

# Quantitative Measurement of Perceptual Distortion in Keratoconus

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## **Disclosure Statement:**

None

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# Objectives



- To create a profile of the keratoconus patients attending the Optometry Clinic at the University of the West Indies
- To assess the perceptual distortion experienced in keratoconus using psychophysical methods.
- To correlate the perceptual distortion with clinical parameters.

# Introduction



- Keratoconus
- What is its relation to Perceptual Distortion?



# Methodology

- **Participants**

- 25 Keratoconus (UWI Optometry Clinic)
- 25 Controls (Age matched)

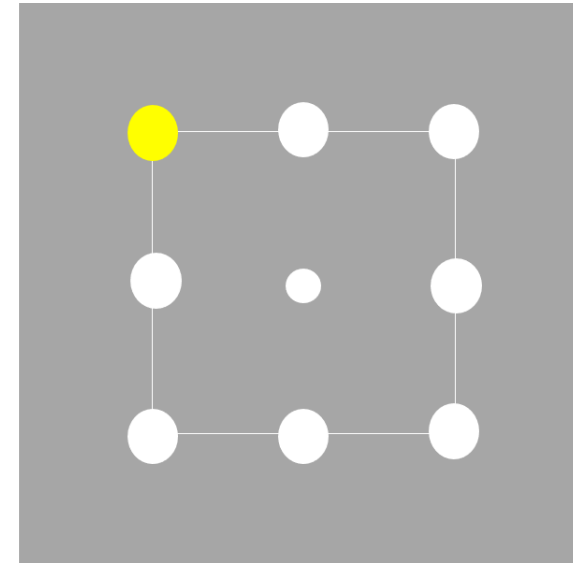
- **Clinical Parameters**

- BCVA
- Refractive error
- Corneal topography indices (Kmax, Ks etc.)
- Central Corneal Thickness
- Signs of Keratoconus

