Semantic Role Labeling of Emotions in Tweets

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Clouds of tweet words @MittRomney and @BarackObama (Oct 23 - Nov 7)
Early Project Specifications

- Emotion analysis of tweets
  - Who is feeling?
  - What emotion?
  - Towards whom?
  - And why?

- Domain
  - Tweets about the US 2012 presidential elections
Challenges

- Many more kinds of emotions than sentiment
- Not explicitly stated
  - Need world knowledge and context
- No tone, pitch, or other prosodic information
- Text may have sarcasm, exaggeration, etc
Applications of Emotion Detection in Electoral Tweets

- Nowcasting and forecasting
- Identifying key electoral issues
- Understanding the role of target entities (politicians, press, NGOs, voters)
- Impact of fake tweets (twitterbots, botnets, and sock-puppets)
- Measuring the impact of activist movements through text generated in social media
- Detecting how people use emotion-bearing-words and metaphors to persuade and coerce others
DATA ANNOTATION

- Data collection
- Crowdsourcing
- Questionnaires
- Annotation analyses
Collecting Election Tweets

- Polled the Twitter API for certain hashtags
  - August—September 2012

<table>
<thead>
<tr>
<th></th>
<th>tweet</th>
<th>tweet</th>
<th>tweet</th>
</tr>
</thead>
<tbody>
<tr>
<td>#4moreyears</td>
<td>#Barack</td>
<td>#campaign2012</td>
<td></td>
</tr>
<tr>
<td>#dems2012</td>
<td>#democrats</td>
<td>#election</td>
<td></td>
</tr>
<tr>
<td>#election2012</td>
<td>#gop2012</td>
<td>#gop</td>
<td></td>
</tr>
<tr>
<td>#joebiden2012</td>
<td>#mitt2012</td>
<td>#Obama</td>
<td></td>
</tr>
<tr>
<td>#ObamaBiden2012</td>
<td>#PaulRyan2012</td>
<td>#president</td>
<td></td>
</tr>
<tr>
<td>#president2012</td>
<td>#Romney</td>
<td>#republicans</td>
<td></td>
</tr>
<tr>
<td>#RomneyRyan2012</td>
<td>#veep2012</td>
<td>#VP2012</td>
<td></td>
</tr>
<tr>
<td>Barack</td>
<td>Obama</td>
<td>Romney</td>
<td></td>
</tr>
</tbody>
</table>

- Number of tweets: about one million
  - most frequent: #election2012, #campaign, #gop, #president
- Removed: non-English tweets, badly spelled tweets, retweets
Two Phases of Annotation

- Questionnaire I: 3 annotations per tweet
  - Identifies tweets with emotion
  - Determine style and purpose of tweet
  - Determines if tweet is relevant to 2012 US elections

- Questionnaire II: 5 annotations per tweet
  - Detects the experiencer, emotional state, stimulus
  - Identifies the relevant electoral issue

Annotated about 2000 tweets.
Tweeter: Mitt Romney is arrogant as hell. He has racism written all over his face.

Q1. Which of the following best describes the Emotions in this tweet? (required)

- This tweet has no emotional content.
- There is some emotion here, but the tweet does not give enough context to determine which emotion it is.
- This tweet expresses or suggests an emotional attitude or response to something.
- This tweet expresses or suggests two or more contrasting emotional attitudes or responses. (For example, the tweeter likes X but dislikes Y and Z.)
- It is not possible to decide which of the above options is appropriate because of reasons such as: the tweet does not give enough information, one needs additional context to understand the emotion, and the tweet does not make sense because of weird spellings.
Tweeter: Mitt Romney is arrogant as hell. He has racism written all over his face.

Q1. Which of the following best describes the Emotions in this tweet? (required)

- This tweet has no emotional content.
- There is some emotion here, but the tweet does not give enough context to determine which emotion it is.
- This tweet expresses or suggests an emotional attitude or response to something. 87.98%
- This tweet expresses or suggests two or more contrasting emotional attitudes or responses. (For example, the tweeter likes X but dislikes Y and Z.)
- It is not possible to decide which of the above options is appropriate because of reasons such as: the tweet does not give enough information, one needs additional context to understand the emotion, and the tweet does not make sense because of weird spellings.
Questionnaire 1

Tweeter: Mitt Romney is arrogant as hell. He has racism written all over his face.

