Photopic and mesopic visual resolution in Parkinson's disease patients with and without freezing of gait

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Parkinson's Disease

- Progressive neurodegenerative disease that is characterized by motor problems
  - Tremor of limbs
  - Slowed movement (bradykinesia): simple tasks become difficult and take longer to accomplish.
    - Steps could become shorter or drag feet
    - Difficulty getting out of a chair
  - Rigid muscles
  - Impaired posture and balance
  - Loss of automatic movements.
    - Decreased ability to perform unconscious movements, including blinking, smiling or swinging arms when walking.
  - Speech changes:
    - speak softly, quickly, slur or hesitate before talking.

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Parkinson's Disease

- Primary neuropathology is the degeneration of dopaminergic neurons in the subthalamus:
  - substantia nigra
    - Signals to carry out

    Movement are modulated

    by thalamus, basal ganglion and subthalamus

Parkinson's Disease

- If the neurodegenerative is process is located primarily in the subthalamus and basal ganglion
  - Executive functions and emotions could be affected
- If the process affects primarily dopaminergic neurons
  - Frontal eye fields & sensory visual processes could be affected

Freezing of Gait

- A brief, episodic absence or reduction of forward progression of the feet despite the intention to walk
  - Characteristic appearance of the feet making quick stepping movements in place.
  - Freezing as they try to pass through a narrow doorway or hallway is one of the hallmark symptoms
  - Most of PD who display FOG are in the later stages of PD, but 26% are in the early stages of PD
- FOG seems to develop independently of PD
- Medication and rehabilitation help
  - but not to the same extent as other PD symptoms

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Freezing of Gait

- FOG patients have more visuospatial judgement and motion perception errors which are correlated with walking performance
- Rremoving/reducing visual cues will also increase the number of FOG occurrences.
- Could be poorer processing within the occipito-parietal dorsal stream i.e "where" vision
  - or integrating the "where" information with movement

Previous studies

- Suggest deficits with in the occipito-parietal dorsal stream processing (the “where” visual stream).
  - Interested in whether these deficits would occur in more basic visual functions

Methods

- Participants

Groups	FOG	non-FOG	Healthy Controls
Sample Size (N) (Male/Female)	22 (14/8)	25 (19/6)	25 (8/17)
Age	72.31 (6.9)	67.52 (9.4)	70.43 (7.67)
Cognitive (MoCA) Score	24.95 (4.27)	25.76 (2.18)	26.48 (2.16)
Severity (UPDRS) Score	22.41 (7.94)	19.96 (9.58)	NA
Duration of the Disease	10.52 (6.6)	8.08 (6.35)	NA

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Methods

- Participants
- Excluded if
  - Visual acuity worse than 6/9 (20/30)
  - History of diabetes
  - Nystagmus
  - Strabismus,
  - Other neurological deficits

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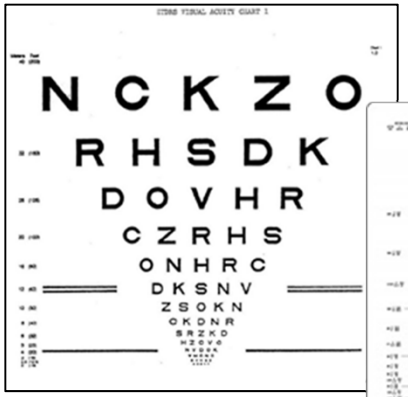
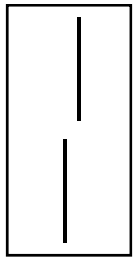
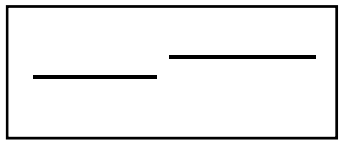
Tests

- Visual Resolution
  - High and Low Contrast Letter Acuity
  - Vernier Acuity (misalignment/position judgments)
  - Contrast Sensitivity (large letters)







- Photopic (~120 cd/m^2) and Mesopic (~1.2 cd/m^2)

