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Leveraging Bias in Pre-trained Word Embeddings for Unsupervised Microaggression Detection

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Microaggressions are subtle manifestations of bias (Breitfeller et al. 2019). These demonstrations of bias can often be classified as a subset of abusive language. However, not much focus has been placed on the recognition of these instances. As a result, limited data is available on the topic, and only in English. Being able to detect microaggressions without the need for labeled data would be advantageous since it would allow content moderation also for languages lacking annotated data. In this study, we introduce an unsupervised method to detect microaggressions in natural language expressions. The algorithm relies on pre-trained word-embeddings, leveraging the bias encoded in the model in order to detect microaggressions in unseen textual instances. We test the method on a dataset of racial and gender-based microaggressions, reporting promising results. We further run the algorithm on out-of-domain unseen data with the purpose of bootstrapping corpora of microaggressions “in the wild”, perform a pilot experiment with prompt-based learning, and discuss the benefits and drawbacks of our proposed method.¹

1. Introduction

The growth of Social Media platforms has been accompanied by an increased visibility of expressions of socially unacceptable language online. In a 2016 Eurobarometer survey, 75% of people who follow or participate in online discussions have witnessed or experienced abuse or hate speech. With this umbrella term, different phenomena can be identified ranging from offensive language to more complex and dangerous ones, such as hate speech or doxing. Recently, there has been a growing interest by the Natural Language Processing community in the development of language resources and systems to counteract socially unacceptable language online. Most previous work has focused on few, easy to model phenomena, ignoring more subtle and complex ones, such as microaggressions (Jurgens, Hemphill, and Chandrasekharan 2019).

Microaggressions are brief, everyday exchanges that denigrate stigmatised and culturally marginalised groups (Merriam-Webster 2021). They are not always perceived as hurtful by either party, and they can often be detected as positive statements by current

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hate-speech detection systems (Breitfeller et al. 2019). The occasionally unintentional hurt caused by such comments is a reflection of how certain stereotypes of others are baked into society. Sue et al. (2007) define microaggressions in the racial context, particularly when directed toward people of color, as “brief and commonplace daily verbal, behavioral, or environmental indignities”, such as: “*you are a credit to your race.*” (intended message: it is unusual for someone of your race to be intelligent) or “*do you think you’re ready for college?*” (intended message: it is unusual for people of color to succeed). The need for moderation of hateful content has previously been explored. For instance, Mathew et al. (2019b) analyses the temporal effects of allowing hate speech on Gab, a social network known for attracting a right-wing userbase, and finds that the language of users tends to become more and more similar to that of hateful users over time. Mathew et al. (2019a) further highlights that the spreading speed and reach of hateful content is much higher than the non-hateful content. As a result, being able to remove instances of hateful language, such as microaggressions, is of great importance.

Previous work on microaggressions with computational methods is quite recent. Breitfeller et al. (2019) is one of the first works to address microaggressions in a systematic way, also introducing a first dataset, SelfMA. A further contribution specifically focused on racial microaggression is Ali et al. (2020), where the authors focus on the development of machine learning systems. In terms of automatic classification, these works propose supervised methods based on linguistic features, obtaining acceptable performance but at the same time tying the results to specific benchmarks and training sets.

In this study we introduce an unsupervised method for microaggression detection. Our method utilizes the existing bias in word-embeddings to detect words with biased connotations in the message. Although unsupervised approaches tend to be less competitive than their supervised counterparts, our method is language-independent and thus it can be applied to any language for which embedding representations exist. Furthermore, the reliance of our methods on specific lexical items and their context of occurrence makes transparent the flagging of a message as an instance of a microaggression. In addition to the usefulness of our method in languages with no labeled data, the reliance of our model on words in the sentences would make it interpretable as it allows human moderators to understand what the system has based its decision on.