Q1. Which of the following best describes the Emotions in this tweet? (required)
- This tweet has no emotional content. 8.21%
- There is some emotion here, but the tweet does not give enough context to determine which emotion it is. 87.98%
- This tweet expresses or suggests an emotional attitude or response to something.
- This tweet expresses or suggests two or more contrasting emotional attitudes or responses. (For example, the tweeter likes X but dislikes Y and Z.)
- It is not possible to decide which of the above options is appropriate because of reasons such as: the tweet does not give enough information, one needs additional context to understand the emotion, and the tweet does not make sense because of weird spellings.
Questionnaire I

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- This tweet has no emotional content. **8.21%**
- There is some emotion here, but the tweet does not give enough context to determine which emotion it is. **87.98%**
- This tweet expresses or suggests an emotional attitude or response to something. **87.98%**
- This tweet expresses or suggests two or more contrasting emotional attitudes or responses. (For example, the tweeter likes X but dislikes Y and Z.) **2.22%**
- It is not possible to decide which of the above options is appropriate because of reasons such as: the tweet does not give enough information, one needs additional context to understand the emotion, and the tweet does not make sense because of weird spellings.
Tweeter: Mitt Romney is arrogant as hell. He has racism written all over his face.

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- This tweet has no emotional content.
- There is some emotion here, but the tweet does not give enough context to determine which emotion it is.
- This tweet expresses or suggests an emotional attitude or response to something. 87.98%
- This tweet expresses or suggests two or more contrasting emotional attitudes or responses. (For example, the tweeter likes X but dislikes Y and Z.)
- It is not possible to decide which of the above options is appropriate because of reasons such as: the tweet does not give enough information, one needs additional context to understand the emotion, and the tweet does not make sense because of weird spellings.

These tweets sent to questionnaire II.
Questionnaire I

Tweeter: Mitt Romney is arrogant as hell. He has racism written all over his face.

Q2. Which of the following best describes the Style of this tweet? (required)

- simple statement or question
- exaggeration or hyperbole
- sarcasm
- rhetorical question
- understatement
- weird, surreal, or off-the-wall
- humorous, but none of the above
- none of the above

Examples of the different kinds are listed in the instructions at the top of the page.
Tweeter: Mitt Romney is arrogant as hell. He has racism written all over his face.

Q2. Which of the following best describes the Style of this tweet? (required)

- simple statement or question 76.87%
- exaggeration or hyperbole
- sarcasm
- rhetorical question
- understatement
- weird, surreal, or off-the-wall
- humorous, but none of the above
- none of the above

Examples of the different kinds are listed in the instructions at the top of the page.
Questionnaire 1

Tweeter: Mitt Romney is arrogant as hell. He has racism written all over his face.

Q2. Which of the following best describes the Style of this tweet? (required)

- simple statement or question 76.87%
- exaggeration or hyperbole 9.75%
- sarcasm
- rhetorical question
- understatement
- weird, surreal, or off-the-wall
- humorous, but none of the above
- none of the above

Examples of the different kinds are listed in the instructions at the top of the page.
Tweeter:  Mitt Romney is arrogant as hell. He has racism written all over his face.

Q2. Which of the following best describes the Style of this tweet? (required)

- simple statement or question 76.87%
- exaggeration or hyperbole 9.75%
- sarcasm 7.39%
- rhetorical question
- understatement
- weird, surreal, or off-the-wall
- humorous, but none of the above
- none of the above

Examples of the different kinds are listed in the instructions at the top of the page.
Tweeter: Mitt Romney is arrogant as hell. He has racism written all over his face.

Q2. Which of the following best describes the Style of this tweet? (required)

- simple statement or question 76.87%
- exaggeration or hyperbole 9.75%
- sarcasm 7.39%
- rhetorical question 3.19%
- understatement
- weird, surreal, or off-the-wall
- humorous, but none of the above
- none of the above

Examples of the different kinds are listed in the instructions at the top of the page.
Tweeter: Watching @MichelleObama's DNC speech at a McDonald's in Ibiza (free wifi). Absolutely moved me to tears. #4moreyears #my #first #lady

Q1. Which of the following best describes the Emotions in this tweet? (required)

- This tweet has no emotional content.
- There is some emotion here, but the tweet does not give enough context to determine which emotion it is.
- This tweet expresses or suggests an emotional attitude or response to something.
- This tweet expresses or suggests two or more contrasting emotional attitudes or responses. (For example, the tweeter likes X but dislikes Y and Z.)
- It is not possible to decide which of the above options is appropriate because of reasons such as: the tweet does not give enough information, one needs additional context to understand the emotion, and the tweet does not make sense because of weird spellings.