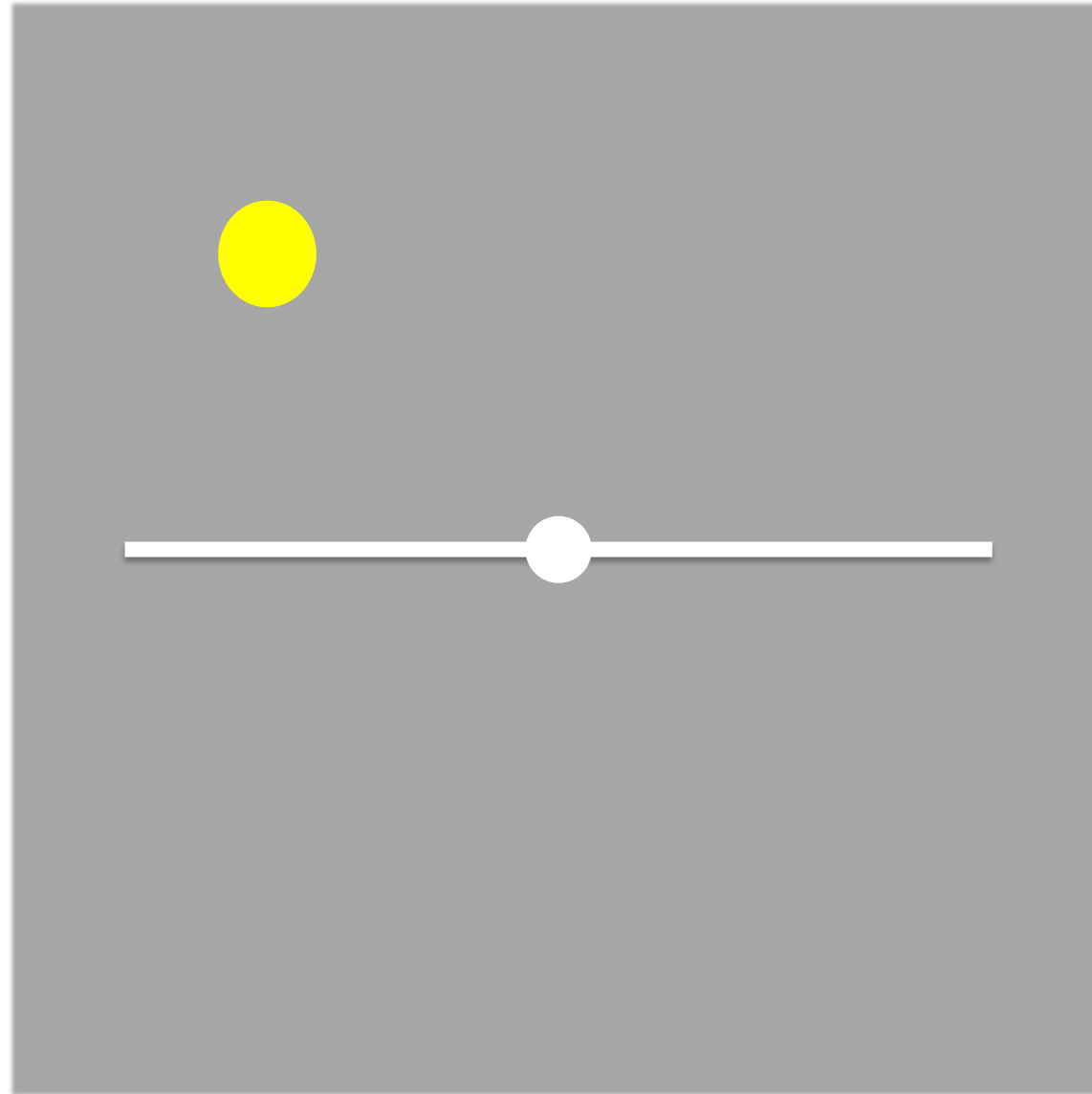


# Methodology – Perceptual Distortion

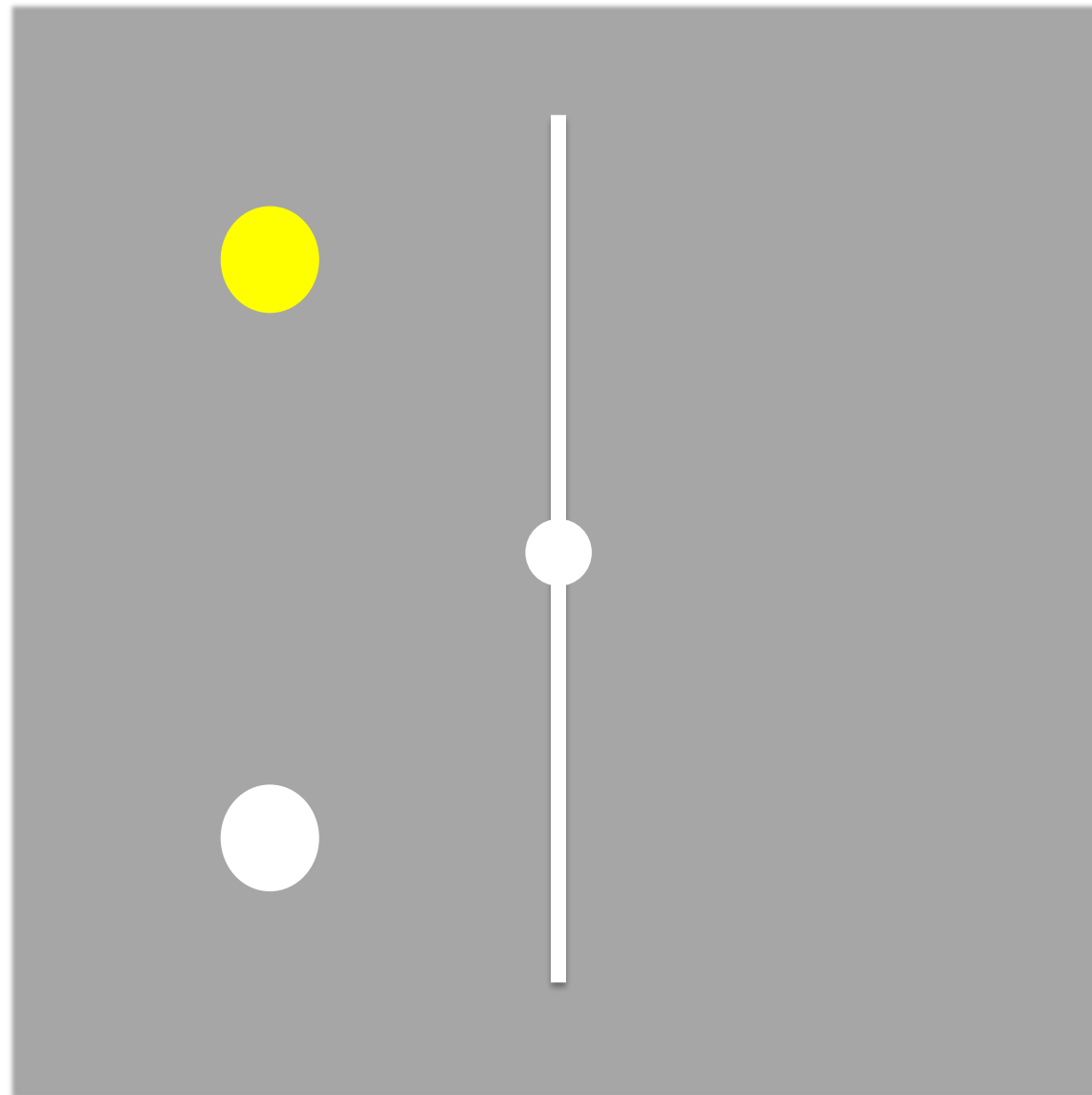
- Custom build program on MATLAB software
- Based on positional and Vernier alignment and field matching techniques
- Participant placed supra threshold contrast circle with mouse click to complete a square
- Monocularly with best ref. correction at 50cm
- 2 practice trials followed by 5 trials of data collection



