



Centre for Sensors, Instruments and  
Systems Development

UNIVERSITAT POLITÈCNICA DE CATALUNYA

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# The accommodative response during the fogging technique: assessment of the magnitude and application time of the fogging lenses

BARCELONATECH · 2022

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31st August 2022

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- 1. Introduction**
- 2. Methods**
- 3. Results**
- 4. Conclusions**



## 1. Introduction

2. Methods

3. Results

4. Discussion

**Refraction:** process of measurement of the ocular refractive error to correct the ametropia achieving the best visual acuity **with the minimum accommodation**



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## Control of accommodation

- Avoid under or hipercorrection
- Avoid asthenopia

## Control of accommodation

### Cycloplegic drugs



- + Solid prevention of accommodation
- Uncomfortable for patients
- Clinician dependent
- Limited in some countries

### Fogging technique



- + Spherical positive power lenses
- + Fit for automated systems
- Unsolved methodology

From +0.75D to +6.00D <sup>1-6</sup>

VA  
20/100 – 20/120 <sup>7</sup>

No time specified

1. Queirós A, González-Méijome J, Jorge J. Influence of fogging lenses and cycloplegia on open-field automatic refraction. *Ophthalmic Physiol Opt.* 2008;28(4):387-392.  
 2. Queirós A, Jorge J, González-Méijome JM. Influence of Fogging Lenses and Cycloplegia on Peripheral Refraction. *J Optom.* 2009;2(2):83-89.  
 3. Hopkins S, Sampson GP, Henticott P, Lacherez P, Wood JM. Refraction in Children. *Optom Vis Sci.* 2012;89(12):1734-1739.  
 4. Esteves Leandro J et al. Adequacy of the Fogging Test in the Detection of Clinically Significant Hyperopia in School-Aged Children. *J Ophthalmol.* 2019;2019:1-5.  
 5. Kee CS, Do TC, Lai RY, Wong G, Lam AK. Could a cycloplegic agent be replaced by a fogging or a corrective lens in the biometric measurement of the crystalline lens? *Ophthalmic Physiol Opt.* 1998;18(6):521-526.  
 6. Ward PA, Charman WN. An Objective Assessment of the Effect of Fogging on Accommodation. *Optom Vis Sci.* 1987;64(10):762-767.  
 7. Benjamin WJ. *Borish's Clinical Refraction.* Elsevier; 2006.

## Purpose

To study the accommodative response with different fogging lenses to find which lens and application time are more suitable to achieve a successful relaxation of accommodation.



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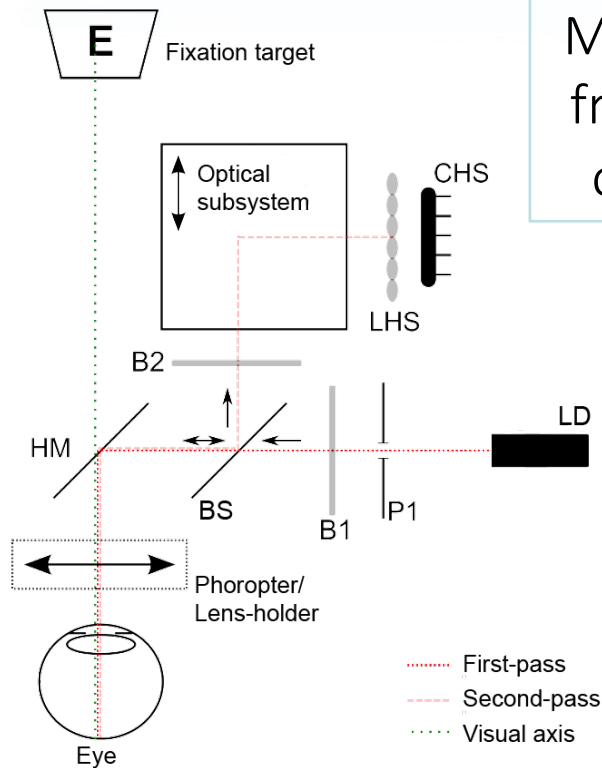
- **Participants:** Young adults between 18 and 30 years old

Exclusion criteria	
Monocular VA	<0.9
Spherical ametropia	+3.00D < Rx > -5.00D
Astigmatism	>1.50 D
Anisometropia	>3.00 D
Amblyopia, strabismus and nystagmus	
Ortho-K	
Previous ocular surgeries	
Anomalies in accommodation values	



