

# Tools and services for text adaptation

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# Extractive summarization



Slider to change summarization

# Syntactic simplification

## TEXTFÖRENKLING

Inom kort kommer bostadsbolaget Bohososs AB troligtvis att höja omkostnader rörande lokalhyra och serviceavgifter. Beslutet kommer tas av bolagsstyrelsen under bolagets årliga sammanträde i maj. En markant stegring av avgifter kan emotes av hyresgästerna om förslaget bifalles. "Hyreshöjningen motsvarar den höjda kvalitén på bostadsservicen", kommenterar en kontaktperson för Bohososs.

Förenklingsgrad

☐ Låg

☐ Medel

☐ Hög

Förenkla

Bostadsbolaget Bohososs AB kommer troligtvis att höja omkostnader rörande lokalhyra och kort.

MOD: [Straight word order]

Beslutet kommer tas av bolagsstyrelsen under bolagets årliga sammanträde i maj.

En markant stegring av avgifter kan emotes av hyresgästerna om förslaget bifalles.

En kontaktperson för Bohososs kommenterar: " Hyreshöjningen motsvarar den höjda kvalitén på bostadsservicen ".

MOD: [Quote inverted]

☒ Anpassad

☒ Passiv till aktiv

☒ Rak ordföljd

☒ Meningsuppdelning

☐ Synonymutbyte

☒ Citatomvändning

☐ Decker set#1

☐ Decker set#2

- ☐ Passive to active
- ☐ Straight word order
- ☐ Sentence split
- ☐ Quotation inversion
- ☐ .
- ☐ .

# Challenges

- How to express text adaptation needs
  - Lexical
  - Syntactic
  - Text complexity
- Different users
  - Text producers
  - Teachers
  - End users



# End user demands

Reader audience	Examples of experienced difficulties
Dyslexia	Long and unfrequent words, homophones, ortographically similar words, new words
Aphasia	High information density, long sentences, long sequences of adjectives, passive tense, compound words
Second language learners	Limited vocabulary, cultural phenomena, text structure
Hearing impairment	Complex grammatical constuctions, text structure
Intellectual disabilities	Difficulties related to working memory, motivation for reading

# Text adaptation as design of intelligent agents

## Outline

- Interaction design and User experience
- Text adaptation examples
- Visualisation of text complexity
- Evaluations

# Interaction design and UX

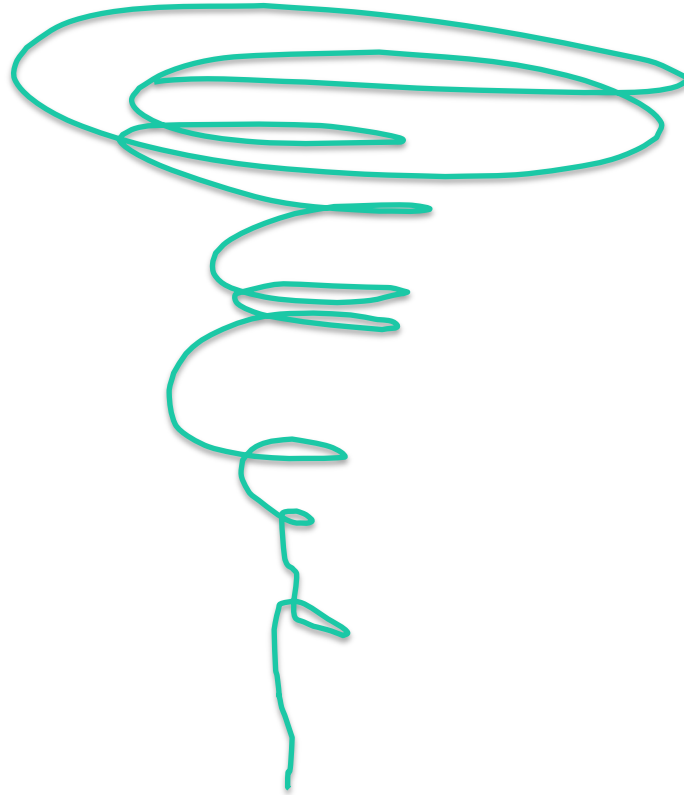
# Definitions

(ISO 9241-210:2010)

- Human-centred design
  - approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques
- User Experience, UX
  - person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service

# Three phases

- Concept phase
  - Ideas
- Adaption phase
  - Protoypes
- Details phase
  - Product



# Concept phase

- Interviews
- Workshops
- Observations
- Literature reviews and previous studies
- Personas

# Mapping users' experiences of an intelligent agent

	Before use	During use	After use
What the user knows <ul style="list-style-type: none"><li>• Knowledge</li><li>• Imaginations</li><li>• Goals</li></ul>	Reading difficulties Goal: understand a text	New words Text properties	Text content
What the user does <ul style="list-style-type: none"><li>• Step by step</li><li>• Tools and means</li></ul>	Start up	Adapt lexically, syntactically, contextually View text properties	Save results and profiles Get feedback
What the user feels <ul style="list-style-type: none"><li>• Experiences</li><li>• Feelings</li><li>• Driving forces</li></ul>	Avoidance	Text gets easier to decode and comprehend	Satisfaction

# Posture and embodiment

How the system presents itself to users

	Robot	Virtual agent	Embedded system
Sovereign			<i>Mail client</i>
Transient	Furhat	Clippy	SIMPLIFICA, AMesure
Daemonic			<i>Background processes</i>
Parasitic, Assisting		Alexa	Grammarly





# Grammarly

“Grammarly analyzes your text to identify misspellings, white and add commonly-confused words underlined in wrong context, like “affect” and “effect” to improve your writing.”

The screenshot displays the TeCST writing tool interface. The top bar includes a menu icon, the text "TeCST easy to write easy-to-read", and a settings gear icon. Below this is a toolbar with various icons for text editing and formatting. The main text area contains an example text about writing rules, with several words underlined in red, indicating corrections or suggestions. A large blue arrow points from the bottom right towards the text area. On the right side, there is a panel with three tabs: "Visualisering", "Textinformation", and "Textförenkling". The "Visualisering" tab is active, showing a circular radar chart with seven axes: "SweVoc (Total)", "Ovix", "Lix", "Genomsnittlig meningslängd", "Genomsnittlig ordlängd", "Andel bisatser", and "Meningsdjup". A color scale legend is positioned to the right of the chart. Below the chart, there is a small text box with a red warning icon and the text: "not only misspellings, but also only confused words used in 'affect' and 'effect.'". At the bottom right of the interface, there is a status bar showing "Antal ord: 392".