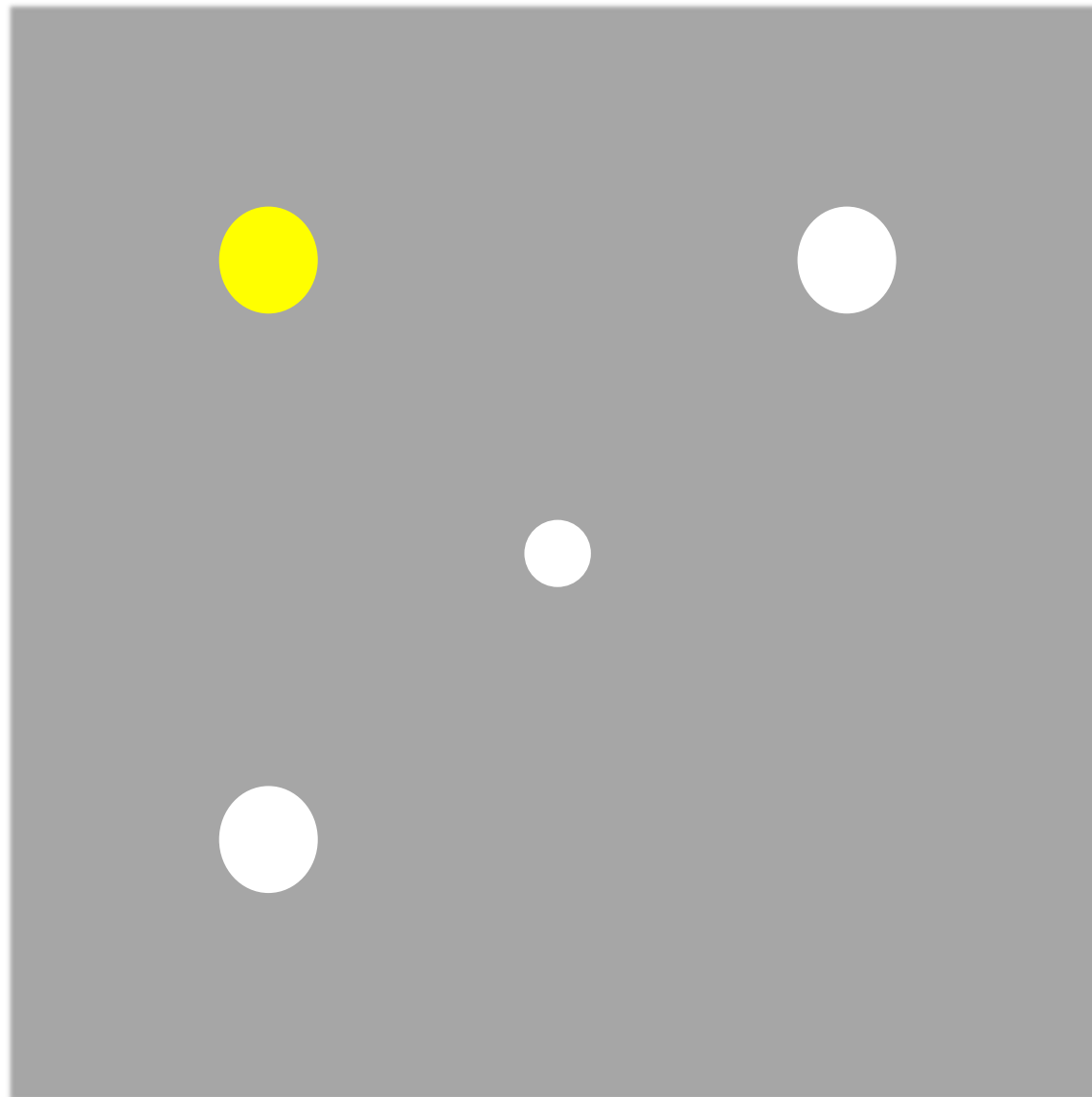
## A single trial of program



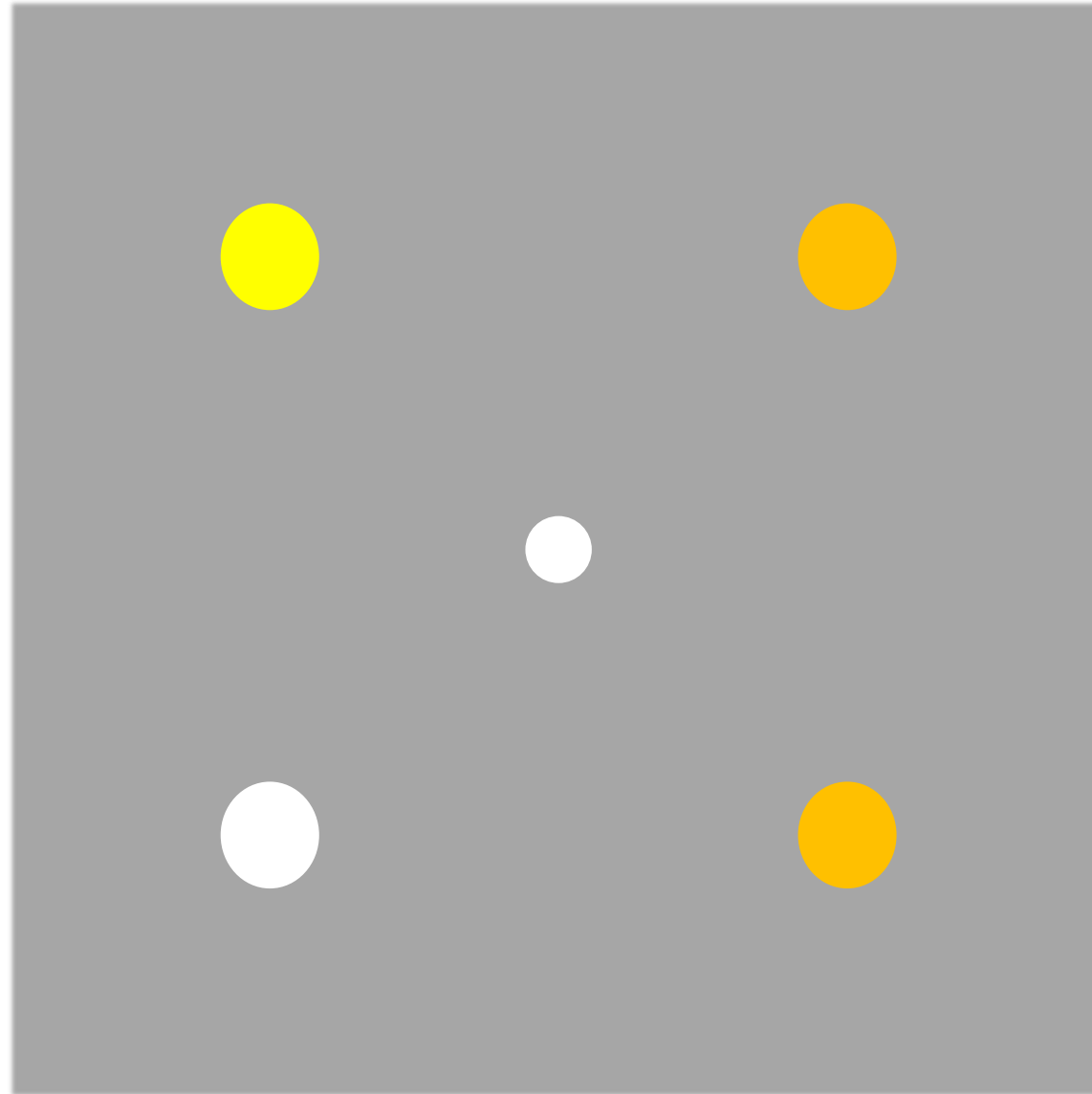
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