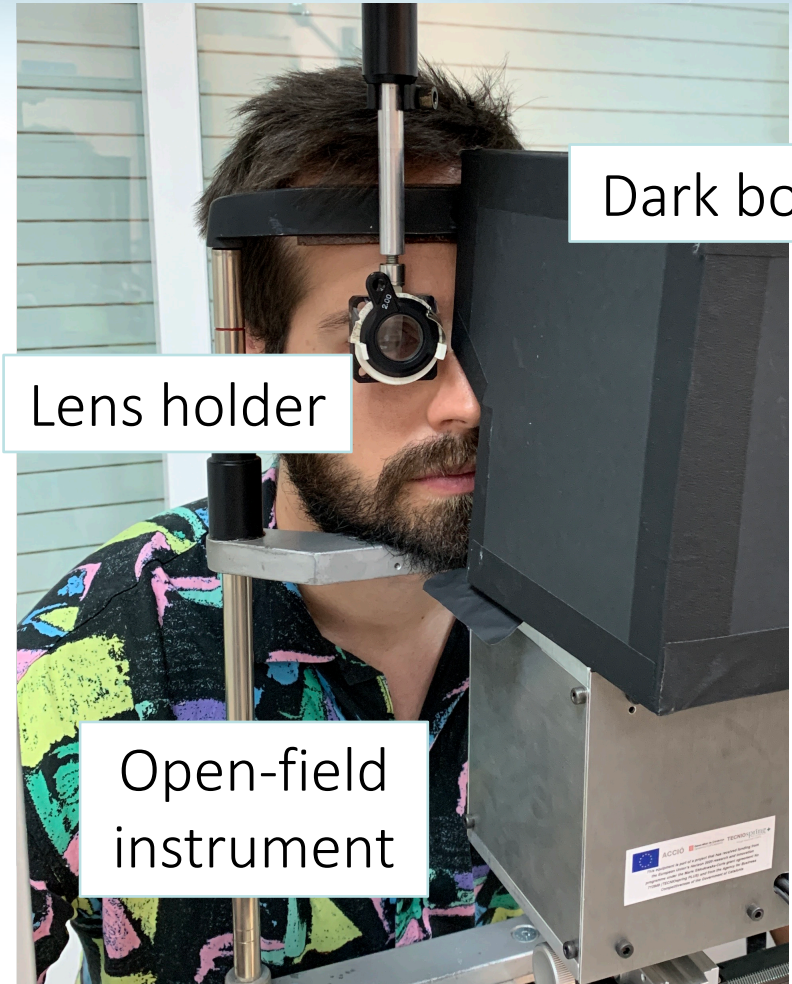
- Set-up:**

## Hartmann-Shack aberrometer<sup>1</sup>



Measuring frequency of 10 Hz

Optical design



Dark box

Lens holder

Open-field instrument

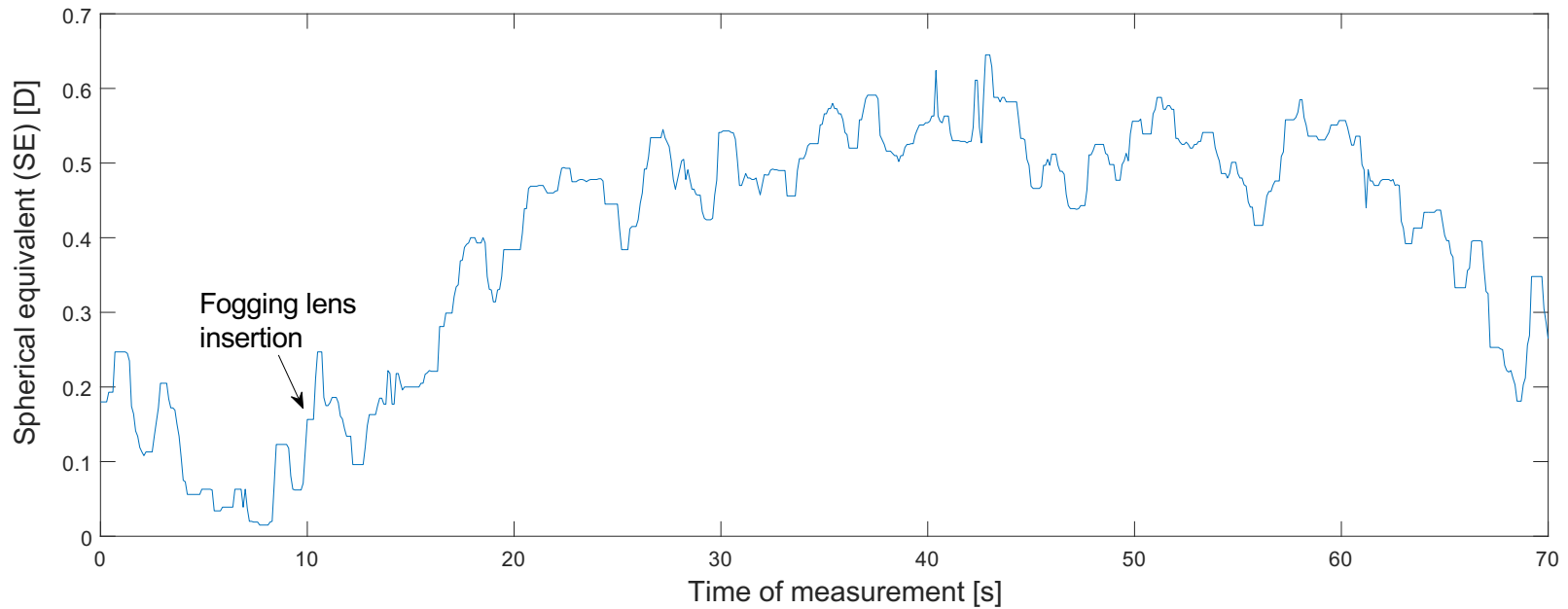
System coupled to the lens holder

1. C. E. García-Guerra, J. Martínez-Roda, M. Aldaba, S. Galera, C. Aransay, F. Díaz-Doutón, J. Pujol, M. Vilaseca; Real-time monitoring of accommodation