Q2. Which of the following best describes the Style of this tweet? (required)

- simple statement or question
- exaggeration or hyperbole
- sarcasm
- rhetorical question
- understatement
- weird, surreal, or off-the-wall
- humorous, but none of the above
- none of the above

Word that describes style if not one of the above:

Q3. Which of the following best describes the Purpose of this tweet? (required)

- to point out hypocrisy or inconsistency
- to point out mistake or blunder
- to disagree
- to ridicule
- to criticize, but none of the above
- to vent
- oppose: 58.07%

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- to agree
- to praise, admire, or appreciate
- to support
- other: 10.17%

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- to motivate or to incite action
- to be entertaining
- to provide information without any emotional content
- favor: 31.76%

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- none of the above

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Questionnaire I

Tweeter: Mitt Romney is arrogant as hell. He has racism written all over his face.

Q4. Is this tweet about US politics and elections? (required)

☐ Yes, this tweet is about US politics and elections.
☐ No. This tweet has nothing to do with US politics or anybody involved in it.
Tweeter: Mitt Romney is arrogant as hell. He has racism written all over his face.

Q4. Is this tweet about US politics and elections? (required)

☐ Yes, this tweet is about US politics and elections. 95.56%

☐ No. This tweet has nothing to do with US politics or anybody involved in it.
Questionnaire I

Tweeter: Mitt Romney is arrogant as hell. He has racism written all over his face.

Q4. Is this tweet about US politics and elections? (required)

- Yes, this tweet is about US politics and elections. 95.56%
- No. This tweet has nothing to do with US politics or anybody involved in it.

These tweets sent to questionnaire II.
Tweeter: Mitt Romney is arrogant as hell. He has racism written all over his face.

Q1. Who is feeling (or who felt) an emotion? In other words, who is the source of the emotion? (required)

If the person who has posted the tweet is the source, then type: tweeter. Otherwise, copy and paste your response from the tweet. If your response is made of words or phrases that are not adjacent to each other (that is, you have to copy and paste more than once), then separate these words and phrases with a semicolon.
Questionnaire II

Tweeter: Mitt Romney is arrogant as hell. He has racism written all over his face.

Q1. Who is feeling (or who felt) an emotion? In other words, who is the source of the emotion? (required)

Tweeter

If the person who has posted the tweet is the source, then type: tweeter. Otherwise, copy and paste your response from the tweet. If your response is made of words or phrases that are not adjacent to each other (that is, you have to copy and paste more than once), then separate these words and phrases with a semicolon.
Q2. What emotion? Choose one of the options from below that best represents the emotion. (required)

**Positive Emotions**
- acceptance
- admiration
- calmness or serenity
- joy or happiness or elation
- like
- trust

**Negative Emotions**
- anger or annoyance or hostility or fury
- disappointment
- dislike
- disgust
- fear or apprehension or panic or terror
- hate
- indifference
- sadness or gloominess or grief or sorrow

**Other Emotions**
- amazement
- anticipation or expectancy or interest
- surprise
- uncertainty or indecision or confusion
Q2. What emotion? Choose one of the options from below that best represents the emotion. (required)

Positive Emotions
- acceptance
- admiration 10.5%
- calmness or serenity
- joy or happiness or elation  8.8%
- like
- trust

Negative Emotions
- anger or annoyance or hostility or fury
- disappointment
- dislike 23.5%
- disgust
- fear or apprehension or panic or terror
- hate
- indifference
- sadness or gloominess or grief or sorrow

Other Emotions
- amazement
- anticipation or expectancy or interest 10.6%
- surprise
- uncertainty or indecision or confusion
Q6. Towards whom or what? In other words, who or what is the target of the emotion? (required)

If the person who has posted the tweet is the target, then type: tweeter. If the target is not specified, then type: not specified. Otherwise, copy and paste your response from the tweet. If your response is made of words or phrases that are not adjacent to each other (that is, you have to copy and paste more than once), then separate these words and phrases with a semicolon.
Q6. Towards whom or what? In other words, who or what is the target of the emotion? *(required)*

If the person who has posted the tweet is the target, then type: tweeter. If the target is not specified, then type: not specified. Otherwise, copy and paste your response from the tweet. If your response is made of words or phrases that are not adjacent to each other (that is, you have to copy and paste more than once), then separate these words and phrases with a semicolon.

