

# **Visualisierung bei linguistischen Annotationswerkzeugen und Auswirkung auf deren Usability**

Dr. Manuel Burghardt

Lehrstuhl für Medieninformatik

Institut für Information und Medien, Sprache und Kultur

Universität Regensburg



Universität Regensburg



# Vortragsgliederung



- ① Linguistische Annotation, Usability und Visualisierung
- ② Evaluationsstudie zur Usability von linguistischen Annotationswerkzeugen
- ③ Usability und Visualisierung bei Annotationswerkzeugen
  - Primärdaten
  - Annotationsschema
  - Annotation (insbesondere parallele Mehrebenenannotationen und Beziehungsannotationen)
- ④ Ausblick

# Linguistische Annotation, Usability und Visualisierung

# #01

# Annotation und Analyse



## Fokus dieses Vortrags

(vgl. Burghardt & Wolff, 2009;  
Burghardt, 2012; Burghardt, 2014)

## Umfangreiche Forschung zu Visualisierung in der Analyse-Phase:

- *KWIC* (Luhn, 1960)
- *WordTree* (Wattenberg & Viégas, 2008)
- *TagCloud Evaluation* (Lohmann et al. 2009)
- *DoubleTree* (Culy & Lyding, 2010)
- *Advanced Visual Analytics* (Oelke et al. 2012)
- u.v.a.

Annotation

Analyse

## Arbeitsintensive Aufgaben



Usability und Visualisierung  
als wichtige Faktoren

# Manuelle vs. automatische Annotation



Viele Annotationsaufgaben können  
gut **automatisiert** werden



Es bleibt trotzdem eine hohe Zahl  
von Annotationsaufgaben, die  
**manuell** gelöst werden müssen



Usability und adäquate Visualisierung  
als wesentliche Anforderung

# Was ist Usability?



Usability bezeichnet das Ausmaß, in dem ein Produkt, System oder ein Dienst durch bestimmte **Benutzer** in einem bestimmten **Anwendungskontext** genutzt werden kann, um bestimmte **Ziele effektiv, effizient und zufriedenstellend** zu erreichen. (vgl. ISO 9241-11)

# Regeln für gute Usability



## Nielsen & Molich (1990)

- ① Consistency and standards
- ② Visibility of system status
- ③ Match between system and real world
- ④ User control and freedom
- ⑤ Error prevention
- ⑥ Recognition rather than recall
- ⑦ Flexibility and efficiency of use
- ⑧ Aesthetic and minimalist design
- ⑨ Help users recognize, diagnose, and recover from errors
- ⑩ Provide online documentation and help

# Evaluationsstudie zur Usability von linguistischen Annotationswerkzeugen

# #02



# Hintergrund und Studiendesign



**Ziel der Studie:** Vergleichende Usability-Evaluation mehrerer Tools und Identifizieren von Stärken und Schwächen

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**Evaluierte Tools:** Dexter, CATMA, UAM Corpus Tool, Glozz, Brat, MMAX2, WordFreak, Analec, WebAnno, Knowtator, GATE

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**Methode:** *Heuristic Walkthrough* (Sears, 1997)

→ Inspektionsmethode

# Ergebnisse der Evaluationsstudie



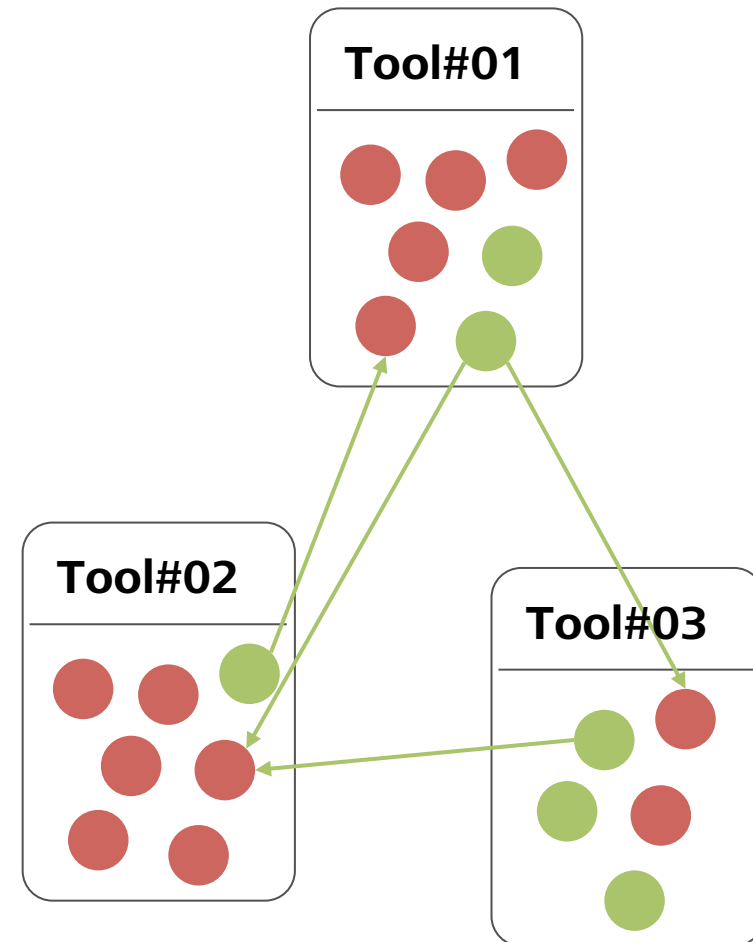
Evaluation von 11  
Annotationswerkzeugen



