Exploration of the Minimum Visual Impairment Criteria for Para Alpine Skiing using Simulated Vision Impairments

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Disclosures

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INTRODUCTION

- Classification
  - 1) Minimum impairment criteria
  - 2) Sport classes for competition
  - Evidence-based and sport-specific
- The purpose of this project was to investigate the minimum vision impairment criteria for Para Alpine Skiing

1. IPC Athlete Classification Code: Rules, Policies and Procedures for Athlete Classification, July 2015

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METHODS

- Within-subjects repeated measures study design
  - Experienced skiers with normal sight were asked to ski with simulated vision impairments
  - Visual Acuity + Contrast Sensitivity Impairments
    - Cambridge Sim Specs
  - Visual Field Impairments
    - Bespoke goggles
  - Visit 1: Visual function assessment + skiing experience questionnaire
    - Static Visual Acuity, Contrast Sensitivity, Visual Field Extent
      - Habitual vision and simulated impairments
  - Visit 2: On snow assessment
    - National Sports Center for the Disabled, Winter Park, USA

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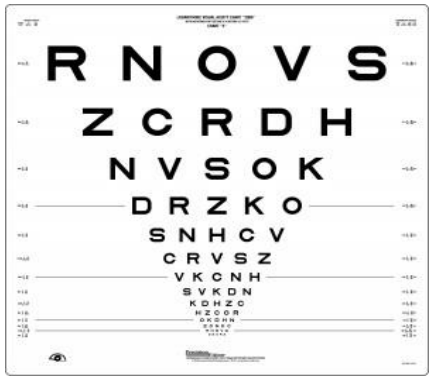
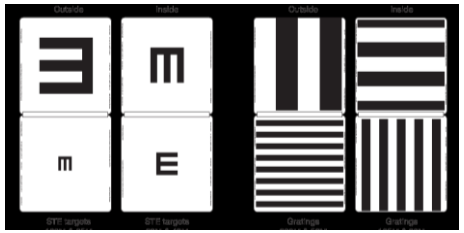
VISIT 1

- Visual Acuity
  - ETDRS and BRVT charts (logMAR)
  - 0.1 logMAR to 1.6 logMAR
- Contrast Sensitivity
  - MARS charts (logCS)
  - 1.7 logCS to 0.1 logCS
- Visual Fields
  - Arc Perimetry with an Esterman Scoring Grid
  - 85% to 20% visual field extent





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VISIT 2

- 20 skiing trials total
  - 2 x 10 gate GS courses; 10 trials per course
    - Goal: maintain consistent 70 to 80% pace across trials
  - First and last trials on each course were always with clear goggles
    - 4 trials total; minimum 2 clear trials per course
  - Middle 16 trials total (8 per course) included:
    - 2 clear goggle trials
    - 8 visual acuity + contrast sensitivity impairments
    - 6 visual field binocular visual field impairments
      - All randomly assigned across both courses

STATISTICAL ANALYSIS

- Shapiro Wilk test, Q-Q plots to check normality
- Friedman's 2-way Analysis of Variance ($p<0.05$) with Dunn post-hoc test
  - Fatigue effects, order effects, simulated impairment effects
    - Dependent variable: Time to complete each run compared to baseline (per course)
- Receiver operator analysis (ROC) was used to identify optimal impairment level
  - Youden's J: maximum sensitivity and specificity overall (optimum criteria)
    - Sensitivity: correctly identify skiers with vision impairments
    - Specificity: correctly identify skiers without vision impairments

POPULATION

- 11 male sighted, experienced Alpine skiers
  - Age: 37.91 ± 18.9 years (17 to 64 years)
  - Years of Experience: 29.91 ± 14.88 years (15 to 58 years)
  - Skiing Hours per Week: 22.45 ± 13.62 hours (6 to 42.5 hours)
  - Ski club racers (n=5), Masters ski racers (n=3), coaches (n=3)

