

Reading with Impaired Vision: Personal and Scientific Perspectives

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Acknowledgements

Grant Support: NIH EY002934

Financial Disclosure: Gordon Legge receives a portion of the income received by the University of Minnesota for sales of the MNREAD test by Precision Vision, and the MNREAD iPad app.

Thanks: To many students and colleagues with whom I have collaborated on studies of reading; and to many others who have helped address the reading difficulties of countless people with low vision.

Outline of Topics

- Historical lack of accessibility of printed text, including my own experience.
- Measuring low-vision reading speed with the MNREAD test.
- Measuring braille reading speed with the MNREAD test.
- Tactile acuity across the lifespan in blind and sighted people.

Historical Perspective on Print Reading and Modern Alternatives

Autobiography

1950s – The Beginning

- Onset of low vision at age 6 years.
- Learned to read print with large magic marker letters.
- Learned braille at the school for the blind.

1960s – High School and College

- Reliance on sighted readers, audio tape, and some braille.

1970s: Grad school and Postdoc

- First closed-circuit TV (CCTV) magnifier. Hurrah!

1980s: Young Faculty Member

- Reliance on volunteer readers for coping with student assignments, exams and journal articles.
- Reading galley proofs with CCTV.

1990s: Transition to Personal Computers:

- Screen-reading software (Jaws).
- Screen-magnification software (ZoomText).

2000s: The Digital Era

- Most student assignments, research materials and communications available in digital formats.
- No longer reliant on sighted readers.

2026: The Present

- Flexible use of audio, braille and highly magnified print for reading.

Auditory Reading at 275 Words/Minute

- Oppenheimer Excerpt 

Online Survey of Digital Reading by Adults with Low Vision

- 133 participants (mostly computer users and well educated)
- Ages 18 to 98
- Mean self-reported acuity 0.93 logMAR (Snellen 20/170)
- Leading diagnoses: albinism, RP, glaucoma
- 76% of participants did more than half of their reading visually
- 44% did more than 75% of their reading visually

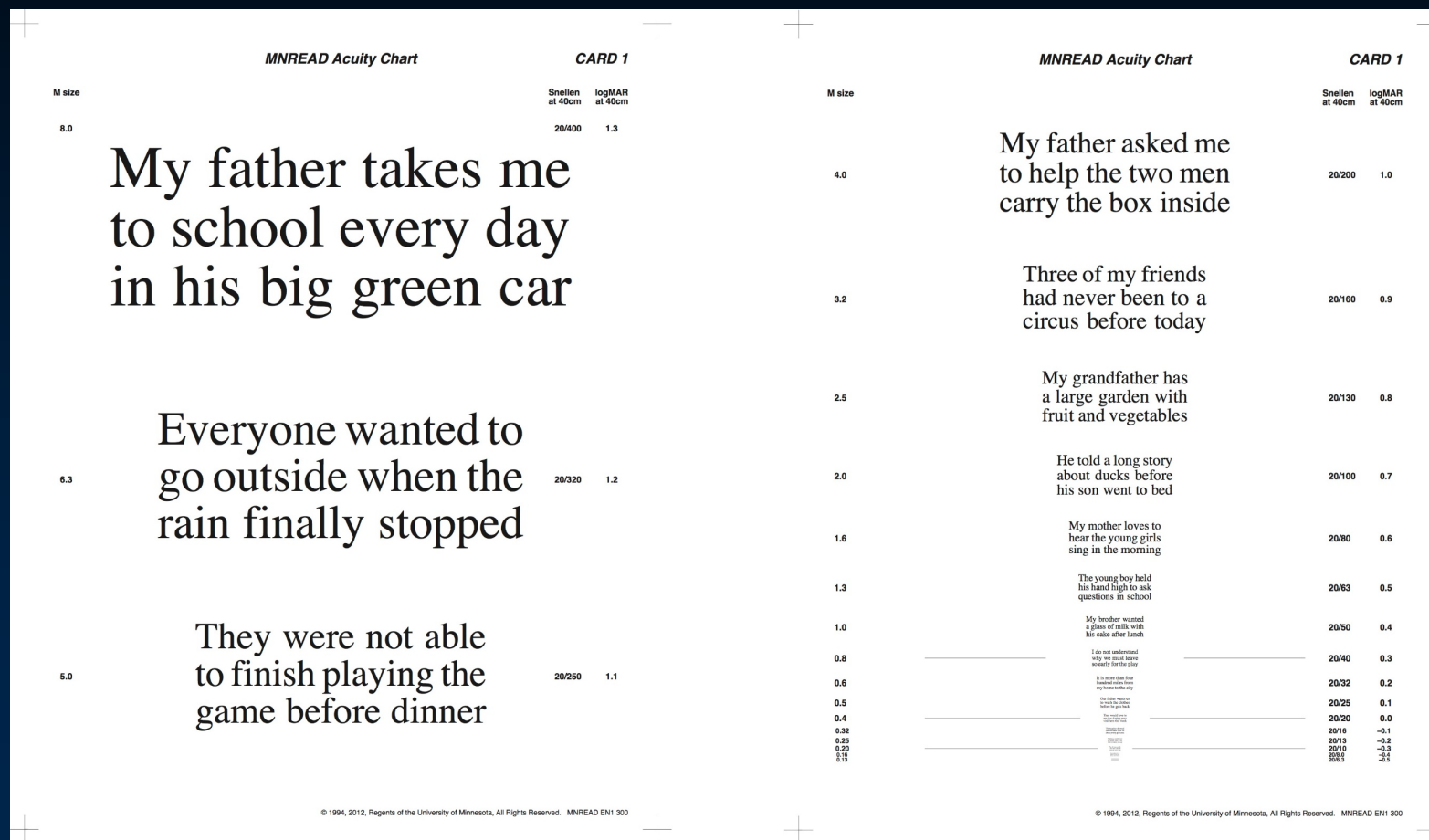
Wu, Y.-H., Granquist, C., Gage, R., Crossland, M.D. & Legge, G.E. (2020). Online survey of digital reading by adults with low vision. *Optometry & Vision Science*, 97(4), 249-256.