207 Usability-Probleme

84 Stärken

Von spezifischen Stärken  
und Schwächen hin zu  
generischen Patterns



# Ergebnis: 26 Usability-Patterns für linguistische Annotationswerkzeuge



## Pattern category: General UI

P1.1 Help for domain-specific functions

## Pattern category: Installation

P2.1 Easy installation and setup

## Pattern category: Primary Data

P3.1 Guided pre-processing of primary data

P3.2 Separated import of documents and mapping to corpora

P3.3 Easy navigation between multiple primary data documents

P3.4 Automatic creation of annotation files

P3.5 Mode for editing primary data

P3.6 Support for reading primary data

P3.7 Tailored display of primary data

## Pattern category: Annotation Scheme

P4.1 Integrated annotation scheme editor

P4.2 Organization of annotation scheme

P4.3 Tailored display of annotation schemes

P4.4 Facilitated distinction of multiple annotation items

## Pattern category: Annotation Process

P5.1 Semi-automatic creation of anchors

P5.2 Conventionalized actions for creation of anchors

P5.3 Feedback for creation of anchor scope

P5.4 Accelerators for selecting and applying annotations

P5.5 Accelerators for annotating multiple anchors

P5.6 Access to existing annotations

P5.7 Assistance for modification of anchors

P5.8 Integrated delete annotation function

P5.9 Mass deletion of annotations

P5.10 Support annotation of relations

## Pattern category: Annotation Visualization

P6.1 Visualization of parallel annotations

P6.2 Tailored display of annotations

P6.3 Alternative visualizations of relational annotations

Visualisierung als wichtiger Usability-Faktor

# Visualisierung bei linguistischen Annotationswerkzeugen



1

**Visualisierung der  
Primärdaten**

2

**Visualisierung des  
Annotationsschemas**

3

**Visualisierung der  
Annotation**

# Usability und Visualisierung bei Annotationswerkzeugen

# #03

# Primärdaten

# Primärdaten

## Unterstützung beim Lesen / Orientierung



Brat

Page



0

Go to



showing 1-10 of 75 sentences

Annotator

- 1 Lifelines for Poor Children What is missi
- 2 This is not a big government boondoggle
- 3 Acting on it would, however, require us to
- 4
- 5 Everyone knows that education boosts p
- 6 But these proposals are too timid.
- 7 They ignore a powerful body of research
- 8 They ignore the role of families in produc
- 9 They also ignore or play down the critical

Flexibility and efficiency of use

Pattern: Row striping

(Tidwell, 2011, S. 220)

Match between system and the real world

Pattern: Pagination

(Tidwell, 2011, S. 224)

Recognition rather than recall

Flexibility and efficiency of use

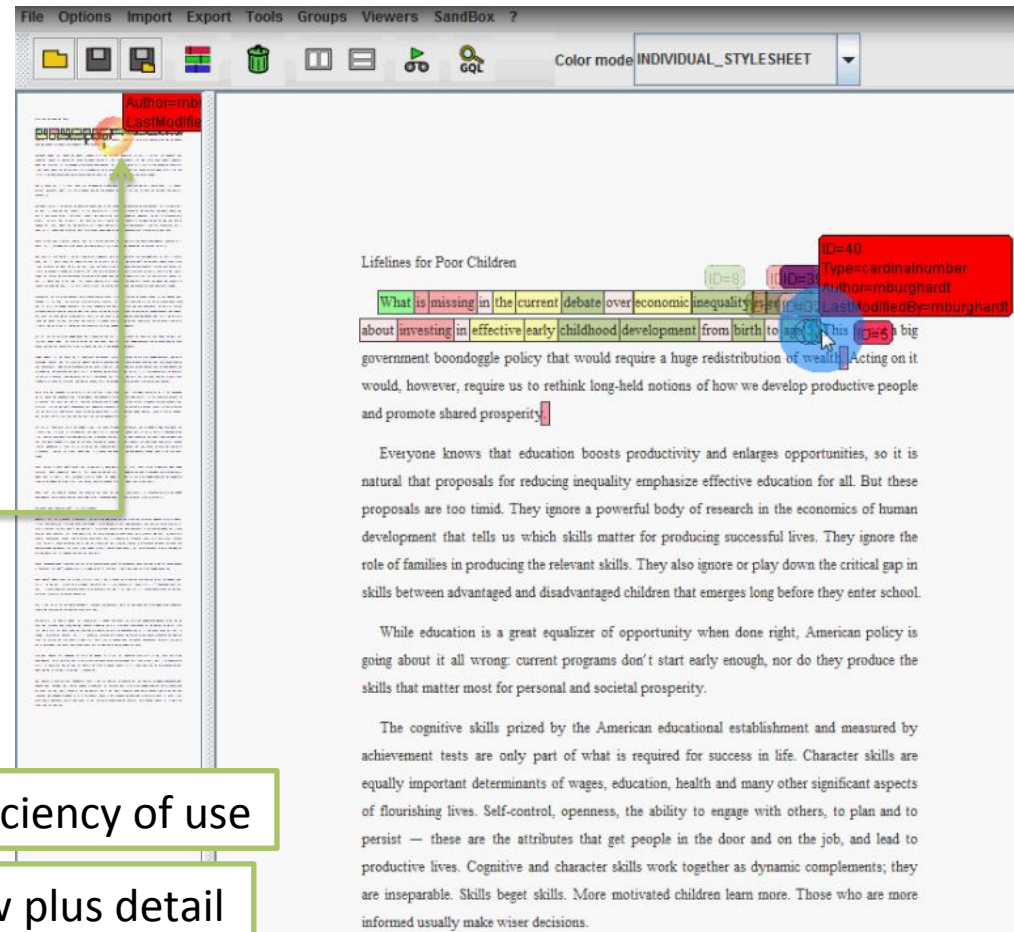


# Primärdaten

## Orientierung im Dokument



Glozz



Flexibility and efficiency of use

Pattern: Overview plus detail

(Tidwell, 2011, S. 296)





# Annotationsschema

# Annotationsschema

## Integrierter Schema-Editor



MMAX2

Darstellung als XML-Markup in externem Editor.

```
1  <?xml version="1.0" encoding="UTF-8"?>
2  <annotationscheme>
3
4  <attribute id="pos" type="nominal_button" name="pos">
5  <value id="nn" name="noun"/>
6  <value id="vb" name="verb"/>
7  <value id="adj" name="adjective"/>
8  <value id="adv" name="adverb"/>
9  <value id="pro" name="pronoun"/>
10 <value id="art" name="article"/>
11 <value id="prep" name="preposition"/>
12 <value id="conj" name="conjunction"/>
13 <value id="int" name="interjection"/>
14 <value id="part" name="particle"/>
15 <value id="num" name="cardinal number"/>
16 </attribute>
17
18 </annotationscheme>
```