Our contributions can be summarised as follows:

- we introduce a **new unsupervised method** for the detection of microaggressions which builds on top of pre-trained word embeddings;
- we **further test** the proposed algorithm **on unseen data from a different domain** (i.e., Twitter), in order to qualitatively evaluate its efficacy in discovering new instances of microaggression;
- we **compare** our approach with prompt-based learning to better assess its advantages and limits.

The rest of this paper is structured as follows: we introduce our method in Section 2. The data and our results are reported in Section 3. We deploy our model and discuss its limitations in Section 4. The application of our unsupervised approach on the Twitter data and the results of this experiment are presented in Section 5. In addition to this, we further compare our method with a very recent approach, i.e., *prompt-based learning*, showing its potential advantages in Section 6. Finally, we present the conclusion and future work in Section 7.

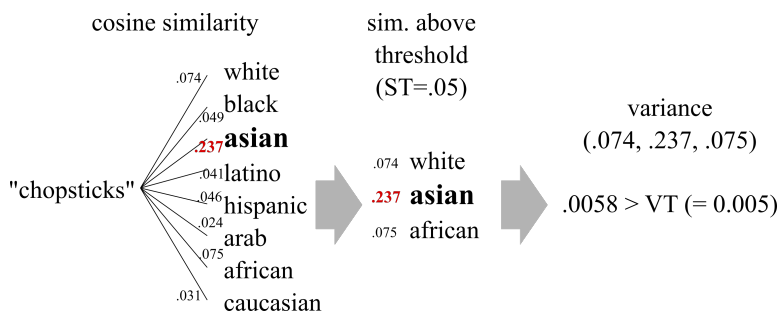


Figure 1
Worked example of unsupervised method for word "chopsticks" in the message "Ford: Built With Tools, Not With Chopsticks"

2. Use the Bias Against the Bias

Embedded representations, either from pre-trained word embeddings or pre-trained language models, have been shown to contain and amplify the biases present in the data used to generate them (Bolukbasi et al. 2016; Lauscher and Glavaš 2019; Bhardwaj, Majumder, and Poria 2020). As such, they often exhibit gender and racial bias (Swinger et al. 2019). Many studies have attempted to reduce this bias (Yang and Feng 2020; Zhao et al. 2018; Manzini et al. 2019). In this work, we take a different turn by using this bias to our advantage: rather than taming the hurtfulness of the representations (Schick, Udupa, and Schütze 2021), we actively use it to promote social good. In this first study, we employ word representations derived from generic textual corpora of English, in order to capture the background knowledge needed to disambiguate instances of microaggressions in the text. Recently, however, there have been studies involving word representations created from tailored collections of social media content aimed at capturing abusive phenomena like verbal aggression (Dynel 2021) and hate speech (Caselli et al. 2021).

We devise a simple and effective method that exploits existing bias in word embeddings and identify words in a message that are related to particular and distant semantic areas in the embedding space. Messages are analysed in three steps: first, for each token t^i we compute its relatedness to a list of manually curated seed words $s = s_1, \dots, s_n$ denoting potential targets of microaggressions; second, we consider only the similarities of the pairs (t_i, s_j) above an empirical *similarity threshold* (ST) and compute their variance v_i ; finally, we classify the token t_i as a micro aggression trigger, and consequently the message as a micro aggression, if the v_i is above an empirically determined *variance threshold* (VT).

The intuitive idea behind this algorithm is that some lexical elements in a verbal microaggression are often (yet sometimes subtly) hinting at specific features of the recipient of the message, in an otherwise neutral lexical context.

In this work, we choose to focus on microaggressions related to race and gender, therefore the seed words have to be chosen accordingly. The seed word lists for race and gender are, respectively, *[white, black, Asian, latino, hispanic, Arab, African, caucasian]* and *[girl, boy, man, woman, male, female]* for gender. There is also a practical reasons to focus on gender and race, namely the scarcity of data available for other categories of microaggression and other idiosyncrasies of the available datasets — the religion class

Table 1

Statistics of the two subsets of the SelfMA dataset used in this paper, and the extra data downloaded to balance the dataset.

