Measuring How Perceived Meanings of Uncertainty Cues Differs with and without Sentence-level Context in Radiology Reports

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Background

- pyConTextNLP
  - Python implementation of ConText
  - https://pypi.python.org/pypi/pyConTextNLP
  - Regex combined with lexical rules
  - uses linguistic cues to determine whether a finding is
    - negated, asserted, or uncertain
    - Temporality
    - Etc.

Linguistic Cues

- Are context independent
- That is, the cues have universal meaning
  - **Cue meaning does not change in different sentences**

Uncertainty Cues

- Need exhaustive set of linguistic cues that accurately represent spectrum of uncertainty

Definitely negated

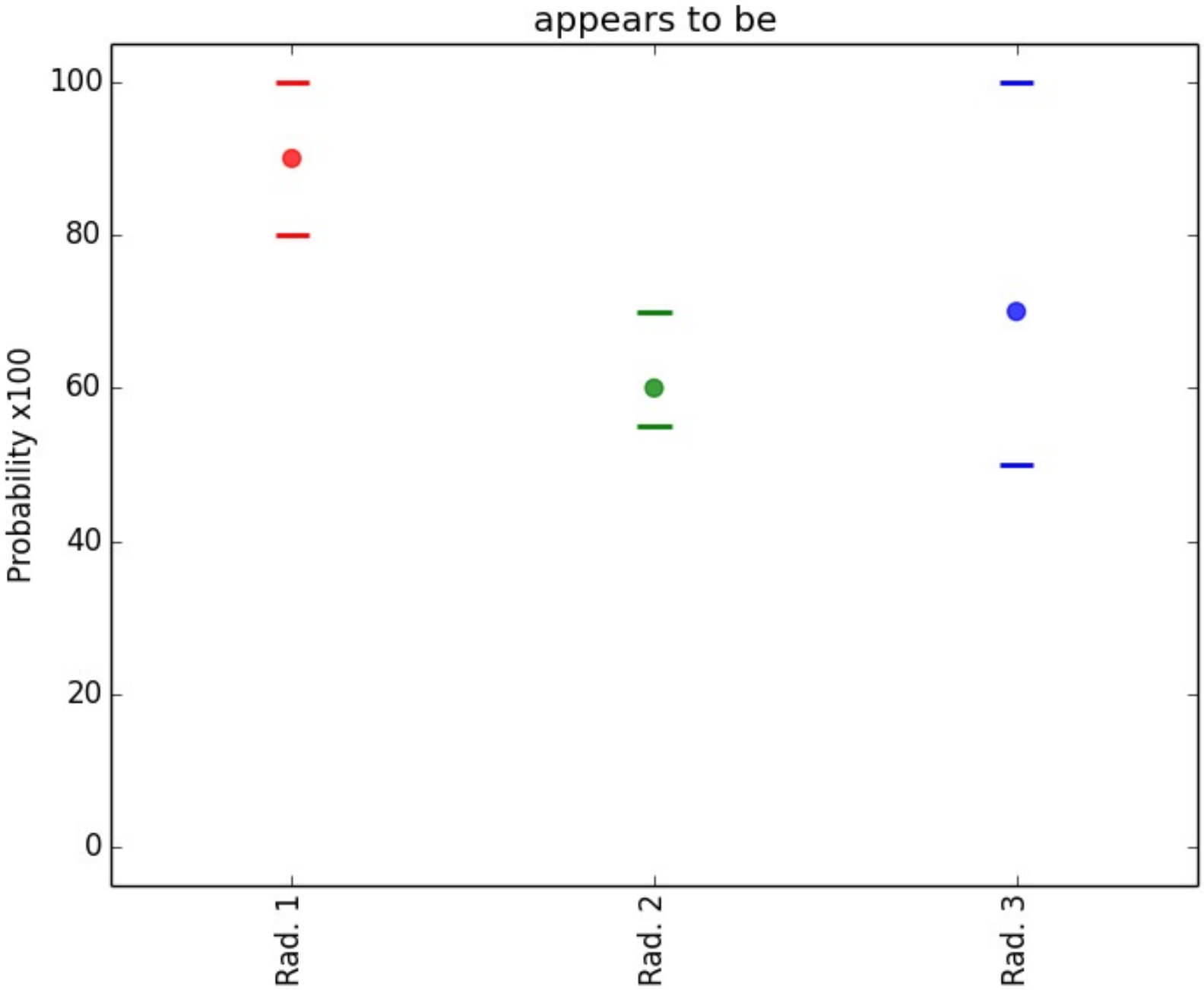
Definitely asserted

Objective of this Study

- Does meaning associated with lexical cues change with sentence context relative to meaning assigned without context?