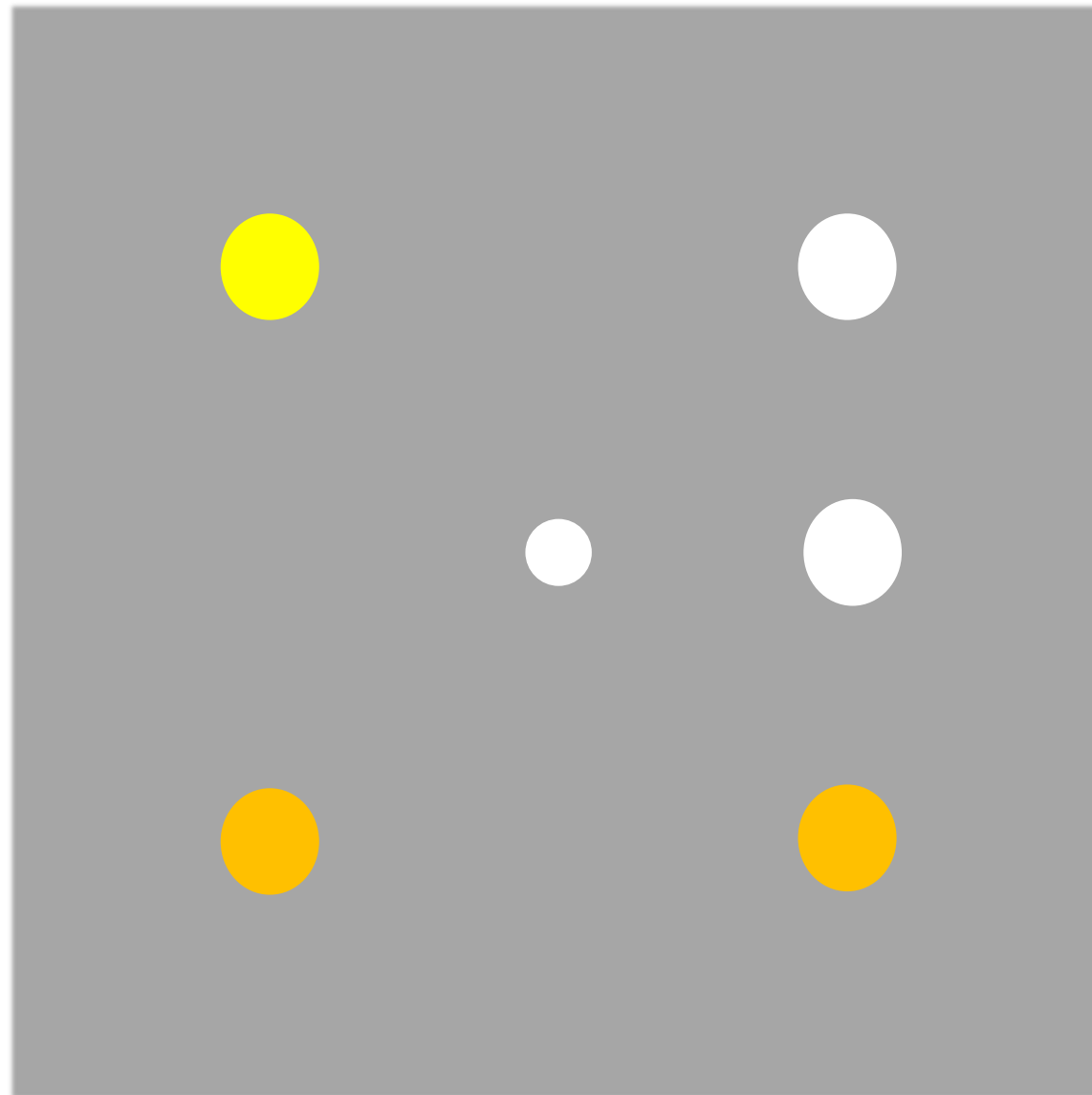
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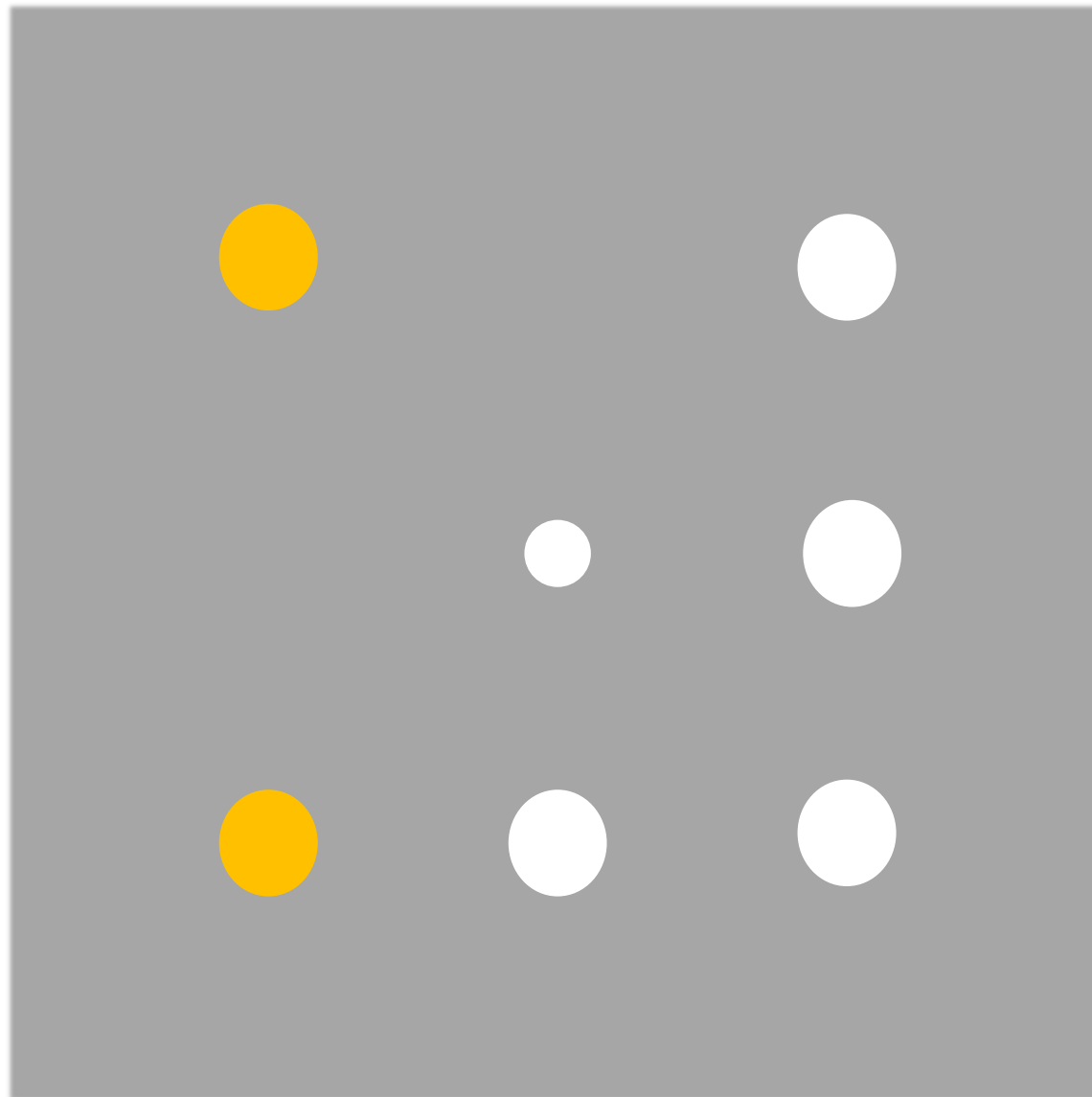
## A single trial of program



