Guidelines for Paper Write Up

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I. Description of the Study

[1] The purpose of this research was to analyze the writings of Agatha Christie, a mystery novelist, in an attempt to optimize the detection of Alzheimer's disease based on writings by the subject[1]. The authors used this study to explore different metrics to test whether Alzheimer's disease and/or dementia were able to be detected by the language used in the corpus of Agatha Christie's works[1].

This problem is significant because Alzheimer's disease affects a large number of people as age increases. Being able to detect these patterns without ever interacting with the subject would be beneficial to society by helping affected people seek treatment and assistance when they normally would not have even been aware of a declining mental state. This problem is also significant in that solving it would result in the much earlier detection of dementia. Giving periodic tests and comparing the results to a healthy person's results may be able to provide insight into deterioration long before the symptoms become pronounced. It will also help inform medical professionals and those close to the subject about the current state of the subject, thus providing more context and additional perspective that can enhance the experiences of these people with regard to the subject.

The research question is summarized as given a corpus of a subject's writing, can natural language processing methods determine the state of the subject's mental state[1]? The objective is to find metrics by which a mental decline can be quantified and determine the effectiveness of each of these metrics in determining the presence of dementia. The hypothesis is that yes, natural language processing methods are effective in determining the mental deterioration (or lack thereof) present in patients[1].

II. Methods and Design

The rationale is described and justified because the given materials (the corpus) need to be processed to gain information from it. The author does a good job of explaining where exactly the ideas for these metrics originate, and since some of the methodologies are based on the peer-reviewed work of other authors, the usage of these methods is justified.

The size of the sample is described as the first 50000 words of each of Agatha Christie's books that have been digitized[1]. The key characteristics are simply the words present in the books since they are the only things that are used.

The sample is very representative as it encompasses almost all the words used in the books. The size of the blocks of text taken from the books is kept consistent across all books used, which can introduce some uncertainty (longer books have more words that could indicate dementia), but as it is a sample, the corpus is well represented.

The data were collected through text processing tools such as *Concordance* and *Text Analysis Computing Tools (TACT)*[1]. The numbers of unique words, n-grams, and indefinite words were counted.

The authors do not discuss the validity of their methods, but they do cite previous authors in the field who used similar methods[1]. This paper's methods can almost be called an ensemble of previous work directed at a previously not analyzed corpus. This study can be reproduced, but it may require further research into the sources used by the authors, especially for the n-gram production and counting since specific methods for this were not explained in the paper.

III. Analysis

The data collected in the text-processing stage were used to evaluate the model. They can be listed as Novel, Age at composition, Word-types, Repeated phrase-types, and Indefinite word percentage (from table 1)[1].

The data was appropriate in that it directly shows the results of the text-processing and where the authors drew conclusions from.

The metrics used to analyze the results come from the trends exhibited by the data. Linear regression was used to add credibility to the authors' conclusion, as well as values for p, which is a statistical value used in determining the significance of a conclusion[1].

The metrics do appear appropriate in that an outside reader can tell where the data comes from as well as the role they play in answering the research question.

IV. Results

The results are presented in a clear way. The table and the discussion of what the data contributes were easy to follow and logical.

The interpretations of the data are consistent with the results presented. The trends discussed are evident and the authors provide specific data points present in the results to highlight the points being made.

The conclusions were accurate as they were presented. The authors made no definitive statements regarding the mental state, they only say that the results *suggest* that the mental state of Agatha Christie was severely deteriorated based on both the corpus and reports from a biographer and relatives[1].

The authors' recommendations were appropriate because they show the areas which require further work. The specific recommendation to exclude the *Passenger to Frankfurt* book seemed a bit out of place, however[1]. To exclude it from some measures but not all simply because it fits the data better is not the best thing to do. The reasoning given by the authors was that the book drew on words from political thinkers and

that Christie heavily relied on them[1]. Given this, the book should not have been used in the method as it does not reflect solely her own words and thinking processes.

The authors did not compare their work to previous works or authors, but they did explain that they drew inspiration and data collection methods from these other authors[1].

V. Limitations

There are a few limitations that stand out to me as I read this paper. For one, there is no concrete data shown to convince the reader that Agatha Christie had dementia. We are only given stories that may be fake, but the reader has no objective way to determine this. The data given may be sufficient to show that there was a decline, but according to the paper, some of this decline may be the direct result of outside forces, namely breaking her hip and then appearing really frail for a time after[1]. the reader was given no baseline reference to which we can compare the given data and results. There is no way to establish given the information in this paper that the declining trend shown in the data is outside of the norm for other authors that did not experience dementia.

VI. Significance

This study contributes to the body of knowledge in that it provides a brief study using techniques that may aid in the early detection of Alzheimer's disease and dementia.

This study shows that we can draw meaningful data from text and use it to provide insight into the mental state of humans. This does not provide a foolproof or even a decisive model for detecting dementia, but it proves that natural language processing can prove to be a valuable tool for professionals to use when assessing mental health. Using the techniques shown in this paper can be used to detect abnormalities. It is up to a professional to act on these abnormalities and conduct further study. This seems to be more of a performance metric rather than a diagnosis tool.

How can these techniques be integrated into regular health checks? What is the minimum size of a corpus that is needed to be able to detect these trends? What does a normal, healthy person's table look like?

VII. Conclusion

I thought this paper was a very good example of a real-world application for natural language processing. It is interesting to see how NLP can be used for things that would normally be very difficult or time-consuming for a human to do. There is almost no semantic value in the results, but it isn't necessary and I find that really interesting. I think that the paper was pretty short and there was a lot of room for an explanation that the authors declined to use. I wish they had given more information on exactly how the n-grams were obtained as well as a snapshot of either the feature vector or the frequencies. Overall it was a good read and I hope we have more papers like this one in the future.

References

[1] Ian Lancashire and Graeme Hirst. Vocabulary changes in agatha christie's mysteries as an indication of dementia: A case study, 2009.