during subjective refraction. *Invest. Ophthalmol. Vis. Sci.* 2020;61(7):1716.

- **Measurements:**

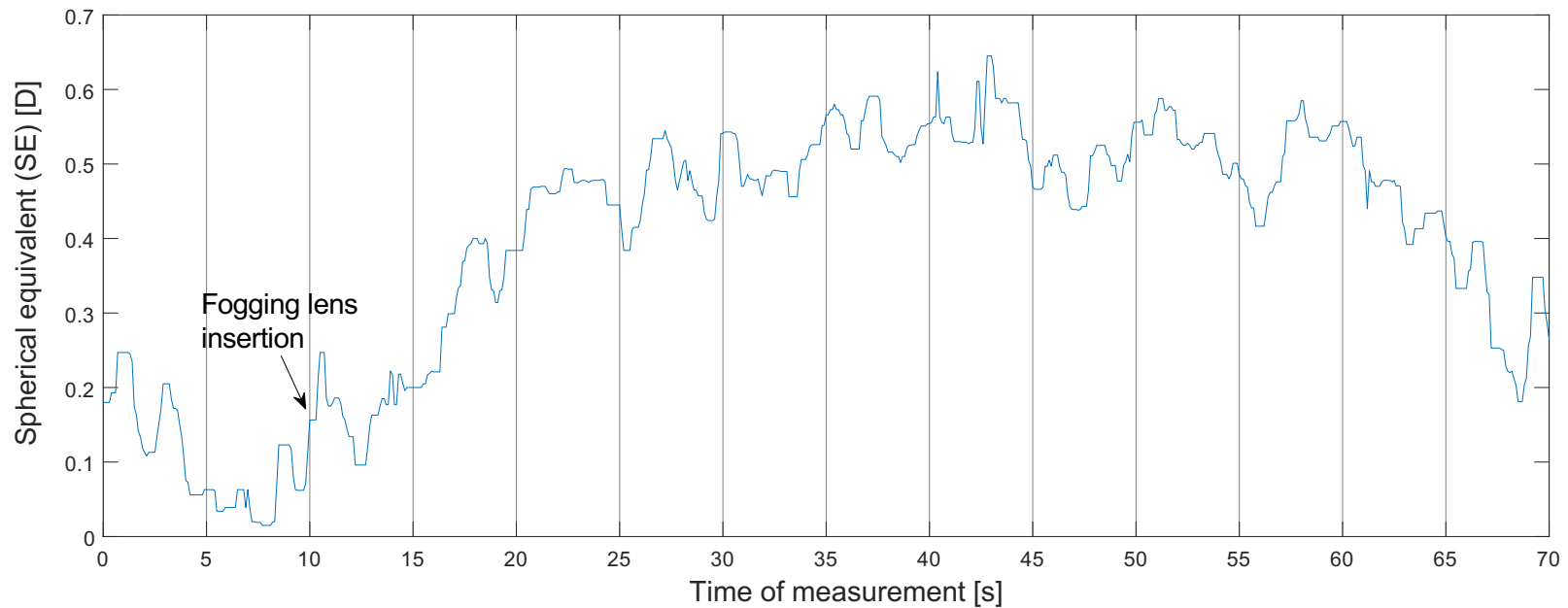
- Accommodative response when wearing the fogging lenses in the corrected eye.
- Whole measurement: 10" without lens + 60" with lens.
- Lenses tested: +1.00 D, +2.00 D, +3.00 D, + 4.00 D and + 5.00 D.
- Lenses were presented in a random order.
- Wash-up time of 90 s.

