

Universität Stuttgart Institut für Maschinelle Sprachverarbeitung

# Emotion Modelling in Text and Social Media

The Contribution of Psychological Models

"Sentiment Analysis in Literary Studies", Graz/Online

February 17, 2021

Roman Klinger roman.klinger@ims.uni-stuttgart.de







https://tinyurl.com/klgraz

Emotions are Events 000000 Events trigger Emotions

Outlook 000

#### University of Stuttgart



- State university with ≈ 26000 students
- Founded 1829 (University since 1876)
- Interdisciplinary focus:
  - Sciences
  - Engineering
  - Cultural Studies

Emotions are Events 000000 Events trigger Emotions

Outlook 000

#### Institute for Natural Language Processing



• Part of

computer science department

- 3 full professors, 3 associate professors/lecturers, 2 independent research groups, 1 assistant professor
- Research across many areas of computational linguistics
- Computational Linguistics B. Sc. and M. Sc. programs
- Contribute to programs in Digital Humanities, Computer Science, Data Science

Emotions are Events 000000 Events trigger Emotions

Outlook 000

#### **Chair for Theoretical Computational Linguistics**



Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

Roman Klinger

Emotions are Events 000000 Events trigger Emotions

Outlook 000

## Current Ph.D. students and project staff



Felix Armbrust financial management (4th year, BWL collab.)



Amelie Wührl biomedical fact checking (1st year, DFG)



Laura Oberländer née Bostan structured emotion modelling (4th year, DFG)



Aswathy Velutharambath style transfer (1st year, external, 100 Worte GmbH)



Enrica Troiano emotion transfer (3rd year, IWM Tübingen collab.)



Yarik Menchaca Resendiz conditional text generation (incoming, DAAD)

Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

Roman Klinger

**About Myself** 

and emotions.

Universität Stuttgart

#### Strukturierte Modellierung von Affekt in Text

Zusammenfassende Darstellung der schriftlichen Habilitationsleistung für das Fach Informatik

Roman Klinger

2020

 Computer scientist by training Minor subject psychology

Research interests and current projects in machine

learning, biomedical text analysis, social media mining,

digital humanities, modelling psychological concepts

Habilitation in modelling of affect in text.

Emotions are Events

Events trigger Emotions

Outlook 000

#### **Slides and Collaborators**



https://www.romanklinger.de/ talks/Klinger-Graz-2021-02.pdf



Felix Casel, Jan Hofmann, Amelie Heindl, Valentino Sabbatino, Sebastian Padó, Kai Sassenberg

Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

Roman Klinger

February 17, 2021

## Outline



#### Emotions and Emotion Analysis



Emotions are Events



Events trigger Emotions

Emotion Components Cognitive Appraisal



Outlook

Emotions and Emotion Analysis •••••••••

## Introduction

Emotions are Events 000000 Events trigger Emotions

Outlook 000



- My research is about understanding and changing the message regarding ...:
  - ...the content
  - ...properties of the sender
  - ...impact on the receiver
  - ...impact of context
  - ...the relation between sender and receiver

Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

Emotions are Events

Events trigger Emotions

Outlook 000

## **Research Life Cycle**



Emotions are Events 000000 Events trigger Emotions

Outlook 000

## **Emotion Examples**

Which emotion is associated with each example? How did you recognize that?

- "She became angry."
- "A tear was running down his face."
- "We will go for a walk."
- "What was that?"
- "Sometimes I want to run away."
- "He raised his hand."

#### With this exercise, we discussed two things:

- What is an appropriate set of emotions? (what we do next)
- How are they expressed/recognized? (later today)

Emotions are Events 000000 Events trigger Emotions

Joy

Roman Klinger

Outlook 000

## **Emotion Models – Basic Emotions**

How to define a categorical system of emotions?

- Distinctive universal signals
- Presence in other primates
- Distinctive physiology
- Distinctive universals in antecedent events
- Coherence among emotional response
- Quick onset
- Brief duration
- Automatic appraisal
- Unbidden occurrence

Ekman (1992): An argument for basic emotions.



