Automatic Text Simplification and Linguistic Complexity Measurements
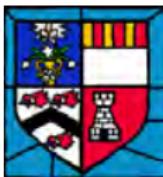
Advaith Siddharthan

University of Aberdeen
Scotland

What is Text Simplification

We are twelve billion light years from the edge,
That's a guess,
No-one can ever say it's true,
But I know that I will always be with you.

- Katie Melua

What is Text Simplification

We are twelve billion light years from the edge,
That's a guess,
No-one can ever say it's true,
But I know that I will always be with you.

- Katie Melua

We are 13.7 billion light-years from the edge of the observable universe,
That's a good estimate,
With well-defined error bars,
And with the available information, I predict that I will always be with you.

- Simon Singh

Text Simplification and Complexity

- Aims to make information/meaning more accessible through reformulation
- I.e. to reduce linguistic complexity, targetting for instance:

Text Simplification and Complexity

- Aims to make information/meaning more accessible through reformulation
- I.e. to reduce linguistic complexity, targetting for instance:
  - Lexis
    - The words in the text reflect the difficulty of the topic
    - Replace difficult words with simpler synonyms
    - Replace technical jargon with definitions

Text Simplification and Complexity

- Aims to make information/meaning more accessible through reformulation
- I.e. to reduce linguistic complexity, targeting for instance:
  - Lexis
  - Syntax
    - Longer sentences with embedded clauses are more difficult to read than shorter sentences
    - Split complicated multi-clause sentences into simpler ones

Text Simplification and Complexity

- Aims to make information/meaning more accessible through reformulation
- I.e. to reduce linguistic complexity, targetting for instance:
  - Lexis
  - Syntax
  - Text Length
    - Longer texts require readers to have more stamina and a greater capacity to remember details
    - Reduce text length by deleting peripheral information

Text Simplification and Complexity

- Aims to make information/meaning more accessible through reformulation
- I.e. to reduce linguistic complexity, targetting for instance:
    - Lexis
    - Syntax
    - Text Length
        - Texts with key information repeated in different ways is more likely to result in retention of information
        - Increase text length by adding redundancy (through reformulation, analogy, metaphor, examples...)

Text Simplification and Complexity

- Aims to make information/meaning more accessible through reformulation
- I.e. to reduce linguistic complexity, targetting for instance:
  - Lexis
  - Syntax
  - Text Length
  - Discourse
    - Chronological or cause/effect ordering of sentences is easier to follow than more sophisticated structures - stories within stories, flashbacks, parallel plots, etc.
    - Reorder information to simplify argumentation

Text Simplification and Complexity

- Aims to make information/meaning more accessible through reformulation
- I.e. to reduce linguistic complexity, targetting for instance:
  - Lexis
  - Syntax
  - Text Length
  - Discourse
    - Cohesive texts are easier to follow
    - Make content more transparent by making discourse relations explicit

Text Simplification and Complexity

- Aims to make information/meaning more accessible through reformulation
- I.e. to reduce linguistic complexity, targetting for instance:
  - Lexis
  - Syntax
  - Text Length
  - Discourse
  - Semantics
    - The readers' background knowledge affects their ability to read and comprehend texts
    - Conceptual simplification
    - Numerical simplification
    - Simplify meaning

Text Simplification and Complexity

- Aims to make information/meaning more accessible through reformulation
- I.e. to reduce linguistic complexity, targetting for instance:
    - Lexis
    - Syntax
    - Text Length
    - Discourse
    - Semantics
    - Quality
        - Errorful text is harder to read
        - Check spelling and grammar

Text Simplification and Complexity

- Aims to make information/meaning more accessible through reformulation
- I.e. to reduce linguistic complexity, targetting for instance:
  - Lexis
  - Syntax
  - Text Length
  - Discourse
  - Semantics
  - Quality
    - More engaging text is easier to read
    - Paint a picture (use visual words)
    - Personal narratives
    - Humour

Manual Text Simplification

- Explored extensively with regard to (typically, middle) school performance

Manual Text Simplification

- Explored extensively with regard to (typically, middle) school performance
  - L'Allier (1980): lexical and syntactic text revision brings low ability readers above the performance level of middle ability readers on the original text.

Manual Text Simplification

- Explored extensively with regard to (typically, middle) school performance
  - L'Allier (1980): lexical and syntactic text revision brings low ability readers above the performance level of middle ability readers on the original text.
  - Beck et al. (1991): Students' reading comprehension improves through making discourse relations explicit.

Manual Text Simplification

- Explored extensively with regard to (typically, middle) school performance
  - L'Allier (1980): lexical and syntactic text revision brings low ability readers above the performance level of middle ability readers on the original text.
  - Beck et al. (1991): Students' reading comprehension improves through making discourse relations explicit.
  - Linderholm et al. (2000): Reformulating causal relations for relatively difficult texts facilitates for poor readers.

Manual Text Simplification

- Explored extensively with regard to (typically, middle) school performance
  - L'Allier (1980): lexical and syntactic text revision brings low ability readers above the performance level of middle ability readers on the original text.
  - Beck et al. (1991): Students' reading comprehension improves through making discourse relations explicit.
  - Linderholm et al. (2000): Reformulating causal relations for relatively difficult texts facilitates for poor readers.
  - Anderson & Davison (1988) and Irwin (1980): Specific information orderings were found to facilitate readers with poorer reading ability

Manual Text Simplification

- Explored extensively with regard to (typically, middle) school performance

- Similar results have been found for readers with low levels of domain expertise Noordman & Vonk (1992); Kamalski et al. (2008); McNamara et al. (1996).