- **Data analysis:**



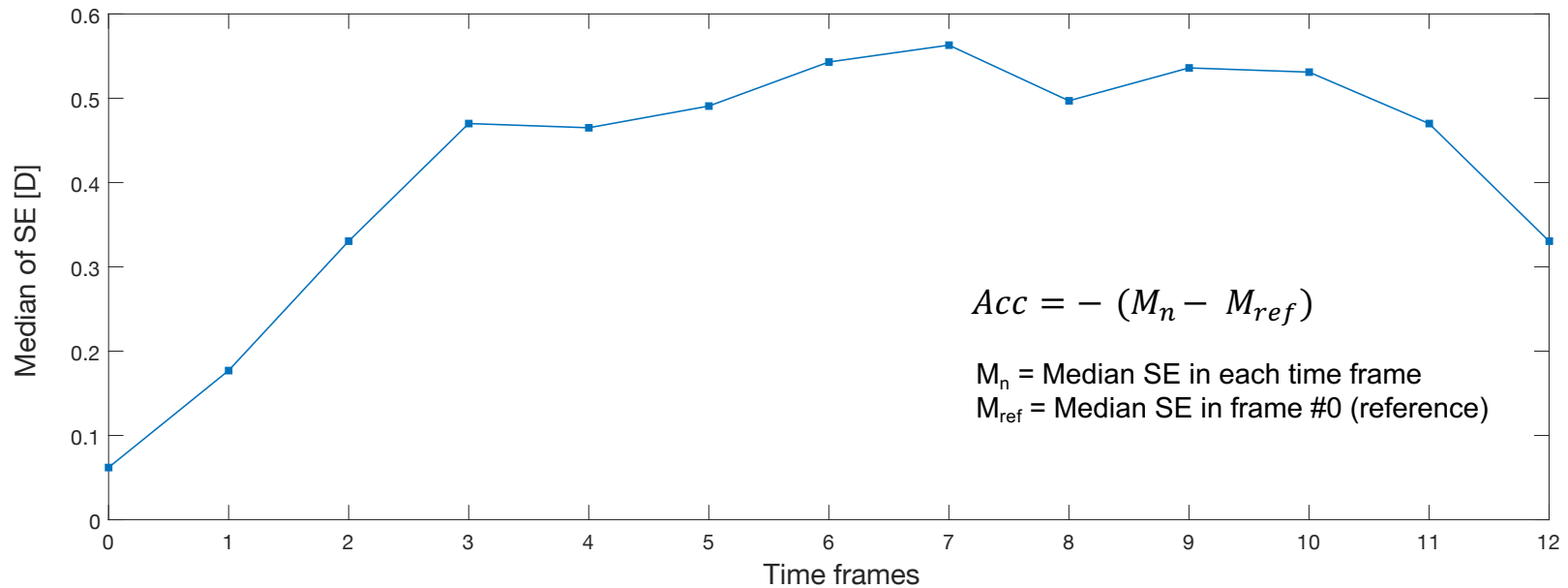
- **Data analysis:**

1. Total time of measurement divided in frames of 5 seconds



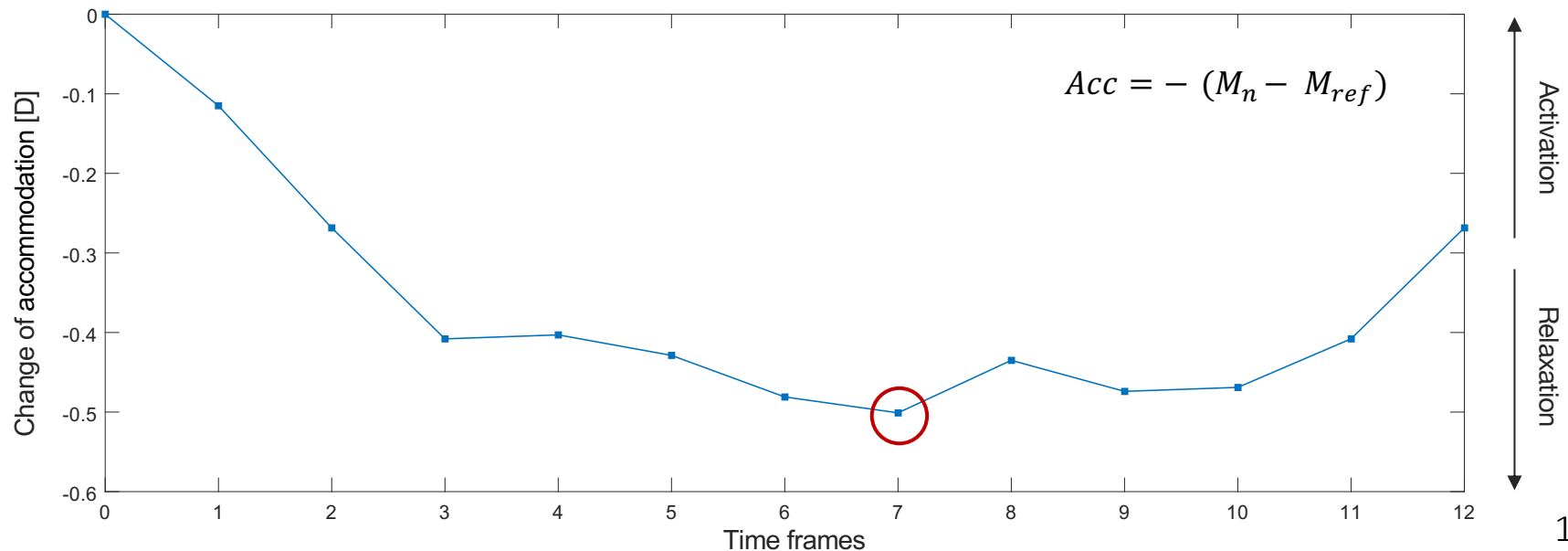
- **Data analysis:**

1. Total time of measurement divided in frames of 5 seconds
2. Median value of each frame



- **Data analysis:**

1. Total time of measurement divided in frames of 5 seconds
2. Median value of each frame
3. Values of accommodative response relative to the median value of refraction of frame #0