Q6b. Which of these best describes the target of the emotion? *(required)*

- Barack Obama and/or Joe Biden
- Mitt Romney and/or Paul Ryan
- Some other individual
- Democratic party, democrats, or DNC
- Republican party, republicans, or RNC
- Some other institution
- Election campaign, election process, or elections
- The target is not specified in the tweet
- None of the above
Q6. Towards whom or what? In other words, who or what is the target of the emotion? *(required)*

If the person who has posted the tweet is the target, then type: tweeter. If the target is not specified, then type: not specified. Otherwise, copy and paste your response from the tweet. If your response is made of words or phrases that are not adjacent to each other (that is, you have to copy and paste more than once), then separate these words and phrases with a semicolon.

Q6b. Which of these best describes the target of the emotion? *(required)*

- Barack Obama and/or Joe Biden 29.90%
- Mitt Romney and/or Paul Ryan 24.87%
- Some other individual
- Democratic party, democrats, or DNC 2.46%
- Republican party, republicans, or RNC 8.42%
- Some other institution
- Election campaign, election process, or elections
- The target is not specified in the tweet
- None of the above
Q8. What reason can be deduced from the tweet for the emotion? What is the cause of the emotion? (required)

If the reason is not specified, then type: not specified. Otherwise, copy and paste your response from the tweet. If your response is made of words or phrases that are not adjacent to each other (that is, you have to copy and paste more than once), then separate these words and phrases with a semicolon.

Please do not copy the whole tweet; copy the relevant portion only.

Tweeter: Neil Armstrong killed in his sleep by Mitt Romney #NeilArmstrong #Romney

Q9. This tweet is about which of the following issues: (required)

ECONOMY
- federal debt
- jobs
- housing
- taxes
- military spending
- About the Economy: but not related to any of the above issues

CONFLICTS AND TERRORISM
- Terrorism
- Afghanistan or Iraq war
- Arab Spring, Egypt, Syria, or Libya
- Iran, Israel, or Palestine
- About Conflicts and Terrorism: but not related to any of the above issues

SOCIAL AND CIVIL ISSUES
- education
- environment
- gay rights
- gun control/rights
- health care
- racism
- religion
- women's rights
- About Social and Civil Issues: but not related to any of the above issues

OTHER
- About the election process, election publicity, or election campaign
- None of the above
Q9. This tweet is about which of the following issues: (required)

ECONOMY
☐ federal debt
☐ jobs
☐ housing
☐ taxes
☐ military spending
☐ About the Economy: but not related to any of the above issues

CONFLICTS AND TERRORISM
☐ Terrorism
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☐ Arab Spring, Egypt, Syria, or Libya
☐ Iran, Israel, or Palestine
☐ About Conflicts and Terrorism: but not related to any of the above issues

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☐ education
☐ environment
☐ gay rights
☐ gun control/rights
☐ health care
☐ racism
☐ religion
☐ women's rights
☐ About Social and Civil Issues: but not related to any of the above issues

OTHER
☐ About the election process, election publicity, or election campaign
☐ None of the above
Other Questions

- How intense is the emotion?
- Which words help identify the emotion?
Data Made Publicly Available

Political Tweets Dataset:
http://www.purl.org/net/PoliticalTweets2012
DETECTING EXPERIENCER, STATE, STIMULUS

- Problem
- Approach
- Results
- Summary
Problem

Input:
Matt tweeted:
I am very happy that #4moreyears came into reality.

Task: find key emotion-oriented information—who feels what towards whom?

Exemplary output:

<table>
<thead>
<tr>
<th>Semantic role</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who (experiencer)</td>
<td>tweeter (Matt)</td>
</tr>
<tr>
<td>Feels what (state)</td>
<td>joy</td>
</tr>
<tr>
<td>Towards whom (stimulus)</td>
<td>Barack Obama</td>
</tr>
</tbody>
</table>
Problem

- FrameNet (Baker et al., 1998): A resource defining and annotating the semantic roles of words in a sentence.
  
  The girl on the swing whispered to the boy beside her.
  
  agent       pred       recipient

- ~1,200 semantic frames defined.
Problem

- FrameNet (Baker et al., 1998): A resource defining and annotating the semantic roles of words in a sentence.
  
  The girl on the swing whispered to the boy beside her.

  
  agent pred recipient

- ~1,200 semantic frames defined.