# Adaptation phase: Prototypes

- A simulation of the final product, not the final product.
- Interactive mock-up with varying degrees of fidelity. Not necessarily looking like the final product.
  - Paper prototyping (using paper, pencil, sticky notes, and index cards)
  - Computer prototypes (Power point, Adobe animate, Figma etc)
  - Wizard of Oz
- Gives insights into the users' interaction, the use flow.
- Test the feasibility and usability. Lead to unexpected discoveries and innovations.

# Text adaptation examples

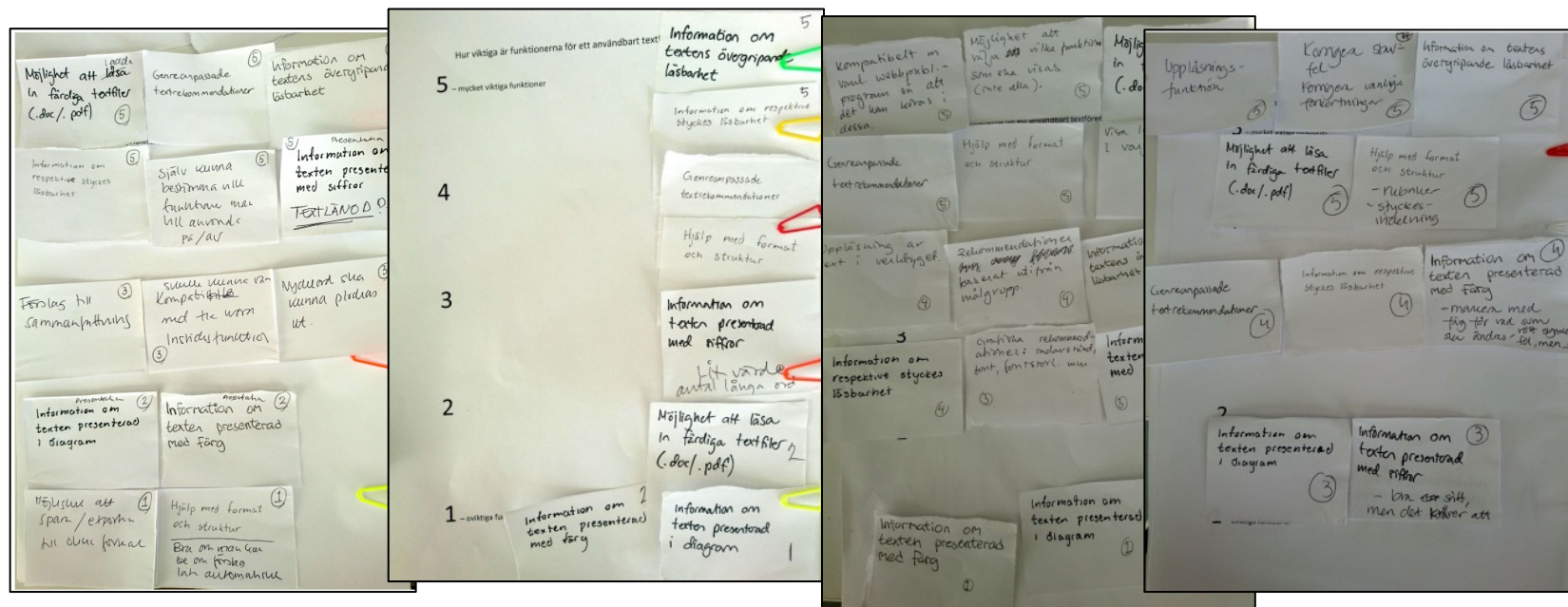
# Workshops

- A tool to write less complex
- Text producers
  - Web editors
- 2 workshops
  - Needs and functionality. Concept phase
  - Interaction and visualisation. Adaption phase



# Workshop A

- Needs and functionality
- Storyboards and brainstorming
- Four web editors



# Workshop B

- Interaction and visualisation
- Prototype evaluations
- Seven web editors

The image displays three side-by-side screenshots of a web editor interface, likely a prototype for a document editor. The interface includes a top toolbar with icons for text formatting (bold, italic, underline, strikethrough, text color, background color), list creation, and other standard editing functions. Below the toolbar is a text area containing Swedish text. The text is annotated with various handwritten notes and highlights in blue, green, and yellow.

**Left Screenshot:** The text area shows the beginning of a paragraph. Handwritten notes include "Lättläst" (Easy to read) and "Svår" (Difficult). A list of notes is visible at the bottom: "Många långa ord", "Ganska många långa meningar", and "OSV OSV".

**Middle Screenshot:** The text area continues the paragraph. Handwritten notes include "Lättläst" and "Svår". A list of notes is visible at the bottom: "Många långa ord", "Ganska många långa meningar", and "OSV OSV".

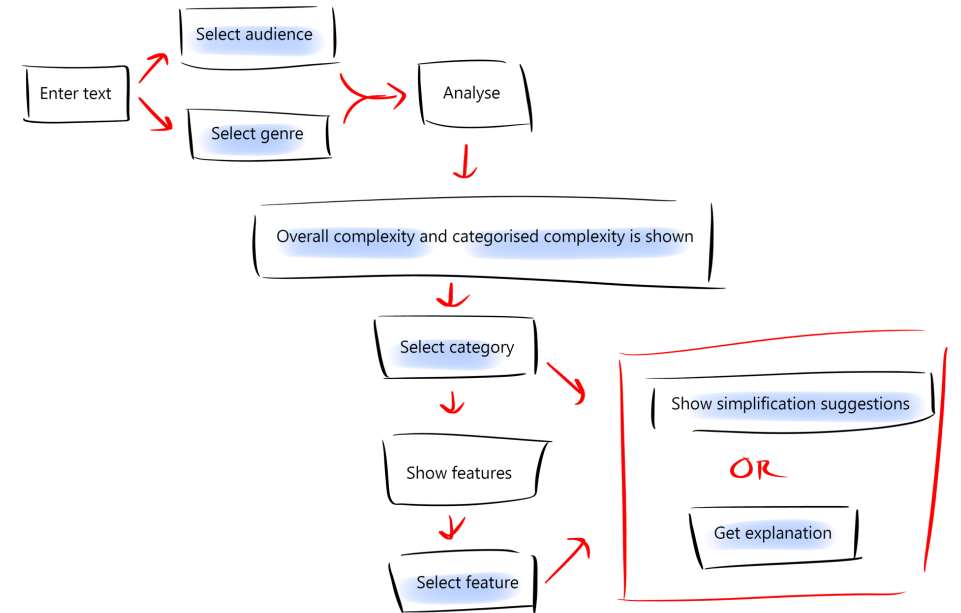
**Right Screenshot:** The text area shows the end of the paragraph. Handwritten notes include "Lättläst" and "Svår". A list of notes is visible at the bottom: "Många långa ord", "Ganska många långa meningar", and "OSV OSV".

