

Role of Emoticons for Multidimensional Sentiment Analysis of Twitter

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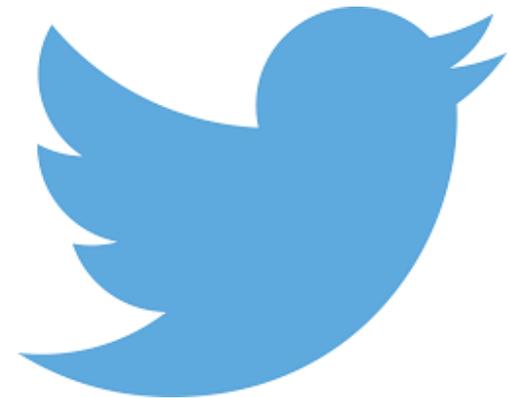
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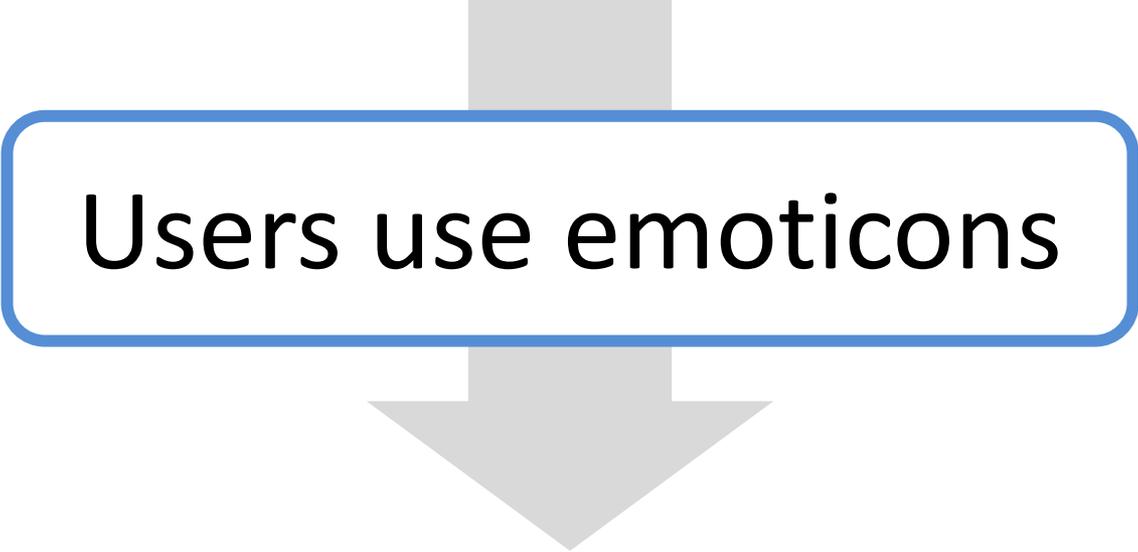
Background 1

- Nowadays, many people all over the world use Twitter on the Internet.
- People can easily post their sentiments to the Internet in real time using such microblogging systems.



Background 2

Twitter is a text-based communication tool.
Cannot accommodate non-verbal communication such as gestures and eye contact.



Users use emoticons

Users sometimes use emoticons to tweet delicate sentiments as an alternative to non-verbal communication tools.

Background 3

Today was happy  Today was happy :)

Right tweet is apparently happier than Left.

I'm angry  I'm angry :)

Right tweet is not angrier than Left.

The emoticons alter sentiment of the tweets by enhancing or softening their original sentiment.

Propose

We proposed the method which analyzes the sentiment of a tweet based on the sentiment of a sentence and the role of an emoticon.

Today was happy :))

Sentence + Emoticon

How to determine the role of emoticon

- 1 Calculating sentiment values of the sentence tweet.**
→ Using the sentiment lexicon.
- 2 Determining sentiment of the emoticon.**
→ Using the Emoticon lexicon.
- 3 Identifying the emoticon role based on results of (1) and (2).**

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Example of Sentiment Lexicon

Sentiment	Entry word	Sentiment value
Joy	Fun	0.85
Liking	Miss	0.64
Relief	Relief	0.45
Sorrow	Sad	0.45
Dislike	Disagreeable	0.82
Fear	Afraid	0.45
Anger	Angry	0.87
Shame	Blush	0.72
Excitement	Thrill	0.45
Surprise	Surprised	0.71

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It consist of 10 dimensional sentiment.

