Measurement of Needed Diopter for Near Low Vision Aids with Telescope

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How do we select a near low vision aid?

Estimate the *magnification* or the *diopter* for near low vision aids.

Conventional methods
- Sloan M system   (standard distance: 40cm)
- Keeler A system   (standard distance: 25cm)
- The N point system   (standard distance: 25cm)
- Kestenbaum method   (reciprocal of Snellen distance chart)
- Logarithmic scale by Bailey   (any reading distance)

[Chiristine M. Dickinson, 1991]

Other methods in terms of reading speed
- MNREAD   (standard distance: 30cm)
- MNREAD-J (modified for Japanese people)

Are there any gadgets to assess the diopter for near low vision aids?

Adjustable focus telescope for near vision allows people with low vision to read the target letters. If a person with low vision can read the target letters through the telescope, the equivalent viewing power (EVP) of the telescope should indicate the proper diopter for a near low vision aid.
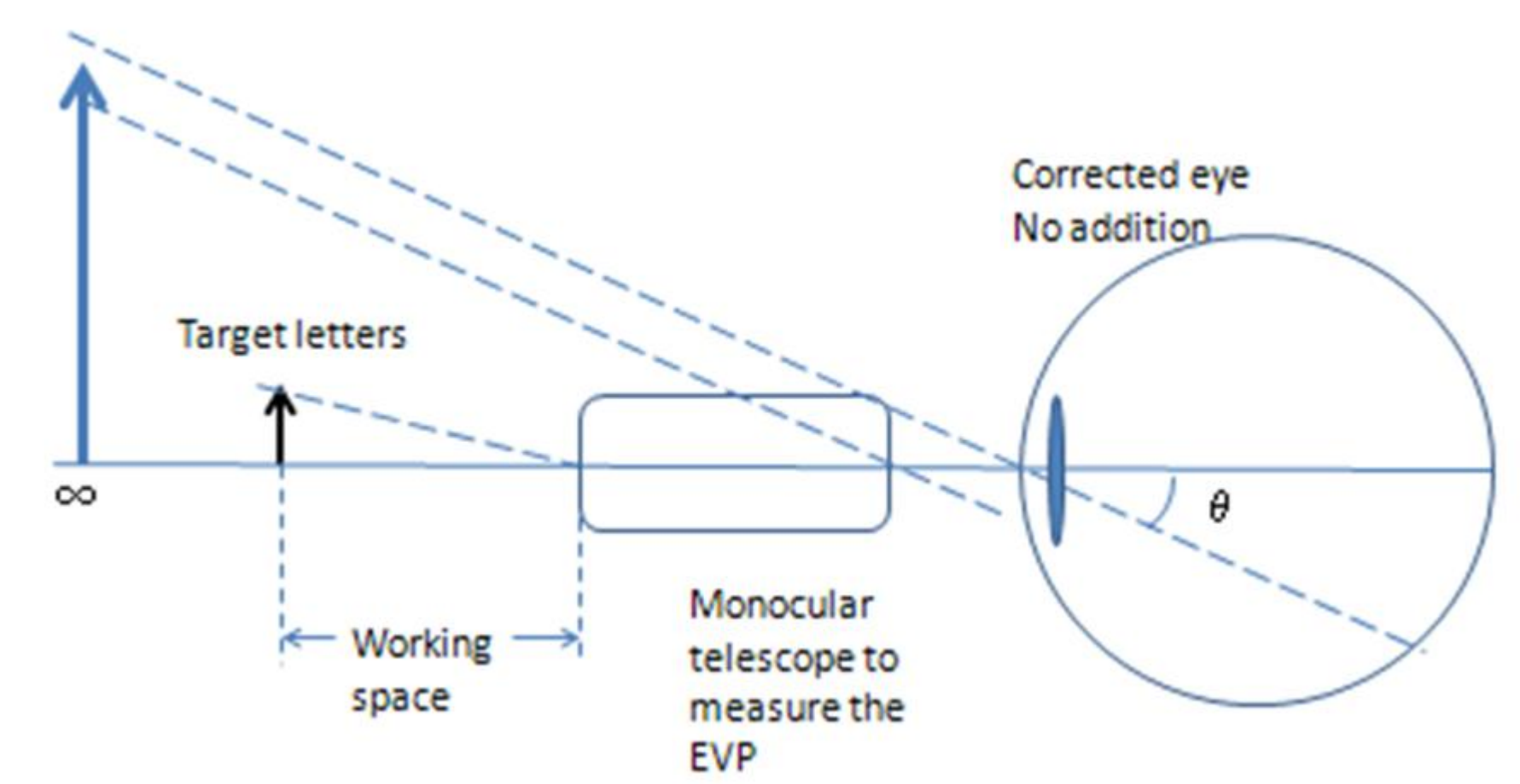

