

# 11830 Report: Biases in Crowdsourced Annotations

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## Abstract

This document is a supplement to the general instructions for \*ACL authors. It contains instructions for using the L<sup>A</sup>T<sub>E</sub>X style files for ACL conferences. The document itself conforms to its own specifications, and is therefore an example of what your manuscript should look like. These instructions should be used both for papers submitted for review and for final versions of accepted papers.

## 1 Introduction

The Stanford Natural Language Inference (SNLI) corpus<sup>1</sup> is a large crowdsourced natural language inference dataset (Bowman et al., 2015). For each premise sentence, annotators were asked to write a hypothesis that is either a contradiction, neutral statement, or entailment of the premise.

The data was collected from Amazon Mechanical Turk (MTurk) crowdsourcing service. Previous studies have shown that MTurk crowd-workers tend to have lower income, higher education levels, and lower average ages (Levy et al., 2016). We believe that biases are inevitably propagated from the dataset authors to the premise text, and from the crowd-workers to the hypothesis text. Therefore, we will analyze the biases in the data by performing word association tests in this report.

## 2 Method

### 2.1 Pointwise Mutual Information

Pointwise Mutual Information (PMI) is used to measure how much word  $w_i$  is associated with word  $w_j$  (Church and Hanks, 1990; Jurafsky and Martin, 2009). PMI is calculated as follows:

$$\text{PMI}(w_i, w_j) = \log_2 \frac{N \cdot c(w_i, w_j)}{c(w_i)c(w_j)}$$

<sup>1</sup><https://nlp.stanford.edu/projects/snli/>

where  $N$  is the total number of sentences in the corpus,  $c(w_i, w_j)$  is number of times  $w_i$  and  $w_j$  co-occur in a sentence,  $c(w_i)$  is the number of times  $w_i$  occurs in the corpus, and  $c(w_j)$  is the number of times  $w_j$  occurs in the corpus.

Note that if a pair of words  $w_i$  and  $w_j$  occurs multiple times in the same sentence,  $c(w_i, w_j)$  is counted as 1.

PMI ranges from negative infinity to positive infinity. Large PMI suggests high word association. Negative PMI implies two words co-occur less often than by chance and is unreliable in practice (Jurafsky and Martin, 2009).

## 3 Experiments

### 3.1 Data Preprocessing

As mentioned before, each data sample contains a premise and a hypothesis. Note that multiple hypotheses might be generated from the same premise, therefore duplicated premise text is removed. All words are converted into its lower case form and stop words are removed. Then we use spaCy (Honnibal et al., 2020) `en_core_web_sm` model to tokenize raw strings into lists of words and remove all punctuations.

Note that words that occurs less than 10 times in the corpus are removed.

### 3.2 Unigram PMI

We first perform unigram PMI analysis on the entire corpus, and then on the premise text and the hypothesis text individually.

For each analysis experiment, we focus on the most associated words with a set of identity labels (Rudinger et al., 2017).

## 4 Results and Discussion

### 4.1 Unigram PMI

Table 1 lists top associated unigrams with some of the identity labels in the entire corpus, in

Identity	Premise	Hypothesis
women	saris, headscarves, bikinis, headdresses, coverings	burkas, husbands, saris, kimonos, bikinis
men	turbans, tuxedos, ladders, jumpsuits, wetsuits,	turbans, rickshaws, wives, cigars, tuxedos,
aficans	tribe, hearts, tap, huts	armed, source, die, cloths, tribal
caucasian	lockers, handsome, explains, contemplates, straddling	slender, fleece, non, zip, festive
muslims <sup>1</sup>	channel, news, sponsored, celebrate, speech	christians, terrorists, celebrate, opening, phones
christians <sup>1</sup>	praising, lord, crazy, fun, woods,	muslims, gospel, impressed, pork, villagers
gay	pride, marriage, attendees, protester, participants,	pride, rights, marriage, experimenting, abraham
straight	razor, ahead, stony, sketch, crack	razor, tambourine, ahead, stared, lanes
israeli	desolate, nuts, pirates, cigarettes, u.s.	problems, eastern, cashier, cigarettes, counter
american	footballer, african, native, patriotic, south	idol, native, african, latin, drapes

<sup>1</sup> Words that don't have associated words that occurs more than 10 times in premise text. The threshold is ignored for these words.

Table 1: Top associated unigrams with identity labels

premise text, and in hypothesis text. We can easily spot some alarmingly biased word association. For example, `muslims` is highly associated with `terrorists`, `aficans` co-occur with `armed` and `die` frequently, while `caucasian` is often associated with `handsome`.

There are also many implicit biases or stereotypes in the data. `women` is most associated with words related to fashion, while `men` with words about tools and work clothes. This implies that women spend more time on fancy clothes while men work on labor jobs and don't care about their looks, which is not true.

Meanwhile, we can spot more heavily biased word associations in the hypothesis data compared to premises. For example, associations between `muslims` and `terrorists` and between `women` and `gossip` is only present in the hypotheses.

However, there are yet some cases where the bias is more prevalent in the premises. For example, `israeli` is most associated with `desolate` and `pirates` in premises, compared to `problems`, `eastern`, `cashier` and so on in hypotheses.

We also find it interesting that `south` is among the top 5 most associated words with `american` while `north` is not found even in the top 20s, as if people think `american` are from North America by default.

## 4.2 Qualitative Analysis

## 4.3 Crowdsourcing Setup

## References

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