Handwritten notes in the right margin of the right screenshot include: "Bestämms delar av texten" (Determined by parts of the text), "Helhet: Lättläst" (Overall: Easy to read), "Många långa ord" (Many long words), "Svår" (Difficult), "Förslag" (Suggestion), and "TIPS: Många långa ord" (TIPS: Many long words).

# Results

## Easy to use

- Supportive, no extra work
  - Clear connection between analysis and suggestions
- Adaptable and simple
  - Explanations
- Want readability measures
  - Understandable measures
  - Connected to passages in the text





# Scenario based design

- Short storys about users and their activities.
- Typical use cases with a focus on goals.
- No interface details.
- Objects and actions.



# Personas and scenarios

- Realistic, but fictive, user
  - Representing multiple users
- Example: Birgitta, one of our personas
  - Based on semistructured interviews
  - 17 students with varying reading problems and needs
  - Each interview lasted 1-1.5h
  - Recorded and transcribed
  - Identify behaviour variables
    - Grouping determines how many personas, Birgitta one of four

# Persona



Birgitta has been visually impaired all her 53-year-old life. She lives with her family in Lambohov and works at the Swedish Association of the Visually Impaired in Linköping. There she works with adult education for the visually impaired and other disabled people. Her duties include finding out what applies to the disabled with the employment service and the social insurance office and other legal aspects of academic studies. She also helps to bring various aids and extra resources to those who need them. This work requires that Birgitta is constantly updated on laws and regulations, which leads to a lot of searching and searching on the internet.

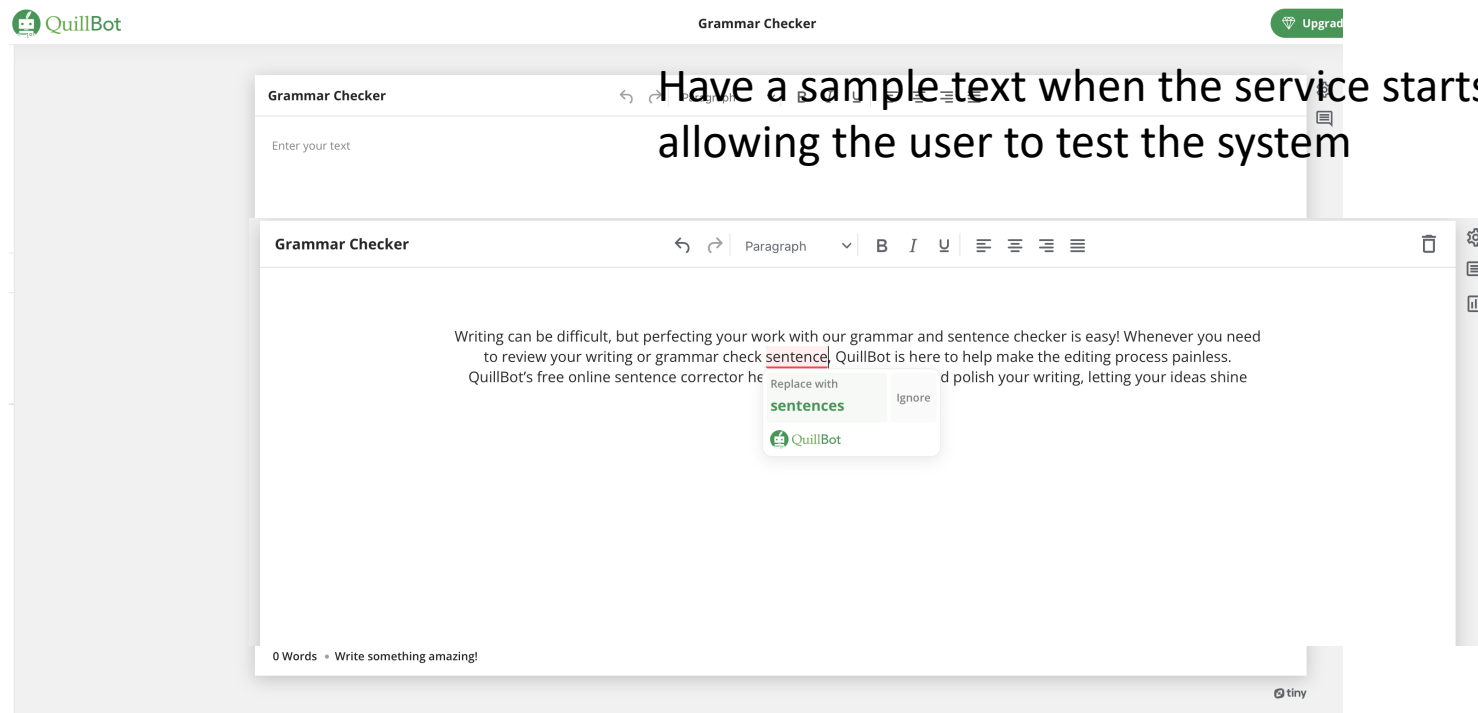
When she reads on the computer, she uses her magnification program and if she has to read a lot of text, she uses her speech synthesis to help, as it takes a lot of time and energy to read even when she uses her magnification program. Speech synthesis is not that fun to listen to and that's why she only uses it when she absolutely has to. Birgitta thinks that she reads a lot unnecessarily just to find what she needs. She finds this difficult and sometimes wishes it had been easier to sift through the information she reads.

Birgitta has difficulty seeing the mouse on the screen and therefore usually uses arrow keys and keyboard shortcuts to navigate the screen. This works differently on different websites. Birgitta thinks that the authorities' websites usually work well, as they are often structured, without unnecessary information and sketchy pictures. Such websites are easy to navigate even when the screen magnifier is on. Structure is a must for Birgitta, if the website is unstructured, it will be almost impossible to find what she is looking for. If the website is sketchy with a lot of information and pictures, it is easy for the speech synthesis to get stuck and this can also happen with the screen magnification program, which Birgitta thinks is incredibly difficult. It takes both time and energy to shut down the computer and start over from the beginning after the computer has hung up.

Birgitta thinks that it will be easier for her to see the text if the colors are inverted, as she experiences that the contrast becomes clearer, which makes her see the text better. She also uses yellow glasses to increase the contrast in the real environment.

# Design of AI services

- Guideline 10: Provide an environment for the user to familiarize themselves with the AI functionality in a test environment (sandbox).



