

# Identifying Parkinson’s Disease from Typing Behavior with Character Embeddings

Anonymous ACL submission

## 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 file for ACL 2023. 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

Parkinson’s Disease (PD) is a neurodegenerative illness impairing motor function [1] affecting 10 million people globally [2]. After Alzheimer’s, it is the second leading degenerative neurological illness in the US [2]. One of the earliest and distinguishing symptoms of PD is bradykinesia, or slowness/rigidity of movement. This often manifests in altered speech patterns and impaired coordination for fine motor tasks, e.g. typing or writing. Early detection of PD is key in administering appropriate medical care for symptom management, which can dramatically improve quality of life for patients. While new diagnosis tools are constantly being developed and improved, they generally do not scale for population screening. There is therefore an urgent need for an accurate and scalable diagnostic tool for early PD detection [1]. Machine learning (ML) models show great potential in this area as a non-invasive diagnostic method based on easily collected patient speech or typing data.

## 2 Background

To produce a PDF file, pdfL<sup>A</sup>T<sub>E</sub>X is strongly recommended (over original L<sup>A</sup>T<sub>E</sub>X plus dvips+ps2pdf or dvi2pdf). XeL<sup>A</sup>T<sub>E</sub>X also produces PDF files, and is especially suitable for text in non-Latin scripts.

## 3 Methods

The first line of the file must be

Command	Output	Command	Output
<code>{\`a}</code>	ä	<code>{\c c}</code>	ç
<code>{\^e}</code>	ê	<code>{\u g}</code>	ğ
<code>{\`i}</code>	ì	<code>{\l}</code>	ł
<code>{\`I}</code>	İ	<code>{\~n}</code>	ñ
<code>{\o}</code>	ø	<code>{\H o}</code>	ő
<code>{\'u}</code>	ú	<code>{\v r}</code>	ř
<code>{\aa}</code>	å	<code>{\ss}</code>	ß

Table 1: Example commands for accented characters, to be used in, e.g., BibT<sub>E</sub>X entries.

```
\documentclass[11pt]{article}
To load the style file in the review version:
\usepackage[review]{ACL2023}
For the final version, omit the review option:
\usepackage{ACL2023}
To use Times Roman, put the following in the preamble:
\usepackage{times}
(Alternatives like txfonts or newtx are also acceptable.) Please see the LATEX source of this document for comments on other packages that may be useful. Set the title and author using \title and \author. Within the author list, format multiple authors using \and and \And and \AND; please see the LATEX source for examples. By default, the box containing the title and author names is set to the minimum of 5 cm. If you need more space, include the following in the preamble:
\setlength\titlebox{<dim>}
where <dim> is replaced with a length. Do not set this length smaller than 5 cm.
```

Output	natbib command	Old ACL-style command
(?)	\citep	\cite
?	\citealp	no equivalent
?	\citet	\newcite
(?)	\citeyearpar	\shortcite
?’s (?)	\citeposs	no equivalent
(FFT; ?)	\citep[FFT; ][]	no equivalent

Table 2: Citation commands supported by the style file. The style is based on the natbib package and supports all natbib citation commands. It also supports commands defined in previous ACL style files for compatibility.

## 4 Results Discussion

### 4.1 Footnotes

Footnotes are inserted with the \footnote command.<sup>1</sup>

### 4.2 Tables and figures

See Table ?? for an example of a table and its caption. **Do not override the default caption sizes.**

### 4.3 Hyperlinks

Users of older versions of L<sup>A</sup>T<sub>E</sub>X may encounter the following error during compilation:

```
\pdfendlink ended up in different
nesting level than \pdfstartlink.
```

This happens when pdfL<sup>A</sup>T<sub>E</sub>X is used and a citation splits across a page boundary. The best way to fix this is to upgrade L<sup>A</sup>T<sub>E</sub>X to 2018-12-01 or later.

### 4.4 Citations

Table ?? shows the syntax supported by the style files. We encourage you to use the natbib styles. You can use the command \citet (cite in text) to get “author (year)” citations, like this citation to a paper by ?. You can use the command \citep (cite in parentheses) to get “(author, year)” citations (?). You can use the command \citealp (alternative cite without parentheses) to get “author, year” citations, which is useful for using citations within parentheses (e.g. ?).