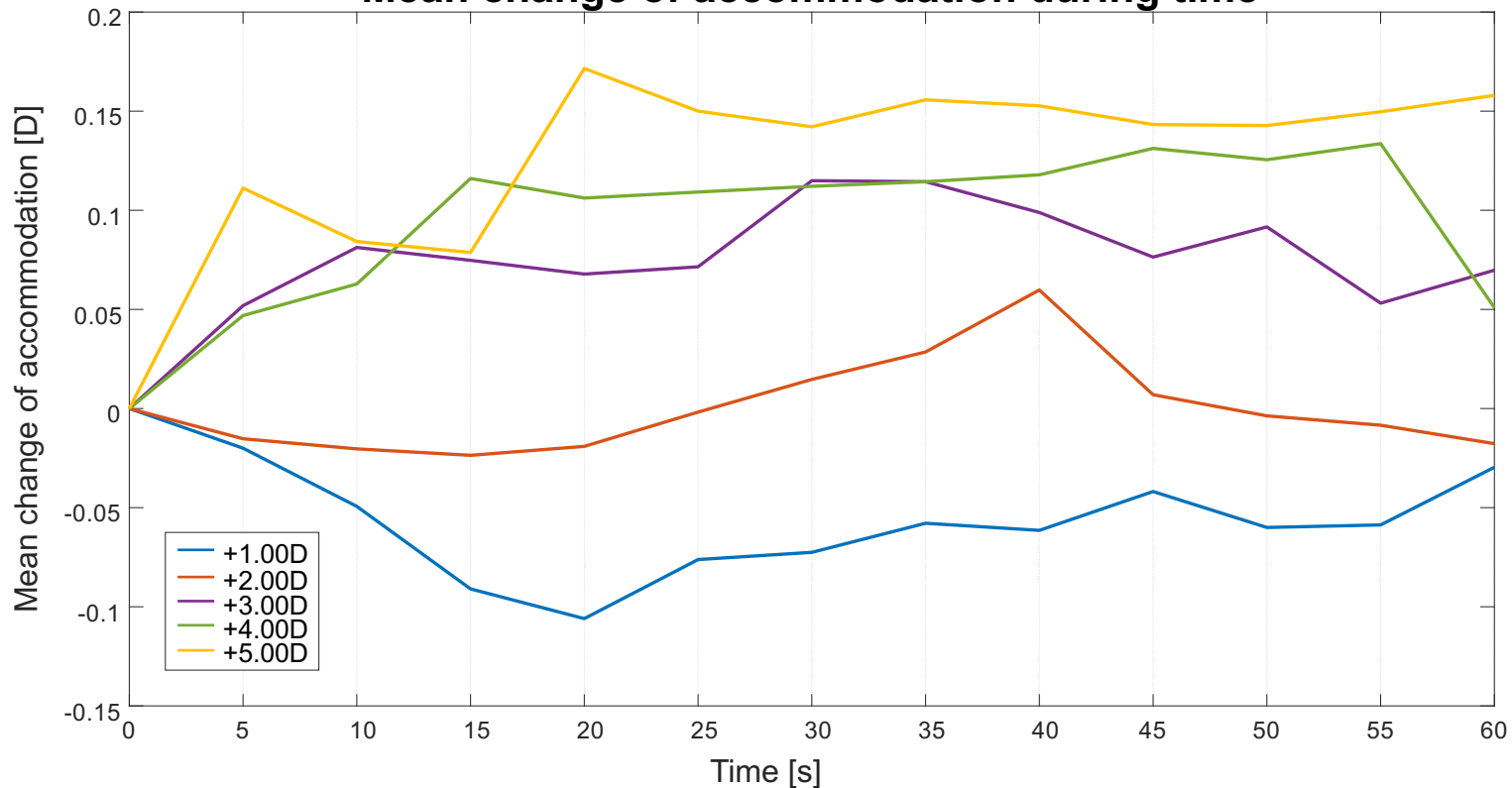


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- Overview

**Sample**

- 30 participants
- 19-30 years old ( $22.73 \pm 3.18$ )
- 24 women
- SE  $-4.00 / +0.75$  D ( $-1.01 \pm 1.40$ )