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many colloquial styles are included in the data, without much slang or disorderly grammar.

We use 74,000 movie review sentences as a training data to create sentiment lexicon.

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We calculate sentiment value by using co-occurrence frequency with sentiment words.

How to determine Sentiment of a Sentence in a Tweet

We extract words from a tweet.

Then we project sentiment lexicon to the extracted word.

Baseball is great fun.

baseball

is

great

fun

Sentiment lexicon

... great ... fun ...

Example of Determining Sentiment of a Sentence in a Tweet

Baseball is great fun.

Sentiment \ word	great	fun	total
Joy	0.13	0.85	0.98
Liking	0.01	0.04	0.05
Relief	0	0	0
Sorrow	0	0	0
Dislike	0	0	0
Fear	0	0.01	0.01
Anger	0.01	0	0.01
Shame	0.38	0.32	0.7
Excitement	0.7	0.03	0.73
Surprise	0	0	0

- Two words, “great” and “funny,” are extracted from the sentence.
- Each sentiment value of the sentence is calculated by summing sentiment values of the constituent words in the corresponding sentiment dimension.

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2 **Determining sentiment of the emoticon.**
→ **Using the Emoticon lexicon.**

3 Identifying the emoticon role based on results of (1) and (2).

Difference between Japanese emoticons and English emoticons

English emoticons

- Consist of 1-byte characters
- Presented vertical

:)

Japanese emoticons

- Consist of 2-byte characters
- Presented horizontally

(^o^)

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(^o^)

How to determining sentiment of the emoticon

We determine sentiment of emoticon by using the emoticon lexicon.

Create emoticon lexicon

Today was happy (^O^)

Emoticon lexicon



How to create Emoticon Lexicon

1. Extract emoticons.

- We extracted 100 emoticons with highest frequency from all the tweets.

2. Determine the sentiment of the emoticons.

- We conducted an experiment to ascertain the sentiment of the emoticons extracted in (1).

3. Determine the sentiment of emoticon parts.

- We separated emoticons into parts and determined the sentiment value of each part.

4. Add other emoticons to the emoticon lexicon.

- We added 400 emoticons to the emoticon lexicon.

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Extract Emoticons

We extracted emoticons that had a high frequency of appearance from Twitter.

- We extracted 17,647 tweets that had emoticons from Twitter.
- We extracted 100 emoticons with highest frequency from all the tweets.

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Determine the sentiment of the emoticons

We conducted an experiment to ascertain the sentiment of the emoticons extracted in (1).

Subjects: 10 people

They use emoticons very often participated in our experiment.

Datasets: 100 emoticons

They had a high frequency of appearance from Twitter.

The subjects watch 100 emoticons, and judged their sentiment.

➔ Emoticon: (^o^)

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Determine the sentiment of emoticon parts

- We separated emoticons into parts and determined the sentiment value of each part.

(* ^ · ω · ` *)

Determine the sentiment of emoticon parts

- We separated emoticons into parts and determined the sentiment value of each part.



Eyes



Mouth



Relief

Eyebrows



Fear

Cheek



Joy

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Add other emoticons to the emoticon lexicon

Sentiment	Emoticons
Joy	(^o^)
Liking	(≥ ∇ ≤)
Relief	(•ω•)
Sorrow	(> <)
Dislike	(`•ω•')
Fear	(`Д')
Anger	(`•-•')
Shame	(//ω//)
Excitement	(≥ ∇ ≤)
Surprise	(° Д °)

- We manually determined other emoticons sentiment based on the results of (3).
- We added 400 emoticons to the emoticon lexicon.

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Role of Emoticons

We define the role of emoticons based on the relations between sentiments of the sentences and emoticons constituting tweets.

Today was happy :) :_)

Sentence + Emoticon → Role of emoticons

We conducted user experiments to investigate their relations.

User Experiment

Subjects: 100 people

From 10s to 50s; 10 men and 10 women in each age group.

Datasets: 200 tweets

100 emoticon tweet and 100 sentence tweet.