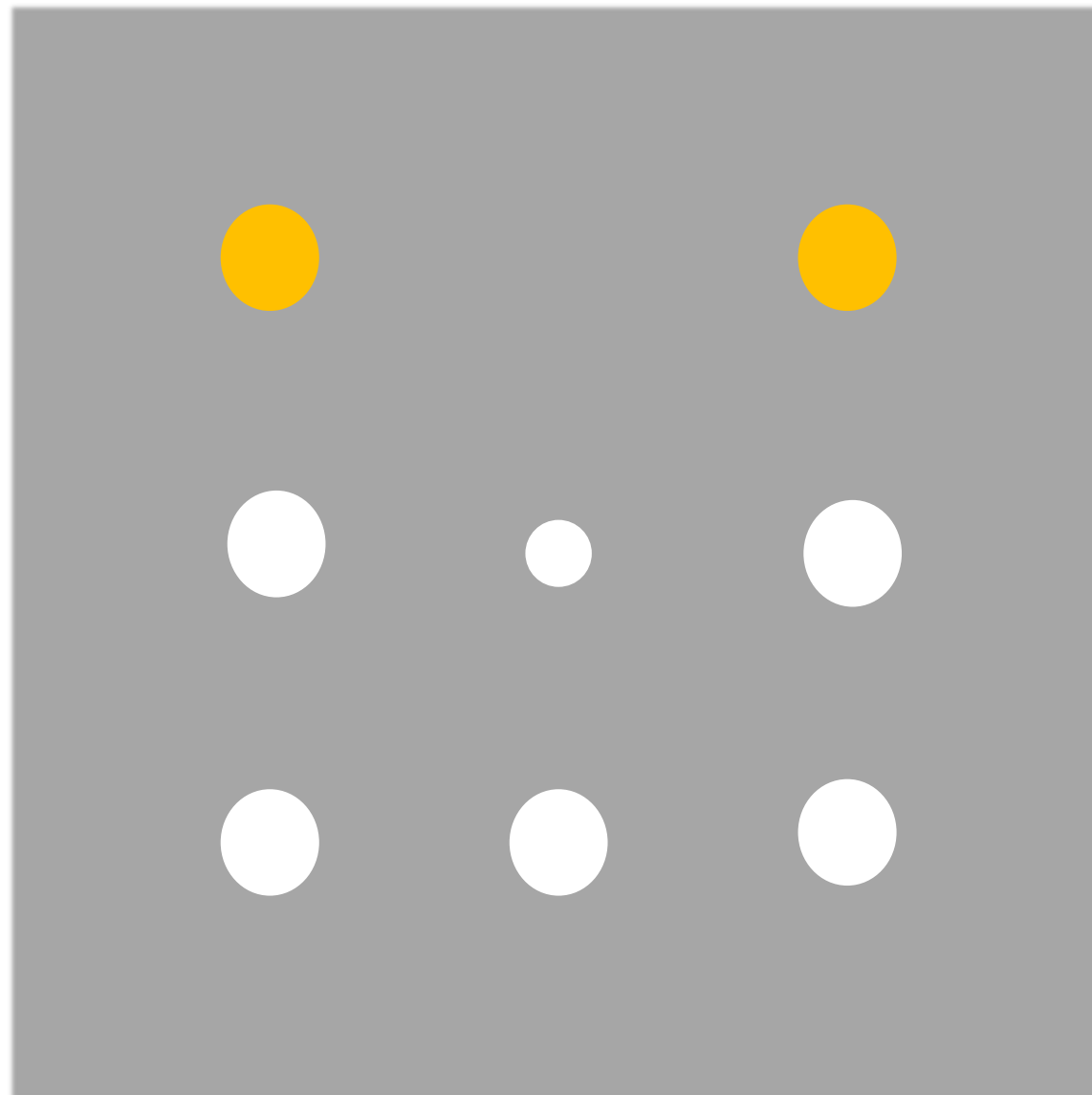
## A single trial of program



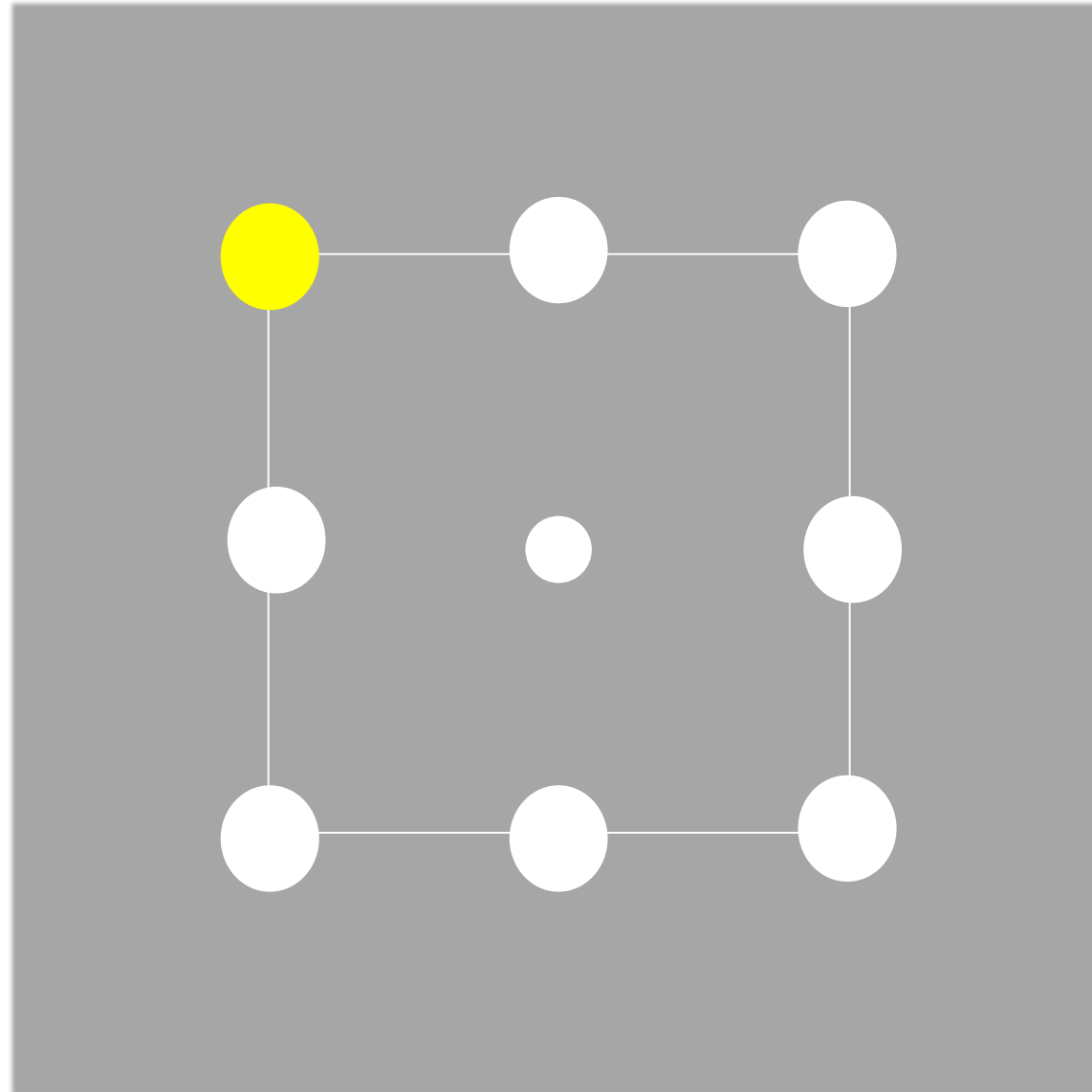
## A single trial of program



## A single trial of program

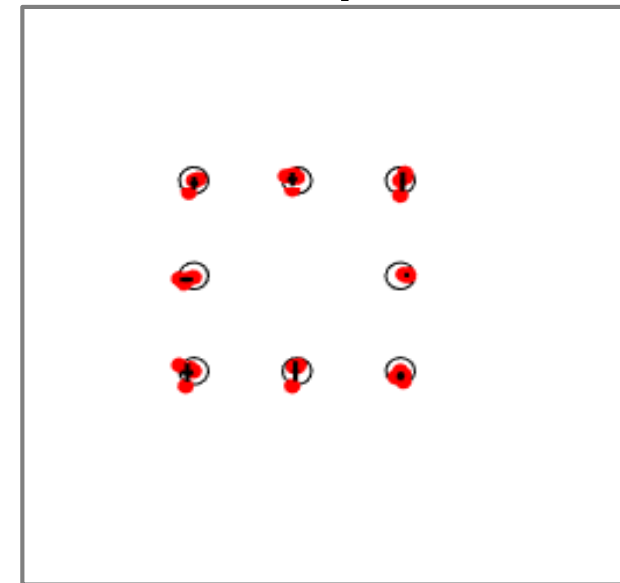


## A single trial of program



# Methodology – Perceptual Distortion

- Global Distortion Index – mean of positional uncertainty at 9 positions from 5 trials
- Global Uncertainty Index – standard dev. of positional uncertainty at 9 positions from 5 trials
- Results analyzed using t – tests, regressions analysis on SPSS software



# Results and Interpretations

Table 1.0 showing age with various clinical parameters that were measured.

	Keratoconic (50 Eyes)	Controls (50 Eyes)
<b>Age (Years)</b>	29.84 ± 7.46	22.12 ± 2.62
<b>BCVA (LogMAR)</b>	0.21 ± 0.27	0.07 ± 0.47
<b>Refraction (DC)</b>	-3.55 ± 2.17	-0.77 ± 0.89
<b>K max (D)</b>	54.56 ± 6.21	45.66 ± 1.57
<b>CCT (μm)</b>	496.34 ± 48.00	555.30 ± 25.15