Manual Text Simplification

- Explored extensively with regard to (typically, middle) school performance

- Similar results have been found for readers with low levels of domain expertise Noordman & Vonk (1992); Kamalski et al. (2008); McNamara et al. (1996).

- Similar results have been found for L2 (Long & Ross, 1993; Yano et al., 1994; Tweissi, 1998; Gardner & Hansen, 2007)

Some criticisms of text simplification

Honeyfield (1977); Long & Ross (1993); Yano et al. (1994); Oh (2001):

- Can impede language acquisition
- Homogenises vocabulary across the text, and makes important information harder to identify
- Simplified texts are not interesting
- Not really simpler (e.g. use of readability formulae as guides to writing)

System Complexity $\longrightarrow$ Text Complexity

- System Complexity is an (unstatistical) property
  What is allowed by the language?

System Complexity $\longrightarrow$ Text Complexity

- System Complexity is an (unstatistical) property
  What is allowed by the language?
- Text Complexity is then a counting exercise

System Complexity $\longrightarrow$ Text Complexity

- System Complexity is an (unstatistical) property
  What is allowed by the language?
- Text Complexity is then a counting exercise
- If most of the difficult bits in the grammar are rarely used, the text is considered simple

System Complexity $\longrightarrow$ Text Complexity

- System Complexity is an (unstatistical) property
  What is allowed by the language?
- Text Complexity is then a counting exercise
- If most of the difficult bits in the grammar are rarely used, the text is considered simple
- Automatic Text Simplification rewrites texts by translating difficult constructs to easier ones

System Complexity $\longrightarrow$ Text Complexity

- System Complexity is an (unstatistical) property
  What is allowed by the language?
- Text Complexity is then a counting exercise
- If most of the difficult bits in the grammar are rarely used, the text is considered simple
- Automatic Text Simplification rewrites texts by translating difficult constructs to easier ones
  - Monolingual Translation

System Complexity $\longrightarrow$ Text Complexity

- System Complexity is an (unstatistical) property
  What is allowed by the language?
- Text Complexity is then a counting exercise
- If most of the difficult bits in the grammar are rarely used, the text is considered simple
- Automatic Text Simplification rewrites texts by translating difficult constructs to easier ones
  - Monolingual Translation
  - Same "system", different probabilities

My recent work on Automatic Text Simplification

The original police inquiry, which led to Mulcaire being jailed in 2007, also discovered evidence that he has successfully intercepted voicemail messages belonging to Rebekah Brooks, who was editor of the Sun when Mulcaire was working exclusively for its Sunday stablemate.

My recent work on Automatic Text Simplification

The original police inquiry, which led to Mulcaire being jailed in 2007, also discovered evidence that he has successfully intercepted voicemail messages belonging to Rebekah Brooks, who was editor of the Sun when Mulcaire was working exclusively for its Sunday stablemate.

- Syntactic Simplification (Siddharthan, 2010, 2011):

  The original police inquiry led to Mulcaire being jailed in 2007. The inquiry also discovered evidence that he has successfully intercepted voicemail messages belonging to Rebekah Brooks. Rebekah Brooks was editor of the Sun. Mulcaire was working exclusively for its Sunday stablemate then.

My recent work on Automatic Text Simplification

The original police inquiry led to Mulcaire being jailed in 2007. The inquiry also discovered evidence that he has successfully intercepted voicemail messages belonging to Rebekah Brooks. Rebekah Brooks was editor of the Sun. Mulcaire was working exclusively for its Sunday stablemate then.

- Lexical Simplification (Siddharthan & Angrosh, 2014):

The first police inquiry led to Mulcaire being jailed in 2007. The police enquiry also found proof that he has successfully intercepted voicemail messages belonging to Rebekah Brooks. Rebekah Brooks was editor of the Sun. Mulcaire was working only for its Sunday stablemate then.

Text Simplification and Complexity
○○○○○●○

Simple Language
○○○○○

Automatic Text Simplification
○○○○○○

Evaluating Simplified Texts
○○○○○○

My recent work on Automatic Text Simplification

The first police inquiry led to Mulcaire being jailed in 2007. The police enquiry also found proof that he has successfully intercepted voicemail messages belonging to Rebekah Brooks. Rebekah Brooks was editor of the Sun. Mulcaire was working only for its Sunday stablemate then.

- Sentence Compression (Angrosh et al., 2014):

The police inquiry led to Mulcaire being jailed in 2007. The enquiry found proof that he has intercepted messages belonging to Rebekah Brooks. Brooks was editor of the Sun. Mulcaire was working for its Sunday stablemate.