# First impression guidelines

- Guideline 17: Communicate what the service does. Help the user to understand what capabilities the service contributes and what data functionality is based on.
  - Training data for abstractive text summarisers affect the summary
  - Extractive summarisation can be incoherent
  - Rule based and model based text simplification
- Guideline 18: Communicate what the service does not do. Help the user to understand the limitations of the service.
  - Text analysis or text editor
  - Are texts changed or only suggestions

# Continuous use guidelines

- Guideline 23: Let the service communicate uncertainties in the model of what the user's goal is, so that the user can make the final decision on what action to take.
- Multiple synonyms displayed

Text simplification editor for medical and health-related information

Participation ID: visitor

Simplification Lexical Chains Statistics

Select synonyms from:

- ☒ Wordnet
- ☒ UMLS

Other word-level suggestions:

- ☒ Get verb forms
- ☒ Get underlying meaning
- ☒ Use positive tone

Level of Suggestions:

Simplification level: 10

Less More

Variety level: 0.5

Less More

Sentence Level suggestions:

Simplify Text Clear Undo Submit

Leroy *et al.*, Evaluation of an online text simplification editor using manual and automated metrics for perceived and actual text difficulty, *JAIMA Open*, 2014

# Continuous use guidelines, 2

- Guideline 19: Explain how well the service works. Help the user to establish the right level of expectation.

- Simplification level = number of words identified as difficult
- Variety level = number of alternatives

Text simplification editor for medical and health-related information

Simplification Lexical Chains Statistics Participation ID: visitor

Cirrhosis, also known as liver cirrhosis or hepatic cirrhosis, and end-stage liver disease, is the impaired liver function caused by the formation of scar tissue known as fibrosis, due to damage caused by liver disease. Damage causes tissue repair and subsequent formation of scar tissue, which over time can replace normal f following issue leading to the impaired liver function of cirrhosis. The locally develops slowly over months or years. Early symptoms may next edness, weakness, loss of appetite, unexplained weight loss, followed by omitting, and discomfort in the right upper quadrant of the abdomen.

*Sentence Level suggestions:*

*Select synonyms from:*

- ☒ Wordnet
- ☒ UMLS

*Other word-level suggestions:*

- ☒ Get verb forms
- ☒ Get underlying meaning
- ☒ Use positive tone

*Level of Suggestions:*

Simplification level: 10

Less More

Variety level: 0.5

Less More

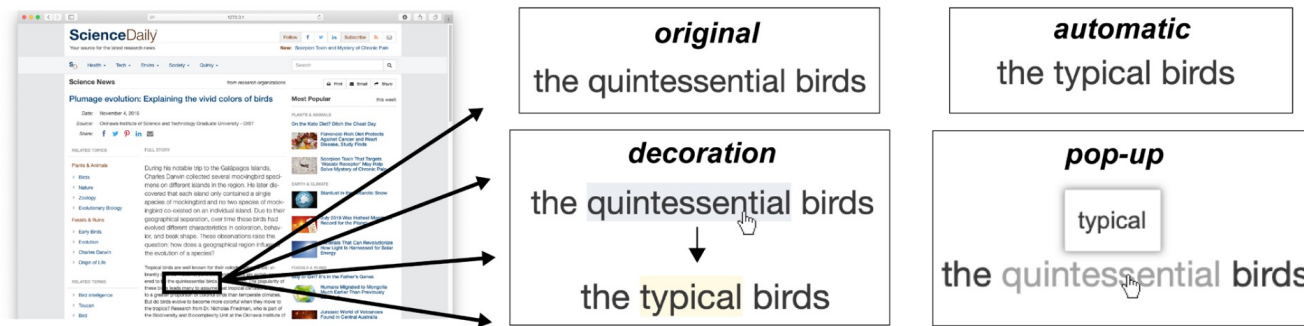
Simplify Text Clear Undo Submit

# Continuous use guidelines, 3

- Guideline 24: Design the service so that it communicates predictions and leaves decision-making to the user.
  - Found in our workshops with web editors

# Guideline 24: Lexical simplification

- Study with deaf and hard of hearing
- Three different conditions, and a baseline



Decoration changes  
Pop-up only displays

- No difference in comprehension
- Users prefer autonomy
  - Pop-up and decoration significantly higher scores on "likely to use"



# Lexi

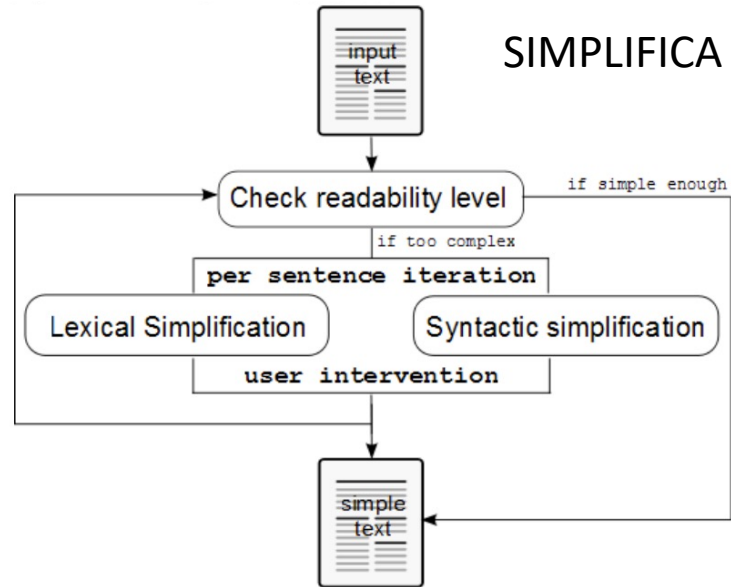
- When the user clicks on a green word it is replaced with a simpler alternative

## Tidlige karriere [\[ redigér | redigér wikikode \]](#)

Natasja startede allerede som 13-årig med at synge og DJ'e i København, hvor hun gjorde sig bemærket sammen med Miss Mukupa, McEmzee og DJ Kruzh'em i bandet No Name Requested.<sup>[2]</sup> I den periode optrådte hun blandt andet sammen med Queen Latifah og Dr. Baker<sup>[3]</sup>. Men i 1998 faldt hun af sin hest under sin uddannelse til professionel jockey, hvilket for en stund lagde en dæmper på hendes karriere.<sup>[4]</sup>

# Continuous use guidelines, 4

- Guideline 26: Remember, and use, the user's interaction history.



# FriendlyReader

- Seamless simplify text – summarise – further simplification – less summarisation – measure complexity –
- Very hard to implement.