Measuring Low-Vision Reading with the MNREAD Test

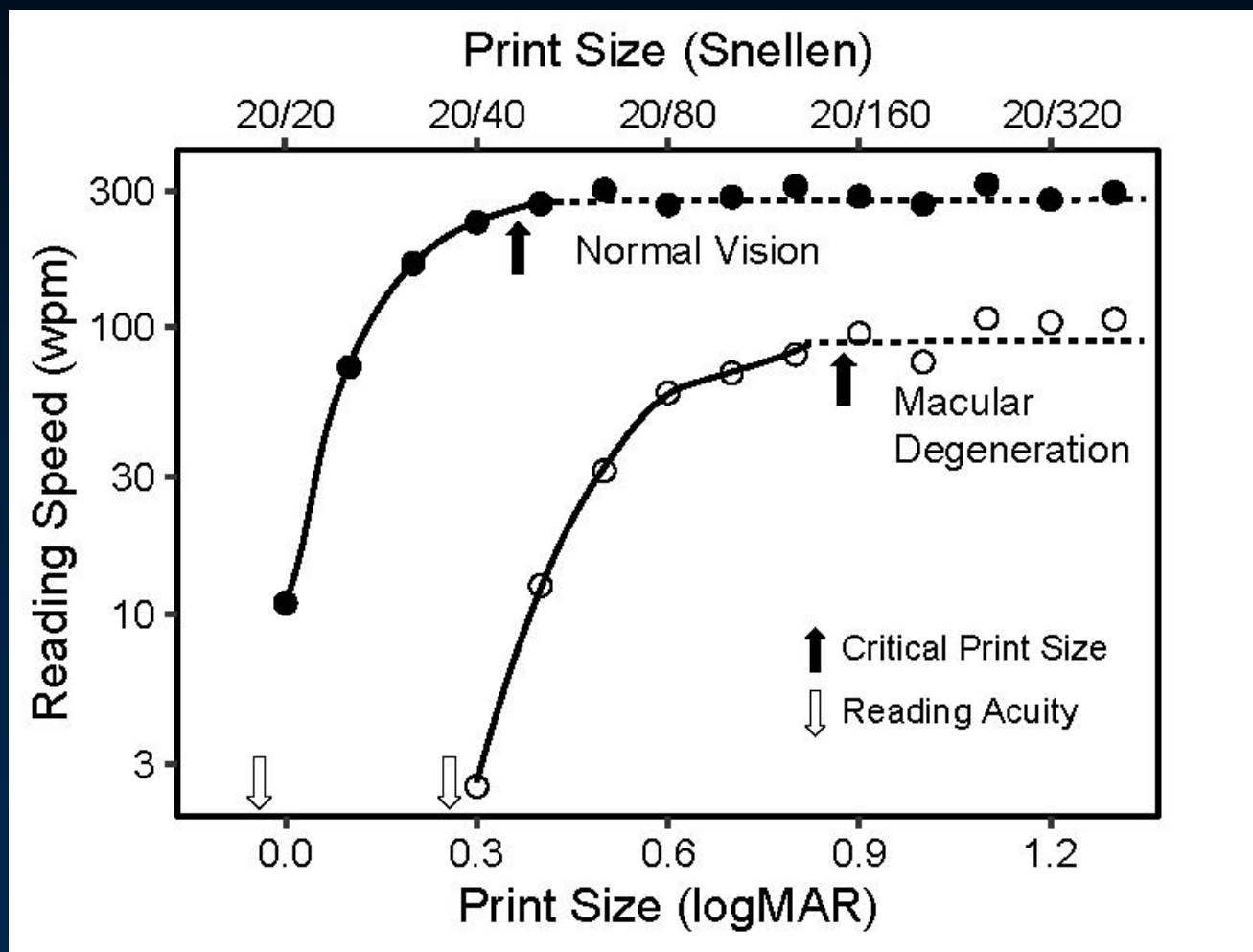
Tests of Visual Reading

- *Reading Speed* in words per minute is sensitive to vision status and text properties
- Available tests include:
 - MNREAD
 - Radner Reading Chart
 - Colenbrander Reading Card
 - SK Read Card Test
 - Bailey-Lovie Reading Chart
 - IReST
- These tests are used in
 - Prescription of glasses and magnifiers
 - Outcome measures in clinical trials of eye therapies
 - Functional assessment of reading ability

MNREAD Chart

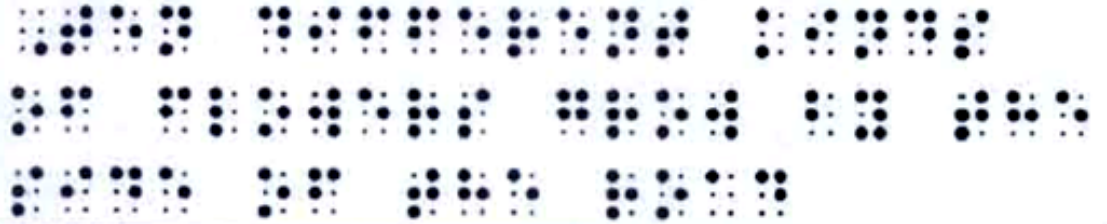
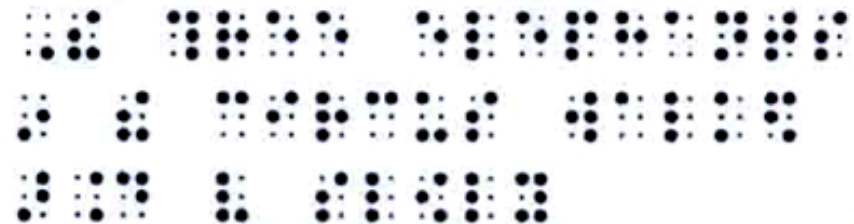