ATS and complexity

- Automatic Text Simplification
  - Aims to reduce text complexity - reduce likelihood of encountering difficult constructs permitted by the grammar

ATS and complexity

- Automatic Text Simplification
  - Aims to reduce text complexity - reduce likelihood of encountering difficult constructs permitted by the grammar
  - References a variety of disciplines (in a slightly ad-hoc manner) to decide what to simplify

ATS and complexity

- Automatic Text Simplification
  - Aims to reduce text complexity - reduce likelihood of encountering difficult constructs permitted by the grammar
  - References a variety of disciplines (in a slightly ad-hoc manner) to decide what to simplify
  - Is evaluated through various online and offline tests

ATS and complexity

- Automatic Text Simplification
  - Aims to reduce text complexity - reduce likelihood of encountering difficult constructs permitted by the grammar
  - References a variety of disciplines (in a slightly ad-hoc manner) to decide what to simplify
  - Is evaluated through various online and offline tests
- Generally, readability/complexity metrics are not very informative for evalating ATS

ATS and complexity

- Automatic Text Simplification
  - Aims to reduce text complexity - reduce likelihood of encountering difficult constructs permitted by the grammar
  - References a variety of disciplines (in a slightly ad-hoc manner) to decide what to simplify
  - Is evaluated through various online and offline tests
- Generally, readability/complexity metrics are not very informative for evalating ATS
  - These assume error-free text

ATS and complexity

- Automatic Text Simplification
  - Aims to reduce text complexity - reduce likelihood of encountering difficult constructs permitted by the grammar
  - References a variety of disciplines (in a slightly ad-hoc manner) to decide what to simplify
  - Is evaluated through various online and offline tests
- Generally, readability/complexity metrics are not very informative for evalating ATS
  - These assume error-free text
  - ATS struggles to produce error-free text
  - Evaluations focus on correctness of operations, and (sometimes) impact on comprehension

Example of simplified language

- Motherese: The language adults use to talk to children
  (Cross, 1977; Papoušek et al., 1987; Gleitman et al., 1984)

Example of simplified language

- Motherese: The language adults use to talk to children (Cross, 1977; Papoušek et al., 1987; Gleitman et al., 1984)
  - Lexical:
    - reduced vocabulary
    - reduction in the number of verb inflections
    - replacement of pronouns with names

Example of simplified language

- Motherese: The language adults use to talk to children (Cross, 1977; Papoušek et al., 1987; Gleitman et al., 1984)
    - Syntactic:
        - reduction of pre-verb length and complexity
        - reduction in the number of embedded clauses and conjunctions
        - shortening of utterance lengths
        - reduction in the number of disfluencies and fragments

Text Simplification and Complexity
○○○○○○○

Simple Language
●○○○○

Automatic Text Simplification
○○○○○○

Evaluating Simplified Texts
○○○○○○

Example of simplified language

- Motherese: The language adults use to talk to children (Cross, 1977; Papoušek et al., 1987; Gleitman et al., 1984)
  - Speech: slowing of speech rate

Example of simplified language

- Motherese: The language adults use to talk to children (Cross, 1977; Papoušek et al., 1987; Gleitman et al., 1984)
    - Similar observations for bilingual accommodation (e.g., Giles et al., 1973)

Text Simplification and Complexity
0000000

Simple Language
●0000

Automatic Text Simplification
000000

Evaluating Simplified Texts
000000

Controlled language

- Controlled Language: interest from industries in creating better (less ambiguous and easier to translate) user manuals (O'Brien, 2003)

Controlled language

- Controlled Language: interest from industries in creating better (less ambiguous and easier to translate) user manuals (O'Brien, 2003)
  - Lexical:
    - Rule out use of particular acronyms, synonyms, pronouns and ambiguous anaphoric reference, double negations
    - insist on inclusion of relative pronoun
    - standardise format for numbers and dates
    - specify dictionary, rule out ambiguous words.

Controlled language

- Controlled Language: interest from industries in creating better (less ambiguous and easier to translate) user manuals (O'Brien, 2003)
    - Syntactic:
        - rule out ellipsis
        - insist on use of article or demonstrative
        - restrict size of noun cluster
        - specify location of prepositions to reduce ambiguity
        - rule out passive voice, insist on indicative mood
        - specify use of punctuation

Controlled language

- Controlled Language: interest from industries in creating better (less ambiguous and easier to translate) user manuals (O'Brien, 2003)
  - Textual Structure:
    - specify when lists or tables should be used
    - constrain maximum sentence and paragraph lengths
    - specify keywords to use for coherence
    - restrict use of parentheticals.

Controlled language

- Controlled Language: interest from industries in creating better (less ambiguous and easier to translate) user manuals (O'Brien, 2003)
  - Pragmatic:
    - rule out use of metaphor, slang or idiom
    - urge author to be as specific as possible

Target reader populations

- Deaf readers
  (Quigley & Paul, 1984; Marschark & Spencer, 2010)
  - infrequent words, coordination, subordination,
    pronominalisation, passive voice and relative clauses...

Target reader populations

- Deaf readers
  (Quigley & Paul, 1984; Marschark & Spencer, 2010)
  - infrequent words, coordination, subordination, pronominalisation, passive voice and relative clauses...

- Aphasic readers
  (Shewan & Canter, 1971; Caplan, 1992; Parr, 1993)
  - infrequent and sppecific words, long sentences, coordinated and relative clauses and passive voice...

Target reader populations

- Deaf readers
  (Quigley & Paul, 1984; Marschark & Spencer, 2010)
  - infrequent words, coordination, subordination, pronominalisation, passive voice and relative clauses...

- Aphasic readers
  (Shewan & Canter, 1971; Caplan, 1992; Parr, 1993)
  - infrequent and sppecific words, long sentences, coordinated and relative clauses and passive voice...

- Dyslexic readers
  (Vellutino et al., 2004; Ramus, 2003)
  - infrequent and long words...

ATS for target reader populations

- Deaf readers (Daelemans et al., 2004)
- Aphasic readers (Carroll et al., 1998)
- Children (De Belder & Moens, 2010)
- Low Literacy Adults (Specia, 2010)
- L2 learners (Petersen, 2007)
- Dyslexic readers (Rello et al., 2013)

Challenges for ATS (and complexity?)