Source	Number of posts
SelfMA Gender	1,314
SelfMA Racial	1,278
Tumblr	2,021

was specific to different religions, therefore hard to generalise, sexuality and gender presented a large overlap, and so on.

An example of how the proposed method works is illustrated in Figure 1. In the example, consider the word "chopsticks" in the message "*Ford: Built With Tools, Not With Chopsticks*" (from the SelfMA dataset, described in Section 3). The target word exhibits a much higher relatedness to the word *Asian* (0.237) than any other seed words. Even just considering the seed words with a similarity above a fixed threshold (*white*, *Asian* and, *African*), the variance of their similarity score with respect to *chopsticks* is still higher than the variance threshold, and therefore this target word, in this context, triggers a microaggression according to the algorithm. This process is repeated for all the words in the message in order to detect microaggressions. Some categories of words are bound to exhibit a high relatedness to all the seed words, e.g., "people" or "human". This is the reason to introduce the variance threshold in the final step of our algorithm, to filter out these cases when classifying a given message, and instead focus on words that are related to different races (or genders) unevenly, with a skewed distribution of similarity scores.

An important by-product of this algorithm is that the output is one or more trigger words, in addition to the microaggression label — in the example, the trigger word is indeed *chopsticks* — therefore enabling a more informative and interpretable decision process.

3. Experiments

To test our method, we use two subsets of the *SelfMA: microaggressions.com* dataset (Breitfeller et al. 2019), comprised of 1,314 and 1,278 Tumblr posts respectively². The posts in SelfMA are all instances of microaggressions, manually tagged with one of four categories: race, gender, sexuality and religion. These posts can be tagged with more than one form of microaggressions, meaning certain instances can appear in both subsets of race and gender used for the purposes of this study. The dataset consists of first and second hand accounts of microaggressions, as well as direct quotes of phrases or sentences said to the person posting. In order to reduce linguistic perturbation introduced by accounts of a situation, we only take direct quotes found in the dataset as instances of microaggressions that we can detect with our unsupervised method. For training, we pull out direct quotes from the gender (561) and racial (519) dataset to test the algorithm. In order to balance the dataset, we scraped 2,021 random Tumblr posts, for a total of 4,612 instances. Table 1 summarises the composition of our dataset.

² Tumblr is a popular American microblogging platform <https://www.tumblr.com>

It is important to note that a microaggression can have multiple tags, so there is an overlap of instances. However, the seed words used to detect microaggression types in the method are different for each target phenomenon (e.g., race, gender).

We ran the algorithm on the *SelfMA* dataset, empirically optimising the two thresholds on the training split, for each word embedding type and each microaggression category, filtering by the seed words listed in Section 2. We test the algorithm with three pre-trained word embedding models for English, namely *FastText* (Joulin et al. 2017), trained on Wikipedia and Common Crawl, *word2vec* (Mikolov et al. 2013), trained on Google News, and *GloVe* (Pennington, Socher, and Manning 2014), trained on Wikipedia, GigaWord corpus, and Common Crawl. The optimization is performed by exhaustive grid search over the hyperparameter space.

To provide a better context to interpret the results, we also present the results of a simple baseline method based on the presence of seed words in the text instances. In this method, an instance is considered a microaggression if and only if any of the seed words used by the unsupervised algorithm is present in the text.

The results, shown in Table 2, indicate that *FastText* has a better F1 score on Racial microaggressions while *word2vec* performs better on Gender microaggressions. The difference in performance between *FastText* and *word2vec* is not major, and we attribute this to the difference between the corpora on which the two models were trained (i.e., web crawl and Wikipedia for *FastText* vs. news data for *word2vec*). The *GloVe* pretrained model, trained on a combination of newswire texts, encyclopedic entries and texts from the Web, underperforms in both experiments. In general, the absolute figures are encouraging, especially considering the simplicity of this unsupervised approach.