**Mean change of accommodation during time**



- Lens

Change of accommodation for each lens

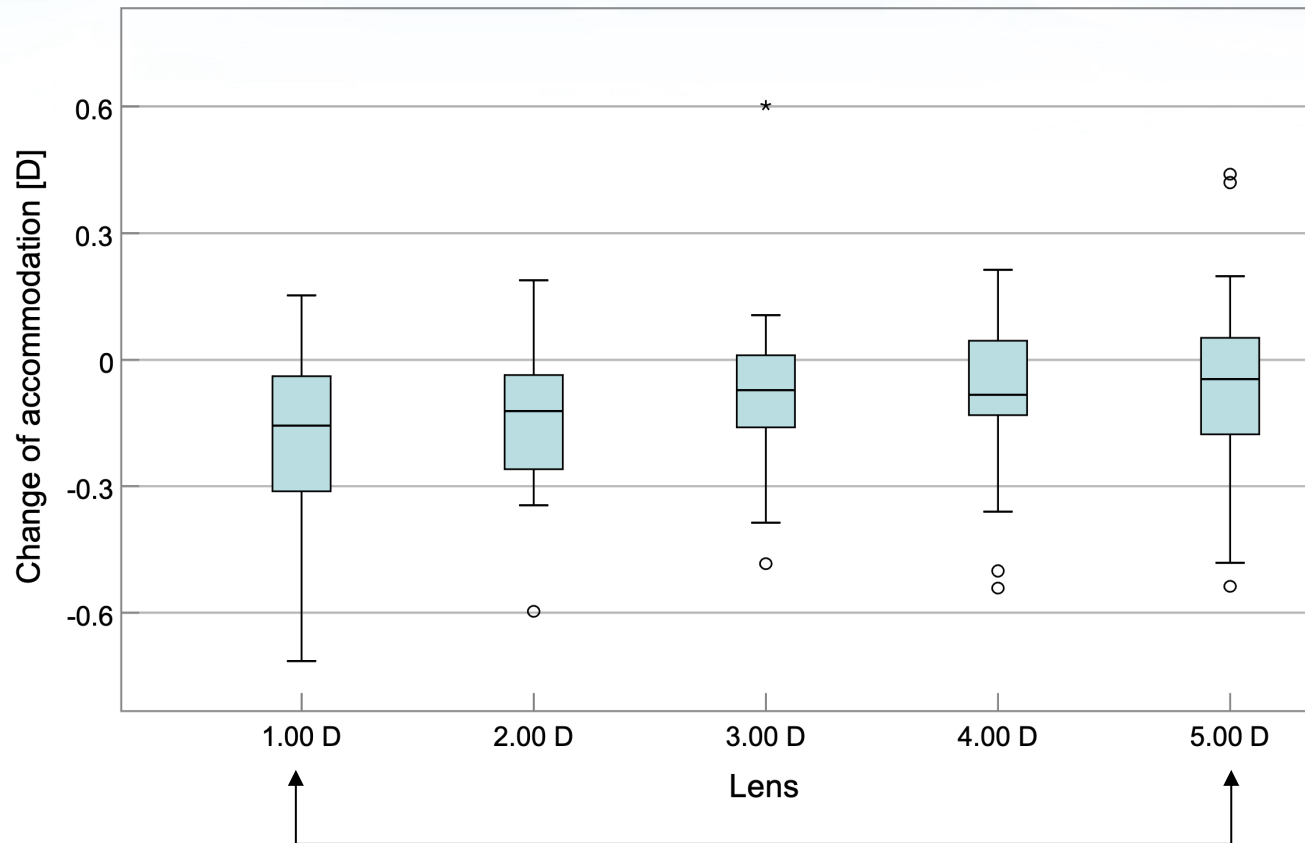


Table 1. Mean change of accommodation for each lens

Lens	Mean $\pm$ SD
+1.00 D	-0.18 $\pm$ 0.18
+2.00 D	-0.14 $\pm$ 0.16
+3.00 D	-0.07 $\pm$ 0.18
+4.00 D	-0.09 $\pm$ 0.17
+5.00 D	-0.06 $\pm$ 0.21

