Understanding and Detecting Supporting Arguments of Diverse Types

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Project page: http://xinyuhua.github.io/Resources/
Problem

• Alice wants to write an essay

• Topic: Video game and youth violence

• Thesis: Video game contributes to youth violence
Problem

• Alice uses Google to find some related documents.

• But, wait...

*Image of a Google search result for "video game youth violence"*

*About 2,530,000 results (0.99 seconds)*
Problem

Do Violent Video Games Contribute to Youth Violence? - Violent ...
videogames.procon.org/view.answers.php?questionID=001608
*An overlooked but highly potent factor in youth violence and gun violence is the influence of first-person shooter video games. Neuroscientific research during ...

Violent video games and young people - Harvard Health
www.health.harvard.edu/newsletter_article/violent-video-games-and-young-people
Oct 1, 2010 - They argue that most youths are not affected by violent video games. ... General on the topic of youth violence made a similar judgment. Some ...

Video Games and Youth Violence: A Prospective Analysis in ...
https://link.springer.com/article/10.1007/s10964-010-9610-x
by CJ Ferguson - 2011 - Cited by 167 - Related articles
The potential influence of violent video games on youth violence remains an issue of concern for psychologists, policymakers and the general public. Although ...

Do video games lead to violence? - CNN.com
Jul 26, 2016 - The Munich rampage led many parents to worry that violent video games may be negatively affecting their own teens, but recent studies ...

Do Video Games Influence Violent Behavior? - Michigan Youth ...
yvpc.sph.umich.edu/video-games-influence-violent-behavior/
Aug 24, 2011 - A more critical analysis of the link between video game playing and violence is necessary for fully understanding a complex problem like youth ...
Problem

• How to efficiently select relevant arguments?

• Can we ensure the arguments cover different aspects and are non-redundant?
Diverse Types of Arguments

1. The 18-year old gunman who killed 9 people in Munich, Germany, on Friday was a fan of first-person shooter video games. **Event**

2. A 2015 peer-reviewed study found “compelling evidence that the use of realistic controllers can have a significant effect on the level of cognitive aggression.” **Study**

3. Violent video games require active participation and identification with violent characters, which reinforces violent behavior. **Reasoning**
Our Goal

• Characterize different types of arguments

• Detect supporting arguments by leveraging type information
Related Work

• Argumentation mining
  - Argument component extraction (Moens et al 2007; Palau and Moens, 2009; Mochales and Moens, 2011; Park and Cardie, 2014)
  - Argument scheme classification (Biran and Rambow, 2011; Al Khatib et al, 2006; Feng and Hirst 2011; Stab and Gurevych 2014)

• Evidence detection
  - Evidence retrieval, on identifying whole documents (Cartright et al., 2011; Bellot et al., 2013)
  - Detection of sentence-level factual evidence from Wikipedia articles (Aharoni et al., 2014; Rinott et al, 2015)

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Data

- Data source: Idebate.org
  - A Wikipedia style online debate forum
  - Around 1,000 debate motions

This House believes university education should be free

Individuals have a right to the experience of higher education

POINT
University offers personal, intellectual, and often spiritual, exploration. In secondary school and in professional life, no such opportunities exist as they are about instruction and following orders, not about questioning norms and conventions in the same way university so often is.[1] A life without the critical thinking skills provided by university will be less useful to society, as citizens will be unable to engage with political debate effectively – citizens need to be critical of what politicians tell them. The state has a responsibility to provide citizens with the skillset to take partake in the democratic process.

[2] Free universities benefit both the citizen, as an exploration for his/her own development, and to society, for an educated and active populace.


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Annotation

• 200 debate motions are randomly chosen for annotation.
  - 462 claims with 640 citation documents
  - Annotation includes supporting arguments and their types.

• Inter-annotator agreement (Cohen’s $\kappa$): 0.80 overall
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Annotation – Four types of arguments

• **Study**
  - Only 11.7% of bird-owning households currently seek veterinary advice for their birds.

• **Factual**
  - Ongoing circulation of H5N1 and H7N9 continue to pose threats to public heath.

• **Opinion**
  - Birds could spread diseases.

• **Reasoning**
  - Birds are routinely denied two of their fundamental natural behaviors – flying and socialization, which can cause physical and behavioral abnormalities.
Argument Type Prediction

• A log-linear model with one-vs-rest setup
• Dataset: Arguments annotated with types, divided as training, development, and test sets
• Features:
  - **Basic Features**: part-of-speech tags, named entities
  - **Discourse Features**: discourse connections from the Penn Discourse Treebank (Prasad et al, 2007)
  - **Sentiment Features**: negative and positive words (Wilson et al, 2005; Stone et al, 1966)
  - **Style Features**: concreteness (Brysbaert et al, 2014), dominance, arousal, and valence (Warriner et al, 2013)
Sample Features

• Concreteness
  - STUDY, FACTUAL -> more concrete words
  - luckiness, happiness vs. ginger, bicycle

• Named Entities
  - REASONING -> less NEs

• Sentiment
  - FACTUAL -> less sentiment words
  - admirable, bright vs. movie, sound
Type Prediction - Results