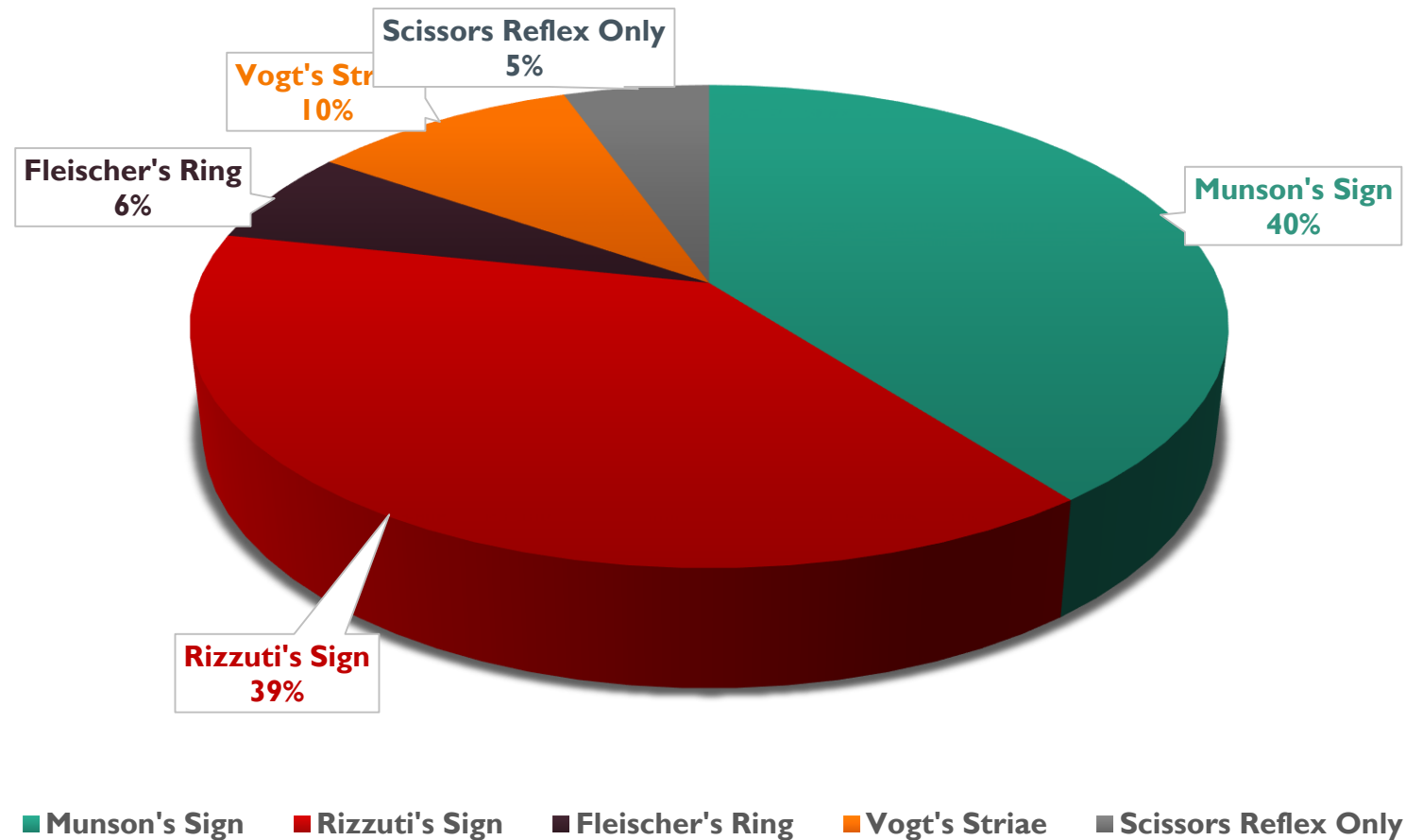
# Results and Interpretations

Table 1.1 showing prevalence of the different keratoconus gradings based on Amsler Classification from the corneal topographer.

Grading	n (%)
0	0 (0)
1	8 (17)
2	23 (48)
3	13 (27)
4	4 (8)
Total	48 (100)

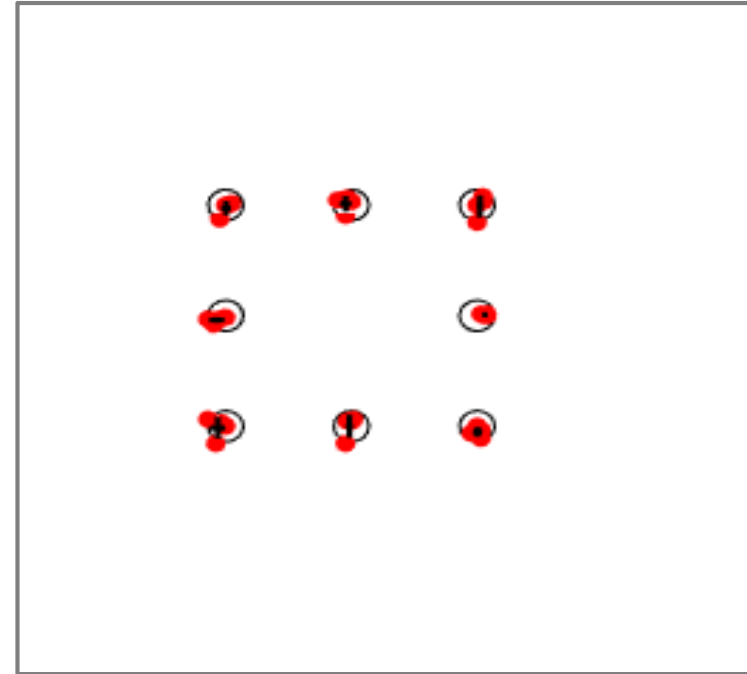
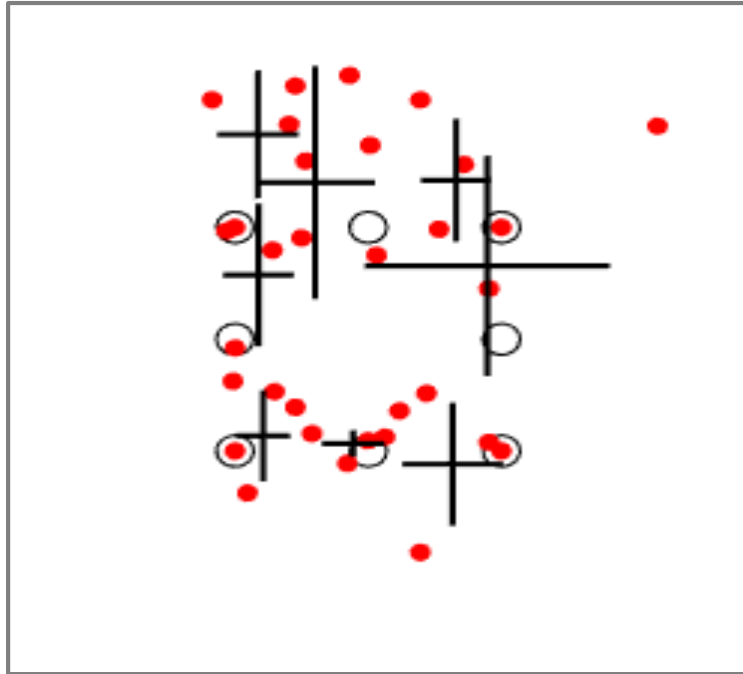
# Results and Interpretations

Figure 1.0 showing the percentages of keratoconic signs found in the keratoconic group of patients under slit lamp examination and observation.



# Results – sample result

Image 1.0 distortion index (GDI) and global uncertainty index (GUI) from the MATLAB data. (Left – keratoconic participants. Right – controls.)