Sample MNREAD Data



Measuring Braille Reading Speed with the MNREAD Test

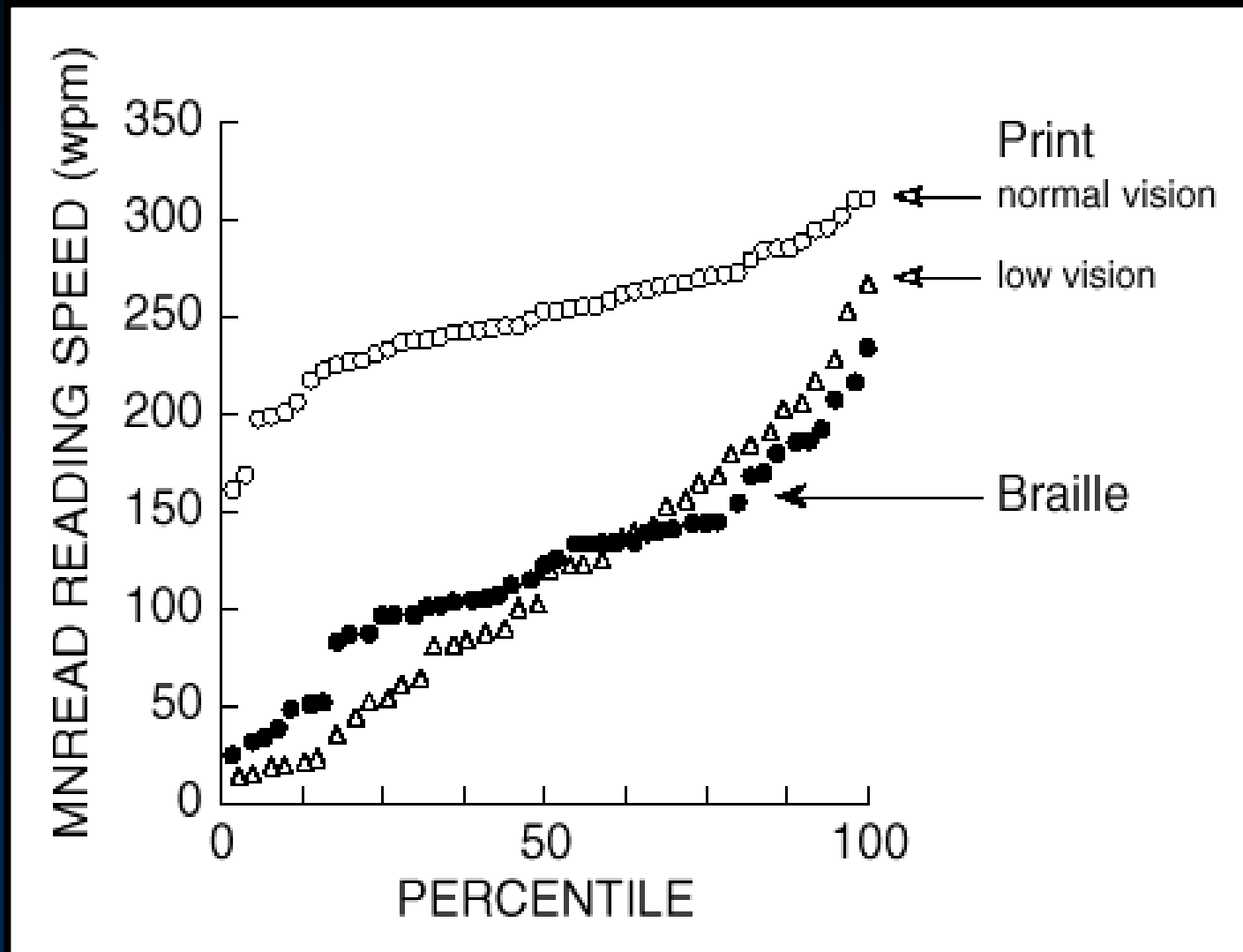
MNREAD Sentences in Braille: Grade 1 and Grade 2 Versions

Uncontracted (Grade 1)	Contracted (Grade 2)
Ten different kinds of flowers grow by the side of the road	The three elephants in the circus walked around very slowly
	

Braille Reading Speed – Study Details

- 44 experienced braille readers; 10 male, 34 female; mean age 45.5 years (range 18 to 74)
- 21 preferred reading braille with left hand and 23 with right.
- Timed reading of ten MNREAD sentences in each of five conditions:
 - Condition 1: Regular reading – Grade 2.
 - Conditions 2-5: 2 x 2 cross: Grade 1 / Grade 2 x normal / scrambled word order.
- Mean reading speed calculated in words per minute (wpm).