4. Limitations of Unsupervised Method

Despite promising results with the unsupervised methods, it is important to note that this method currently works on the basis of one trigger word. An analysis of the set of trigger words for each instance show that the vast majority of instances marked as microaggressions are explicitly realized, i.e., they have trigger words that are similar to or substitutes for our sets of race-related or gender-related seed words e.g Chinese, Japanese, Mexican, mister, or girlfriend. The mention of a “girlfriend” or the word “Chinese” alone in a statement should not flag it as a microaggression, so the methods needs more work to more accurately detect microaggressions with detailed reasoning. However, as the examples in Table 3 highlight, it suffice the presence of a single word to a seemingly neutral or positive statement to make it a microaggression. Examples are in Table 3.

In instances where there are multiple trigger words, the set of words selected seems to paint a picture explaining why such a word triggers a microaggression. Examples are in Table 4. In the first example, we see that the person quoted felt the need to mention that the person spoken about is “*Black*, you know”, because he was *smiling*. We see something similar take place when *cute* is equated to being *feminine*.

It is possible that a method that incorporates the set of these words, or even the juxtaposition of individual words with words that don’t get flagged up with the current method may lead to more precise and categorisations.

Table 2

Results of the experiment on the Gender and Racial subset of SelfMA, in terms of Precision (P), Recall (R), and F1-score (F1) on the positive class (MA), on the negative class (not-MA), and their macro-average. Best scores per microaggression category are in bold.

Target	Model	Class	Precision	Recall	F1-Score
Gender	baseline	not-MA	.613	.912	.734
		MA	.825	.418	.555
		<i>macro avg.</i>			.644
	FastText	not-MA	.609	.746	.671
		MA	.714	.570	.634
		<i>macro avg.</i>			.680
	GloVe	not-MA	.692	.380	.491
		MA	.603	.848	.705
		<i>macro avg.</i>			.598
	word2vec	not-MA	.659	.789	.718
		MA	.769	.634	.694
		<i>macro avg.</i>			.706
Race	baseline	not-MA	.576	.950	.717
		MA	.826	.253	.388
		<i>macro avg.</i>			.552
	FastText	not-MA	.659	.875	.654
		MA	.814	.547	.752
		<i>macro avg.</i>			.702
	GloVe	not-MA	.765	.371	.500
		MA	.611	.896	.726
		<i>macro avg.</i>			.613
	word2vec	not-MA	.640	.814	.747
		MA	.776	.584	.667
		<i>macro avg.</i>			.692

5. Discovering Microaggressions

To better understand the performance of our unsupervised model, we performed an additional experiment. Our goal is to understand the false positive results and the potential harm the model could cause. To do so, we use our unsupervised model to label unseen instances from another domain (Twitter) than the SelfMA dataset (Tumblr) in order to see how the model would perform in detecting microaggressions.

We begin by performing keyword searches on Twitter (using Twitter’s official API) and collect a new dataset of 3M tweets with seven keywords potentially containing race and gender expressions. Next, we set the threshold values ST and VT in our model in order to obtain the highest Precision scores, rather than the highest F1 value. This step is performed exactly like the optimization described in Section 2 with the only difference of the target metric. The aim of this step is to only label tweets as microaggressions with the highest possible degree of confidence. We set $ST = 0.12$ and $VT = 0.014$ for racial microaggressions leading to Precision of .931 and $ST = 0.13$ and $VT = 0.019$ for gender-based microaggressions leading to a Precision of .912. Precision has been measured on the original SelfMA dataset used as a validation set.

Table 3
Instances of microaggressions identified by one word.

Instance	Trigger word
<i>"I've seen you around and always wanted to talk to you. You just have this wonderful... ethnicity about you."</i>	ethnicity
<i>"Stop acting like a princess! You're acting like a princess!! Ooh... little princess... boo hoo."</i>	princess
<i>"They hit a state trooper head on. And they were both illegals. Well, I don't know if they were illegals, but they had illegal sounding names."</i>	illegals

Table 4
Instances of microaggressions identified by several words.