Extractive summarizer

Abstractive summarizer

Syntactic simplification

Synonyms

Text complexity

The screenshot shows the FriendlyReader web application. The interface is divided into a left sidebar with a menu, a main content area, and a right sidebar with controls. The menu items are: 'Förkorta texten', 'Sammanfatta texten', 'Viktigaste meningarna', 'Förenkla texten', 'Anpassa textförenklingen', 'Visa synonymer', 'Få texten uppläst', 'Textinformation', 'Textkomplexitet', and 'Återställ texten'. The 'Förenkla texten' item is selected. The main content area displays a paragraph of text in Swedish. The right sidebar contains controls for font size (A<sup>-</sup>, A<sup>+</sup>), line spacing (↕, ⇅), font family (Calibri, Arial), and text alignment (↔, ⇄). Annotations with green arrows point from the text on the left to specific features in the interface: 'Extractive summarizer' points to 'Förkorta texten'; 'Abstractive summarizer' points to 'Sammanfatta texten'; 'Syntactic simplification' points to 'Förenkla texten'; 'Synonyms' points to 'Visa synonymer'; and 'Text complexity' points to 'Textkomplexitet'.

**Friendlyreader**

Förkorta texten

Förkorta texten genom att välja en storlek med dragreglaget

Sammanfatta texten

Viktigaste meningarna

Förenkla texten

Anpassa textförenklingen

- ☒ Rak ordföljd
- ☒ Passiv till aktiv form
- ☒ Proximering
- ☒ Citatomvändning
- ☒ Meningsuppdelning

Förenkla

Visa synonymer

Få texten uppläst

Textinformation

Textkomplexitet

Återställ texten

Genomsnittlig ordlängd

Genomsnittlig meningslängd

Återställ texten

FriendlyReader är en tjänst för att på olika sätt förenkla texter. Tjänsten består av ett antal språkteknologiska verktyg för textförenkling, mätning av textkomplexitet, byte av svåra ord mot synonymer och visualisering av textkomplexitet. I FriendlyReader kan du välja flertalet olika funktioner för att förenkla läsning och förståelse av text och också få texten uppläst, ändra textstorlek, radavstånd, kolumnbredd och texttyp. Du kan ta denna text som en exempeltext som du kan testa verktyget med genom att trycka knappen KÖR! Du kan också ta bort exempeltexten och klistra in en egen text som du vill förenkla.

A<sup>-</sup> A<sup>+</sup>

↕ ⇅

T

Calibri

T

Arial

↔ ⇄

# Continuous use guidelines, 5

- Guideline 28: Minimize the cost of bad guesses and allow the user to use partially performed work whenever possible
  - Abstractive summarisation often takes time and it is hard to change the length

# Visualisation of text complexity

# Text complexity - Readability

Sentence length and long words

- Flesch-Kincaid
- Gunning Fox
- Coleman-Liau
- SMOG
- LIX (Swedish)



LIX = 42



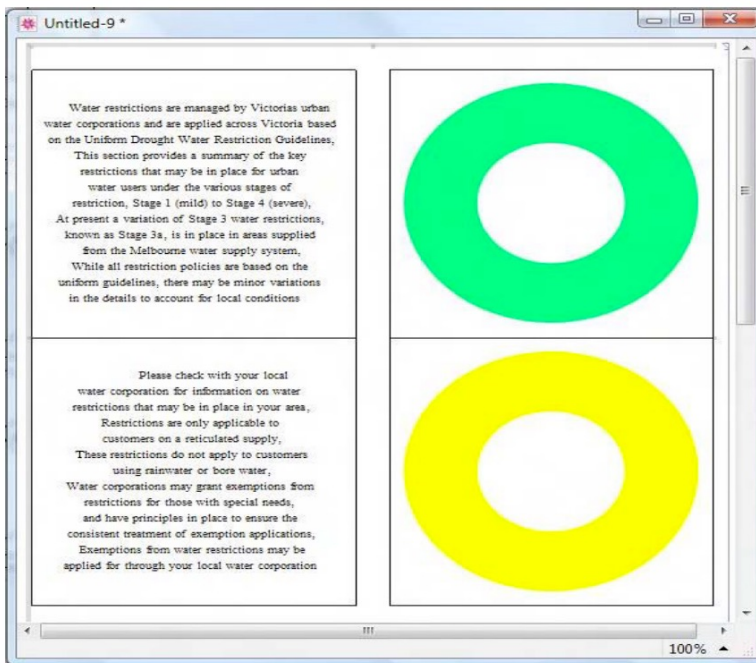
Text difficulty	LIX
Very Easy	< 30
Easy	30-40
Medium	40-50
Difficult	50-60
Very Difficult	> 60



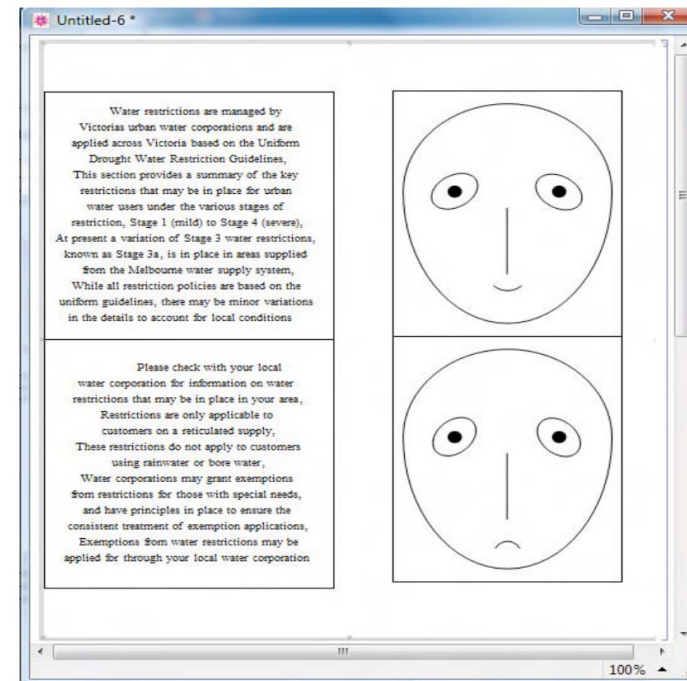
Medium, normal news paper text

# Visualizing multiple text readability indexes

Five sentence length readability indexes (Flesch-Kincaid, Gunning Fox, Coleman-Liau, SMOG, Automatic readability index)