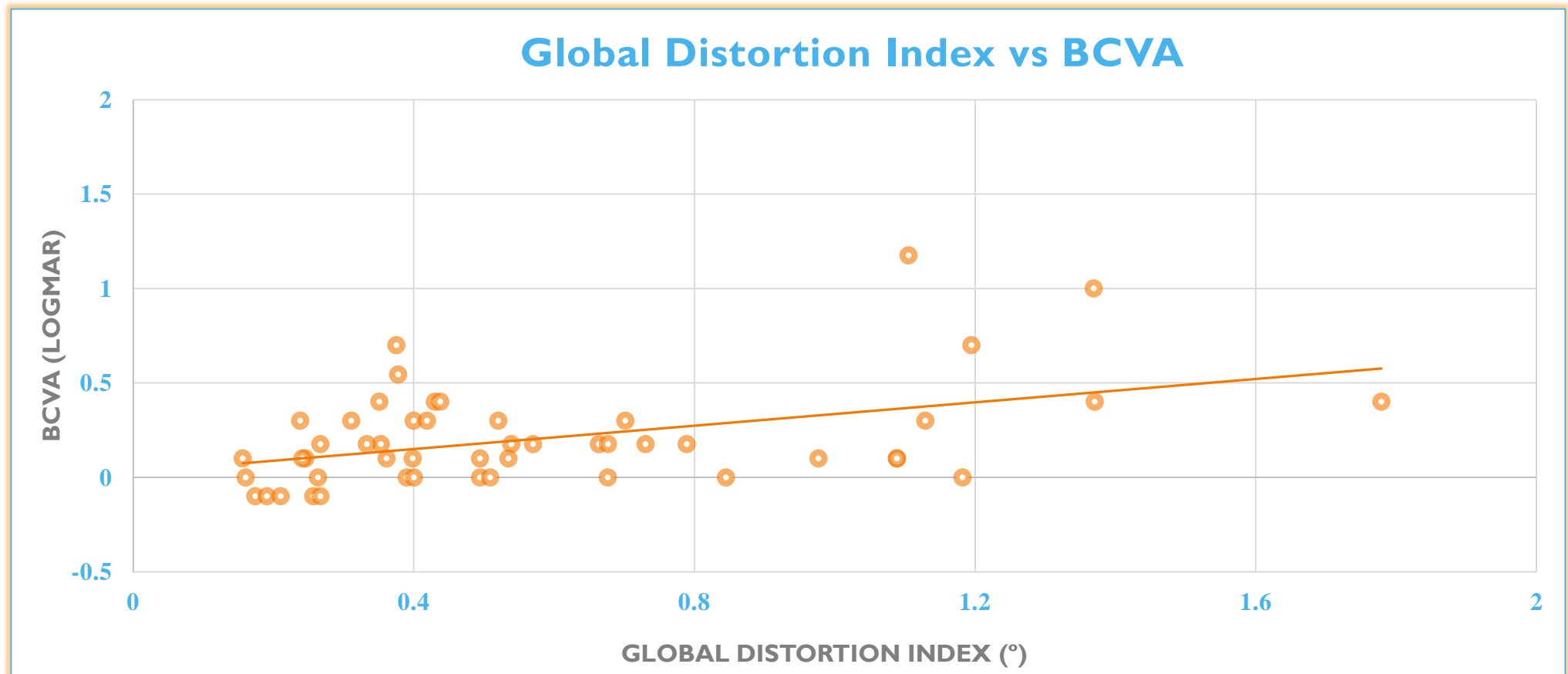
# Results and Interpretations

Table 2.0 showing mean and standard deviation of GDI and GUI for both keratoconic and control eyes.

	GDI (°)		GUI (°)	
	Keratoconic	Control	Keratoconic	Control
<b>Mean ± SD</b>	0.58 ± 0.38	0.36 ± 0.21	0.57 ± 0.49	0.36 ± 0.34
<b>PValue</b>	$t (77.79) = -3.56$ $p < 0.01$		$t (86.96) = -2.42$ $p < 0.05$	

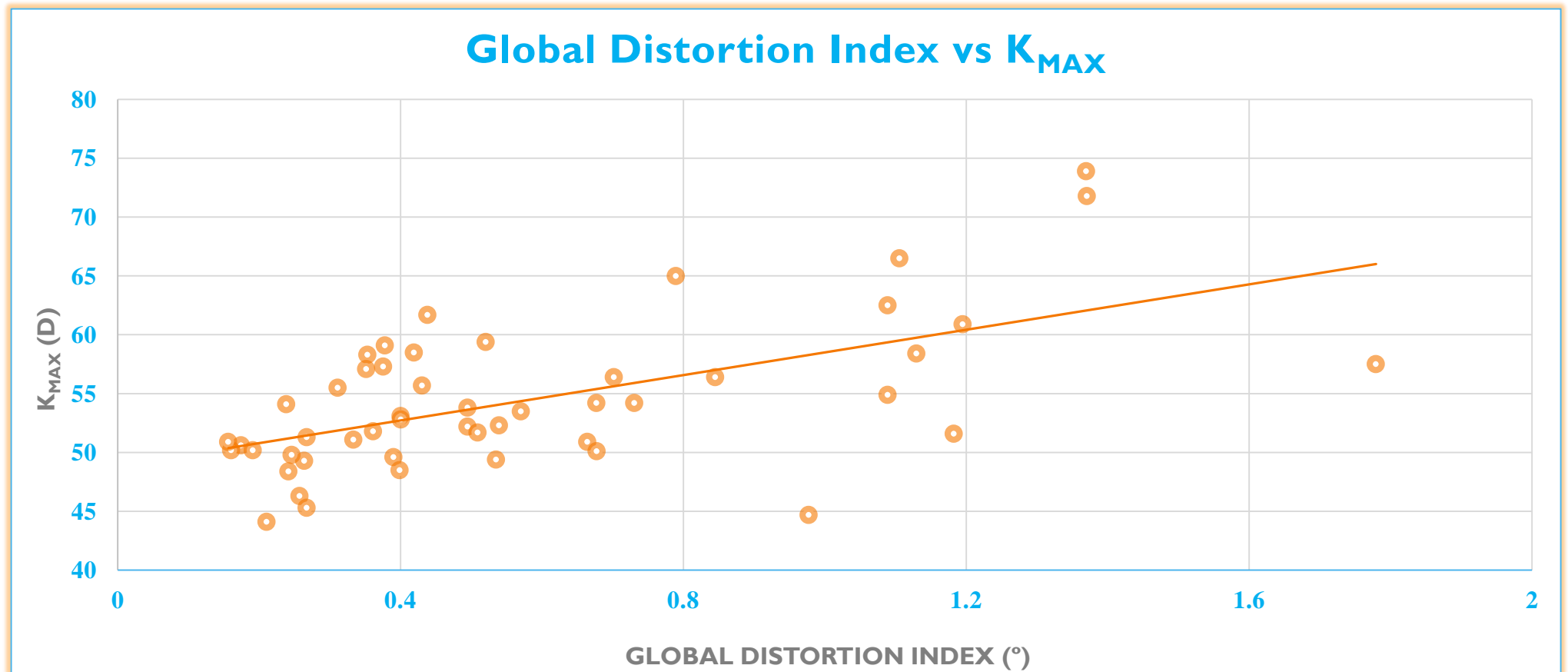
# Results and Interpretations

**Figure 2.0 showing a scatter plot of the correlation between GDI and the best corrected visual acuity values for keratoconic eyes. (Correlation coefficient (  $r$  )= -0.45,  $P < 0.01$  )**



