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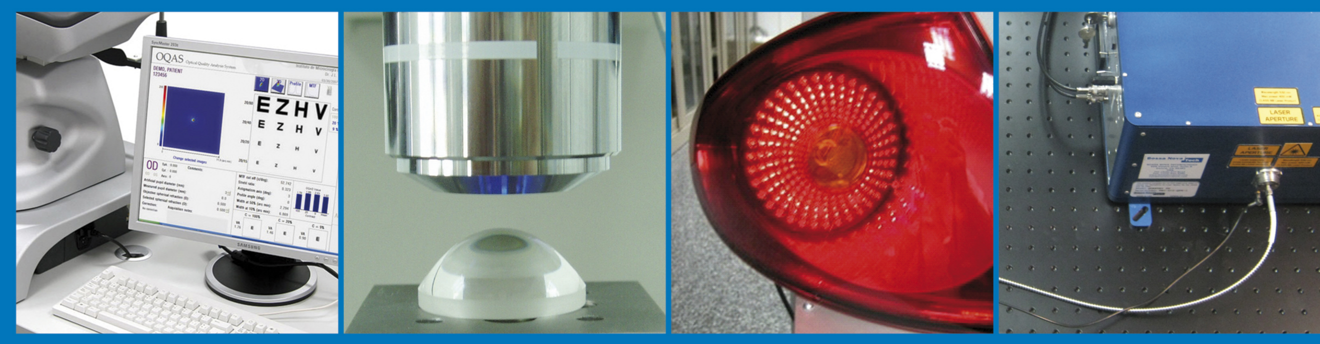

THE IMPORTANCE OF NUMBER OF READINGS IN AUTOREFRACTION

AUTHORS:
Carles OTERO[1]*, Mikel ALDABA[1], Carme ALAVEDRA-ORTIZ[1], Jaume PUJOL[1], Juan Carlos ONDATEGUI-PARRA[1]
[1]Davalor Research Center, Universitat Politècnica de Catalunya (UPC, Spain) *carles.otero.molins@cd6.upc.edu

1 - PURPOSE

To determine the minimum number of autorefraction readings needed for obtaining precise results.

2 - INTRODUCTION

The development of all types of autorefractometers led to several studies reporting its precision, repeatability, reproducibility, reliability, validity or accuracy.

Intra-test repeatability has been given little relevance in precision studies of autorefraction. Some studies reported repeatability values considering 3 consecutive refraction measurements, five measurements, six or even more.

It would be convenient to determine if the number of readings can influence the intra-test repeatability or what would be the minimum number of autorefraction readings needed for obtaining optimal precise results under different accommodation stimulations (AS).

Additionally, it is not clearly studied whether the fogging function (typically implemented in closed-field autorefractometers) affects the precision of the measurement when applied to each reading instead of only in the first one of a set of readings.

3 - METHODS

The following three groups were measured in one eye: far refraction (117 people), accommodation (64 people) and sampling frequency group (24 people).

For the far refraction (AS at 0.0 D) and accommodation (AS at 2.0 D and 5.0 D) groups:

- Data was obtained in static mode.
- The mean refraction (MRx) and within-subject standard deviations (SDws) were computed accumulatively from 1 to 10 readings, i.e., readings were progressively added up to 10. Accordingly, just one reading was considered in the first case and in the last case the average of ten readings was used.

For the sampling frequency group (which evaluated data for AS at 0.0 D, 2.5 D and 5.0 D):

- Dynamic measurements of autorefraction were recorded at 25 Hz.
- The MRx and SDws were computed sub-sampling the frequency from 25 Hz to 1 Hz (in 0.04 s steps).