- Simplify through elaboration or use of analogy/metaphor
  - Ubiquitous in science texts for children:
    "The cell as a marketplace", etc.
  - Also emphasised by L2 community

Challenges for ATS (and complexity?)

- Simplify through elaboration or use of analogy/metaphor
  - Ubiquitous in science texts for children:
    "The cell as a marketplace", etc.
  - Also emphasised by L2 community
  - ATS: How?

Challenges for ATS (and complexity?)

- Simplify through elaboration or use of analogy/metaphor
  - Ubiquitous in science texts for children:
    "The cell as a marketplace", etc.
  - Also emphasised by L2 community
  - ATS: How?
  - Complexity: Can complexity/readability measures capture this?

Challenges for ATS (and complexity?)

- Be unambiguous and specific
  - Emphasized by Controled Language prescriptions
  - But, simpler / more frequent words have more senses
  - But, simpler / more frequent words are less specific

Challenges for ATS (and complexity?)

- Be unambiguous and specific
  - Emphasized by Controled Language prescriptions
  - But, simpler / more frequent words have more senses
  - But, simpler / more frequent words are less specific
  - ATS: Do lexical simplifications always help?
    In a pilot study, readers showed a preference for less polysemous (but also less frequent) words (Walker et al., 2011)

Challenges for ATS (and complexity?)

- Be unambiguous and specific
  - Emphasized by Controled Language prescriptions
  - But, simpler / more frequent words have more senses
  - But, simpler / more frequent words are less specific
  - ATS: Do lexical simplifications always help?
    In a pilot study, readers showed a preference for less polysemous (but also less frequent) words (Walker et al., 2011)
  - Complexity: Can complexity/readability measures capture ambiguity effects?

Early Motivations for ATS

Text Simplification and Complexity
OOOOOOO

Simple Language
OOOOO

Automatic Text Simplification
●OOOOO

Evaluating Simplified Texts
OOOOOO

Early Motivations for ATS

- Reduce linguistic complexity as a pre-processing step for a parser (Chandrasekar & Srinivas, 1997)
  - learnt syntactic rules from aligned parse trees aimed to produce shorter sentences so parsers didn't time out as often

Early Motivations for ATS

- Reduce linguistic complexity as a pre-processing step for a parser (Chandrasekar & Srinivas, 1997)
  - learnt syntactic rules from aligned parse trees aimed to produce shorter sentences so parsers didn't time out as often
- Extend S-TAG formalism for "Reluctant paraphrase" (Dras, 1999)
  - appied synchronous grammars to simplification
  - used ILP for optimising output characteristics

Early Motivations for ATS

- Reduce linguistic complexity as a pre-processing step for a parser (Chandrasekar & Srinivas, 1997)
    - learnt syntactic rules from aligned parse trees aimed to produce shorter sentences so parsers didn't time out as often
- Extend S-TAG formalism for "Reluctant paraphrase" (Dras, 1999)
    - appied synchronous grammars to simplification
    - used ILP for optimising output characteristics
- Reading aid for aphasics (Devlin & Tait, 1998; Carroll et al., 1998)
    - explored lexical simplification and pronoun replacement

Early Motivations for ATS

- Reduce linguistic complexity as a pre-processing step for a parser (Chandrasekar & Srinivas, 1997)
  - learnt syntactic rules from aligned parse trees aimed to produce shorter sentences so parsers didn't time out as often
- Extend S-TAG formalism for "Reluctant paraphrase" (Dras, 1999)
  - appied synchronous grammars to simplification
  - used ILP for optimising output characteristics
- Reading aid for aphasics (Devlin & Tait, 1998; Carroll et al., 1998)
  - explored lexical simplification and pronoun replacement
- Study coherence issues (Siddharthan, 2003)
  - detected and fixed disfluencies by modelling attentional state and intentional structure

Modelling Complexity

Early systems:

- Syntax: typically considered relative clauses, conjuction and (sometimes) passive voice
- Lexis: used resources such as Oxford Psycholinguistic Database (Quinlan, 1992) to measure lexical difficulty

Recent Work

- Text Simplification as Machine Translation

Recent Work

- Text Simplification as Machine Translation
  - Does not model complexity directly, but learns mappings between constructs in the two genres
  - Usually uses corpus of English Wikipedia and aligned Simple English Wikipedia
  - Parallel corpora do not really exist at this scale for other languages, but manual analysis of small parallel corpora can inform ATS: Portuguese (Aluísio et al., 2008); French (Brouwers et al., 2014)

Recent Work

- Text Simplification as Machine Translation
  - Phrase Based Machine Translation
    (Specia, 2010; Wubben et al., 2012; Coster & Kauchak, 2011):

    - Map word sequences: Do not attempt syntactic simplification

Recent Work

- Text Simplification as Machine Translation
  - Syntax based Machine Translation
    (Zhu et al., 2010)
    - Does not attempt lexical simplification
    - Does not handle morphology, but can reorder, delete or substitute constituents

Recent Work

- Text Simplification as Machine Translation
  - Quasi-Synchronous Tree Substitution Grammars
    (Woodsend & Lapata, 2011)
    - Lexical: Can perform word substitutions, but no method for
      modelling lexical context for preserving word senses
    - Syntactic: Does not handle morphology, but can reorder,
      delete or substitute constituents