### 4.5 References

The L<sup>A</sup>T<sub>E</sub>X and BibT<sub>E</sub>X style files provided roughly follow the American Psychological Association format. If your own bib file is named custom.bib, then placing the following before any appendices in your L<sup>A</sup>T<sub>E</sub>X file will generate the references section for you:

<sup>1</sup>This is a footnote.

```
\bibliographystyle{acl_natbib}
```

```
\bibliography{custom}
```

You can obtain the complete ACL Anthology as a BibT<sub>E</sub>X file from <https://aclweb.org/anthology/anthology.bib.gz>. To include both the Anthology and your own .bib file, use the following instead of the above.

```
\bibliographystyle{acl_natbib}
```

```
\bibliography{anthology, custom}
```

Please see Section ?? for information on preparing BibT<sub>E</sub>X files.

### 4.6 Appendices

Use \appendix before any appendix section to switch the section numbering over to letters. See Appendix ?? for an example.

## 5 Conclusion

Unicode cannot be used in BibT<sub>E</sub>X entries, and some ways of typing special characters can disrupt BibT<sub>E</sub>X’s alphabetization. The recommended way of typing special characters is shown in Table ??.

Please ensure that BibT<sub>E</sub>X records contain DOIs or URLs when possible, and for all the ACL materials that you reference. Use the doi field for DOIs and the url field for URLs. If a BibT<sub>E</sub>X entry has a URL or DOI field, the paper title in the references section will appear as a hyperlink to the paper, using the hyperref L<sup>A</sup>T<sub>E</sub>X package.

### Limitations

ACL 2023 requires all submissions to have a section titled “Limitations”, for discussing the limitations of the paper as a complement to the discussion of strengths in the main text. This section should occur after the conclusion, but before the references. It will not count towards the page limit. The discussion of limitations is mandatory. Papers

without a limitation section will be desk-rejected without review.

While we are open to different types of limitations, just mentioning that a set of results have been shown for English only probably does not reflect what we expect. Mentioning that the method works mostly for languages with limited morphology, like English, is a much better alternative. In addition, limitations such as low scalability to long text, the requirement of large GPU resources, or other things that inspire crucial further investigation are welcome.

## Ethics Statement

Scientific work published at ACL 2023 must comply with the ACL Ethics Policy.<sup>2</sup> We encourage all authors to include an explicit ethics statement on the broader impact of the work, or other ethical considerations after the conclusion but before the references. The ethics statement will not count toward the page limit (8 pages for long, 4 pages for short papers).

## Acknowledgements

This document has been adapted by Jordan Boyd-Graber, Naoaki Okazaki, Anna Rogers from the style files used for earlier ACL, EMNLP and NAACL proceedings, including those for EACL 2023 by Isabelle Augenstein and Andreas Vlachos, EMNLP 2022 by Yue Zhang, Ryan Cotterell and Lea Frermann, ACL 2020 by Steven Bethard, Ryan Cotterell and Rui Yan, ACL 2019 by Douwe Kiela and Ivan Vulić, NAACL 2019 by Stephanie Lukin and Alla Roskovskaya, ACL 2018 by Shay Cohen, Kevin Gimpel, and Wei Lu, NAACL 2018 by Margaret Mitchell and Stephanie Lukin, BibTeX suggestions for (NA)ACL 2017/2018 from Jason Eisner, ACL 2017 by Dan Gildea and Min-Yen Kan, NAACL 2017 by Margaret Mitchell, ACL 2012 by Maggie Li and Michael White, ACL 2010 by Jing-Shin Chang and Philipp Koehn, ACL 2008 by Johanna D. Moore, Simone Teufel, James Allan, and Sadaoki Furui, ACL 2005 by Hwee Tou Ng and Kemal Oflazer, ACL 2002 by Eugene Charniak and Dekang Lin, and earlier ACL and EACL formats written by several people, including John Chen, Henry S. Thompson and Donald Walker. Additional elements were taken from the formatting instructions of the *International Joint Conference*

*on Artificial Intelligence and the Conference on Computer Vision and Pattern Recognition.*

## References

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## A Example Appendix

This is a section in the appendix.

<sup>2</sup><https://www.aclweb.org/portal/content/acl-code-ethics>