Figure 1. **Principle of the telescopic method to determine the diopter**
Dr. Reich LN(1991) found a linear relationship between the front vertex focal distance and the Equivalent Viewing Distance (EVD).

Methods

1. Calibration

To measure the diopter or the EVP for a near low vision aid with the telescope, calibrations were put on the tube of the telescope and the optical bench.
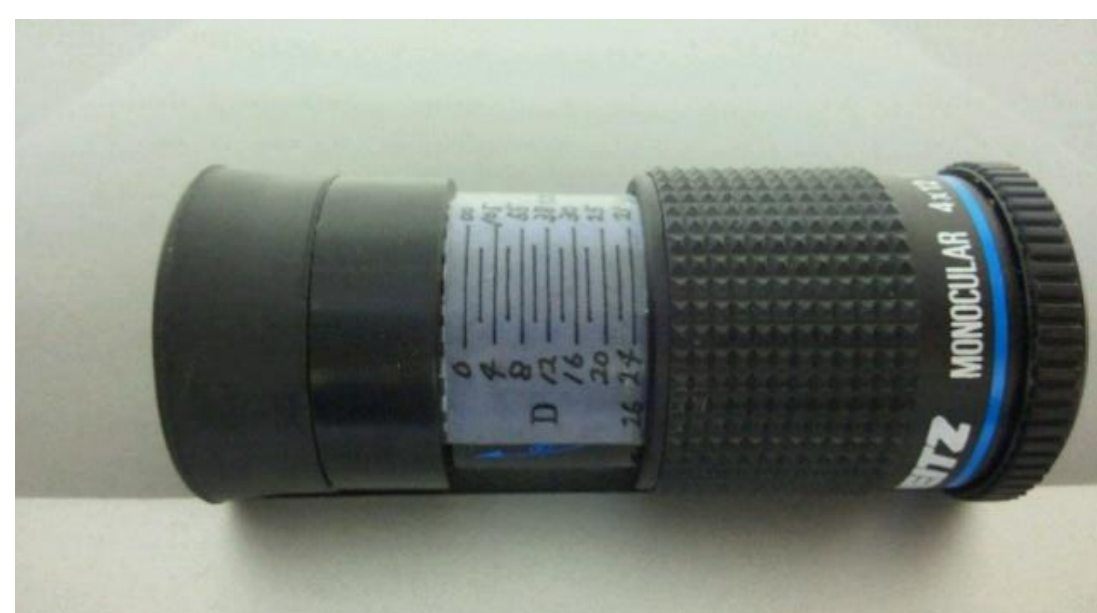

Figure 2. Calibration of the EVP and the working space on the tube of the telescope

