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Building Textual Entailment Specialized Data Sets: a Methodology for Isolating Linguistic Phenomena Relevant to Inference

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Outline

1. Introduction
   - TE as a task for automatic systems
   - Motivation
2. Methodology
   - Classification of linguistic phenomena
   - Procedure for the creation of monothematic pairs
3. Feasibility Study on RTE5-data
4. Conclusions

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TE as a task for automatic systems

- In 2005, the Recognizing Textual Entailment (RTE) Challenge has been launched
- **TASK:** developing a system that, given two text fragments (T-H), can determine whether the meaning of one text is entailed from the other
- **DATASET:** training and test sets composed of T-H pairs

T: The Mona Lisa hangs in Paris' Louvre Museum. ENTAILMENT √
H: The Mona Lisa is in France.

T: Oracle fought to keep the forms from being released. CONTRADICTION X
H: Oracle released a confidential document.

T: An Afghan translator kidnapped in December was freed Friday. UNKNOWN X
H: Translator kidnapped in Iraq.

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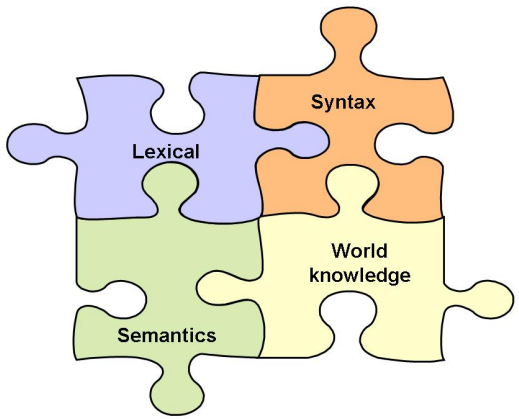
Motivation

Different linguistic phenomena are involved in TE, and interact in a complex way:

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...]

H: Doris Lessing won the Nobel Prize in Literature in 2007.



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Motivation

On RTE data sets, **difficulties in the evaluation of the impact of linguistic modules addressing specific inference types**:

- Sparseness (i.e. low frequency) of the single phenomena
- Impossibility to isolate each phenomenon, and to evaluate each module independently from the others

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Our Proposal:

Methodology *for the creation of specialized TE data sets made of* **monothematic T-H pairs**, *i.e. pairs in which a certain phenomenon relevant to the entailment relation is highlighted and isolated*

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Procedure for the creation of monothematic pairs

Starting from an existing RTE pair:

1. **Identify the linguistic phenomena** which contribute to the entailment in T-H
2. **Apply an annotation procedure** to isolate each phenomenon and create the related monothematic pair
3. **Group together all the monothematic T-H pairs relative to the same phenomenon**, hence creating specialized data sets

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Classification of linguistic phenomena

- **Fine-grained phenomena** are grouped into **macro categories**:
  - **lexical**: acronymy, demonymy, synonymy, semantic opposition, hyperonymy
  - **lexical-syntactic**: nominalization/verbalization, transparent head, paraphrase
  - **syntactic**: negation, modifier, argument realization, apposition, active/passive alternation
  - **discourse**: coreference, apposition, zero anaphora
  - **reasoning**: elliptic expression, meronymy, metonymy, reasoning on quantity, general inferences using background knowledge

Creation of monothematic pairs

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...]

H: Doris Lessing won the Nobel Prize in Literature in 2007.

APPOSITION

VERBALIZATION

SYNONYMY

ARGUMENT REALIZATION

1. Identify all the phenomena which contribute to the entailment/contradiction in T-H

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Creation of monothematic pairs

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H: Doris Lessing won the Nobel Prize in Literature in 2007.

ARGUMENT REALIZATION

1. entailment rule: Pattern: *X Y ↔ Y IN X*
   Constraint: *TYPE(X)=TEMPORAL_EXPRESSION*
2. instantiation:
   2007 Nobel Prize in Literature ⇒ Nobel Prize in Literature in 2007
3. substitution:
   H1: British writer Doris Lessing, recipient of the Nobel Prize in Literature in 2007 [...]
4. judgment: ENTAILMENT

Creation of monothematic pairs

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ARGUMENT REALIZATION

1. entailment rule: Pattern: *X Y* ↔ *Y IN X*
   Constraint: *TYPE(X)=TEMPORAL_EXPRESSION*
2. instantiation:
   2007 Nobel Prize in Literature ⇒ *Nobel Prize in Literature in 2007*
3. substitution:
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H: Doris Lessing won the Nobel Prize in Literature in 2007.