Anger

Disgust

Surprise

Emotions are Events 000000 Events trigger Emotions

Outlook 000

#### **Emotion Models – Basic Emotions**

Are these categories structured?



Plutchik, R. (1980). A general psychoevolutionary theory of emotion.

Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

Emotions are Events 000000 Events trigger Emotions

Outlook 000

## **Emotion Models – Valence-Arousal Model of Affect**

- Perhaps predefined emotion categories do not make sense?
- Perhaps mixtures and opposites do not make sense, but there are other ways to explain the relations between emotions?





Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

Emotions are Events 000000 Events trigger Emotions

Outlook 000

#### Emotion Analysis: What we want to do.



Interesting from different perspectives:

- Computational linguistics and modelling:
  - How to represent emotions as they occur in language?
- Psychology/Social sciences:
  - Better understand emotions and their effects
- Applications ranging from humanities, social sciences over pharmacovigilance to robotics and intelligent agents.

Emotions are Events

Events trigger Emotions

Outlook 000

## Literary Studies: Reagan et al., 2016



Reagan et al., 2016. The emotional arcs of stories are dominated by six basic shapes.

Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

Roman Klinger

Emotions are Events

Events trigger Emotions

Outlook 000

#### Literary Studies: Reagan et al., 2016



Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

#### Roman Klinger

February 17, 2021

Emotions are Events

Events trigger Emotions

Outlook 000

### Literary Studies: Kim et al., 2017



Kim et al., 2017. Investigating the Relationship between Literary Genres and Emotional Plot Development. Institut für Maschinelle Sprachverarbeitung. Universität Stuttgart Roman Klinger February 17, 2021

Emotions are Events

Events trigger Emotions

Outlook 000

## Literary Studies: Mohammad, 2011



#### Figure 1: Emotions pie chart of Shakespeare's tragedy *Hamlet*. (Text from Project Gutenberg.)

As You Like It



Figure 2: **Emotions pie chart** of Shakespeare's comedy *As you like it.* (Text from Project Gutenberg.)





Figure 7: Timeline of the emotions in Hamlet.

Mohammad et al., 2011.From Once Upon a Time to Happily Ever After:Tracking Emotions in Novels and Fairy Tales.Institut für Maschinelle Sprachverarbeitung, Universität StuttgartRoman KlingerFebruary 17, 2021

Emotions are Events

Events trigger Emotions

Outlook 000

#### Happiness in Art and Public: Dodds 2009



Dodds et al. 2009. Measuring the Happiness of Large-Scale Written Expression: Songs, Blogs, and Presidents.

Emotions are Events

Events trigger Emotions

Outlook 000

#### Happiness in Art and Public: Dodds 2009



Emotions are Events 000000 Events trigger Emotions

Outlook 000

#### **Emotions and Emotion Analysis**



context

Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

Emotions are Events 000000 Events trigger Emotions

Outlook 000

#### How do these emotion models help NLP?

- Ekman:
  - Serves as a categorical system for text classification.
- Plutchik:
  - Serves as a categorical system for text classification.
  - Models have been proposed which build classifiers that consider the structure of the wheel. (e.g., Suttles/Ide (2013):

Distant Supervision for Emotion Classification with Discrete Binary Values. CICLING.)

- Russel:
  - Serves as a basis for regression tasks.

Emotions are Events 000000 Events trigger Emotions

Outlook 000

## **Emotions and Events**

Emotions and Events are linked in (at least) two ways:

#### Emotions are events

- "Donald is happy about his birthday present."
- FrameNet Emotion Directed Frame:
  - Event: "happy"
  - Experiencer: "Donald"
  - Stimulus: "his birthday present"
  - ...
- ⇒ Motivated the task of emotion semantic role labeling (we'll talk about that now for a bit)

#### Events cause emotions

- "There is a car on fire."
  - Relevant event for the speaker, might cause fear.
  - Requires interpretation of events to infer possible emotions.
  - Little previous work
    - Udochukwu/He (2015), Shaikh et al. (2009), Balahur et al. (2011)
- (main part of today's talk, coming up next)

