Author's response to reviews

Title: Detecting Causality from Online Psychiatric Texts Using Inter-Sentential Language Patterns

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Version: 4 Date: 2 June 2012

Author's response to reviews: see over
To the Editor,

I hereby submit the revised manuscript, “Detecting Causality from Online Psychiatric Texts Using Inter-Sentential Language Patterns,” for publication. In this revision, we have carefully addressed the issues raised in the reviewer’s comments such as including a method that considers sentence structure for comparison, explaining the selection of the proposed method for causality detection, and adding some new citations. Please see the two attached files, Manuscript and Response to Reviews.

Sincerely,

Pei-Chann Chang
Dean, College of Informatics
Professor, Department of Information Management, Yuan Ze University, Chung-Li, Taiwan, R.O.C.
Responses to the comments of reviewer 1

The paper addresses a very interesting topic on detecting causality on natural language texts using inter/sentential language patterns. The approach proposes a text mining approach (actually, a variation of "association rules") to deal with inter/sentential and intra/sentential patterns so as to discover candidate cause-effect patterns from psychiatric texts. The model is compared against classical word pairs from previous state-of-the-art. Results are very promising, however, I'd expected other baseline beyond pair-of-words as to em it seems any further method considering "structure" or patterns would outperform pair-of-words approaches, isn't?

Ans:
Thank you very much for your valuable comments. In addition to the originally proposed association rule mining, we have additionally implemented a method called sentence parsing that considers sentence structure to discover intra-sentential language patterns which are then used to generate inter-sentential language patterns for causality detection. The details of sentence parsing are presented in Intra-sentential language pattern mining — Method 2: Sentence parsing (page 11), and the comparative results are presented in Table 2 (page 21).
Responses to the comments of reviewer 2

The topic selected, and the experiments described are very significant and important to the field of Medicine. However, the methods describe need some more explanation for why these approaches are selected. Additionally, there need to be some more citations from the fields of NLP and information extraction, on which this paper seems to be based.

*Ans:*

Thank you very much for your valuable comments. Before answering each of the following questions, we first provide a brief summary of our responses regarding our selection of extended association mining to discover inter-sentential language patterns for causality detection. Because this study aims to identify causality between sentences, we propose the use of inter-sentential features rather than intra-sentential features to capture feature relationships between sentences (Question 6). The inter-sentential features include word pairs proposed in a previous study (Marcu and Echihabi, 2002), and inter-sentential language patterns in the present study. A word pair is constituted by one word from the cause text span and another from the effect text span. This can capture the associations of *individual words* between sentences, while an inter-sentential language pattern is composed of intra-sentential language patterns, which can capture the associations of *multiple words* within and between sentences (Question 3). To acquire inter-sentential language patterns, we extended the classical association rule mining algorithm rather than use a parser to directly generate inter-sentential language patterns because feature relationships between sentences are not easily captured by a parser that provides dependencies of words within sentences. Nevertheless, as you suggested, parsing is indeed a useful method to discover intra-sentential language patterns. Therefore, in addition to the extended association rule mining, we have implemented a method called *sentence parsing* to indirectly generate inter-sentential language patterns. That is, a parser is first used to discover intra-sentential language patterns, and these patterns are then used to generate inter-sentential language patterns for causality detection (Question 4).

The following are a few comments.

**Abstract:**

1. The authors use the terms - *Inter-sentential language patterns* and provide examples such as "<<broke up, boyfriend>>", and "<<life, meaningless>>". How are these patterns different from word pairs?. The authors also describe that the ISL patterns outperform the word patterns, without providing examples on how each of these are different. The usage of terms in the abstract, without providing any supporting examples makes it difficult to understand without reading the entire article. Simple examples differentiating ISL and word pairs would be useful.

*Ans:*

We have provided a short description and several examples to differentiate word pairs and inter-sentential language patterns in the Abstract (page 2).
2. The authors provide compelling reasons for why discovering causality from discourse is an important problem in psychiatric texts, and other types of discourse. However, a large number of citations are dated, and the related work section could benefit from additional citations:


Ans:
Thank you for recommending these useful references. We have cited the above papers [5,11,20,21] and the following additional paper [8] on pages 5-6.


3. On page 5, paragraph 2, the authors mention that extracting word pairs might lead to semantically incorrect word pairs such as <<broke up, life>> and <<boyfriend, life>>. Such issues will usually not happen if a parser is used to get the typed dependencies of the lexical words. For instance, I ran E3 on the online version of standard parser, and obtained the following results:

Your query: I broke up with my boyfriend. Life is now meaningless to me.

Parse
(ROOT
(S
(NP (PRP I))
(VP (VBD broke))
(PRT (RP up))
(PP (IN with))
(NP (PRP$ my) (NN boyfriend)))))
(.
)))

(ROOT
(S
(NP (NNP Life))
(VP (VBZ is))

4
Observe that the typed dependencies link <<broke up, boyfriend>> and <<life, meaningless>> and <<meaningless, me>>

The difference provided between word pairs and language patterns is not very convincing, as the language patterns seem to be word pairs with proper correct dependencies.