Methods

- Determining cue meaning without context
  - Three radiologists separately reviewed cues presented in random order
    - Assigned single-point probabilities
    - Assigned probability ranges
- Presentation VSIN31-08
- Same three radiologist reviewed cues with sentence context


appears to be
Probability x100
100
80
60
40
20
0
Rad. 1
Rad. 2
Rad. 3

Methods: Cues

- 133 pyConTextNLP cues
- 108 cues translated from Swedish texts

131	highly suggestive	DEFINITE_EXISTENCE
132	obvious	DEFINITE_EXISTENCE
133	positive study for	DEFINITE_EXISTENCE
134	represents	DEFINITE_EXISTENCE
135	believe	DEFINITE_EXISTENCE
136	can see	DEFINITE_EXISTENCE
137	gross evidence	DEFINITE_EXISTENCE
138	high probability	DEFINITE_EXISTENCE
139	is positive	DEFINITE_EXISTENCE
140	reveals	DEFINITE_EXISTENCE
141	are ruled out	DEFINITE_NEGATED_EXISTENCE
142	can be ruled out	DEFINITE_NEGATED_EXISTENCE
143	could be ruled out	DEFINITE_NEGATED_EXISTENCE
144	free	DEFINITE_NEGATED_EXISTENCE
145	has been ruled out	DEFINITE_NEGATED_EXISTENCE
146	have been ruled out	DEFINITE_NEGATED_EXISTENCE
147	is negative	DEFINITE_NEGATED_EXISTENCE
148	is ruled out	DEFINITE_NEGATED_EXISTENCE

Methods: Sentence Identification

- Sentences containing the cues were identified in a corpus of 4727 de-identified CTPA reports.
  - Limited to impression section
  - Randomly selected up to five sentences containing per cue
- 321 sentences identified
  - 88 Cues

Methods: Evaluation

- Three radiologist assigned assertion cues meaning (probability of existence) for each sentence.
- Both single-point and ranges were separately obtained.

Methods: Point Mapping

Existence Cue Point Mapping with sentence context.

469 of 469 cues remaining to be mapped; Annotator: brian

Please assign the probability (0-100) a subject would have a finding, given this cue as a modifier in this sentence.

If the term seems nonsensical (that is, is not being used to describe existence) or if you have other concerns, please enter a comment. There is no need to provide a comment otherwise.

cue: **compatible with**

sentence: **"PATCHY AREAS OF GROUND-GLASS CONSOLIDATION IN BOTH UPPER LOBES ARE COMPATIBLE WITH BRONCHOPNEUMONIA."**

Probability:	
Comment:	
Save and Next unmarked	
SENTENCEID:	68

logout Program Listing

Methods: Range Mapping

465 of 469 cues remaining to be mapped; Annotator: brian

Please assign the probability range (lower and upper limit, each expressed as 0-100) a subject would have a finding, given this cue as a modifier.

If the term seems nonsensical or if you have other concerns, please enter a comment. There is no need to provide a comment otherwise.

cue: **no CT evidence**

sentence: "**IMPRESSION: NO CT EVIDENCE OF PULMONARY EMBOLUS.**"

LowProbability:	
HighProbability:	
Comment:	
Save and Next unmarked	
SENTENCEID:	462

Methods: Measurements

- Probability shifts with context
- Intra-radiologist discordance
  - Std of cue probabilities across sentences
- Correlation between
  - Inter-radiologist discordance (w/o context)
  - Intra-radiologist discordance (w context)

Results

- Positive shift in probabilities (0.024) viewed in context
  - (paired t-test, p=0.35).
- High inter-radiologist disagreement w/o context correlates with high intra-radiologist discordance with context
  - (Pearson's R=0.36,p=0.0006).
  - Problematic cues?

Results

- Assertion cues with context changed more than negation cues
  - (Pearson 0.26, p=0.016).

Conclusion

- Overall context did not significantly change cue probability assignments
- However, assertion cues changed more than negation cues. Evaluating probability assignments for lexical assertion, negation, and uncertainty cues may not require displaying the cues in context.