4 - RESULTS

Figure 1

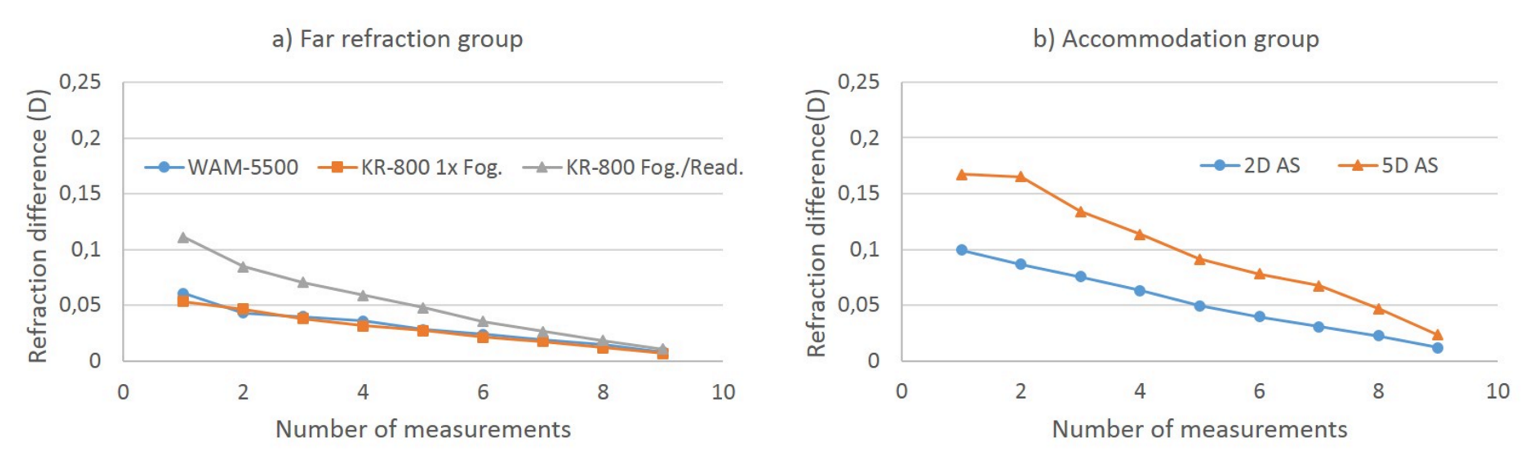

Figure 2

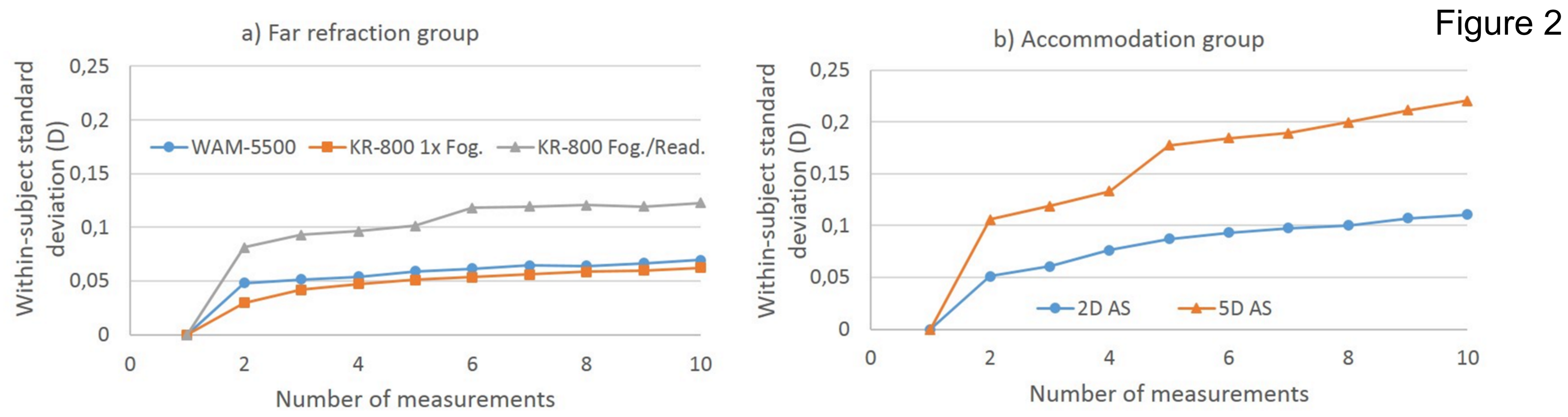

Figure 1. Refraction difference with respect the reference value (i.e., the average of 10 readings) as a function of the number of measurements for a) Far spherical refraction (AS at 0 D) and b) Accommodation stimulation at 2 D and 5 D. 1x Fog: Only one fogging. Fog./Read.: One fogging for each reading. D: Diopters. Figure 2. Ídem as in figure 1 but plotting the mean intratest repeatability values (i.e., mean within-subject standard deviations) as a function of the number of measurements.