Recent Work

- Text Simplification as Machine Translation
  - Hybrid Systems
    (Narayan & Gardent, 2014)
    - PBMT for lexical rules
    - Syntactic rules using DRT representations

Recent Work

- Text Simplification as Machine Translation
  - Hybrid systems
    (Siddharthan & Angrosh, 2014)
    - Uses handwritten linguistically sound rules for syntactic simplification
    - Uses Synchronous Dependency Grammars for lexicalised constructs

Lexical Simplification

Text Simplification and Complexity
OOOOOOO

Simple Language
OOOOO

Automatic Text Simplification
OOO●OO

Evaluating Simplified Texts
OOOOOO

Lexical Simplification

- Lexical Substitution
  - Identify difficult words
    - typically using some frequency-based metric
    - but need to be clever for compounding languages (hjärteko)
  - Identify easier lexical substitutions where possible, and filter/rank these using a context vector or Word Sense Disambiguation
  - Where no lexical substitutions exist, use definitions of words

Lexical Simplification

- Technical terms often do not have easier synonyms
  - Explanations can be constructed using ontology relations (e.g., MESH) (Zeng-Treitler et al., 2007; Kandula et al., 2010)
    - "Pulmonary atresia" is simplified as "Pulmonary atresia (a_type_of birth defect)"
  - Definition can be obtained with "Google define:"
    - "Pulmonary atresia" is defined as "Pulmonary atresia is a form of heart disease that occurs from birth (congenital heart disease), in which the pulmonary valve does not form properly."

ATS for different languages

- Basque (Aranzabe et al., 2012)
- Bulgarian (Lozanova et al., 2013)
- Danish (Klerke & Søgaard, 2013)
- Dutch (Daelemans et al., 2004)
- English (De Belder Moens, 2010 ... Narayan Gardent, 2014)
- French (Seretan, 2012; Brouwers et al., 2014)
- Italian (Barlacchi & Tonelli, 2013)
- Japanese (Inui et al., 2003)
- Korean (Chung et al., 2013)
- Portuguese (Aluísio et al., 2008; Watanabe et al., 2009)
- Spanish (Bott et al., 2012)
- Swedish (Smith & Jönsson, 2011; Abrahamsson et al., 2014)

Multilingual simplification and complexity

- In general, development of complexity measures and simplification systems lags behind English for other languages.
- PITR: Workshop on Predicting and Improving Text Readability
  - Last year, lots of submissions from compounding languages and morphologically rich languages
  - Approaches for English often can't be used off the shelf

Text Simplification and Complexity
0000000

Simple Language
00000

Automatic Text Simplification
000000●

Evaluating Simplified Texts
000000

Evaluating Text Simplification

- *How good does automatic text simplification need to be?*
  - The typical target reader of a text simplification system has poor reading skills.
  - Errorful system output might be unusable, even when it could be understood by a fluent reader.

Evaluating Text Simplification

- *How are text simplification systems evaluated?*
  - Few ATS studies to date with target reader populations
  - Evaluations of fluency and correctness have been on a small scale
  - Not clear how useful text simplification systems really are.

Evaluating Text Simplification

- *How are text simplification systems evaluated?*
  - Automated evaluations:
    - Compare system output to manually simplified text (BLEU or NIST scores) (Coster & Kauchak, 2011)
    - Intrinsic Readability scores (Louis & Nenkova, 2013)
    - None of these account properly for errors that increase comprehension difficulty, or for unintentional meaning change.

Evaluating Text Simplification

- *How are text simplification systems evaluated?*
  - Automated evaluations:
    - Compare system output to manually simplified text (BLEU or NIST scores) (Coster & Kauchak, 2011)
    - Intrinsic Readability scores (Louis & Nenkova, 2013)
    - None of these account properly for errors that increase comprehension difficulty, or for unintentional meaning change.
  - Ratings by fluent readers:
    - Fluency, Simplicity, Meaning (Siddharthan, 2006; Wubben et al., 2012; Woodsend & Lapata, 2011)

Text Simplification and Complexity
0000000

Simple Language
00000

Automatic Text Simplification
000000

Evaluating Simplified Texts
0●0000

Evaluating Text Simplification

- *How are text simplification systems evaluated?*
  - Automated evaluations:
    - Compare system output to manually simplified text (BLEU or NIST scores) (Coster & Kauchak, 2011)
    - Intrinsic Readability scores (Louis & Nenkova, 2013)
    - None of these account properly for errors that increase comprehension difficulty, or for unintentional meaning change.
  - Ratings by fluent readers:
    - Fluency, Simplicity, Meaning (Siddharthan, 2006; Wubben et al., 2012; Woodsend & Lapata, 2011)
  - Online Methods:
    - Eye-tracking: Fixation times etc. (Bott et al., 2012)

Evaluating Text Simplification

- *How are text simplification systems evaluated?*
  - Automated evaluations:
    - Compare system output to manually simplified text (BLEU or NIST scores) (Coster & Kauchak, 2011)
    - Intrinsic Readability scores (Louis & Nenkova, 2013)
    - None of these account properly for errors that increase comprehension difficulty, or for unintentional meaning change.
  - Ratings by fluent readers:
    - Fluency, Simplicity, Meaning (Siddharthan, 2006; Wubben et al., 2012; Woodsend & Lapata, 2011)
  - Online Methods:
    - Eye-tracking: Fixation times etc. (Bott et al., 2012)
  - Offline Methods for recall / comprehension:
    - Cloze tests (Jonnalagadda et al., 2009)
    - Sentence Recall (Siddharthan & Katsos, 2012)
    - MCQs (Canning, 2002; Angrosh et al., 2014)

Questions for Complexity metrics

- All simplification systems result in shorter sentences and simpler words
  - Can complexity metrics distinguish these systems?