- Baselines: majority class, log-linear model with only unigram and bigram features

<table>
<thead>
<tr>
<th>Model</th>
<th>Accuracy</th>
<th>F1</th>
</tr>
</thead>
<tbody>
<tr>
<td>majority class</td>
<td>0.520</td>
<td>0.171</td>
</tr>
<tr>
<td>log-linear (unigram, bigram features only)</td>
<td>0.535</td>
<td>0.277</td>
</tr>
<tr>
<td>log-linear (all features)</td>
<td>0.622</td>
<td>0.436</td>
</tr>
</tbody>
</table>

Used in our argument detection model
Supporting Argument Detection

- A state-of-the-art ranking model: LambdaMART (Burges, 2010)
- Dataset: Annotated relevant arguments, split as training, development, and test sets
- Features:
  - **Sentence Features**: unigram, bigram, part-of-speech, named entities, sentiment features, style features
  - **Similarity Features**: word2vec and TF-IDF similarity between claim and candidates; ROUGE (Lin, 2004) and BLEU (Papineni et al., 2002)
  - **Composite Features**: linguistic features combined with argument type
Composite Features

• Goal: explicitly modeling the interplay of type and linguistic features

• Consider a candidate sentence $s$ for a given claim $c$

• Composite feature function: $\phi_{\text{TYPE, feature}}(s, c)$
  - Assume sentence type $\text{REASONING}$, and feature $\text{ROUGE}_L$

  \[ \phi_{\text{REASONING, ROUGE}_L}(s, c) = \text{ROUGE}_L (s, c) \]
Supporting Argument Detection - Metrics

• Evaluate using ranking metrics
  - Mean Reciprocal Ranking (MRR)
  - Normalized Discounted Cumulative Gain (NDCG)
    (higher score -> correct sentence is ranked higher)
Supporting Argument Detection - Results

MRR (x100) for models trained with different features

- Similarity: 47.65
- Sentence Features: 55.38
- Comp(type, Sentence) + Comp(type, Similarity): 55.75
- Sentence + Similarity + Comp(type, Sentence) + Comp(type, Similarity): 57.65
Feature Analysis

• Understand the interplay between argument type and linguistic features

• Composite features: compare relevant arguments to irrelevant ones
Feature Analysis – Sentence Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Study</th>
<th>Factual</th>
<th>Opinion</th>
<th>Reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position of sentence</td>
<td>↓</td>
<td>↓</td>
<td></td>
<td>↓</td>
</tr>
<tr>
<td>Concreteness of sentence</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Arousal of sentence</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Number of hedging word</td>
<td>↑</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

↑: Significantly higher in this category  
↓: Significantly lower in this category
# Feature Analysis – Named Entities

<table>
<thead>
<tr>
<th>Feature</th>
<th>Study</th>
<th>Factual</th>
<th>Opinion</th>
<th>Reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of PERCENTAGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of LOCATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

: Significantly higher in this category
### Feature Analysis – Claim Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Study</th>
<th>Factual</th>
<th>Opinion</th>
<th>Reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROUGE</td>
<td>🔺</td>
<td>🔺</td>
<td>🔺</td>
<td></td>
</tr>
<tr>
<td>Concreteness of claim</td>
<td>🔺</td>
<td></td>
<td>🔺</td>
<td>🔻</td>
</tr>
<tr>
<td>Arousal of claim</td>
<td>🔺</td>
<td></td>
<td>🔺</td>
<td>🔻</td>
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</tbody>
</table>

- 🔺: Significantly higher in this category
- 🔻: Significantly lower in this category
Conclusion

• We study sentence-level relevance estimation for supporting arguments construction.

• We characterize relevant arguments by four types and annotate accordingly on a newly collected dataset of 200 debate motions.

• We find that
  - human writers seek for different types of supporting arguments;
  - relevant arguments of different types are indicated by different linguistic features.
Future Work – Towards Automatic Argument Generation

<table>
<thead>
<tr>
<th>Operation</th>
<th>Sentence in cited article</th>
<th>Sentence reused by human</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paraphrase</td>
<td>The global counterfeit drug trade, a billion-dollar industry, is thriving in Africa.</td>
<td>This is exploited by the billion dollar global counterfeit drug trade.</td>
</tr>
<tr>
<td>Summarize</td>
<td>“I think it sets up a cycle of resistance to school because they don't have access to the cultural and emotional and learning support which middle-class children can get.”</td>
<td>Teachers in Britain fear that poor children, because they lack the support to do their homework, will be turned off school.</td>
</tr>
<tr>
<td>Generalize</td>
<td>Hidjaba is struggling to take care of her family - like nearly 200,000 other Malians who have fled the north of their country to escape the fighting ...</td>
<td>Much of the population of the North had already fled to the south.</td>
</tr>
</tbody>
</table>

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Thank you!

• Check out our released dataset at: http://xinyuhua.github.io/Resources/

• Contact: hua.x@husky.neu.edu

• Find us at: https://nlp.ccis.northeastern.edu

• Any question?