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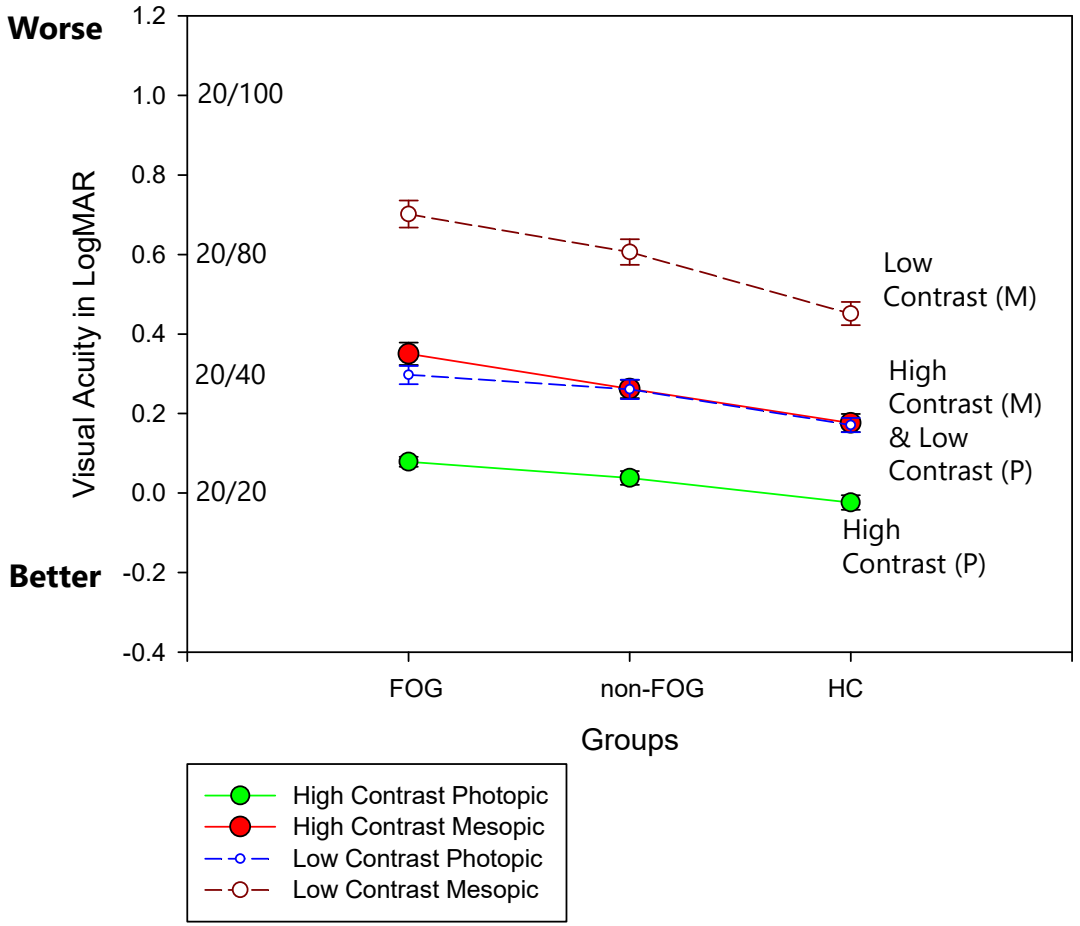
Results

- Visual Acuity
- For all:
  - worse for low contrast and low light
- Controls better than both PD groups,
- FOG subjects had the largest decrease at low contrast and low light



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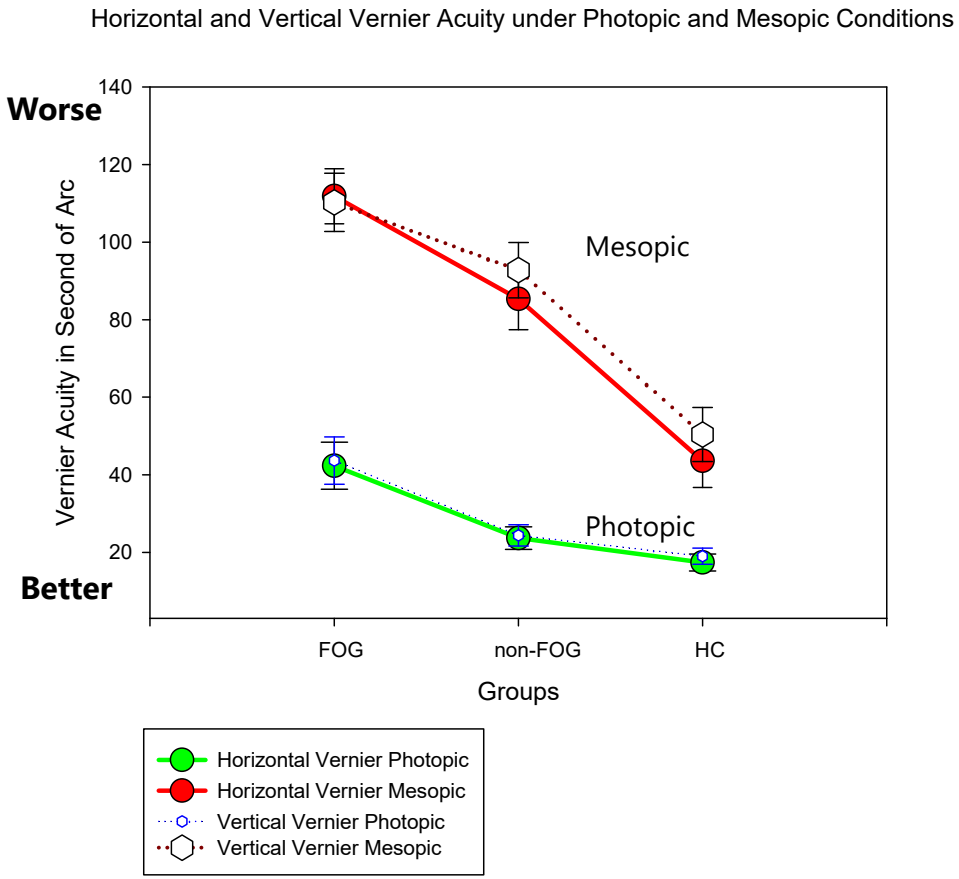
Vernier Acuity