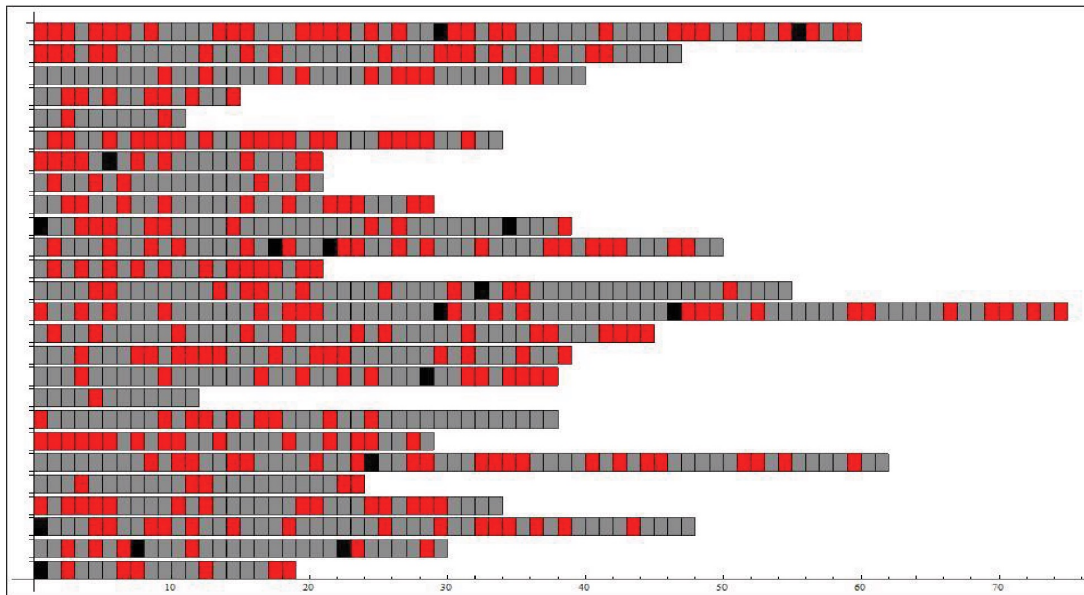
... weighted and colour coded



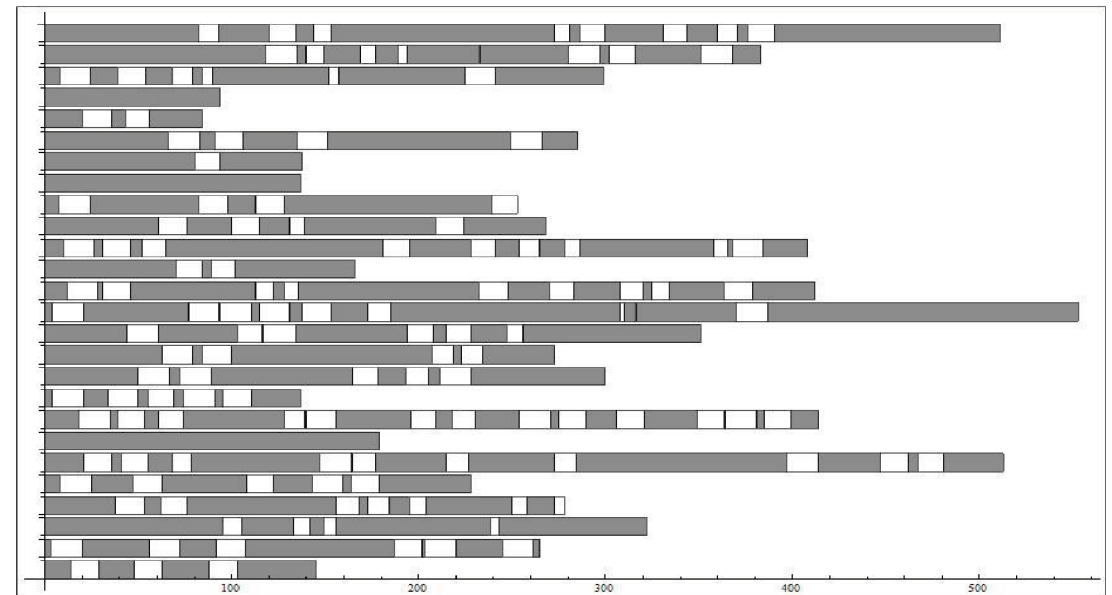
... mapped to facial characters

# Visualizing text complexity, Karmakar & Zhu

Each bar represents a sentence. Each section represents a word (left) or sub-clause (right).



Lexical complexity (Dale-Chall in grey), red means not on that list and black are non words



Syntactic complexity, sub-clauses in grey. The white gaps are indicators of the level of depth.




# Lärka

Colour codes representing different reading proficiency levels

Pilán, *et.al.*, Coursebook Texts as a Helping Hand for Classifying Linguistic Complexity in Language Learners' Writings, *Proceedings of the Workshop on Computational Linguistics for Linguistic Complexity*, Japan, 2016

Exercise GeneratorHit-ExLearner Corpora EditorText evaluation

SvenskaEnglish



Language Acquisition Reusing *Korp*

Filmen hanlar om en pojke . Han heter NN och han gilla dansar ballet så mycket . När han har idrott lektion , brukar han inte träna boxning så att träna ballet med många tjejer i nästa klassrummet . Han tränar dansa mycket , var och när han kan . Hans lärare ger för han ett par skor av ballet och han gömmer den mellan för två medrasser . Den mest intressanta person i filmen är Billy . Han är en snål pojke . Hans mamma dog , han bor med hans pappa , brott och hans mormor . Han älskar hans mormor så mycket . Hon är gammal och hon brukar göra konstiga saker . Billy sörjer när han saknar hans mamma . Hans pappa är en gruvs och han stöjar för att alla person måste jobba mycket hårt men för inte mycket pengar för familj , mat och deras liv . Deätte arg filmen utspelar @ ag i England på 1984- talet . Liv av människor är fattiga . Man syns på kläderna i filmen . Man trots att det måste vara på 1984- talet .