Aesthetic and minimalist design

Error prevention



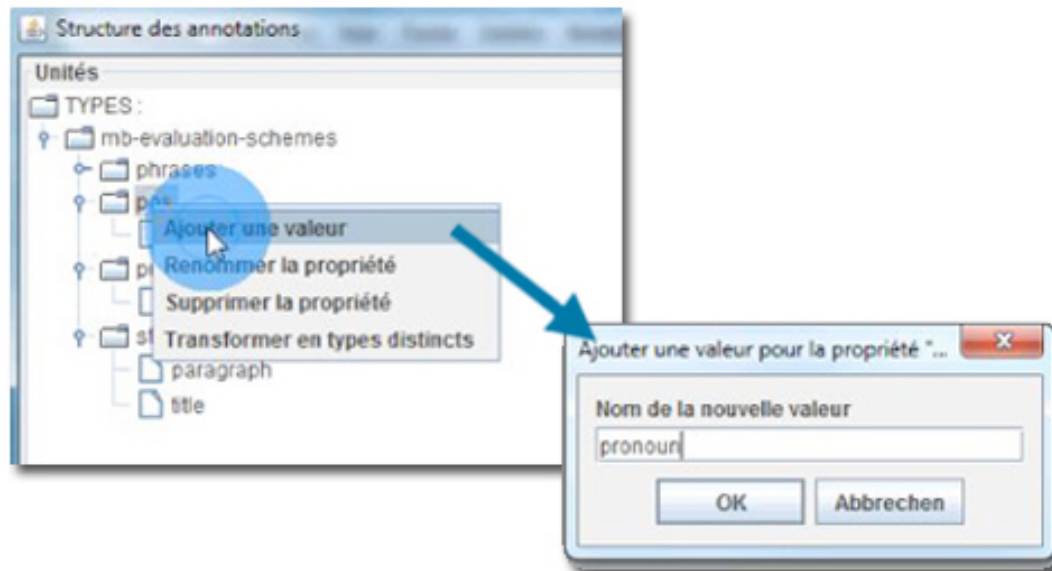
# Annotationsschema

## Integrierter Schema-Editor

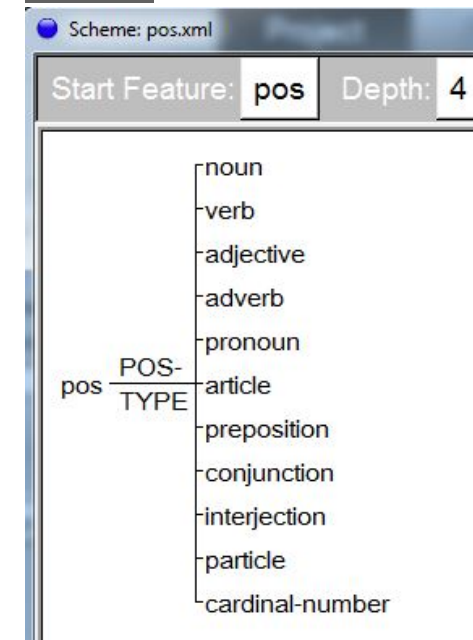


Hierarchische Baum-Darstellung innerhalb des Annotationstools.