Instance	Trigger words
<i>"Oh he's very nice. He's so intelligent and always happy and smiling, and very professional. (pause) He's black, you know."</i>	smiling, black
<i>"You like little cute dogs. That's feminine."</i>	cute, feminine

We then run the unsupervised model on the new Twitter dataset by automatically labelling 256,843 tweets for gender and 373,631 tweets for race. After the data is labeled, we manually explore the positive instances in order to evaluate the performance of the model. The algorithm tuned for high precision found in this dataset 6,306 gender-related microaggression candidates, 13,004 race-related microaggression candidates.

We find that while the model does detect actual instances of microaggression, there is a noticeable amount of false positive instances. These tweets discuss race or gender in some manner. However, they do not necessarily contain microaggressions towards these groups. While the model does learn to detect discussions of these topics, it seems to sometimes confuse these discussions with microaggressions towards the aforementioned groups. Some examples follow, paraphrased to avoid tracking the original messages.

1. *Saying "Arrested Development isn't funny" in an office full of women just to feel something*
2. *"Men have moustaches, women have oversized bracelets"*

The humorous attempts in this tweets hinge on gender stereotypes, and therefore in some contexts it could be perceived as offensive by some recipients. The high relatedness in the word embedding space between some words (moustaches and bracelets) and gender-related seed words (men and women) triggers the detection algorithm.

The automatic detection of racial microaggressions "in the wild" is more challenging than gender-based ones, according to our manual exploration of this automatically labeled dataset. This may be due to the difficulty of crafting a list of seed words that

is sufficiently race-related, but at the same time avoids generating too many false positives. We indeed found many of them, mainly due to named entities and multi-word expressions such as “White House”, or simply because of the polysemy of color words, e.g. “black” and “white”. We, however, still found instances of messages containing different extent of racial stereotyping, as indicated in the following examples:

3. *“why are you being so dramatic? just say I’m not originally arab, you don’t have to fight about it”*
4. *“I will need to explain that to the chinese old lady who works at my school’s administrative office”*

In summary, running the unsupervised microaggression detection algorithm on unseen data seems to represent a promising intermediate step towards the semi-automatic creation of language resources for this phenomenon. While the accuracy is not ideal, and lists of seed words have to be handcrafted carefully in order to avoid false positives, these drawbacks are balanced by the fairly cheap computational cost and the ease of application in a multilingual scenario.

6. Prompt-based Classification of Microaggressions

One of the advantages of the method we propose in this paper is that, being unsupervised, it allows us to perform microaggression classification in a zero-shot fashion. *Prompt-based learning* (Liu et al. 2023) is a recent paradigm which gained enormous traction in the NLP community, applied, among other tasks, to zero-shot classification. In a nutshell, prompt-based classification makes use of large pre-trained language models to map labels to handcrafted or automatically derived natural language expressions. The plausibility of the instance to classify augmented with the prompt according to the model determines the label, without the need for further training or fine-tuning.

As a final experiment on the microaggression benchmark we presented in this paper, we compute the performance of a basic prompt-based method for classification. We test two variants of prompts, one “objective” and one “subjective”. The objective prompts have the form of the short sentence *“This is [mask]”* following the text of the instance to classify. *[mask]* is replaced by *offensive* and *ok*, linked respectively to the labels *MA* and *not-MA*. The subjective prompts work similarly, but the alternative template is *“I feel [mask]”* and, in order to keep the syntax consistent, the fillers for the mask are *offended* and *ok*. Table 5 summarizes the design of the prompts for this experiment.

Table 5
Objective and subjective prompts used for zero-shot microaggression classification.

Prompt type	Label	Prompt text
Objective	MA	This is offensive.
Objective	non-MA	This is ok.
Subjective	MA	I feel offended.
Subjective	non-MA	I feel ok.