What do you want to assess? ⓘ

Learner essayText readability

Show all words of the following CEFR level(s) ⓘ

☒ A1☐ A2☒ B1☒ B2☒ C1

Additional options ⓘ

☒ Mark all potentially incorrect words☐ Use Spellchecker

Edit textReset

### Evaluation

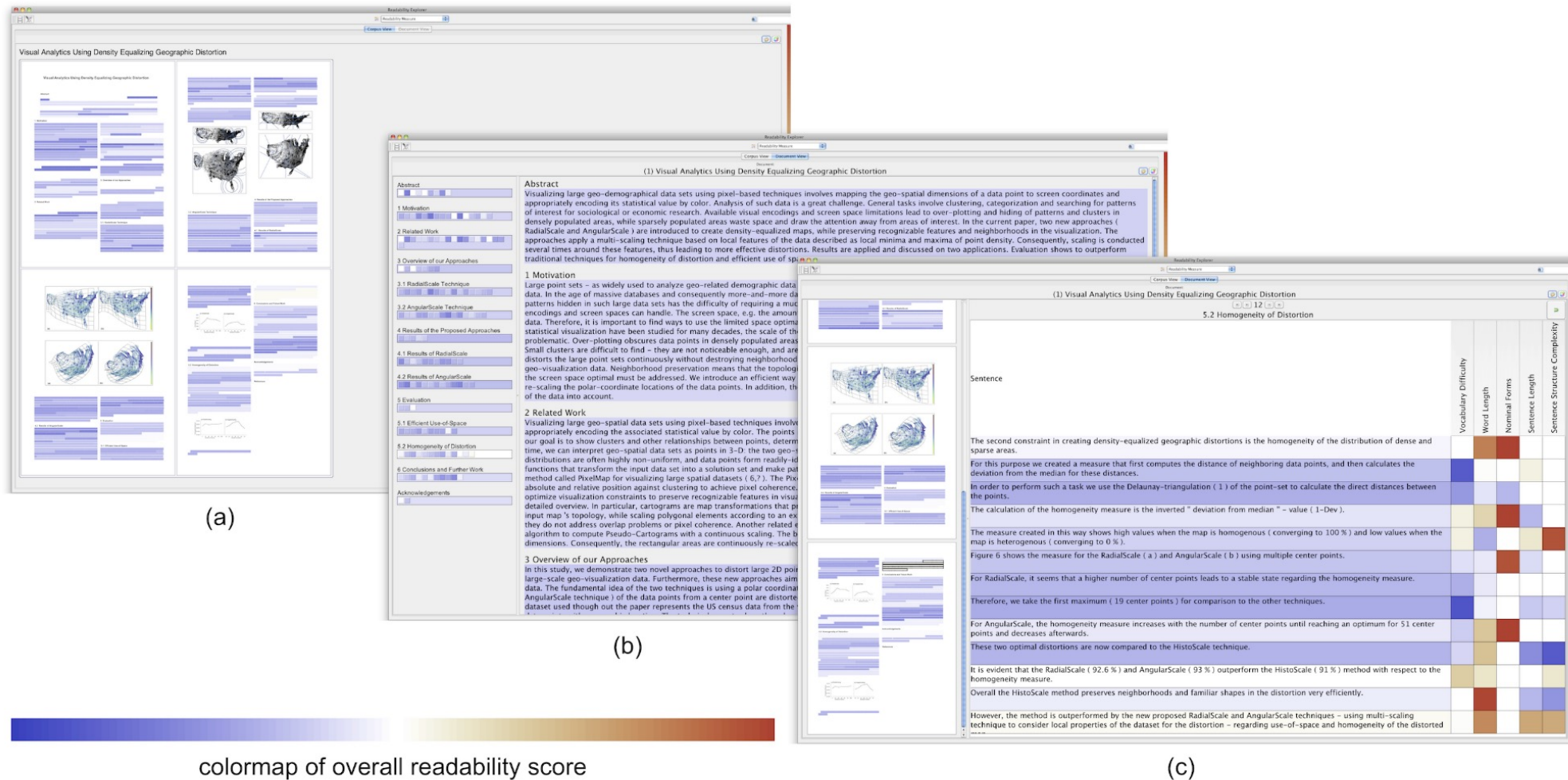
Overall level: B1

Detailed evaluation

Number of sentences	16
Number of tokens	189
Non-lemmatized forms	11
Average sentence length	11.81
Average token length	3.8
Average dependency length	1.92
LIX score	18 (very easy)

# VisRA

- Filtered feature set, displayed in various ways



Oelke *et al.*, Visual readability analysis: How to make your writings easier to read, *VAST 10 - IEEE Conference on Visual Analytics Science and Technology 2010*, Utah, USA

# AMesure

- Writing tool
- Performance evaluated

François *et.al.*, AMesure: A Web Platform to Assist the Clear Writing of Administrative Texts, *Proceedings of the 1st Conference of the Asia-Pacific Chapter of the Association for Computational Linguistics and the 10th International Joint Conference on Natural Language Processing: System Demonstrations*, Suzhou, China, 2020

Exemple

3/5

Difficulté globale

Difficulté lexicale

Difficulté syntaxique

Difficulté textuelle

Pourcentage de mots difficiles :	0.183	
Nombre de mots rares :	9	
Densité des abréviations :	0,00 %	
Abréviations non expliquées :	0	
Nombre de termes techniques :	9	

Analyse détaillée

Palette d'analyse

Analyse des phrases

Subordonnées

Toutes 11 [22]

Relatives 3 [6]

Complétives 1 [1]

Autres 7 [15]

Voix passive

Toutes 11

Texte annoté :

Le rôle est un document fiscal global qui reprend le nom de l'ensemble des redevables ainsi que le montant de l'impôt ou de la taxe dont ils sont redevables.

En matière de redevance télévision, vous êtes tenu par la loi, entantque redevable, de payer la redevance dans le délai fixé par l'invitation à payer qui vous est adressée par l'administration fiscale wallonne (Direction générale opérationnelle de la Fiscalité).

Si vous n'effectuez pas le paiement réclamé par cette invitation, le montant dû est alors enrôlé et un avertissement-extrait de rôle ( qui est donc un extrait individuel du rôle vous concernant personnellement) vous sera alors envoyé.

# LX CEFR

- Flesch Reading Ease Index
- Lexical category density in proportion of nouns
- Average word length in number of syllables per word
- Average sentence length in number of words per sentence

Branco *et.al.*, Rolling out text categorization for language learning assessment supported by language technology, *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 2014



Desenvolvido na [Universidade de Lisboa](#), Departamento de Informática, pelo NLX-Grupo de Fala e Linguagem Natural.

[ver um exemplo](#) | [características](#)