Reading Speed: Print Versus Braille



Tactile Acuity and Braille Reading

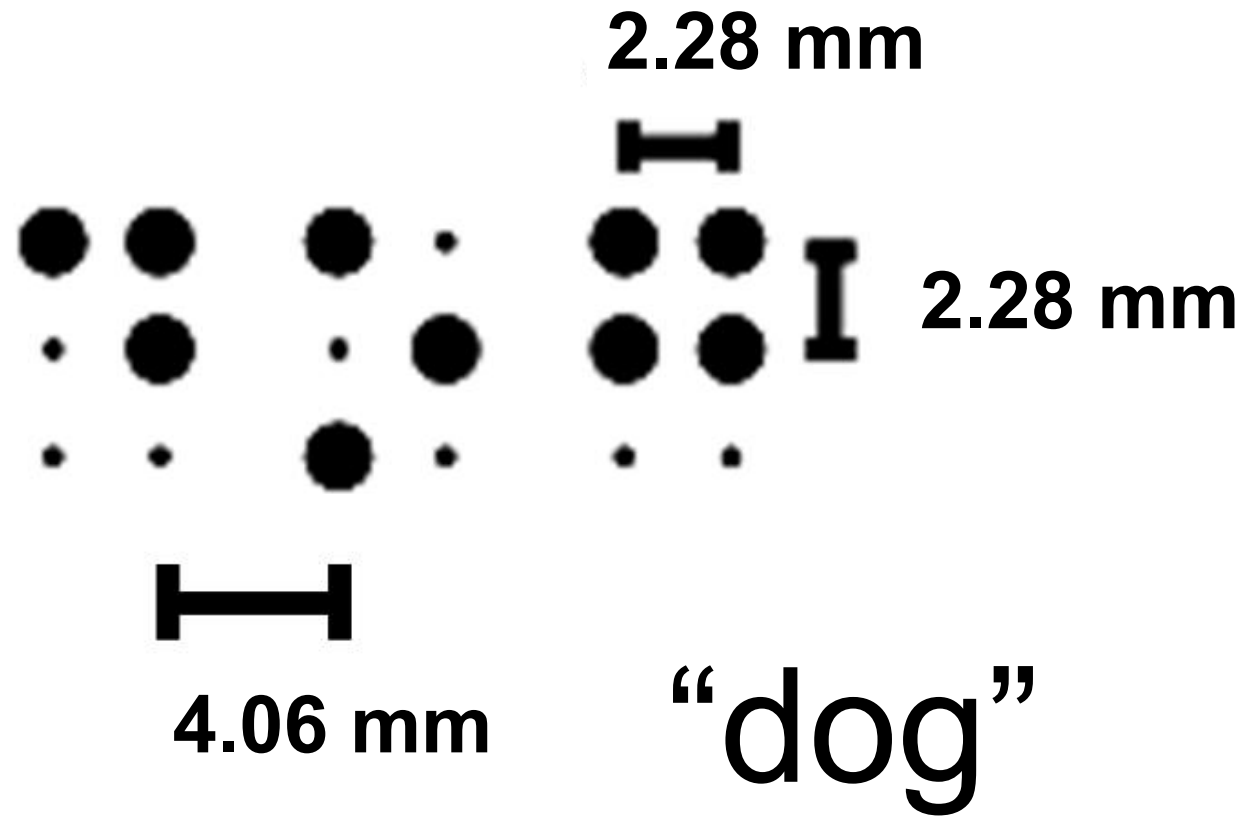
Previous Findings on Tactile Acuity

- Blind subjects have better tactile acuity than sighted subjects. They can resolve gaps 15% smaller than sighted subjects.
- Both blind and sighted subjects display an age-related decline in tactile acuity by about 1% per year. Threshold gap size on the fingertip nearly doubles from age 20 to 80 years.