Questions for Complexity metrics

- All simplification systems result in shorter sentences and simpler words
  - Can complexity metrics distinguish these systems?

- Can/should complexity metrics quantify fluency as well as simplicity?
  - It should be easy to put together a dataset with manual ratings for various system output

Text Simplification and Complexity
○○○○○○○

Simple Language
○○○○○

Automatic Text Simplification
○○○○○○

Evaluating Simplified Texts
○○●○○○

Questions for Complexity metrics

- All simplification systems result in shorter sentences and simpler words
  - Can complexity metrics distinguish these systems?

- Can/should complexity metrics quantify fluency as well as simplicity?
  - It should be easy to put together a dataset with manual ratings for various system output

- Can complexity metrics correlate with comprehension data?

Example of errorful system output 1

EW: Four generations of the Willis family continued the family tradition of organ building until 1997 when Henry Willis 4 retired, and the first non-family Managing Director was appointed.

- Siddharthan & Angrosh (2014):
  - Four generations of the Willis family continued the family tradition of organ building until 1997.
  - At that time, Henry Willis 4 retired.
  - And the first non-family Managing Director was given.
- SEW:
  - Four generations of the Willis family continued the family tradition of organ building until 1997, when Henry Willis the fourth retired and the new Managing Director of the firm was not a member of the Willis family .

Example of errorful system output 2

EW: The music may be performed by a single musician, sometimes then called a recital, or by a musical ensemble, such as an orchestra, a choir, or a musical band.

- Siddharthan & Angrosh (2014):
  - The music may did a single musician, normally then named a recital , or a musical ensemble, such as an orchestra, or a choir, or a musical band.
- SEW:
  - A concert given by just one performer (or perhaps two) is usually called a recital.

Conclusions

- There should be synergies between research in complexity and research in simplification.

Conclusions

- There should be synergies between research in complexity and research in simplification. But there is not a lot.

Text Simplification and Complexity
OOOOOOO

Simple Language
OOOOO

Automatic Text Simplification
OOOOOO

Evaluating Simplified Texts
OOOOOO●

Conclusions

- There should be synergies between research in complexity and research in simplification. But there is not a lot.
- ATS needs automated metrics for evaluation.

Conclusions

- There should be synergies between research in complexity and research in simplification. But there is not a lot.

- ATS needs automated metrics for evaluation.

- ATS could potentially use complexity metrics to achieve different degrees of simplification.

Text Simplification and Complexity
OOOOOOO

Simple Language
OOOOO

Automatic Text Simplification
OOOOOO

Evaluating Simplified Texts
OOOOOO●

Conclusions

- There should be synergies between research in complexity and research in simplification. But there is not a lot.
- ATS needs automated metrics for evaluation.
- ATS could potentially use complexity metrics to achieve different degrees of simplification.
- Perhaps complexity research needs a challenge too?

,

References

Abrahamsson, E., T. Forni, M. Skeppstedt, & M. Kvist. 2014. Medical text simplification using synonym replacement: Adapting assessment of word difficulty to a compounding language. Proceedings of the Third Workshop on Predicting and Improving Text Readability for target reader populations.

Aluísio, S. M., L. Specia, T. A. Pardo, E. G. Maziero, & R. P. Fortes. 2008. Towards brazilian portuguese automatic text simplification systems. Proceedings of the eighth ACM symposium on Document engineering.

Anderson, R. C., & A. Davison. 1988. Conceptual and Empirical Bases of Readibility Formulas. Alice Davison & G. M. Green, eds., Linguistic Complexity and Text Comprehension: Readability Issues Reconsidered. Hillsdale, NJ: Lawrence Erlbaum Associates.

Angrosh, M., T. Nomoto, & A. Siddharthan. 2014. Lexico-syntactic text simplification and compression with typed dependencies. Proceedings of COLING 2014, the 25th International Conference on Computational Linguistics: Technical Papers.

Aranzabe, M. J., A. Díaz de Ilarraza, & I. Gonzalez-Dios. 2012. First Approach to Automatic Text Simplification in Basque. Proceedings of the Natural Language Processing for Improving Textual Accessibility (NLP4ITA) Workshop (LREC 2012), Istanbul, Turkey.

Barlacchi, G., & S. Tonelli. 2013. ERNESTA: A Sentence Simplification Tool for Childrens Stories in Italian. Computational Linguistics and Intelligent Text Processing, 476–487. Springer.

Beck, I. L., M. G. McKeown, G. M. Sinatra, & J. A. Loxterman. 1991. Revising social studies text from a text-processing perspective: Evidence of improved comprehensibility. Reading Research Quarterly 251–276.

Bott, S., H. Saggion, & S. Mille. 2012. Text Simplification Tools for Spanish. LREC.

Brouwers, L., D. Bernhard, A.-L. Ligozat, & T. François. 2014. Syntactic Sentence Simplification for French. Proceedings of the Third Workshop on Predicting and Improving Text Readability for target reader populations.

Canning, Y. 2002. Syntactic simplification of Text. Ph.D. thesis, University of Sunderland, UK.

Caplan, D. 1992. Language: Structure, Processing, and Disorders. Cambridge, Massachusetts: MIT Press.