Figure 3. Target letters are set on the optical bench

2. How can we measure the diopter with the telescope?

1) The corrected eye is placed near the eye piece.
2) Set the target letters at the nearest working space calibrated on the optical bench.
3) Focus the telescope to the same value on the tube as the calibration of the optical bench.
4) Move the target letters to the next calibration until the critical size to be read is determined.
5) Lastly, the indicated EVP on the tube of the telescope and the optical bench is the appropriate diopter for a near low vision aid.
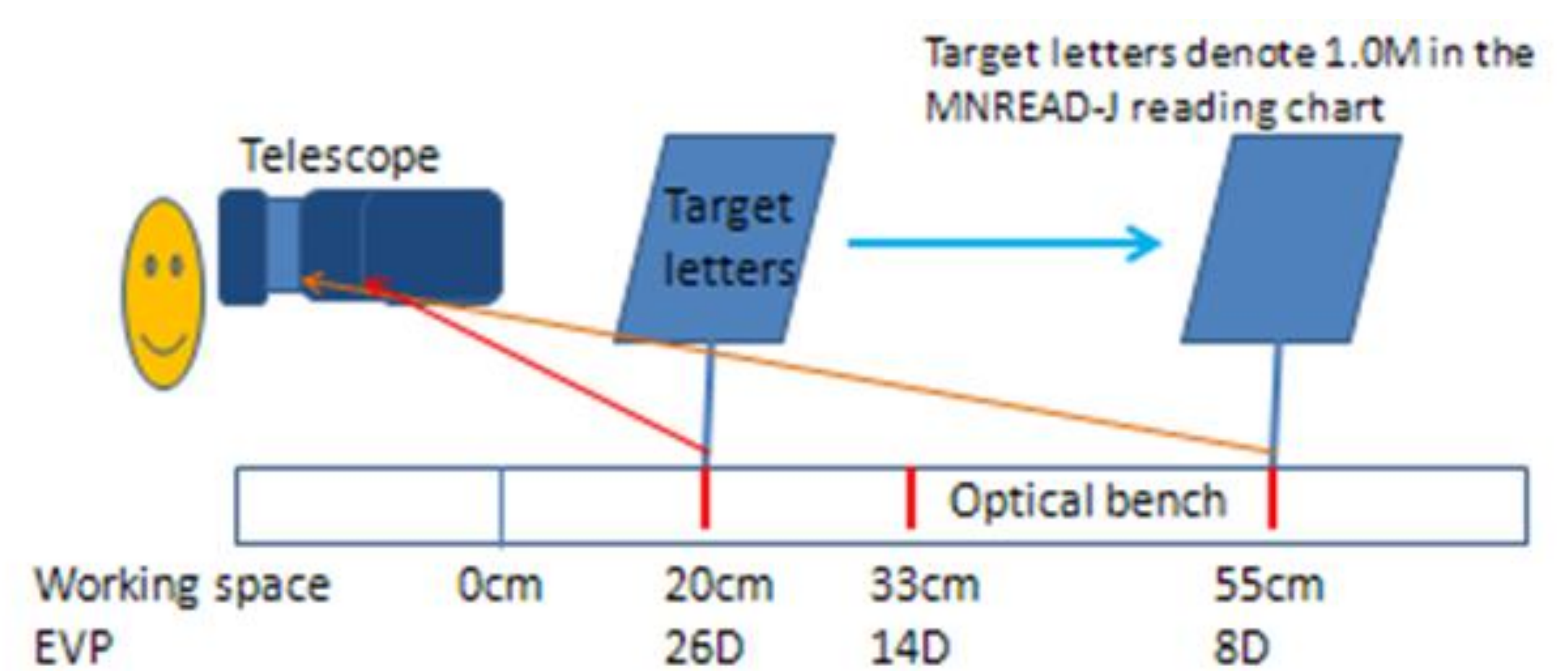

Figure 4. Corresponding calibrations are put on the tube of the telescope and the optical bench

3. Investigation

Six normal sighted subjects simulated low vision with the right eye. The diopter measured with the telescope was compared with the diopter which was calculated using the MNREAD-J reading chart.

Results

The mean diopter needed for near low vision aids measured with the telescope was 7.0±0.8D. The mean critical size of MNREAD-J was logMAR0.68±0.04, which could be converted to 6.4±0.5D for the mean diopter needed for near low vision aids. There was *no significant difference* between the telescope and MNREAD-J to estimate the diopter needed for near low vision aids.

Bland-Altman plot is as follows. The mean difference between the values of the telescope and MNREAD-J is -0.6D. The 95% limits of agreement for the difference is ±2.3, meaning that on average there is 95% confidence that the difference is within 1.7 and -2.8.