## Outline



#### Emotions and Emotion Analysis



Emotions are Events



events trigger Emotions

Emotion Components Cognitive Appraisal



)utlook

Emotions are Events

Events trigger Emotions

Outlook 000

#### **Emotions are Events**



Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

Emotions are Events

Events trigger Emotions

Outlook 000

#### **Emotions are Events**

<document author="Glasgow Ellen" author death year="1945" book title="The Battle Ground" doc. id="6872"</p> genre="Historical fiction" url="http://www.gutenberg.org/ebooks/6872"> <text>In loving me, my darling?" "In loving you like that." "Nonsense.</text> <adiudicated> <spans> <span annotation id="51002" annotatorId="B" cbegin="17" cend="24" type="character">darling</span> <span annotation id="49637" annotatorId="A" cbegin="31" cend="37" type="ioy">loving</span> <span annotation id="49644" annotatorId="A" cbegin="31" cend="37" type="trust">loving</span> <span annotation id="50015" annotatorId="BIA" cbegin="38" cend="41" type="character">you</span> </spans> <relations> <relation annotatorId="B" left="17" right="37" relation id="51009" source annotation id="49637" target annotation id="51002" type="experiencer">darling[CHARACTER]...loving[JOY]</relation> <relation annotatorId="BIA" left="31" relation id="50022" right="41" source annotation id="49637" target annotation id="50015" type="target">loving[JOY]...you[CHARACTER]</relation> </relations> </adjudicated> <other> <spans> <span altTo="49644" annotation\_id="49581" annotatorId="C" cbegin="31" cend="37"</p> type="other-emotion">loving</span> </spans> <relations /> </other> </document>

Emotions are Events

Events trigger Emotions

Outlook 000

#### Vision: Automatic Relation Extraction for Network Analysis



Emotions are Events

Events trigger Emotions

Outlook 000

## **Emotion Semantic Role Labeling as Sequence Labeling**

#### Example

## 

#### Corpora

- Tweets with Cue, Stimulus, Experiencer, Target: Mohammad et al. (2014)
- Blogs with Stimuli: Ghazi et al. (2015)
- Literature, with Cue, Stimulus, Experiencer, Target: Kim/Klinger (2018) with Stimuli: Gao et al. (2017)
- News headlines with Cue, Stimulus, Experiencer, Target: Bostan/Kim/Klinger (2020)

Emotions are Events

Events trigger Emotions

Outlook 000

## **Emotion Stimulus Detection**

Token Sequence Labeling vs. Clause Classification

0	0	0	0	0	В	1	I	0
John	hates	cars	because	they	pollute	the	environment	
No Stimulus [ John hates cars ] [ because they ]						ulus e the e	environment. ]	

- Clause classification is standard formulation in Mandarin (Gui et al., 2017)
- We showed that token sequence labeling outperforms clause classification in English (Oberländer/Klinger 2020).
- $\Rightarrow$  Now we move to event interpretations to infer an emotion ("events cause emotions")

Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

## Outline



#### Emotions and Emotion Analysis



Emotions are Events



Events trigger Emotions

Emotion Components Cognitive Appraisal



utlook

Emotions are Events 000000 Events trigger Emotions

Outlook 000

#### Definition of emotions and their linguistic realizations

#### Emotion (Scherer, 2005)

Emotions are "an episode of interrelated, synchronized changes in the states of [...] five organismic subsystems in response to the evaluation of a [...] stimulus-event ..."



Emotions are Events

Events trigger Emotions

Outlook 000

#### **Appraisal-based Emotion Classification**



Emotions are Events

Events trigger Emotions

Outlook 000

#### **Emotion Components**



34 / 51

Emotions are Events 000000 Events trigger Emotions

Outlook 000

## **Does Component Knowledge help Emotion Classification?**

- Annotation of two corpora: TEC (Tweets) and REMAN (literature) for components
- Labels of TEC (one-of): anger, disgust, fear, joy, sadness, surprise
- Labels of REMAN (many-of):

anger, disgust, joy, sadness, fear, surprise, trust, anticipation, other, neutral

• 2041 Tweets, 1000 sentence triples from Project Gutenberg

Emotions are Events 000000 Events trigger Emotions

Outlook 000

## **Does Component Knowledge help Emotion Classification?**

#### Examples

#### Cognitive

- I can't stop.
- found my old lava lamp!