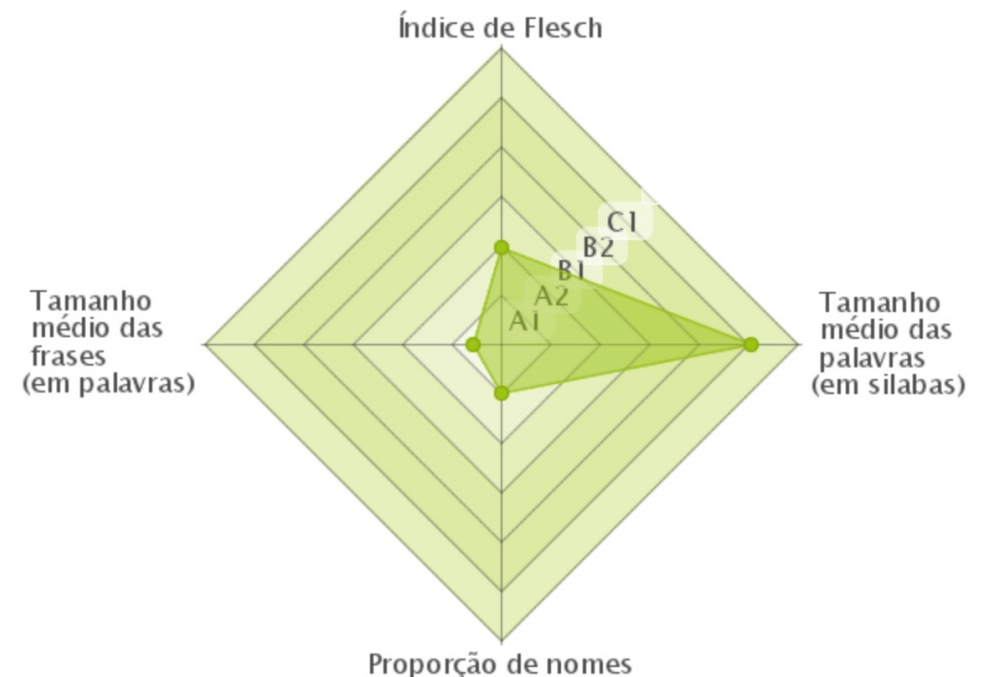
**Introduza uma frase:**

A família de Luciano  
Luciano tem oito anos e possui uma família que admira muito. Ele gosta de desenhar seus familiares quando está de férias.

Sua mãe chama-se Olívia e tem cabelos castanhos e longos. Ela gosta de assistir novelas e cultivar um jardim de rosas brancas.

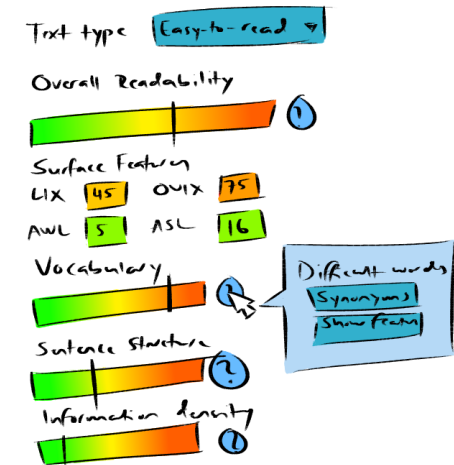
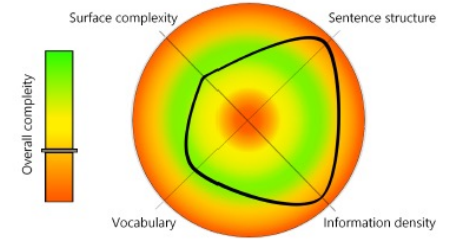
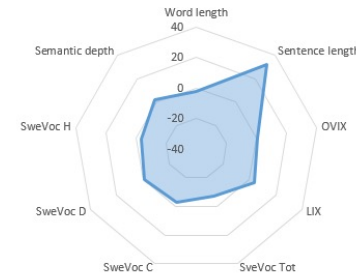
[Analisar](#)

[Limpar](#)



# A user study on visualisations

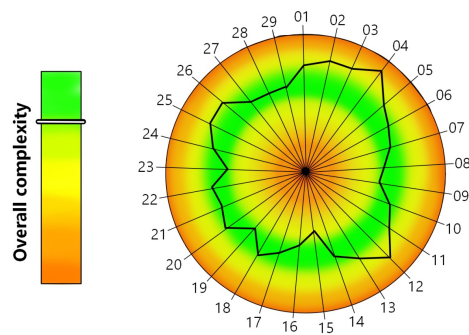
- Web form
  - 11 web editors
  - Various visualisations presented
  - Different visualisation interpretation tasks
  - Questionnaire
- Results
  - Preferred Bar, easier to understand, fewer parameters
  - Radar diagram more informative, more nuanced, compact
  - Combined





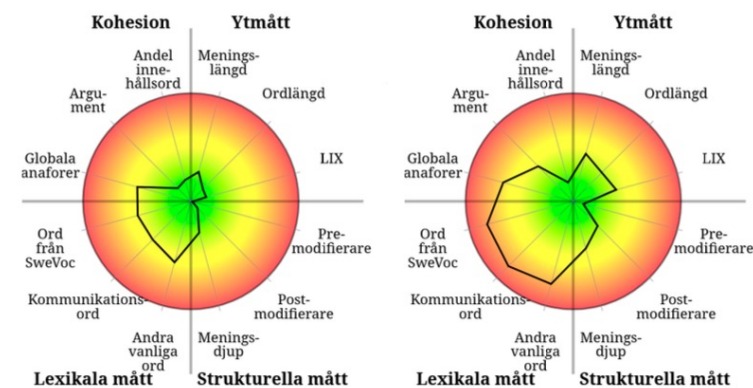
# Which measures

- Workshop with 12 experts
  - No consensus
  - Group parameters
  - Parameters correlate
- Factor analysis (PCA)
  - 29 components



# Evaluation of the text complexity visualisation

- Three semi-structured focus groups with two special teachers
- Open questions on text complexity and two radar diagrams
- Text complexity
  - Do not always know exactly what their students are struggling with
  - Intuition regarding a text's complexity,
  - Challenging to explain what aspects make a text complex.
    - Text length, word length, unusual words, too much to read between the lines, sentence length and the visual impression of the text
- Visualisation
  - Sentence length, word length and number of long words pretty straightforward
  - Arguments, sentence depth, SweVoc, pre-/post-modifiers and anaphors more difficult to understand
  - Difficult for most participants to connect the colours to the measurements and what it indicates about the texts



Kohesion=Cohesion,  
Ytmått=Surface,  
Strukturella mått=Structural,  
Lexikala mått=Lexical

# Evaluations



# Evaluation of adapted texts

- Intrinsic
  - Data driven
  - Various metrics
    - Readability metrics
      - Lexical Complexity
      - Sentence Complexity
    - BLEU
    - SARI
    - SAMSA
    - BERTScore
  - Few corpora on various user groups
  - "Cheaper"
- Extrinsic
  - Human evaluations
  - More user group specific
  - Fewer data points
  - Crowdsourcing

# Extrinsic evaluations of simplifications

- Lexical and syntactic evaluations
  - Fluency, adequacy, and simplicity
  - Eye tracking
- Summarisations
  - Content, fluency
- Text complexity
  - Classifiers
  - Recall, precision, and F1-score for various phenomena

# Evaluation of tools and services

- Formative
  - During the development
  - Allow for adjustments
  - Target user groups
    - Personas guide
  - Low-fi prototypes
  - Users perform tasks
- Summative
  - Test of complete system
  - Intrinsic
    - Chat bots evaluated on corpora
  - Extrinsic
    - Standard evaluations, e.g. SUS
    - Intended user groups

# Summary

- Tools for adaptation must be usable
- Users have different needs
  - Writers, readers, teachers
- Not straightforward to express how to adapt
- Various techniques to understand users' needs
  - Interviews
  - Workshops
  - Personas
- Design principles guide interface development