Carroll, J., G. Minnen, Y. Canning, S. Devlin, & J. Tait. 1998. Practical simplification of English newspaper text to assist aphasic readers. Proceedings of AAAI98 Workshop on Integrating Artificial Intelligence and Assistive Technology.

,

Chandrasekar, R., & B. Srinivas. 1997. Automatic Induction of Rules for Text Simplification. Knowledge-Based Systems 10: 183–190.

Chung, J.-W., H.-J. Min, J. Kim, & J. C. Park. 2013. Enhancing readability of web documents by text augmentation for deaf people. Proceedings of the 3rd International Conference on Web Intelligence, Mining and Semantics.

Coster, W., & D. Kauchak. 2011. Learning to simplify sentences using wikipedia. Proceedings of the Workshop on Monolingual Text-To-Text Generation.

Cross, T. G. 1977. Mothers' speech adjustments: The contribution of selected child listener variables. Talking to children: Language input and acquisition 151–188.

Daelemans, W., A. Höthker, & E. F. T. K. Sang. 2004. Automatic Sentence Simplification for Subtitling in Dutch and English. LREC.

De Belder, J., & M.-F. Moens. 2010. Text simplification for children. Proceedings of the SIGIR workshop on accessible search systems.

Devlin, S., & J. Tait. 1998. The use of a psycholinguistic database in the simplification of text for aphasic readers. J. Nerbonne, ed., Linguistic Databases, 161–173. Stanford, California: CSLI Publications.

Dras, M. 1999. Tree adjoining grammar and the reluctant paraphrasing of text. Ph.D. thesis, Macquarie University NSW 2109 Australia.

Gardner, D., & E. C. Hansen. 2007. Effects of Lexical Simplification During Unaided Reading of English Informational Texts. TESL Reporter 40(2): 27–59.

Giles, H., D. M. Taylor, & R. Bourhis. 1973. Towards a theory of interpersonal accommodation through language: Some Canadian data. Language in society 2(2): 177–192.

Gleitman, L. R., E. L. Newport, & H. Gleitman. 1984. The current status of the motherese hypothesis. Journal of Child Language 11(01): 43–79.

Honeyfield, J. 1977. Simplification. TESOL Quarterly 431–440.

Inui, K., A. Fujita, T. Takahashi, R. Iida, & T. Iwakura. 2003. Text simplification for reading assistance: a project note. Proceedings of the second international workshop on Paraphrasing-Volume 16.

,

Irwin, J. 1980. The effects of explicitness and clause order on the comprehension of reversible causal relationships. Reading Research Quarterly 15(4): 477–488.

Jonnalagadda, S., L. Tari, J. Hakenberg, C. Baral, & G. Gonzalez. 2009. Towards effective sentence simplification for automatic processing of biomedical text. Proceedings of Human Language Technologies: The 2009 Annual Conference of the North American Chapter of the Association for Computational Linguistics, Companion Volume: Short Papers.

Kamalski, J., T. Sanders, & L. Lentz. 2008. Coherence marking, prior knowledge, and comprehension of informative and persuasive texts: Sorting things out. Discourse Processes 45(4): 323–345.

Kandula, S., D. Curtis, & Q. Zeng-Treitler. 2010. A semantic and syntactic text simplification tool for health content. AMIA Annual Symposium Proceedings, vol. 2010.

Klerke, S., & A. Søgaard. 2013. Simple, readable sub-sentences. 51st Annual Meeting of the Association for Computational Linguistics Proceedings of the Student Research Workshop.

L'Allier, J. 1980. An evaluation study of a computer-based lesson that adjusts reading level by monitoring on task reader characteristics. Ph.D. thesis, University of Minnesota, Minneapolis, MN.

Linderholm, T., M. Everson, P. van den Broek, M. Mischinski, A. Crittenden, & J. Samuels. 2000. Effects of Causal Text Revisions on More- and Less-Skilled Readers' Comprehension of Easy and Difficult Texts. Cognition and Instruction 18(4): 525–556.

Long, M. H., & S. Ross. 1993. Modifications that preserve language and content. Technical report, ERIC.

Louis, A., & A. Nenkova. 2013. What Makes Writing Great? First Experiments on Article Quality Prediction in the Science Journalism Domain. Transactions of the Association for Computational Linguistics 1: 341–352.

Lozanova, S., I. Stoyanova, S. Leseva, S. Koeva, & B. Savtchev. 2013. Text Modification for Bulgarian Sign Language Users. Proceedings of the Second Workshop on Predicting and Improving Text Readability for Target Reader Populations.

Marschark, M., & P. E. Spencer. 2010. The Oxford handbook of deaf studies, language, and education, vol. 2. Oxford University Press.

McNamara, D., E. Kintsch, N. Songer, & W. Kintsch. 1996. Are good texts always better? Interactions of text coherence, background knowledge, and levels of understanding in learning from text. Cognition and instruction 14(1): 1–43.

Narayan, S., & C. Gardent. 2014. Hybrid Simplification using Deep Semantics and Machine Translation. Proceedings of the 52nd Annual Meeting of the Association for Computational Linguistics (ACL'14).

Noordman, L. G. M., & W. Vonk. 1992. Reader's knowledge and the control of inferences in reading. Language and Cognitive Processes 7: 373–391.

O'Brien, S. 2003. Controlling Controlled English. An analysis of several controlled language rule sets. Proceedings of EAMT-CLAW 3: 105–114.