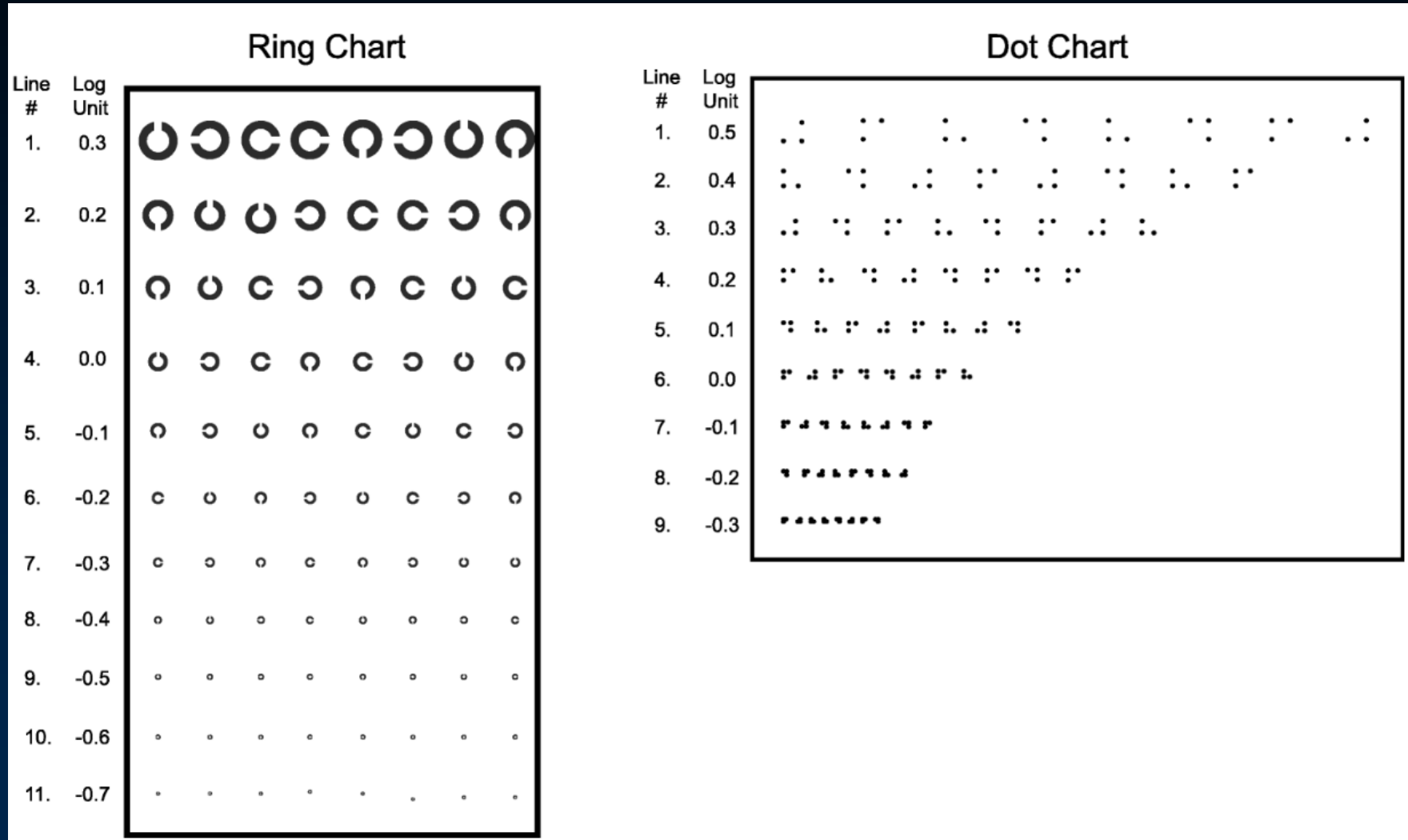
Question

- Does this mean that Braille reading becomes more difficult in old age?