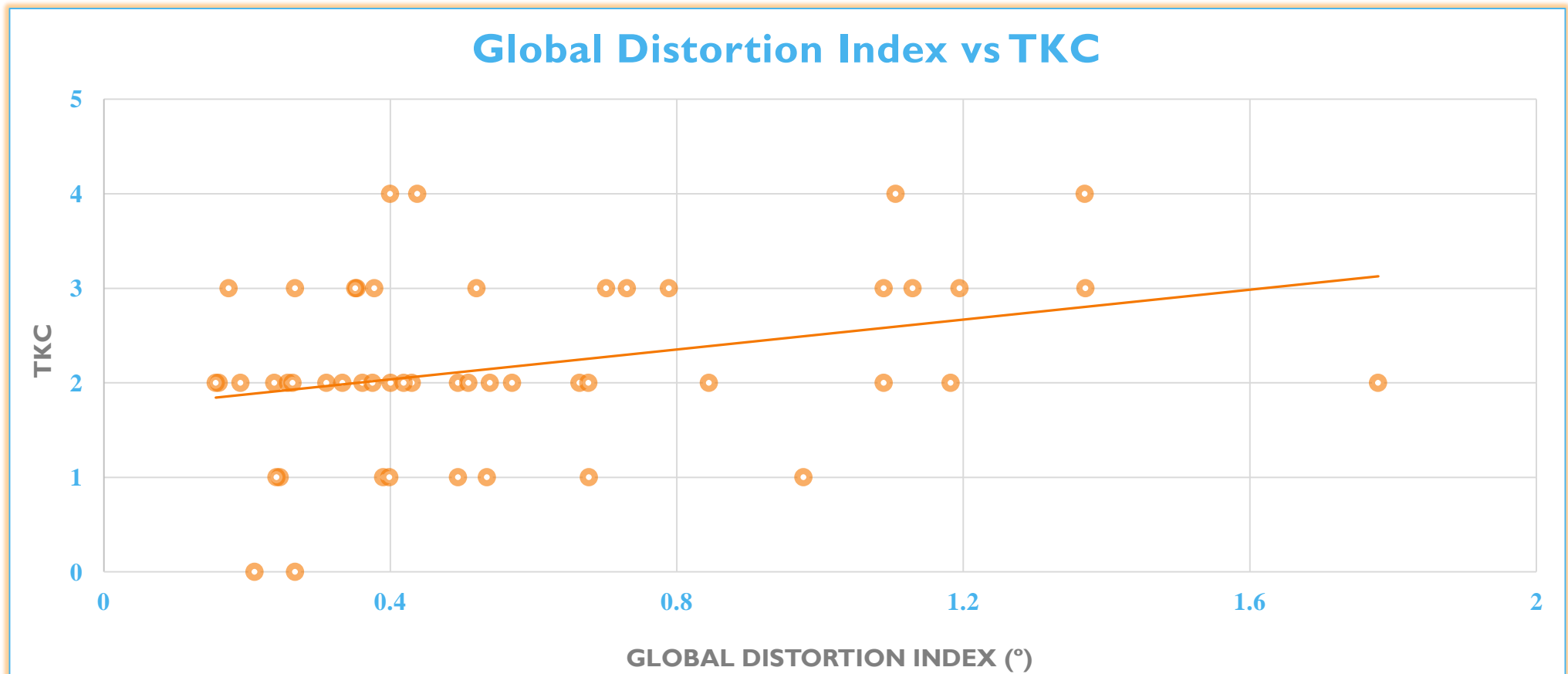
# Results and Interpretations

Figure 2.I showing a scatter plot of the correlation between GDI and the  $K_{MAX}$  values for keratoconic eyes. (Correlation coefficient (  $r$  )= 0.58,  $P < 0.01$  )



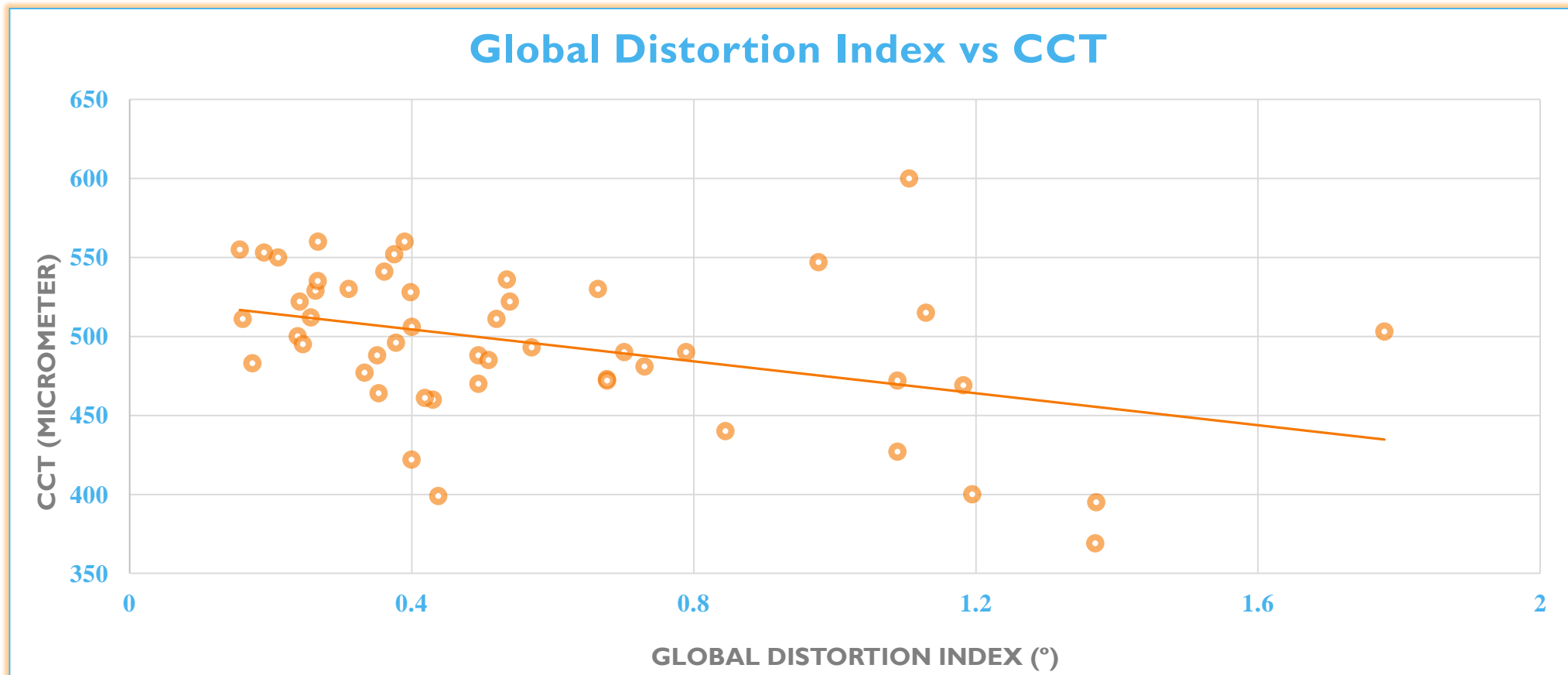
# Results and Interpretations

Figure 2.2 showing a scatter plot of the correlation between GDI and the TKC values for keratoconic eyes. (Correlation coefficient (  $r$  ) = 0.32,  $P < 0.05$  )



# Results and Interpretations

**Figure 2.3 showing a scatter plot of the correlation between GDI and central cornea thickness (CCT) values for keratoconic eyes. (Correlation coefficient ( $r$ )= -0.40,  $P < 0.01$ )**



# Results and Interpretations

**Table 3.0 showing correlation values between GUI and the different clinical parameters.**

Clinical Parameter	Correlation Coefficient ( r )	P Value
<b>BCVA</b>	-0.51	0.000 **
<b>Kmax</b>	0.53	0.000 **
<b>TKC</b>	0.39	0.006 **
<b>CCT</b>	-0.16	0.282

\*\* - Significant at the 0.01 level (2-tailed).

# Conclusions

- Perceptual visual distortion was higher in Keratoconus compared to normal controls.
- The measured distortion indices correlated with clinical measurements of Keratoconus.
- A home based perceptual distortion measurement could be useful tool to monitor progression of keratoconus.
- Future studies will test the validity of the perceptual measurements using test/retest and other statistics in a larger sample size.

# References

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