Analec



UAM



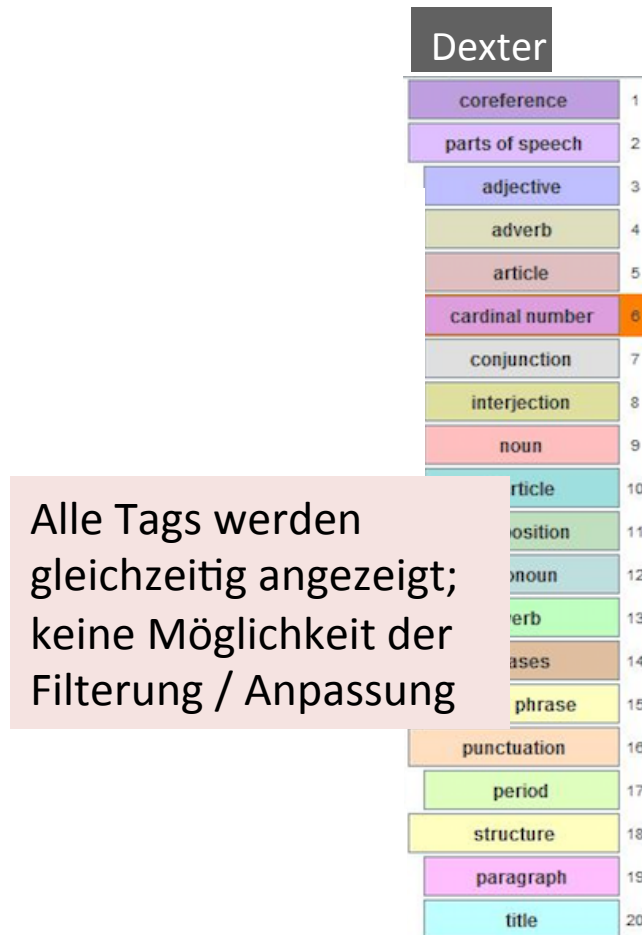
Aesthetic and minimalist design

Error prevention



# Annotationsschema

Anpassbarkeit / Ausblenden unnötiger  
Annotationsebenen



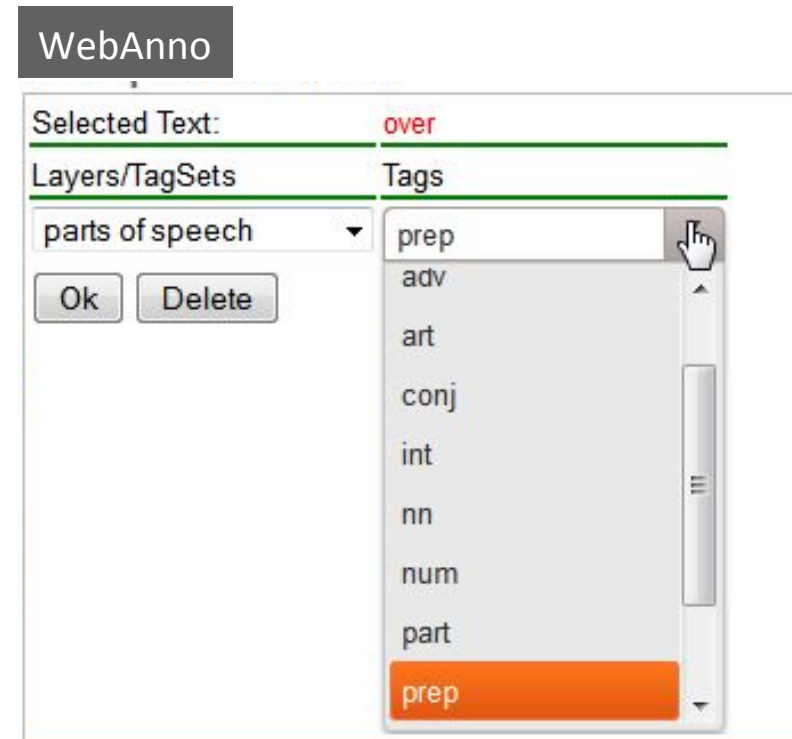
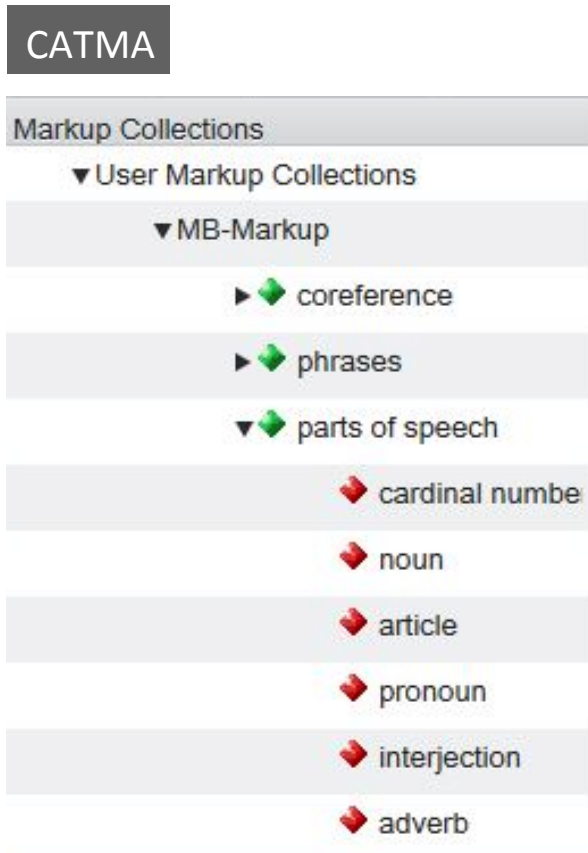
Error prevention

Aesthetic and minimalist design



# Annotationsschema

Anpassbarkeit / Ausblenden unnötiger  
Annotationsebenen



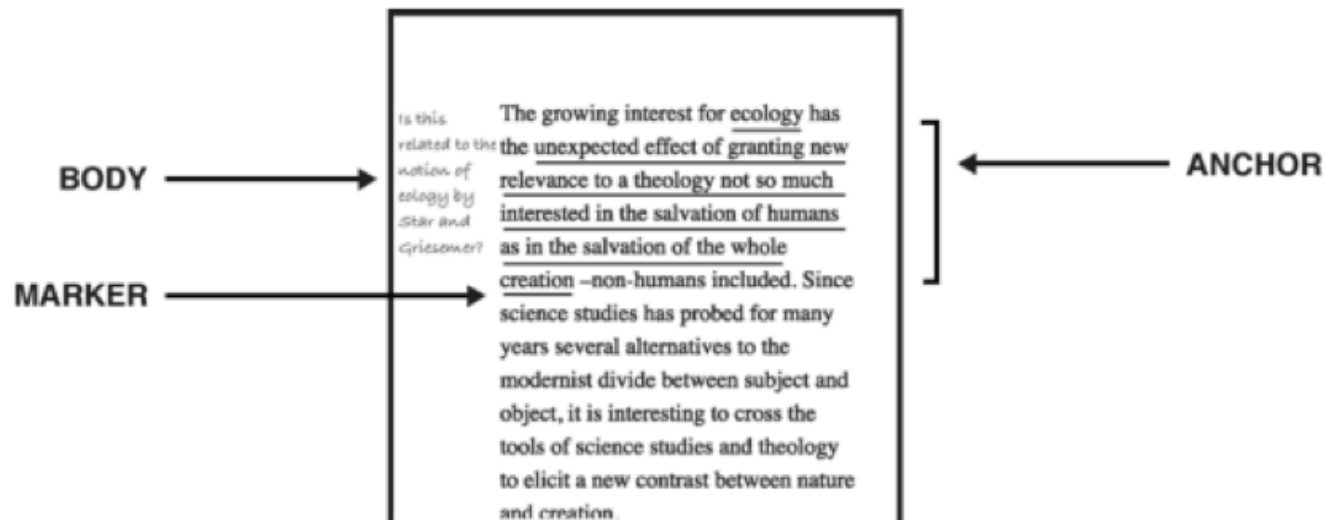
Error prevention

Aesthetic and minimalist design



# Annotationen

# Terminologie bei Annotationen



Außerdem möglich:

- *Anchor-only annotations*
- *Body-only annotations*

# Annotation-Anchor

## Visualisierung von Ankern innerhalb der Primärdaten



### UAM Unterstreichung

Lifelines for Poor Children

What is missing in the current debate over economic inequality is enough serious discussion about investing in effective early childhood development from birth to age 5. This is not a big government boondoggle policy that would require a huge

### GATE Hinterlegung

Everyone knows that education boosts productivity and enlarges opportunities, so it is natural that proposals for universal education for all. But these proposals are too timid. They ignore a powerful body of research in the economic sciences that matter for producing successful lives. They ignore the role of families in producing the relevant skills. They also ignore the gap between advantaged and disadvantaged children that emerges long before they enter school.

While education is a great equalizer of opportunity when done right, American policy is going about it all wrong. It does not produce the skills that matter most for personal and societal prosperity.

### Brat Klammerung

1 Lifelines for Poor Children



# Annotation-Body

## Typische Visualisierung des Annotationswerts



### Brat Inline Visualisierung

What is missing in the current debate over economic inequality is enough

The Brat interface shows the sentence with various parts of speech tags above the words. A red arrow points to the word 'enough' which is tagged as an Adverb.

Word	Tag
What	Pronoun
is	Verb
missing	Verb
in	Preposition
the	Article
current	Adjective
debate	Noun
over	Preposition
economic	Adjective
inequality	Noun
is	Verb
enough	Adverb

### Dexter Visualisierung mittels dynamischem Overlay

is enough serious discussion about investing early childhood development from birth to age  
require a huge redistribution of wealth. Acting verb noun phrase require us to rethink long-held notions  
prosperity.  
as opportunities, so it is natural that proposals for reducing inequality emphasize effective education for

The Dexter interface shows the sentence with a dynamic overlay. A red arrow points to the word 'Acting' which is tagged as a verb.