Example of Braille



Two Tactile Acuity Charts

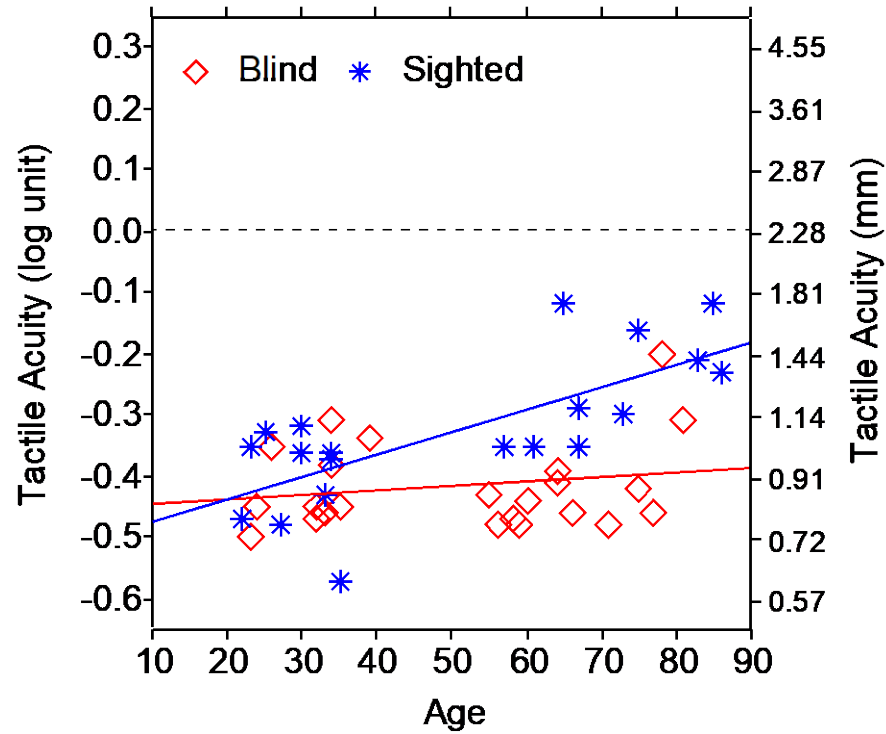


2008 Study Experiment 2: Subjects

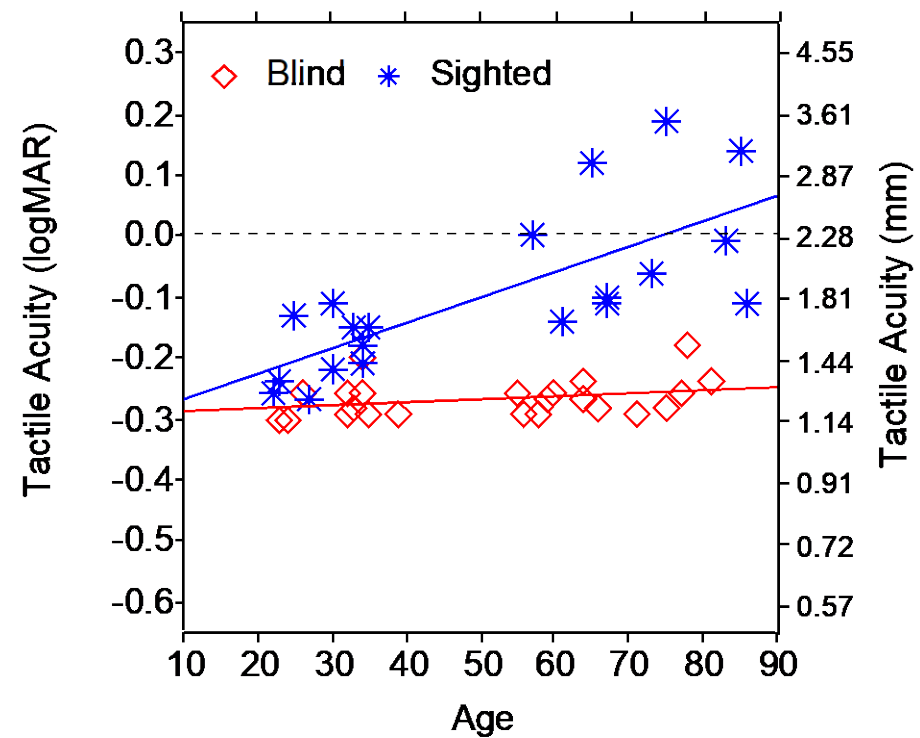
	Blind subjects		Sighted subjects	
Groups	Young (n=10)	Old (n=12)	Young (n=10)	Old (n=9)
Age (yrs)	31.2 ± 5.8 (range: 23-39)	67.4 ± 8.7 (range: 56-81)	29.3 ± 4.8 (range: 22-35)	70.3 ± 9.5 (range: 57-85)