Oh, S.-Y. 2001. Two types of input modification and EFL reading comprehension: Simplification versus elaboration. TESOL quarterly 35(1): 69–96.

Papoušek, M., H. Papoušek, & M. Haekel. 1987. Didactic adjustments in fathers' and mothers' speech to their 3-month-old infants. Journal of Psycholinguistic Research 16(5): 491–516.

Parr, S. 1993. Aphasia and Literacy. Ph.D. thesis, University of Central England.

Petersen, S. 2007. Natural language processing tools for reading level assessment and text simplification for bilingual education. Ph.D. thesis, University of Washington, Seattle, WA.

Pitler, E., & A. Nenkova. 2008. Revisiting readability: A unified framework for predicting text quality. Proceedings of the Conference on Empirical Methods in Natural Language Processing.

Quigley, S. P., & P. V. Paul. 1984. Language and Deafness. College-Hill Press, San Diego, California.

Quinlan, P. 1992. The Oxford Psycholinguistic Database. Oxford University Press, U.K.

Ramus, F. 2003. Developmental dyslexia: specific phonological deficit or general sensorimotor dysfunction? Current Opinion in Neurobiology 13(2): 212 – 218.

Rello, L., C. Bayarri, A. Gòrriz, R. Baeza-Yates, S. Gupta, G. Kanvinde, H. Saggion, S. Bott, R. Carlini, & V. Topac. 2013. DysWebxia 2.0!: more accessible text for people with dyslexia. Proceedings of the 10th International Cross-Disciplinary Conference on Web Accessibility.

Seretan, V. 2012. Acquisition of Syntactic Simplification Rules for French. LREC.

Shewan, C., & G. Canter. 1971. Effects of vocabulary, syntax and sentence length on auditory comprehension in aphasic patients. Cortex 7: 209–226.

Siddharthan, A. 2003. Syntactic simplification and Text Cohesion. Ph.D. thesis, University of Cambridge, UK.

,

Siddharthan, A. 2006. Syntactic Simplification and Text Cohesion. Research on Language and Computation 4(1): 77–109.

Siddharthan, A. 2010. Complex lexico-syntactic reformulation of sentences using typed dependency representations. Proceedings of the 6th International Natural Language Generation Conference (INLG 2010).

Siddharthan, A. 2011. Text Simplification using Typed Dependencies: A Comparision of the Robustness of Different Generation Strategies. Proceedings of the 13th European Workshop on Natural Language Generation (ENLG 2011).

Siddharthan, A., & M. Angrosh. 2014. Hybrid Text Simplification using Synchronous Dependency Grammars with Hand-written and Automatically Harvested Rules. Proceedings of the 14th Conference of the European Chapter of the Association for Computational Linguistics (EACL'14).

Siddharthan, A., & N. Katsos. 2012. Offline sentence processing measures for testing readability with users. Proceedings of the First Workshop on Predicting and Improving Text Readability for target reader populations.

Smith, C., & A. Jönsson. 2011. Automatic summarization as means of simplifying texts, an evaluation for swedish. Proceedings of the 18th Nordic Conference of Computational Linguistics (NoDaLiDa-2010), Riga, Latvia.

Specia, L. 2010. Translating from complex to simplified sentences. Proceedings of the Conference on Computational Processing of the Portuguese Language.

Tweissi, A. I. 1998. The Effects of the Amount and Type of Simplification on Foreign Language Reading Comprehension. Reading in a foreign language 11(2): 191–204.

Vellutino, F. R., J. M. Fletcher, M. J. Snowling, & D. M. Scanlon. 2004. Specific reading disability (dyslexia): What have we learned in the past four decades? Journal of child psychology and psychiatry 45(1): 2–40.

Walker, A., A. Siddharthan, & A. Starkey. 2011. Investigation into human preference between common and unambiguous lexical substitutions. Proceedings of the 13th European Workshop on Natural Language Generation.

Watanabe, W. M., A. C. Junior, V. R. Uzêda, R. P. d. M. Fortes, T. A. S. Pardo, & S. M. Aluísio. 2009. Facilita: reading assistance for low-literacy readers. Proceedings of the 27th ACM international conference on Design of communication.

Woodsend, K., & M. Lapata. 2011. Learning to simplify sentences with quasi-synchronous grammar and integer programming. Proceedings of the Conference on Empirical Methods in Natural Language Processing.

Text Simplification and Complexity
○○○○○○○

Simple Language
○○○○○

Automatic Text Simplification
○○○○○○

Evaluating Simplified Texts
○○○○○●

,

Wubben, S., A. van den Bosch, & E. Krahmer. 2012. Sentence simplification by monolingual machine translation. Proceedings of the 50th Annual Meeting of the Association for Computational Linguistics: Long Papers-Volume 1.

Yano, Y., M. H. Long, & S. Ross. 1994. The effects of simplified and elaborated texts on foreign language reading comprehension. Language Learning 44(2): 189–219.

Zeng-Treitler, Q., S. Goryachev, H. Kim, A. Keselman, & D. Rosendale. 2007. Making texts in electronic health records comprehensible to consumers: a prototype translator. AMIA Annual Symposium Proceedings, vol. 2007.

Zhu, Z., D. Bernhard, & I. Gurevych. 2010. A monolingual tree-based translation model for sentence simplification. Proceedings of the 23rd international conference on computational linguistics.

Text Simplification and Complexity
○○○○○○○

Simple Language
○○○○○

Automatic Text Simplification
○○○○○○

Evaluating Simplified Texts
○○○○○○●