ARGUMENT REALIZATION

1. entailment rule: Pattern: *X Y* $\leftrightarrow$ *Y IN X*
   Constraint: *TYPE(X)=TEMPORAL_EXPRESSION*
2. instantiation:
   2007 Nobel Prize in Literature $\Rightarrow$ *Nobel Prize in Literature in 2007*
3. substitution:
   H1: British writer Doris Lessing, recipient of the Nobel Prize in Literature in 2007 [...]
4. judgment: ENTAILMENT

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Creation of monothematic pairs

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...]

H: Doris Lessing won the Nobel Prize in Literature in 2007.

APPOSITION

1. entailment rule: Pattern: *X, Y* ↔ *Y is X*
   Constraint: *apposition(X, Y)*
2. instantiation:
   Doris Lessing, recipient of ⇒ *Doris Lessing is the recipient of*
3. substitution:
   H2: British writer Doris Lessing is the recipient of Nobel Prize in Literature in 2007 [...]
4. judgment: ENTAILMENT

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Creation of monothematic pairs

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...]

H: Doris Lessing won the Nobel Prize in Literature in 2007.

VERBALIZATION

1. entailment rule: Pattern: $X \leftrightarrow Y$
   Constraint: $TYPE(X)=N$; $TYPE(Y)=V$
   $verbalization\_of(Y,X)$
2. instantiation:
   $recipient \Rightarrow received$
3. substitution:
   H3: British writer Doris Lessing received the Nobel Prize in Literature in 2007 [...]
4. judgment: ENTAILMENT

Creation of monothematic pairs

H3 $\Rightarrow$ T': British writer Doris Lessing received the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ''wasn't that terrible'' [...]

H: Doris Lessing won the Nobel Prize in Literature in 2007.
SYNONYMY

1. entailment rule: Pattern: $X \leftrightarrow Y$
   Constraint: $synonym\_of(X, Y)$
2. instantiation:
   $received \Rightarrow won$
3. substitution:
   H4: British writer Doris Lessing won the Nobel Prize in Literature in 2007 [...]
4. judgment: ENTAILMENT

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Creation of specialized dataset

SYNTACTIC:ARGUMENT_REALIZATION

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...]
H1: British writer Doris Lessing, recipient of the Nobel Prize in Literature in 2007, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...]

SYNTACTIC:APPOSITION

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...]
H2: British writer Doris Lessing is the recipient of the 2007 Nobel Prize in Literature.

LEXICAL-SYNTACTIC:NOMINALIZATION_VERBALIZATION

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...]
H3: British writer Doris Lessing received the 2007 Nobel Prize in Literature.

LEXICAL:SYNONYMY

T’: British writer Doris Lessing received the 2007 Nobel Prize in Literature.
H4: British writer Doris Lessing won the 2007 Nobel Prize in Literature.

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Feasibility Study on RTE5-data

- 90 T-H pairs (30 entailment, 30 contradiction, 30 unknown randomly extracted examples)
- 2 annotators with skills in linguistics
- **Inter Annotator Agreement**:
  - "complete agreement": 64.4% (58 out of 90 pairs)
  - "partial" agreement (DICE coefficient): 0.78

	complete	partial (DICE)
ENTAILMENT	60%	0.86
CONTRADICTION	57%	0.75
UNKNOWN	76%	0.68

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Feasibility Study on RTE5-data

original RTE pairs	phenomena/monothematic pairs			
	E	C	U	TOTAL
E (30)	91	-	-	91/30
C (30)	44	35	-	79/30
U (30)	23	-	13	36/11
TOT (90)	**158**	**35**	**13**	**206/77**

- Different absolute frequency of macro and fine-grained phenomena (most frequent category: *reasoning*)
- Phenomena appearing only in positive/negative examples
  - only positive: e.g. *apposition*, *coreference*
  - only negative: e.g. *semantic opposition*, *negation*

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Specialized Data Sets

- Higher number of monothematic positive pairs (76.7%), wrt negative (23.3%, divided into 17% contradiction, 6.3% unknown)
- The only source of negative monothematic pairs are RTE-5 contradiction pair (BUT 15% of the data set)

- How to balance the proportion of negative examples?

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Conclusions

Methodology for the creation of specialized TE data sets, made of monothematic T-H pairs in which a certain phenomenon underlying the entailment relation is highlighted and isolated.

- Feasibility of the task (quality, effort required)
- Annotation of previous RTE data with the linguistic phenomena
- **Resource available at Textual Entailment Resource Pool website**

http://www.aclweb.org/aclwiki/index.php?title=Textual_Entailment_Resource_Pool