2008 Study Experiment 2: Results

Ring Chart

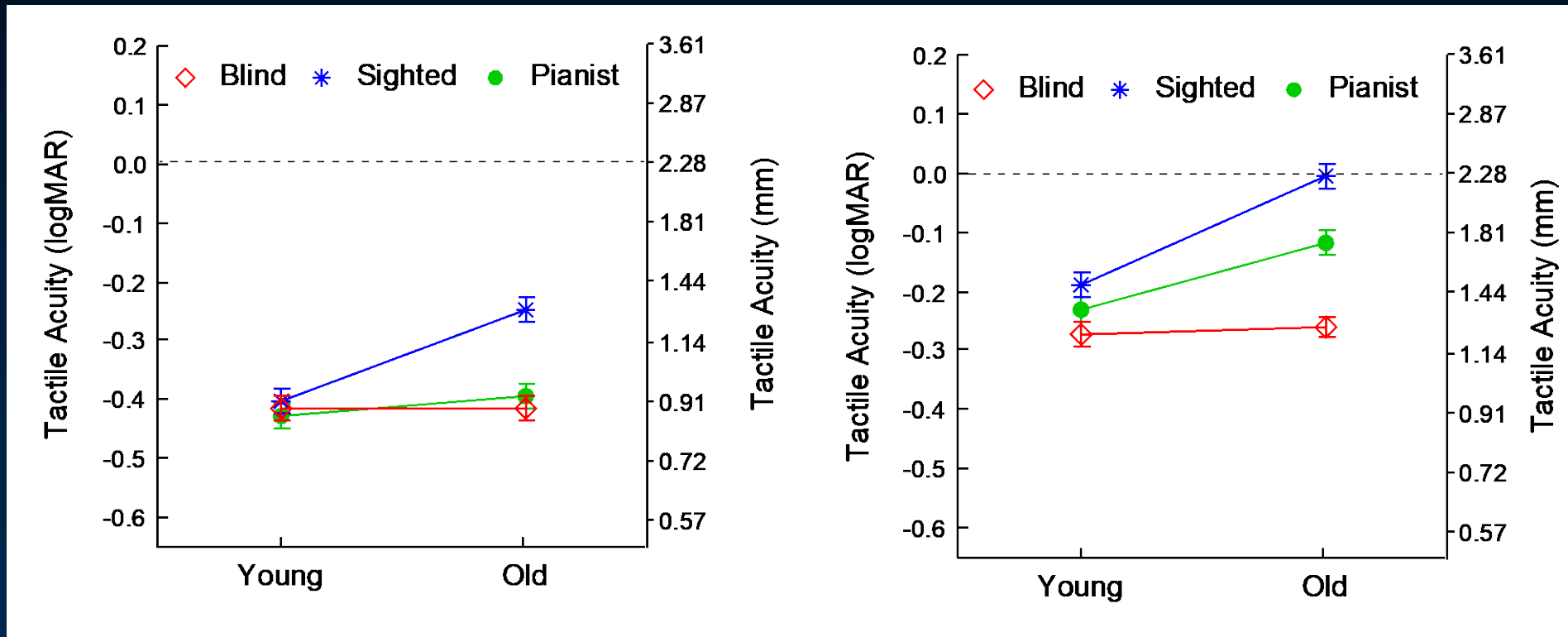


Dot Chart

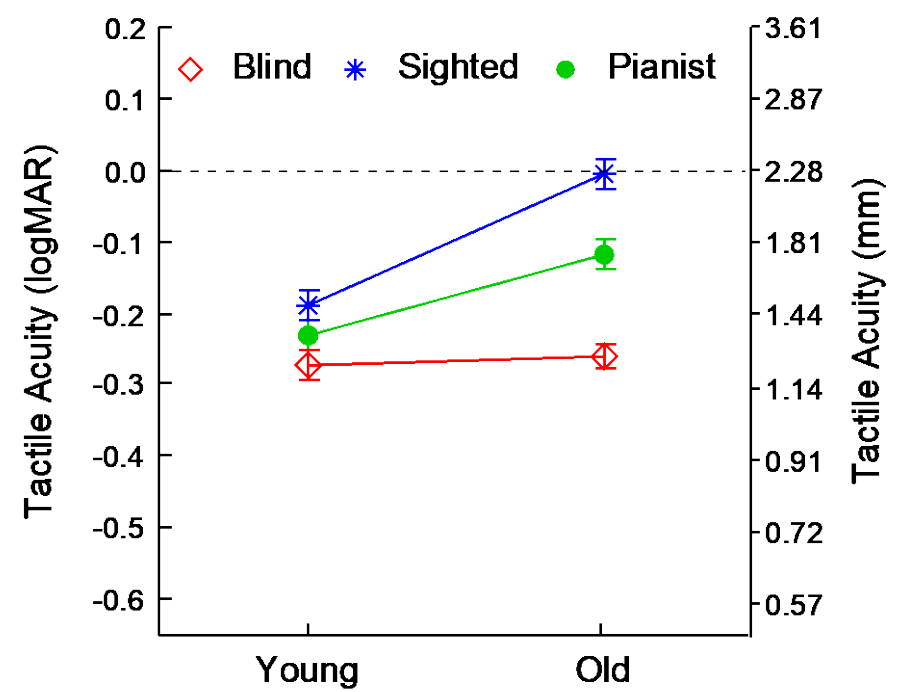


Pianist Study: Results

Ring Chart



Dot Chart



Implications

- Lifelong experience with focused attention to touch may act to preserve tactile acuity into old age, for both blind and sighted subjects.
- Blind readers have adequate tactile acuity for proficient Braille reading into old age.
- The age-related loss in tactile acuity among sighted subjects means that by their mid 70s, Braille symbols are at or beyond the acuity limit.

Conclusions

- Historically, print accessibility has been a major problem for people with impaired vision. Modern technology has vastly improved options for text access through digital print, audio, and braille.
- MNREAD and other research methods have been developed to study and improve low-vision reading.
- MNREAD has also been used to measure braille reading speed and compare it with print reading by people with normal vision and low vision.
- While most sighted people exhibit declining tactile acuity across the lifespan, blind or sighted people who use touch intensively throughout their lives appear to retain high tactile acuity into old age.