Word	Tag
is	verb
enough	noun phrase
serious	verb
discussion	noun phrase
about	verb
investing	noun phrase
early	verb
childhood	noun phrase
development	verb
from	noun phrase
birth	verb
to	noun phrase
age	verb
require	noun phrase
a	verb
huge	noun phrase
redistribution	verb
of	noun phrase
wealth	verb
.	noun phrase
Acting	verb
require	noun phrase
us	verb
to	noun phrase
rethink	verb
long-held	noun phrase
notions	verb
prosperity	noun phrase
.	verb
as	noun phrase
opportunities	verb
,	noun phrase
so	verb
it	noun phrase
is	verb
natural	noun phrase
that	verb
proposals	noun phrase
for	verb
reducing	noun phrase
inequality	verb
emphasize	noun phrase
effective	verb
education	noun phrase
for	verb

### GATE Visualisierung über Farbindex und ausgelagertes Tagset

atural that proposals for reducing inequality emphasize effective  
ch in the economics of human development that tells us which skills  
evant skills. They also ignore or play down the critical gap in skills  
hool.  
ing about it all wrong: current programs don't start early enough, nor do

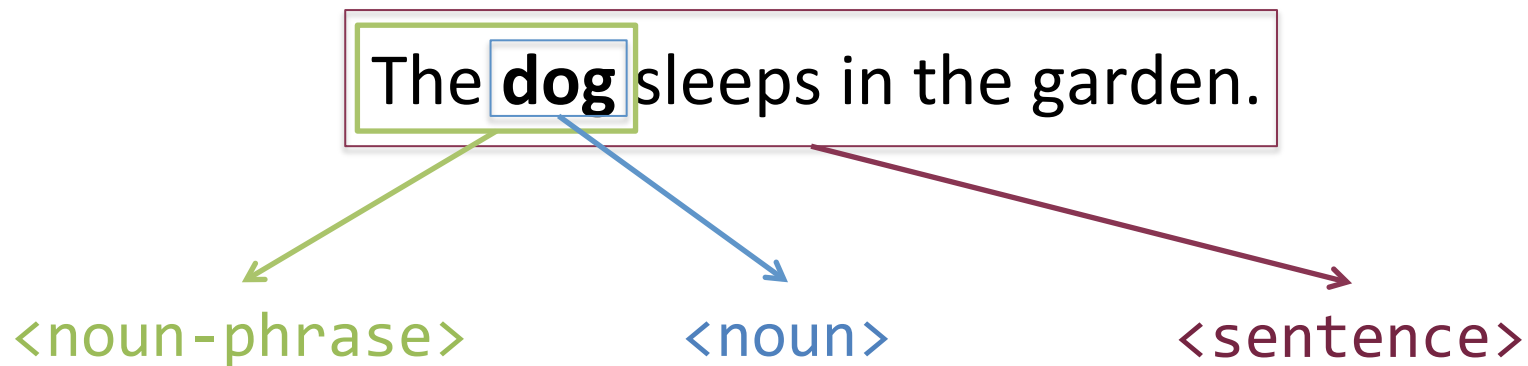
The GATE interface shows the sentence with color-coded words. A red arrow points to the word 'programs' which is tagged as a noun.

Word	Tag
atural	adjective
that	adverb
proposals	article
for	cardinal number
reducing	noun
inequality	prep
emphasize	adjective
effective	adverb
ch	article
in	cardinal number
the	noun
economics	prep
of	adjective
human	adverb
development	article
that	cardinal number
tells	noun
us	prep
which	adjective
skills	adverb
.	article
They	cardinal number
also	noun
ignore	prep
or	adjective
play	adverb
down	article
the	cardinal number
critical	noun
gap	prep
in	adjective
skills	adverb
.	article
hool	cardinal number
.	noun
ing	prep
about	adjective
it	adverb
all	article
wrong	cardinal number
:	noun
current	prep
programs	adjective
don't	adverb
start	article
early	cardinal number
enough	noun
,	prep
nor	adjective
do	adverb

# Besondere Herausforderung: Parallele Mehrebenenannotation



Ein wesentliches Merkmal linguistischer Annotation ist die parallele Annotation eines Ankers mit mehreren Annotationswerten



# Parallele Annotationen

Visualisierung von Markern > Besondere  
Herausforderung bei parallelen Annotationen!



Dexter

Lifelines for Poor Children

What is missing in the current debate over economic inequality is e  
investing in effective early childhood development from birth to age  
boondoggle policy that would require a huge redistribution of wealth  
require us to rethink long-held notions of how we develop productive  
prosperity.

Farbliche Hinterlegungen sind bei parallelen Annotationen kaum  
voneinander unterscheidbar → gegenseitige Überlagerung

Error prevention

Aesthetic and minimalist design



# Parallele Annotationen

Visualisierung von Markern > Besondere Herausforderung bei parallelen Annotationen!



CATMA

What is missing in the current debate over economic inequality is enough serious discussion about investing in effective early childhood development from birth to age 5. This is not a big government boondoggle policy that would require a huge redistribution of wealth. Acting on it would, however, require us to rethink long-held notions of how we develop productive people and promote shared prosperity.

Everyone knows that education boosts productivity and enlarges opportunities, so

Tagsets	Tag Color
▶ phrases	
▼ parts of speech	
→ cardinal r	<input type="checkbox"/>
→ noun	<input type="checkbox"/>
→ article	<input type="checkbox"/>
→ interjective	<input type="checkbox"/>

Unterstreichung als gute Visualisierung für parallele Annotationen → „stapelbar“

Error prevention

Aesthetic and minimalist design



# Parallele Annotationen



GATE

Everyone knows that education boosts productivity and enlarges opportunities, so it is natural that proposals for education for all. But these proposals are too timid. They ignore a powerful body of research in the economic matter for producing successful lives. They ignore the role of families in producing the relevant skills. They between advantaged and disadvantaged children that emerges long before they enter school.

While education is a great equalizer of opportunity when done right, American policy is going about it all wrong. They produce the skills that matter most for personal and societal prosperity.