1. The subjects read 100 sentence tweets, and judged their sentiment.

➡ Tweet: **Today was happy**

1. The subjects also read 100 emoticon tweets, and judged their sentiment.

➡ Tweet: **Today was happy :)**

User Experiment 2

- We use 'positive', 'negative', 'neutral' sentiment to determine the role of emoticon.
- This was performed to avoid combinatorial explosion between the 10-dimensional sentiments.

Positive

Joy	Liking	Relief	Excitement
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Negative

Sorrow	Dislike	Shame	Fear	Surprise	Anger
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Result of Experiment

The results of the comparison showed four types of emoticon roles: “Emphasis”, “Assuagement”, “Conversion”, and “Addition”. Table 11 shows a classification of the emoticon roles.

Positive → P
 Negative → N
 Neutral → Nu

Sentence + Emoticons	#Sentiment of Tweet		
	P	N	Nu
P + P	14	0	0
P + N	12	5	3
P + Nu	0	0	0
N + P	1	19	0
N + N	1	35	0
N + Nu	0	0	0
Nu + P	3	0	1
Nu + N	0	3	1
Nu + Nu	0	0	0

Sentence + Emoticons	Sentiment of Tweet		
	P	N	Nu
P + P	Emphasis	-	-
P + N	Assuagement	Conversion	-
P + Nu	-	-	-
N + P	Conversion	Assuagement	-
N + N	-	Emphasis	-
N + Nu	-	-	-
Nu + P	Addition	-	-
Nu + N	-	Addition	-
Nu + Nu	-	-	-

Result of Experiment

Left side shows sentence sentiment

Positive → P
 Negative → N
 Neutral → Nu

Sentence + Emoticons	#Sentiment of Tweet		
	P	N	Nu
P + P	14	0	0
P + N	12	5	3
P + Nu	0	0	0
N + P	1	19	0
N + N	1	35	0
N + Nu	0	0	0
Nu + P	3	0	1
Nu + N	0	3	1
Nu + Nu	0	0	0

Sentence + Emoticons	Sentiment of Tweet		
	P	N	Nu
P + P	Emphasis	-	-
P + N	Assuagement	Conversion	-
P + Nu	-	-	-
N + P	Conversion	Assuagement	-
N + N	-	Emphasis	-
N + Nu	-	-	-
Nu + P	Addition	-	-
Nu + N	-	Addition	-
Nu + Nu	-	-	-

Result of Experiment

Right side shows emoticons sentiment

Positive → P
 Negative → N
 Neutral → Nu

Sentence + Emoticons	#Sentiment of Tweet		
	P	N	Nu
P + P	14	0	0
P + N	12	5	3
P + Nu	0	0	0
N + P	1	19	0
N + N	1	35	0
N + Nu	0	0	0
Nu + P	3	0	1
Nu + N	0	3	1
Nu + Nu	0	0	0

Sentence + Emoticons	Sentiment of Tweet		
	P	N	Nu
P + P	Emphasis	-	-
P + N	Assuagement	Conversion	-
P + Nu	-	-	-
N + P	Conversion	Assuagement	-
N + N	-	Emphasis	-
N + Nu	-	-	-
Nu + P	Addition	-	-
Nu + N	-	Addition	-
Nu + Nu	-	-	-

Result of Experiment

This sentence is positive and emoticon is also positive. In this case all subjects judged sentiment of tweet positive.

⇒ We assume role of 'Emphasis'.

Sentence + Emoticons	#Sentiment of Tweet		
	P	N	Nu
P + P	14	0	0
P + N	12	5	3
P + Nu	0	0	0
N + P	1	19	0
N + N	1	35	0
N + Nu	0	0	0
Nu + P	3	0	1
Nu + N	0	3	1
Nu + Nu	0	0	0

Sentence + Emoticons	Sentiment of Tweet		
	P	N	Nu
P + P	Emphasis	-	-
P + N	Assuagement	Conversion	-
P + Nu	-	-	-
N + P	Conversion	Assuagement	-
N + N	-	Emphasis	-
N + Nu	-	-	-
Nu + P	Addition	-	-
Nu + N	-	Addition	-
Nu + Nu	-	-	-

Role of Emoticons

Emphasis

Emoticons enhance the sentence sentiment in a tweet.

Tweet: I did it! \('▽`)/

Assuagement

Emoticons assuage the sentence sentiment in a tweet.

Tweet: I'm fed up with this (^O^)

Conversion

Emoticons change the sentence sentiment in a tweet.