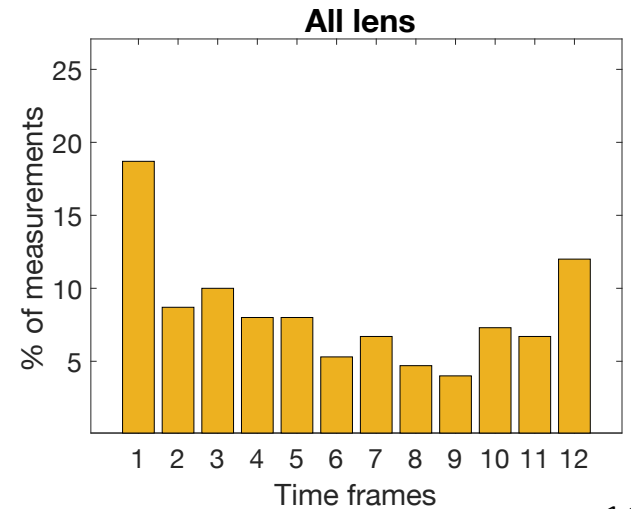
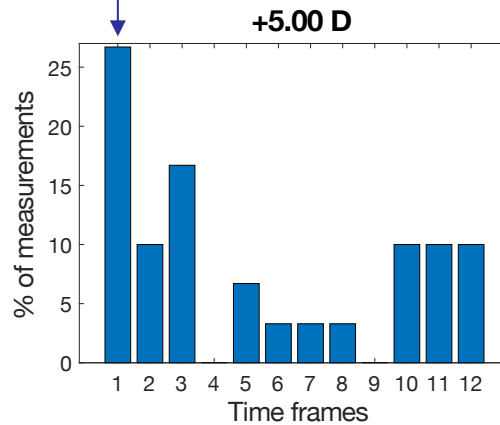
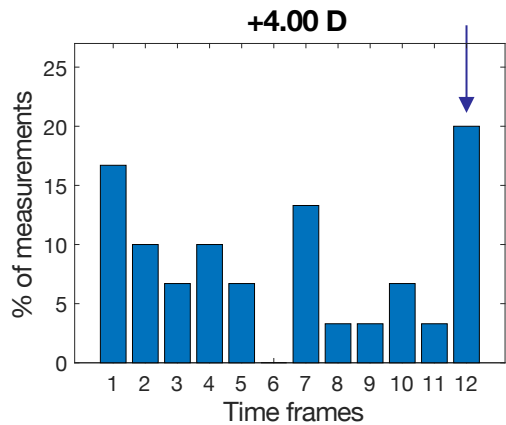
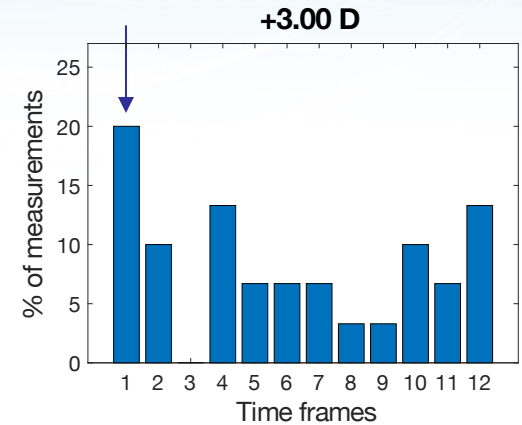
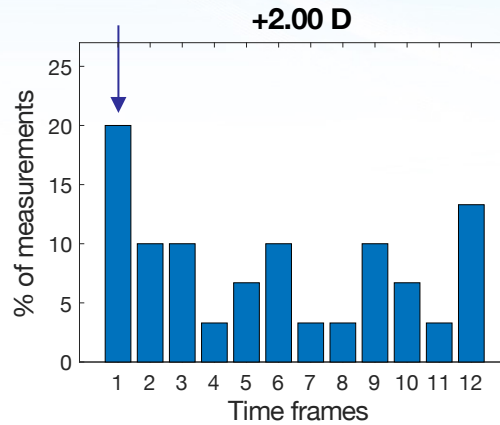
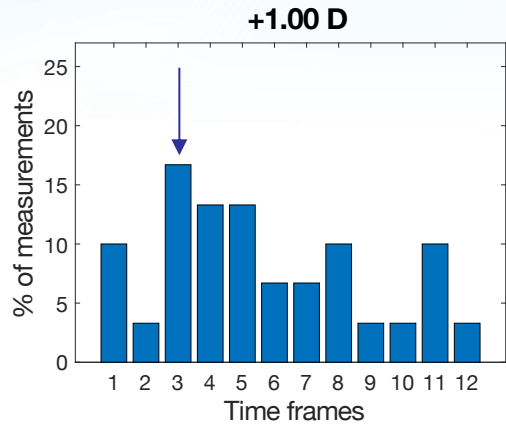
Statistically significant differences (p=0.013)

- **Clinically interesting cases:** Cases relaxing at least 0.12D
  - 25 of 30 participants relaxed at least 0.12 D with some of the lenses

Table 2. Mean change of accommodation for cases relaxing accommodation 0.12 D or more

<b>Lens</b>	<b>n</b>	<b>%</b>	<b>Mean <math>\pm</math> SD</b>
+1.00 D	16	53.30	-0.32 $\pm$ 0.13
+2.00 D	15	50.00	-0.27 $\pm$ 0.12
+3.00 D	11	36.67	-0.23 $\pm$ 0.11
+4.00 D	11	36.67	-0.26 $\pm$ 0.15
+5.00 D	11	36.67	-0.25 $\pm$ 0.14

- Time

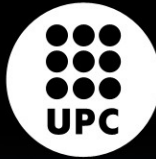




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- The fogging technique had the ability to relax the accommodation.
- There is a trend for the +1.00 D lens to provide the maximum relaxation, although with no significant differences with the other lenses.
- It cannot be concluded that there is a preferred timespan.
- A lot of variability was shown between participants for which control of accommodation should be focused individually.
- Real-time monitoring systems could provide useful information about refraction and accommodation and are interesting in the development of new technologies for refraction assessment.



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