- Worse in lower light for all groups
- No differences between horizontal and vertical alignments
- FOG showed largest reduction at both light levels.
  - Decrease is greater in low light levels



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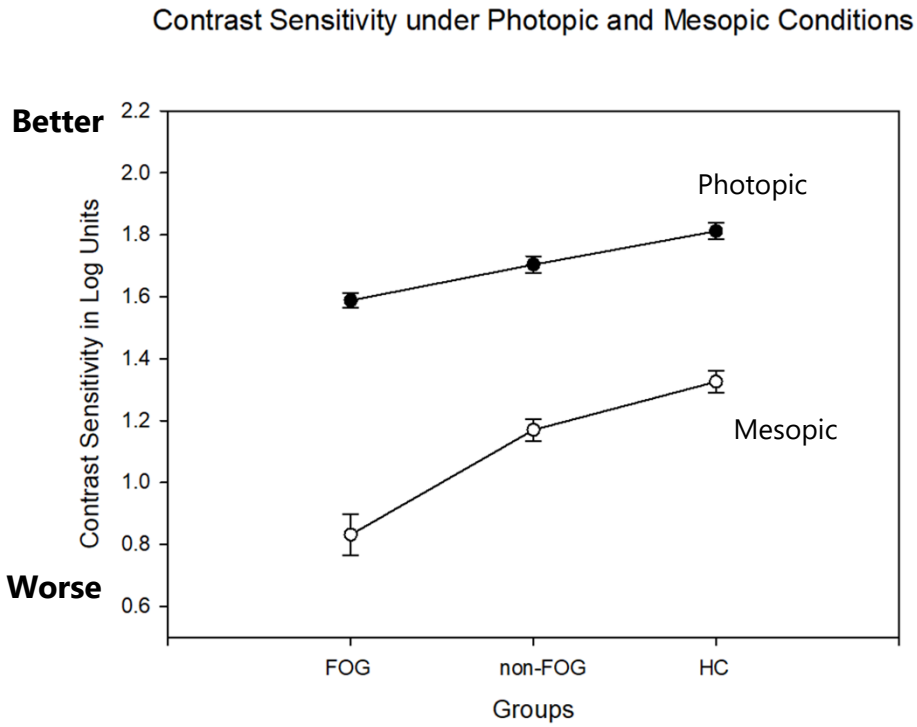
Contrast Sensitivity

- Similar trend.
  - FOG worse especially at low light levels.



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Multinomial Logistic Regression

- Performed to determine the tests that best discriminate between groups

Test	Chi-Square	df	P value
Intercept	7.448	2	0.024
Contrast Sensitivity Mesopic	16.704	2	0.000
Vertical Vernier Acuity Mesopic	8.424	2	0.015
Low Contrast VA Photopic	6.975	2	0.031
Horizontal Vernier Acuity Mesopic	6.638	2	0.036

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Conclusions

- Visual function in PD subjects is compromised more than acuity matched controls, especially in lower light levels and in FOG PD subjects
- Although PD is considered to be a movement disorder, results suggest that they could benefit in increased lighting and contrast
  - Raises the issue whether all individuals with balance/mobility problems, but "normal visual system" would also benefit increased lighting/contrast
- FOG losses for low contrast objects and alignment tasks add additional evidence that occipital-parietal pathway may be affected to a greater extent.
- Another possibly is that the eye movements become unstable and irregular in low light levels and smears the retinal images.

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Funded by

- Saudi Arabian Cultural Bureau in Canada
- College of Optometrists in Vision Development
- The Canadian Optometric Educational Trust Fund

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