Tweet: I have a lot of cares ('▽`)

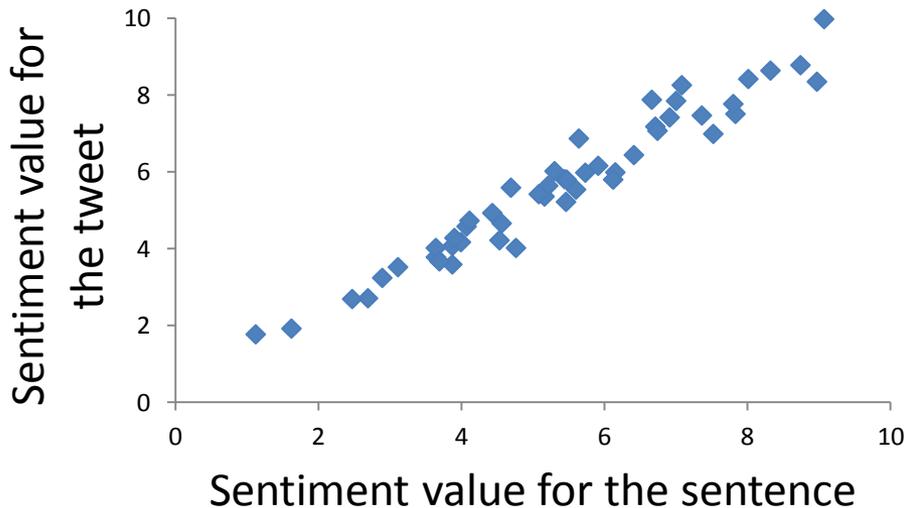
Addition

Emoticons add sentiment to a neutral sentiment sentence.

Tweet: I'm in school (^O^)

Scatter diagram in a case of Emphasis

This figure shows a scatter diagram exhibiting the relation of the sentiment values between the emoticon tweets and the sentence tweets in the role of “Emphasis”.



- A strong positive correlation is apparent between the data series in this figure.
- It is possible to formalize the relation of sentiment values between emoticon tweets and sentence tweets in all roles using regression analysis.

Regression equations based on emoticon

Role	Coefficient of correlation	Regression equations
Emphasis	0.95	$y=0.9886x+0.3215$
Assuagement	0.91	$y=0.8728x+0.3083$
Conversion	0.95	$y=-0.8002x+0.001$

This table shows results of the simple linear regression analysis. The results are all good.

Calculating sentiment values of the emoticon tweet using a regression expression corresponding to the emoticon role.

Experiment

1. We divided 100 arbitrary tweets into five, which were obtained from the data sets used in the user experiments.
2. We applied simple linear regression analysis to data consisting arbitrary four of the five datasets in each.
3. We calculated sentiment values of all tweets in the remaining dataset in each role of “Emphasis,” “Assuagement,” and “Conversion” using the regression expressions obtained in (2).
4. We calculated RMSEs between the calculated sentiment values and the averages of the sentiment values manually scored in the user experiment in the remaining dataset.

Results and Discussion

	Emphasis	Conversion	Assuagement	Addition
Propose method	0.28	0.96	0.38	0.50
Baseline method	0.44	0.97	0.59	0.63

- Results of the averages of the five RMSEs in each role for our proposed method and a baseline method.
- Baseline method were calculated as differences between the sentiment values of emoticon tweets and those of sentence tweets in the remaining dataset.

Results show that our proposed method is effective for calculating sentiments of tweets with emoticons.

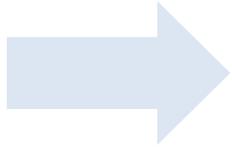
Conclusion and Future work

- Conclusion
 - Our proposed method determines the sentiment of a tweet based on the sentiment of a sentence in the tweet and the role of an emoticon following the sentence.
 - We proposed four types of emoticons
 - Emphasis
 - Assuagement
 - Conversion
 - Addition
- Future work
 - We will also study personalized mining of the tweet sentiment.

How to create our Sentiment Lexicon

Data for building a Sentiment Lexicon

- **Sentiment dimension**



Nakamura's 10-dimensional sentiment

Joy	Liking	Relief	Sorrow	Dislike
Fear	Anger	Shame	Excitement	Surprise

- **Documents which have numerous words**



sentences of movie review data to compile the sentiment lexicon.