The cognitive skills prized by the American educational establishment and measured by achievement tests. Character skills are equally important determinants of wages, education, health and many other significant

Type	Set	Start	End	Id	Features
title	structure	0	27	23	()
pro	parts of speech	29	33	105	()
paragraph	structure	29	434	24	()
verb	parts of speech	34	36	106	()
verb	parts of speech	37	44	109	()
prep	parts of speech	45	47	112	()
article	parts of speech	48	51	125	()
np	phrases	48	91	134	()
adjective	parts of speech	52	59	126	()
noun	parts of speech	60	66	118	()

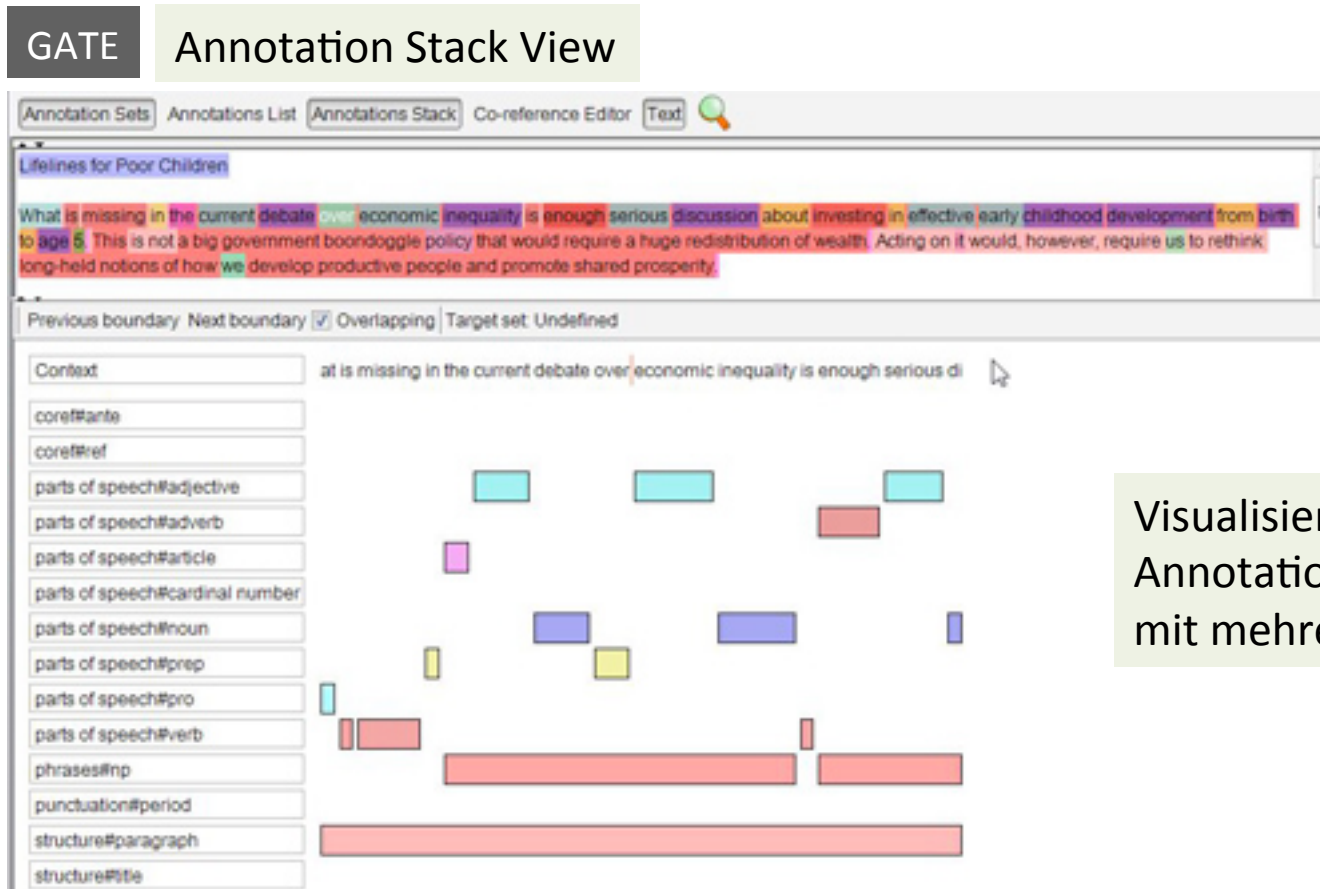
Kein direkter Bezug zu den Ankern, lediglich über Verweise zu bestimmten Zeichenpositionen im Text (*Start / End*)

129 Annotations (0 selected) Select:

Aesthetic and minimalist design



# Parallele Annotationen



Visualisierung paralleler Annotationen als Stapel mit mehreren Ebenen

Aesthetic and minimalist design





# Besondere Herausforderung: Beziehungsannotation



**Example:** [Mr. Smith]<sub>ante\_1</sub> bought [himself]<sub>ref\_1</sub> [a fancy new hat]<sub>ante\_2</sub>. [He]<sub>ref\_1</sub> was really looking forward to wearing [it]<sub>ref\_2</sub> at the big party on Saturday.

What is missing in the current debate over economic inequality is enough serious discussion about investing in effective early childhood development from birth to age 5. This is not a big government boondoggle **policy** that would require a huge redistribution of wealth. Acting on **it** would, however, require **us**<sup>1</sup> to rethink long-held notions of how **we** develop productive people and promote shared prosperity.

<sup>1</sup> „us“ as a generic reference

Everyone knows that education boosts productivity and enlarges opportunities, so it is natural that proposals for reducing inequality emphasize effective education for all. But these **proposals** are too timid. **They** ignore a powerful body of research in the economics of human development that tells us which skills matter for producing successful lives. **They** ignore the role of families in producing the relevant skills. **They** also ignore or play down the critical gap in skills between advantaged and disadvantaged **children** that emerges long before **they** enter school.

Typischer Aufgabenkontext: Annotation von *Koreferenzen* im Text.