Table 1. Percentage of cases with absolute differences < 0.25 D (MAX)

Nº of meas.	Far Refraction			Accommodation	
	WAM	KR-800 1x Fog.	KR-800 Fog./Read.	AS at 2 D	AS at 5 D
1	99.1% (0.550)	97.4% (0.325)	91.5% (0.949)	96.9% (0.298)	84.4% (1.108)
2	100.0% (0.183)	98.3% (0.325)	94.0% (0.949)	98.4% (0.264)	84.4% (1.078)
3	99.1% (0.407)	100.0% (0.221)	96.6% (1.012)	98.4% (0.284)	89.1% (0.906)
4	99.1% (0.262)	100.0% (0.206)	97.4% (0.873)	98.4% (0.282)	93.8% (0.786)
5	100.0% (0.175)	100.0% (0.159)	98.3% (0.701)	100.0% (0.246)	95.3% (0.613)
6	100.0% (0.164)	100.0% (0.133)	100.0% (0.159)	100.0% (0.136)	96.9% (0.483)
7	100.0% (0.129)	100.0% (0.121)	100.0% (0.130)	100.0% (0.125)	96.9% (0.481)
8	100.0% (0.122)	100.0% (0.081)	100.0% (0.133)	100.0% (0.122)	98.4% (0.552)
9	100.0% (0.071)	100.0% (0.050)	100.0% (0.129)	100.0% (0.054)	100.0% (0.245)

4 - RESULTS

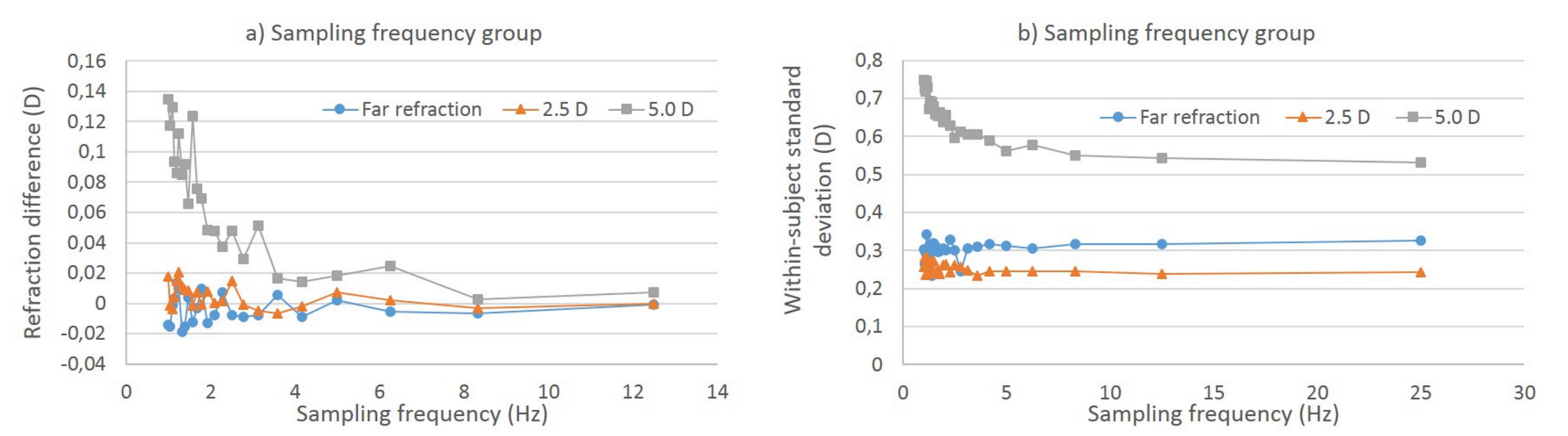

Figure 3. a) Spherical refraction difference with respect the reference refraction (refraction obtained at 25 Hz) as a function of the sampling frequency from 1 Hz to 25 Hz (in steps of 0.04 s) of measurements taken at far refraction, at 2.5 D and at 5.0 D of accommodation stimulation. b) Mean intratest repeatability values (i.e., mean within-subject standard deviations) as a function of the sampling frequency.

In static mode, for spherical MRx, statistically significant differences were not found for spherical MRx among cases (number of readings) in the three AS.

In dynamic mode, only in AS at 5.0 D statistically significant differences were found, e.g., between 1 and 25 Hz cases (spherical MRx difference = 0.135 D, 95%Confidence Limits = [0.002, 0.268], p = 0.038).
Astigmatism (J_0 and J_{45}) did not show any significant change in any case.

5 - CONCLUSIONS

In static mode, one reading can be clinically equivalent to 10 readings for far refraction.

For AS at 2.0 and 5.0 D larger MRx differences and SDws were obtained →more readings are advisable, specially for 5 D of AS.

The sampling frequency seems not to be critical at far refraction and for AS at 2.0 D, whereas at 5.0 D significant differences can be found in MRx and SDws for lower sampling frequencies [1,2].

One fogging per reading is shown to affect more the precision of a measurement than applying only one fogging in the first measurement.

6 - BIBLIOGRAPHY

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[2] Aldaba M, Gómez-López S, Vilaseca M, Pujol J, Arjona M. Comparing Autorefractors for Measurement [In press]. *Optom. Vis. Sci.* 2015;92(10).

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7 - ACKNOWLEDGEMENTS

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