#### **Bodily Reaction**

- She did not know; she trembled.
- Apparently i might have alcohol poisoning. #stupidgirl

#### Subjective

- Woman-woman-I love thee!
- bad day

#### Motivation

- We're going out tonight.
- Sometimes I wanna take your head and ram it into mirrors.

#### Expression

- An expression of annoyance appeared on the emperor's face.
- Finals tomorrow... ugh

Emotions are Events 000000

Events trigger Emotions

Outlook 000

#### Machine Learning models



Emotions are Events

Events trigger Emotions

Outlook 000

#### How well can we predict components?



Emotions are Events 000000 Events trigger Emotions

Outlook 000

#### **Does Component Prediction help Emotion Categorization?**



Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

Roman Klinger

Emotions are Events

Events trigger Emotions

Outlook 000

## **Cognitive Appraisal**



Emotions are Events 000000 Events trigger Emotions

Outlook 000

## **Appraisal Annotation**

Most probably, at the time when the event happened, the writer...

- ...wanted to devote further attention to the event.
- ...was certain about what was happening.
- ...had to expend mental or physical effort to deal with the situation.
- ...found that the event was pleasant. (Pleasantness)
  ...was responsible for the situation. (Responsibility)
  ...found that he/she was in control of the situation. (Control)
  ...found that the event could not have been changed/influenced by anyone. (Circumstance)
  (following concepts by Smith/Ellsworth, 1985)

(Attention) (Certainty)

(Effort)

Emotions are Events 000000

Events trigger Emotions

Outlook 000

## **Corpus Selection**



Emotions are Events 000000 Events trigger Emotions

Outlook 000

#### **Annotation Results**



Emotions are Events 000000

Events trigger Emotions

Outlook 000

#### **Machine Learning Models**



Emotions are Events 000000 Events trigger Emotions

Outlook 000

## **Modelling Results**

How well can we predict appraisal dimensions from text?



Events trigger Emotions 00000000000000000

## **Modelling Results**





## Outline



#### Emotions and Emotion Analysis



Emotions are Events





Emotions are Events 000000 Events trigger Emotions

Outlook 0●0

## Summary

- We presented the first work that combines
  - emotion component process model,
  - appraisal classification

with emotion classification

- Emotion component prediction helps to improve emotion classification
- Appraisal prediction has potential to improve emotion classification

Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

Emotions are Events 000000 Events trigger Emotions

Outlook 00●

## Outlook

- How to make appraisals help emotion classification? more data and other multi task learning methods
- Are the appraisal annotations meaningful? we study that by directly asking event experiencers
- Does knowledge of semantic role positions in text improve emotion classification? Yes, see Oberländer/Reich/Klinger (2020).
- Can we exploit SRL information/stimulus together with appraisal? Maybe, that is a plan to investigate in the future.

Emotions are Events 000000 Events trigger Emotions

Outlook 000

#### Check out our whole lecture on emotion analysis!



## www.emotionanalysis.de

Institut für Maschinelle Sprachverarbeitung, Universität Stuttgart

Roman Klinger

Emotions are Events 000000 Events trigger Emotions

Outlook 000

#### Thanks to

- Ph.D. Students
  - Enrica Troiano
  - Evgeny Kim
  - Laura Oberländer née Bostan
- Collaborators
  - Kai Sassenberg
  - Sebastian Padó
- Undergrads+Master Students
  - Amelie Heindl
  - Felix Casel
  - Jan Hofmann
  - Valentino Sabbatino

Thank you for your attention. Questions? Remarks?





Universität Stuttgart Institut für Maschinelle Sprachverarbeitung

# Emotion Modelling in Text and Social Media

The Contribution of Psychological Models

"Sentiment Analysis in Literary Studies", Graz/Online

February 17, 2021

Roman Klinger roman.klinger@ims.uni-stuttgart.de







https://tinyurl.com/klgraz