vinita Sharma, and Pushpak Bhattacharyya. 2015. Harnessing context incongruity for sarcasm detection. ACL 2015. Beijing.
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