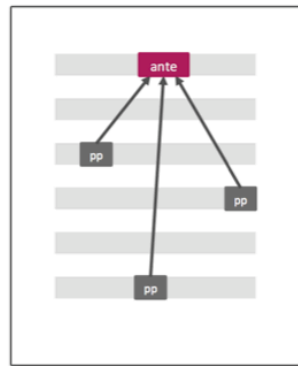
ante

Antecedent

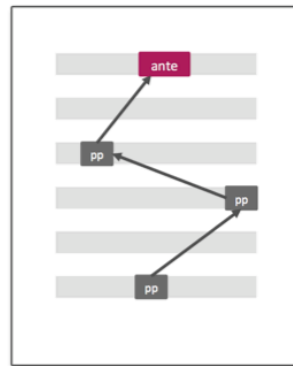
ref

Reference to the antecedent backwards

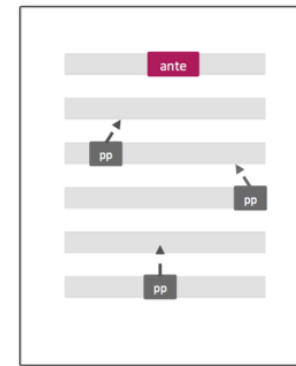
# Überblick: Visualisierung von Beziehungsannotationen



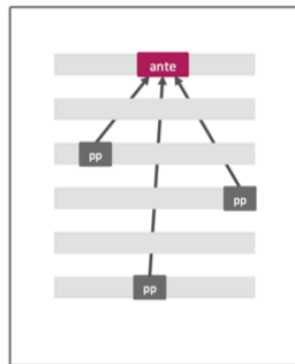
(a) Tree relation.



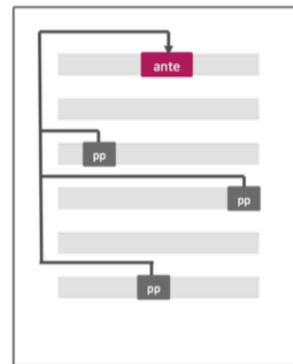
(b) Chain relation.



(c) Deictic relation.



(d) Relation "behind" text.



(e) Margin relation.



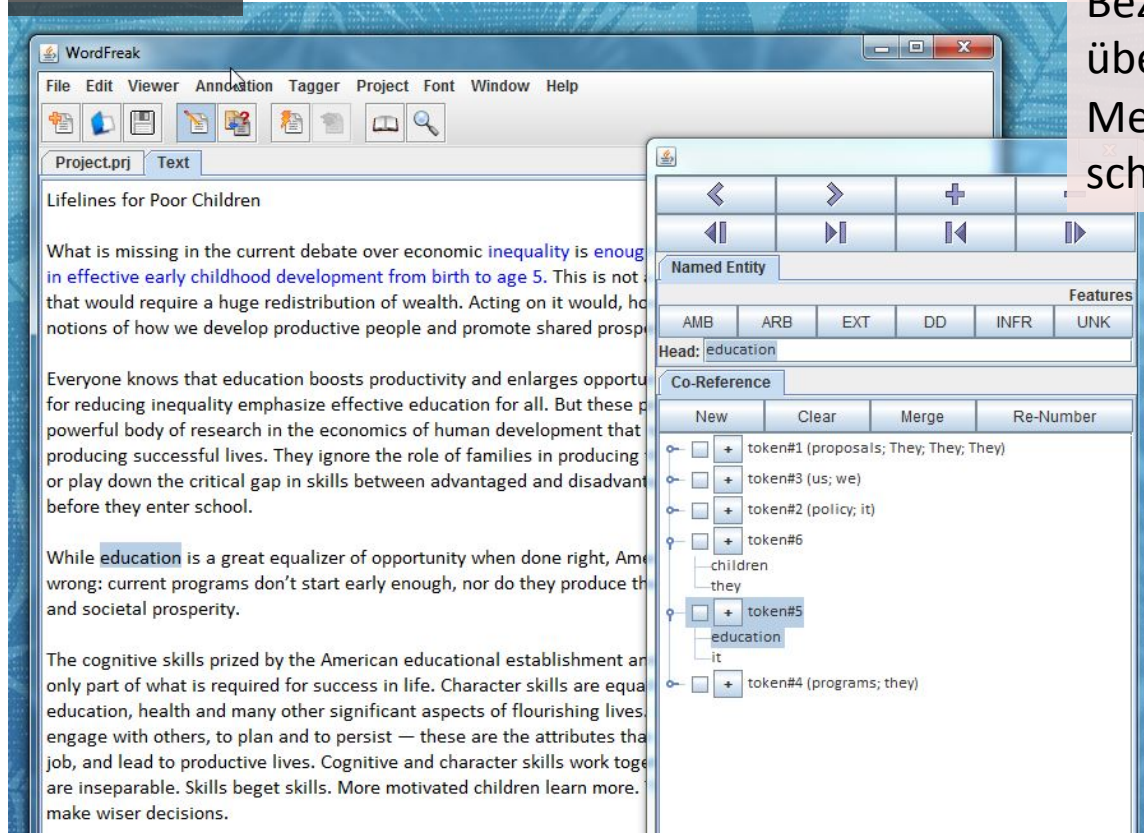
(f) Indices relation.



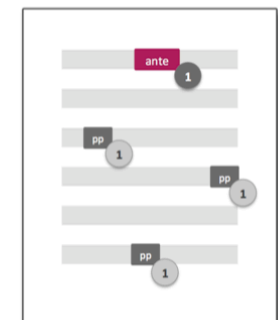
# Beziehungsannotationen



## WordFreak



Beziehungen sind  
über Indizes für  
Menschen nur  
schwer zu erkennen



(f) Indices relation.

Error prevention

Aesthetic and minimalist design

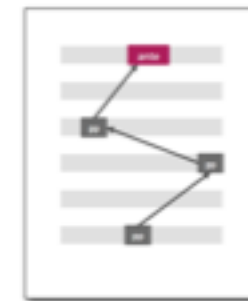


# Beziehungsannotationen



## MMAX2

Everyone knows that education boosts productivity and enlarges opportunities, so it is natural proposals for reducing inequality emphasize effective education for all. But these proposals are too timid. They ignore a powerful body of research in the economics of human development that tells us which skills matter for producing successful lives. They ignore the role of families in teaching the relevant skills. They also ignore or play down the critical gap in skills between



(b) Chain relation.