Table 1. Needed diopter measured with the telescope and MNREAD-J

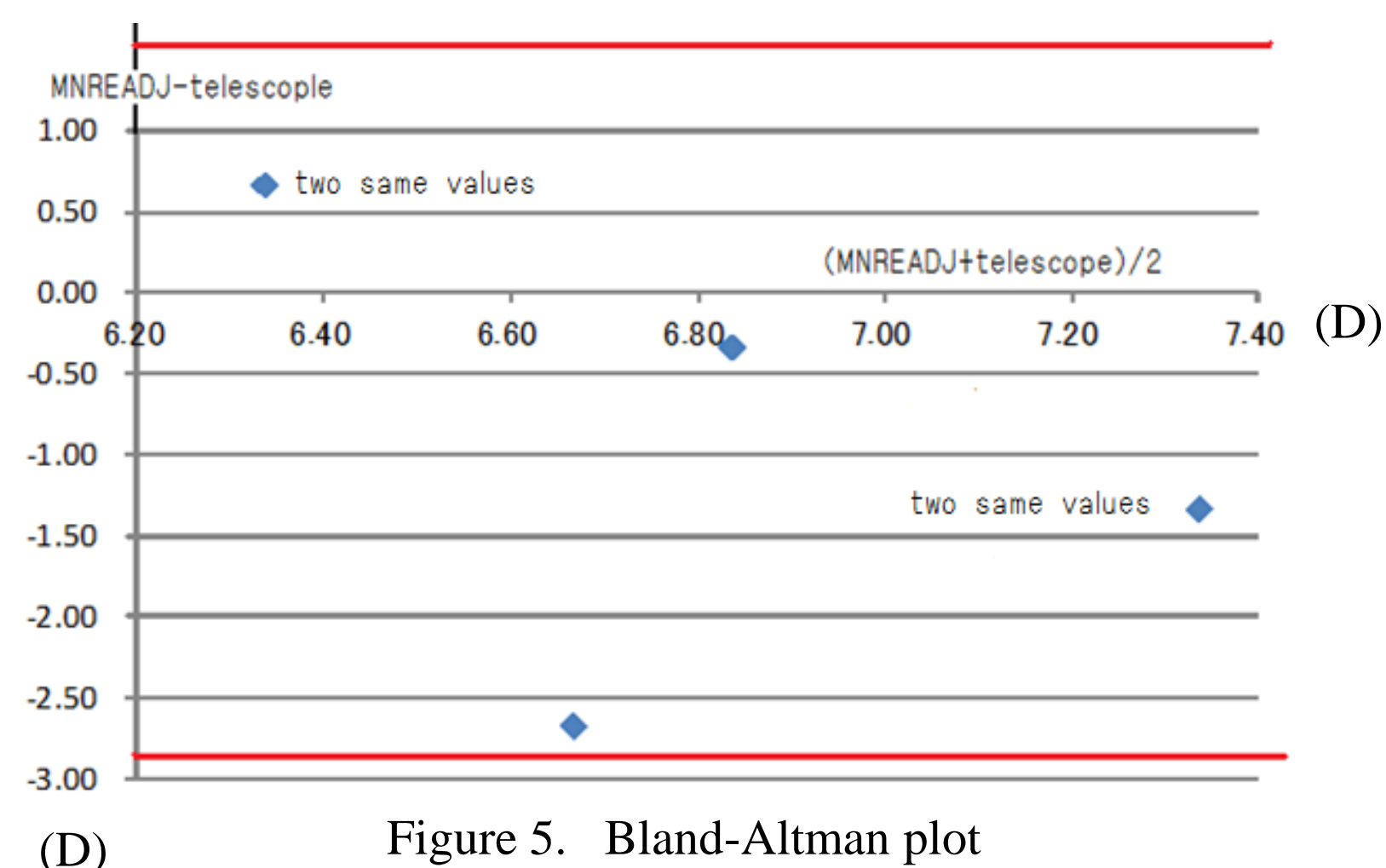| Subjects Age, sex	Telescope Diopter needed	MNREADJ Critical letter size (logMAR)	MNREADJ Diopter needed
A(27、F)	6.0	0.7	6.7
B(30、F)	8.0	0.7	6.7
C(33、F)	7.0	0.7	6.7
D(29、M)	8.0	0.6	5.3
E(23、F)	7.0	0.7	6.7
F(23、M)	6.0	0.7	6.7

Figure 5. Bland-Altman plot

Discussion

・Measurement with the telescope was as useful as MNREAD-J.
・The diopter needed for near low vision aids was directly estimated with the calibration using the adjustable focus telescope for near vision without requiring any calculations.