The emotion frame:

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core:</td>
<td></td>
</tr>
<tr>
<td>Event</td>
<td>Occasion or happening that Experiencers in a certain emotional state participate in.</td>
</tr>
<tr>
<td>Experiencer</td>
<td>Person or sentient entity that experiences or feels the emotions.</td>
</tr>
<tr>
<td>Expressor</td>
<td>Body part, gesture, or expression of the Experiencer that reflects the emotional state.</td>
</tr>
<tr>
<td>State</td>
<td>A lasting (emotion) experience of the Experiencer.</td>
</tr>
<tr>
<td>Stimulus</td>
<td>Person, event, or state of affairs that evokes the emotional response in the Experiencer.</td>
</tr>
<tr>
<td>Topic</td>
<td>General area in which the emotion occurs. It indicates a range of possible Stimulus.</td>
</tr>
<tr>
<td>Non-Core:</td>
<td></td>
</tr>
<tr>
<td>Circumstances</td>
<td>Condition(s) under which the Stimulus evokes its response.</td>
</tr>
<tr>
<td>Degree</td>
<td>Extent to which the Experiencer’s emotion deviates from the norm for the emotion.</td>
</tr>
<tr>
<td>Empathy_target</td>
<td>Individual or individuals with which the Experiencer identifies emotionally.</td>
</tr>
<tr>
<td>Manner</td>
<td>Description of the way in which the Experiencer experiences the Stimulus.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Domain in which the Experiencer experiences the Stimulus.</td>
</tr>
<tr>
<td>Reason</td>
<td>Explanation for why the Stimulus evokes a certain emotional response.</td>
</tr>
</tbody>
</table>
Problem

I am very happy that #4moreyears have come into reality.

experiencer state stimulus

• Instead of labeling the original text spans, we directly classify the semantic roles to the pre-defined categories that users may be interested in.

Happy ➔ joy

#4moreyear, #obama, Barack H. Obama ➔ Barack Obama

• Normalized state and stimulus are often what’s ultimately needed.
• Emotions are often not explicitly expressed.
• Tweet texts are noisy: a labeling task would be very challenging here (e.g. syntactic parsing is less reliable).
Detecting experiencer, state, stimulus

- Detecting *experiencers* is super easy: most experiencers (99.83%) are the tweeters themselves
  - This is actually a good property---many applications need to collect the tweeters’ feeling.

- Below, we focus on detecting *state* and *stimulus*. 
Approach

- A multi-task classification problem: classifying tweets by emotion *state* and *stimulus*.
  - Unfortunately, the two classifiers do not benefit from each other—using the gold labels of one subtask does not help classify the other.
  - We hence simply treat them as two independent subtasks.
Classifying Emotion State & Stimulus

- Classifier: LibSVM (Chang and Lin 2011), RBF kernel
- 10-fold cross validation

Features:

<table>
<thead>
<tr>
<th>Examples</th>
<th>State</th>
<th>Stimulus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Word n-gram</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“F-word good”</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Emoticon</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>:-) D:&lt; :@ :-</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Punctuation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>?! !!!</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Character</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dis-, soooo</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Hashtag</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#BiggestDayOfTheYear</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Lexical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRC-emo, Osgood, autoLex</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Negation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can’t cant n’t</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Position</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beginning of a sentence?</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Combined</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>position/lexical features</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Results of Classifying State

<table>
<thead>
<tr>
<th></th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random baseline</td>
<td>30.26</td>
</tr>
<tr>
<td>Majority baseline</td>
<td>47.75</td>
</tr>
<tr>
<td>Automatic system</td>
<td>56.84</td>
</tr>
<tr>
<td>Upper bound</td>
<td>69.80</td>
</tr>
</tbody>
</table>

Our current system achieves a 56.84% F-score, which is significantly better than those of the two baselines.
Results of Classifying Stimulus

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>R</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>random baseline</td>
<td>16.45</td>
<td>20.87</td>
<td>18.39</td>
</tr>
<tr>
<td>majority baseline</td>
<td>34.45</td>
<td>38.00</td>
<td>36.14</td>
</tr>
<tr>
<td>rule-based system</td>
<td>43.47</td>
<td>55.15</td>
<td>48.62</td>
</tr>
<tr>
<td>SVM system</td>
<td>57.30</td>
<td>59.32</td>
<td>58.30</td>
</tr>
<tr>
<td>upper bound</td>
<td>82.87</td>
<td>81.36</td>
<td>82.11</td>
</tr>
</tbody>
</table>

The performance of *stimulus* classification is similar to that of the *state* subtask: our best system achieves a 58.30% F-score, which is significantly better than those of the baselines.
Summary

- Compiled a large collection of electoral tweets
- Annotated them for style, purpose, and emotion by crowdsourcing
  - Disgust was the dominant emotion
  - Mostly conveyed emotions of the tweeter
- Developed SVM classifiers to detect emotional state, stimulus, and purpose
- Showed that the same emotion can be associated with different types of purpose

Thanks!