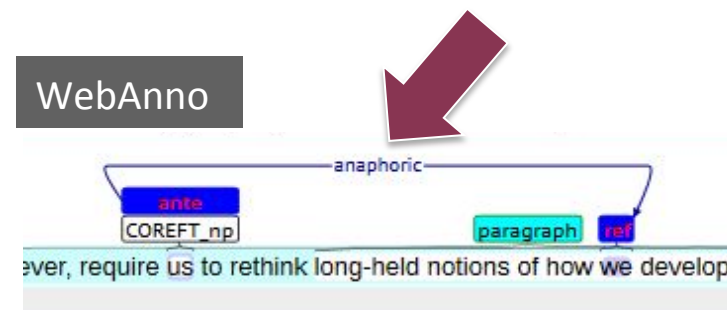
Besser: direkt sichtbare  
Verbindungen in den  
Primärdaten

Error prevention

Aesthetic and minimalist design



# Beziehungsannotationen



Explizite Benennung des Beziehungstyps als Overlay im Primärtext

Visibility of system status



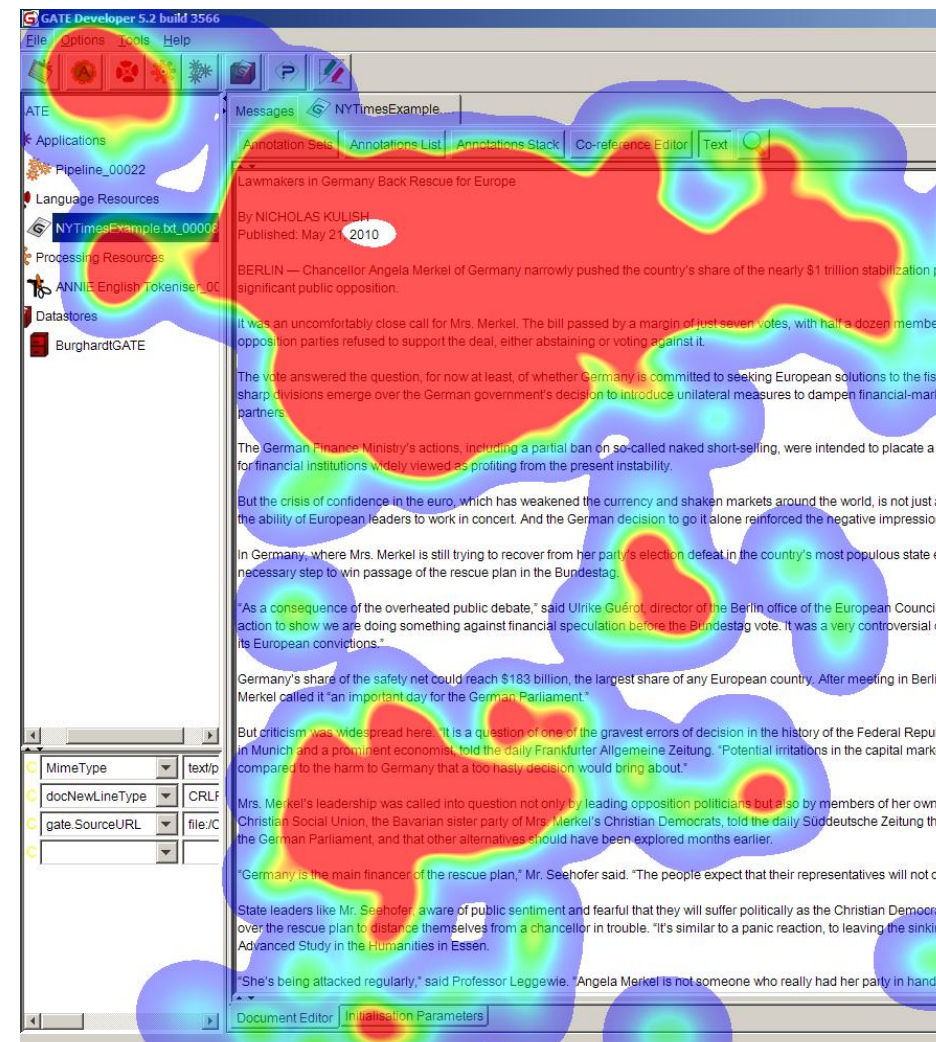
**Ausblick**

**#04**

# Ausblick



## Geplante Folgestudie: Usability-Evaluation unterschiedlicher Annotationsvisuali- sierungen mithilfe eines Eyetrackers



Beispielhafte *Attention Map* für GATE nach 8:35 Min.

- **Bélanger**, M.-E. (2010). The Annotative Practices of Graduate Students: Tensions & Negotiations Fostering an Epistemic Practice. Language. Master thesis, University of Toronto.
- **Burghardt**, M., & Wolff, C. (2009b). Werkzeuge zur Annotation diachroner Korpora. In W. Hoepfner (Ed.), *Proceedings of the GSCL-Symposium "Sprachtechnologie und eHumanities"* (pp. 21–31). Duisburg: Abteilung für Informatik und Angewandte Kognitionswissenschaft, Universität Duisburg-Essen.
- **Burghardt**, M. (2012). Usability Recommendations for Annotation Tools. In *Proceedings of the ACL 2012, 6th Linguistic Annotation Workshop, LAW '12* (pp. 104–112). Stroudsburg, PA, USA: Association for Computational Linguistics.
- **Burghardt**, M. (2014). Engineering annotation usability - Toward usability patterns for linguistic annotation tools. Dissertation, Universität Regensburg.
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- **Lohmann**, S., Ziegler, J. & Tetzlaff, L. (2009). Comparison of Tag Cloud Layouts: Task-Related Performance and Visual Exploration. In *Proc. Interact '09*, LNCS 5726 (pp. 392–404).
- **Luhn**, H. P. (1960). Keyword-in-Context Index for Technical Literature (KWIC). *American Documentation*, 11(4), 288–295.



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- **Oelke**, D., Kokkinakis, D., & Malm, M. (2012). Advanced Visual Analytics Methods for Literature Analysis. In *Proc. of the 6<sup>th</sup> EACL Workshop on Language Technology for Cultural Heritage, Social Sciences, and Humanities* (pp. 35-44).
- **Sears**, A. (1997). Heuristic Walkthroughs: Finding the Problems Without the Noise. *International Journal of Human-Computer Interaction*, 9(3), 213–234.
- **Soehn**, J.-P., Zinsmeister, H., & Rehm, G. (2008). Requirements of a user-friendly, general-purpose corpus query interface. In *Proceedings of the LREC 2008, Workshop on Sustainability of Language Resources and Tools for Natural Language Processing* (pp. 27–32). ELRA.
- **Wattenberg**, M., & Viégas, F. B. (2008). The Word Tree, an Interactive Visual Concordance. *IEEE Transactions on visualization and computer graphics*, 14(6), 1221–1228.

# Vielen Dank für Ihre Aufmerksamkeit.

**E-Mail:** [manuel.burghardt@ur.de](mailto:manuel.burghardt@ur.de)

**Blog:** [www.dhregensburg.de](http://www.dhregensburg.de)