The experiment is implemented with the OpenPrompt library for Python (Ding et al. 2022). The pre-trained model prompted in this experiment is the `bert-base-uncased` model based on BERT (Devlin et al. 2019). And the results

Table 6

Results of the experiment of prompt-based classification on the Gender and Racial subset of SelfMA, in terms of Precision (P), Recall (R), and F1-score (F1) on the positive class (MA), on the negative class (not-MA), and their macro-average.

Target	Prompt type	Class	Precision	Recall	F1-Score
Gender	Objective	not-MA	.823	.627	.712
		MA	.556	.776	.648
		<i>macro avg.</i>			.680
	Subjective	not-MA	.839	.666	.743
		MA	.587	.788	.673
		<i>macro avg.</i>			.708
Race	Objective	not-MA	.819	.624	.708
		MA	.540	.762	.632
		<i>macro avg.</i>			.670
	Subjective	not-MA	.817	.642	.719
		MA	.549	.753	.635
		<i>macro avg.</i>			.677

are shown in Table 6. The first observation we can draw from the results is that the subjective prompts are consistently better at predicting the correct microaggression label. While we did not systematically test a large variety of variations of prompts, this result matches the intuition that microaggression detection is a subjective task, whose perception is dependant on the recipient’s perspective.

Comparing the results of the prompt-based classification with the results of the main experiment (Table 2), we see a generally comparable performance. On the gender subset, the prompt-based classification is actually slightly better in terms of macro-averaged F1-score, although the performance on the positive class (arguably more useful in a detection task) is lower. On the race subset, the classification performance is lower, although not by a large margin. Considering that we only tested fixed, hand-crafted prompts without further tuning and optimization, the results of this experiment indicate a promising application of prompt-based learning to the task of microaggression detection. On the other hand, the main unsupervised method presented in this paper retains characteristics of transparency and interpretability that are difficult to replicate with the prompt-based approach.

7. Conclusion and Future Work

In this paper we introduce a novel algorithm that exploits the existing bias in pre-trained word embeddings to detect subtly abusive language phenomena such as microaggressions. While supervised methods of detection in the field of natural language processing are plentiful, these methods are only viable for languages and topics with available labeled datasets. That is however not the case for many languages. As a result, the unsupervised method of detection introduced in this study could help address the need for the moderation of microaggressions in languages other than English. This is further helped by the availability of multilingual word-embeddings as they would allow the method to be used in any of the languages supported by the embedding.

The method is unsupervised and only needs a small list of seed words. Considering its simplicity, the results obtained from an experiment on a dataset of manually annotated microaggressions are very promising. The experimental results are also compared to a recent approach based on prompt-based learning, which obtains comparable but lower performance. Further, the method is transparent, explicitly identifying the words triggering a microaggression, and thus paving the way for explainable microaggression detection.

Although the preliminary results are promising, an experiment on unseen data from a different domain shows that there is leeway for improvement. Given that we are looking at the explicit words used in each message, our method is not sensitive to implicit expressions like “you people” or “your kind”, often occurring in microaggressions. We would have to add further steps to our algorithm to catch expressions like these.

Polysemy is another known issue, e.g., in words like “black” and “white” whose relatedness to certain identified trigger words could not necessarily be due to race. While a careful composition of the seed word lists helps to minimize this issue, a systematic approach to polysemy would certainly be desirable. The seed word list may also be expanded, either manually or exploiting existing lexicons such as HurtLex (Bassignana, Basile, and Patti 2018) for offensive terms (including stereotypes for several categories of individuals) or specialized lists of identity-related terms³.

In future work, we plan on improving our model to account for lexical ambiguity, and the complexity derived from the interference between pragmatic phenomena and aggression, e.g., in humorous and ironic messages, following the intuition in recent literature (Frenda 2018) about the interconnection between irony or sarcasm and abusive language online. Our current plan is to apply the algorithm presented in this paper to bootstrap the creation of a multilingual resource of online verbal microaggressions and release it to the research community.

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³ See for instance this compendium of LGBTQIA+ terminology: https://www.umass.edu/stonewall/sites/default/files/documents/allyship_term_handout.pdf

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