Ans:
You are correct. A language pattern could be a word pair with proper dependencies when discussing an intra-sentential language pattern because the word pairs (as presented in the above type dependencies) capture word associations within sentences, as do the intra-sentential language patterns. Meanwhile, the term word pair, as used in this and the previous study (Marcu and Echihabi, 2002) does not represent an intra-sentential word pair, but an inter-sentential word pair where one word comes from the cause text span and the other comes from the effect text span. Such inter-sentential word pairs can capture individual word associations between sentences, and thus contribute to identifying causality between sentences. We have explained this in (first paragraph,
page 6), but we still use the term *word pair* to represent the type of inter-sentential word pair to maintain consistent usage with the previous study. Therefore, the word pair used in this study is different from intra-sentential and inter-sentential language patterns. It differs from the intra-sentential language pattern in terms of its ability to capture word associations within or between sentences, and differs from the inter-sentential language pattern because an inter-sentential language pattern composed of intra-sentential language patterns can capture the associations of multiple words within and between sentences. The table below presents some examples of word pairs, intra-sentential language patterns and inter-sentential language patterns extracted from the sample sentence pair: *I broke up with my boyfriend. Life is now meaningless to me.*

<table>
<thead>
<tr>
<th>Term usage</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>word pair</td>
<td>((w_i, w_j) \in W_1 \times W_2)</td>
<td>(broke up, life), (boyfriend, life)</td>
</tr>
<tr>
<td>intra-sentential language pattern</td>
<td>(lp_i = \langle w_{i1}, \ldots, w_{ik}\rangle)\n(w_i \in W_1 ) or (w_j \in W_2)</td>
<td>(&lt;\text{broke up, boyfriend},\text{life, meaningless}&gt;)</td>
</tr>
<tr>
<td>inter-sentential language pattern</td>
<td>(islp_i = \langle lp_i, \ldots, lp_k\rangle)</td>
<td>(&lt;\langle\text{broke up, boyfriend},\text{life, meaningless}\rangle&gt;)</td>
</tr>
</tbody>
</table>

We would also like to thank you for providing detailed parsing results because these results inspired us to use a parser to generate intra-sentential language patterns. Please see the response in the next question.

**Intra-sentential language pattern mining:**

4. The authors have provided an approach to find the correct dependencies between word pairs. It would be good to know why this approach was selected as opposed to using a dependency or a constituency parser, which can usually provide correct links for extracting predicate-argument relations. No compelling evidence for using the join/prune approach is provided. Additionally, in the description of the prune step, no explanation is provided for selecting a value for \(L_k\) (figure 2).

_ans:

The parsing results presented in the previous question suggest another useful method to generate intra-sentential language patterns. Therefore, in addition to the originally proposed association rule mining, we have implemented a method called sentence parsing using a parser to generate intra-sentential language patterns. The details of sentence parsing are presented in *Intra-sentential language pattern mining — Method 2: Sentence parsing* (page 11). To compare association rule mining and sentence parsing, we use both methods to generate two respective intra-sentential language patterns which are then used to generate inter-sentential language pattern sets for causality detection. The comparative results are shown in *Table 2* (page 21).

To select a value for \(L_k\) (figure 2), we have added an explanation “The maximum value of \(L_k\) is determined when no more frequent \(k\)-word sets are found in the generation process” (first paragraph, page 10).
Generating Inter-sentential language patterns:

6. Why can't the intra-sentential language patterns be used directly? Why is it important to use mutual information between sentences? It seems to be that the final set of cause-effect patterns be overly specific to a given set of patterns that have high MI?

*Ans:* In both this and the previous study (Marcu and Echihabi, 2002), each training and test instance is a pair of sentences so that inter-sentential features such as word pairs and inter-sentential language patterns can be acquired from the sentence pairs to identify causality between sentences. Using intra-sentential language patterns alone could not capture such feature relationships between sentences. Due to the large number of candidate patterns, the mutual information is used to select frequently co-occurring patterns between sentences. Another advantage is to reduce the search space for identifying useful features for causality detection.

Causality Detection:

7. The explanations and calculations are reasonable. It would be nice to cite the following papers on information extraction, as they seem to be a motivation of such causal relation extraction:


   Rahul Bhagat and Deepak Ravichandran “Large Scale Acquisition of Paraphrases for Learning Surface Patterns” In the Association for Computational Linguistics (ACL). 2008. [download].

*Ans:* Thank you for recommending these useful references. We have cited the above papers [37,38] on page 15.

Other Comments:

8. Page 3: "these services allow individuals to describing." => "these services allow individuals to describe."

   spell check on the document: Page 18 Figure 5 - x axis is misspelled

*Ans:* We have fixed the misspelling.