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Using abbreviations to increase reading speed in low vision

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INTRODUCTION

Low vision often slows reading because visual impairments limit the visual span (the number of letters recognized in each glance). A reduced visual span places a bottleneck on visual processing that directly limits reading performance (Legge, 2007). Can this limitation be alleviated using abbreviations?

With abbreviations...

fewer eye movements are needed

Abbreviations take advantage of the redundancy in our language to express information using fewer letters. A small span using abbreviations could transmit the same information as a larger span without abbreviations.

Abbreviated texts will require fewer eye movements to navigate through the text, resulting in faster reading.

fewer letters are affected by crowding

Letters within words are potentially crowded by the letters on either side. Shortening words reduces the number of these inner letters, increasing the proportion of letters at the start and end of words where recognition is more accurate.

Can it work?

It does for braille! Braille uses 192 abbreviations, reducing texts to ~75% of their unabbreviated length. These abbreviations increase reading speed by about 35% (Legge, *et al.*, 1999).

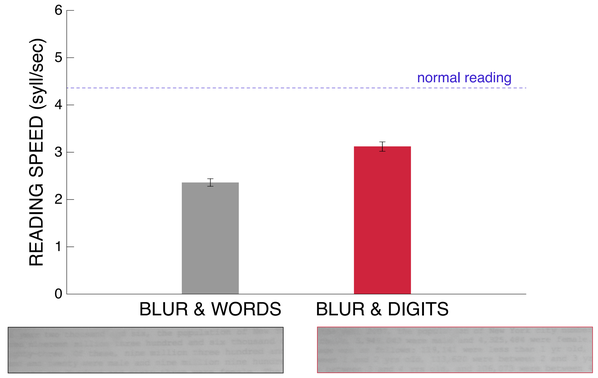
Current study

We have assessed the potential for abbreviations to help reading with low vision.

In the absence of a suitable abbreviation scheme, we abbreviated numbers written as words (e.g., *twenty three*) with their digit equivalents (e.g., *23*). Using digits was convenient for this study: digits are familiar, easy to read, and they substantially reduced the length of the texts.

STUDY 1: Acuity loss

Findings: Simulated acuity loss slowed reading speeds for full-length texts by 40%. With abbreviations this deficit was reduced to 28% ($p<0.05$).



Full length (left) and Abbreviated (right) texts viewed through the blurring goggles

Methods:

- Reading speeds were collected from 64 students with normal vision.
- Acuity loss was simulated using blurring goggles that, on average, increased acuity print size from 0.04 to 0.65 logMAR.

- The text consisted of passages that contained many numbers either written as words or abbreviated using digits.

Full length: numbers written as WORDS

```
In the year two thousand and six, the
population of New York state numbered nineteen
million three hundred and six thousand one
hundred and eighty-three. Of these, nine
million three hundred and fifty-five thousand
and twenty were male and nine million nine
hundred and fifty-one thousand one hundred and
sixty-three were female. The break-down by a
```

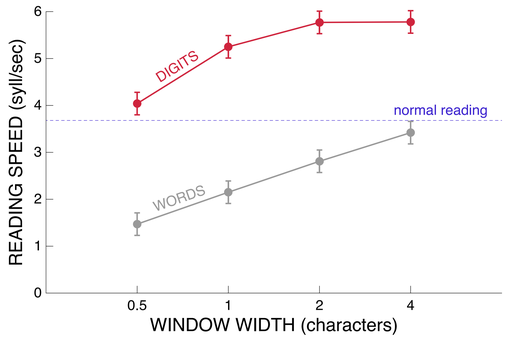
Abbreviated: numbers written as DIGITS

```
In the year 2006, the population of NY state
numbered 19,306,183. Of these, 9,355,020 were
male and 9,951,163 were female. The break-down
by age was as follows. 244,832 were less than 1
yr old, 244,993 were between 1 and 2 yrs old,
245,902 were between 2 and 3 yrs old, 243,362
were between 3 and 4 yrs old, and 241,379 were
between 4 and 5 yrs old.
```

- The text was displayed on a computer monitor in 18pt Courier, and viewed from 40 cm.
- Participants read the passages aloud. They were required to read the digit and word versions of the numbers in the same way (e.g., *2006* is read as *'two thousand and six'*.)

STUDY 2: Field loss

Findings: Reading with a ½-character window slowed reading speeds for full-length texts by 60%. With abbreviations this deficit was completely eradicated ($p<0.001$).



Methods:

- Reading speeds were collected from 4 students with normal vision
- Field loss was simulated by limiting how much text was visible at a time: ½, 1, 2, or 4 characters.
- The texts consisted of three 3-digit numbers, written in words or abbreviated using digits.
  - `six hundred and twenty-nine, two hundred and fifty-three, eight hundred and seventeen`
  - `629, 253, 817`
- The numbers were matched for length (27 characters when written in words, and 7 syllables when spoken.)
- Text was displayed on a single line. The reader used the computer mouse to navigate the viewing window along each line of text.
- Trials were rejected if the reader did not read the numbers correctly.

DISCUSSION

These findings show that abbreviations could produce substantial reading speed gains for people with low vision.

The search is now on for an abbreviation scheme that can realize these benefits in everyday reading materials.

To be successful, the abbreviation scheme needs to be:

- easy to learn
- quick to decode
- maximally compressive

So far we have considered:

Txt'ing

Texting abbreviations do not help. AFAIK, they are intended to enable faster *encoding* and not necessarily faster reading. They are mostly beneficial for shortening conversational writing rather than newspaper articles. In our preliminary studies, texting abbreviations **slowed** reading equally in normal- and low-vision conditions.

Braille

In a pilot study we have had success using braille symbols

e.g., ∴ teacher gave ⁖ book ⁞ poems ⁘ me

although it would be daunting to require readers to learn all 192 contractions in order to achieve the maximum reading benefit.

CONCLUSION

A suitable abbreviation scheme may increase low-vision reading speeds.

In the meantime, simply converting numbers to their digit equivalents could produce slight speed benefits for some low-vision readers.

References

Legge, G. E. (2007). *Psychophysics of Reading in Normal and Low Vision*. Mahwah, NJ & London: Lawrence Erlbaum Associates.

Legge, G. E., Madison, C. M., Mansfield, J. S. (1999). Measuring Braille reading speed with the MNREAD test. *Visual Impairment Research, 1*, 131–145.