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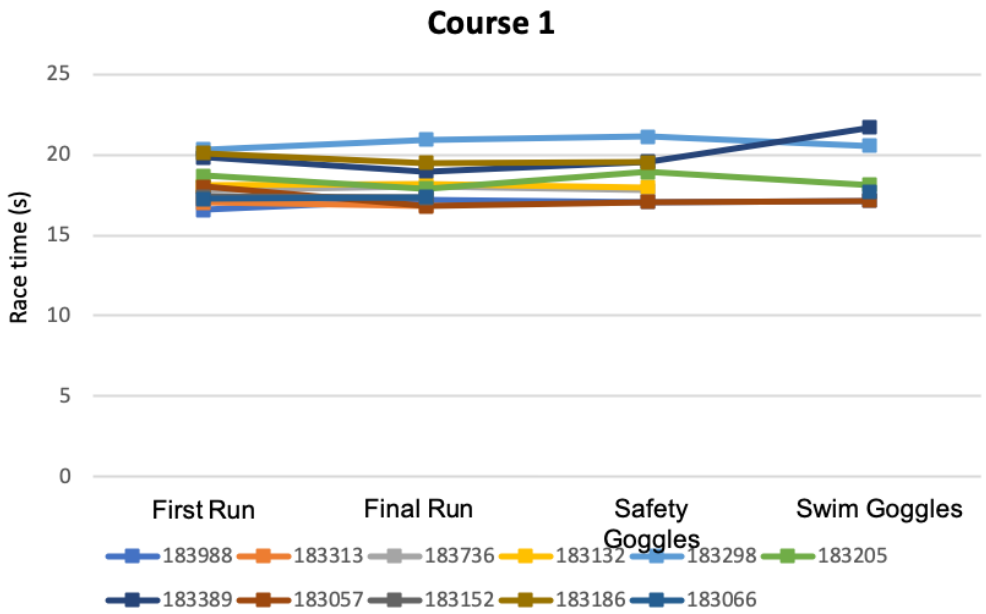
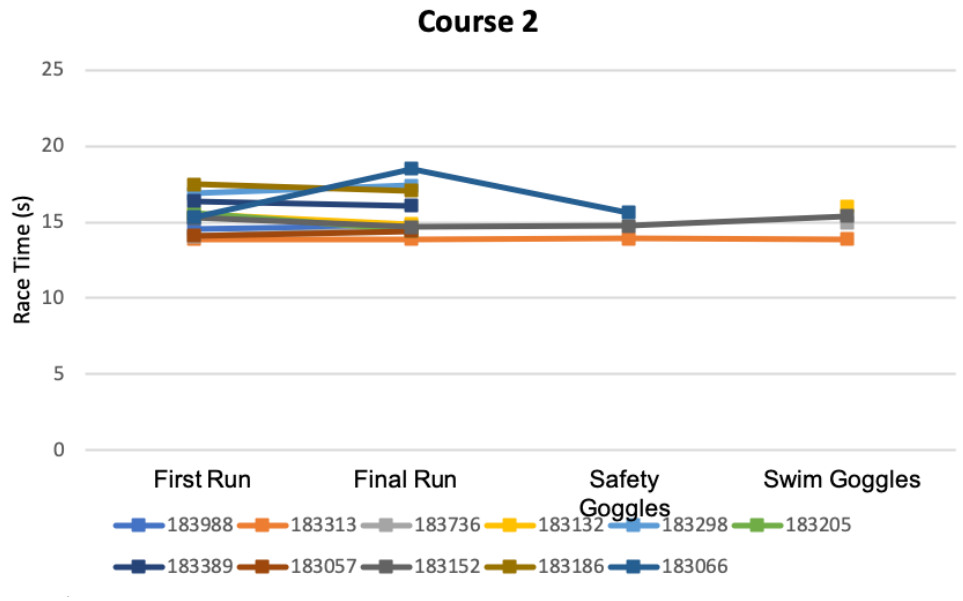
FATIGUE EFFECTS

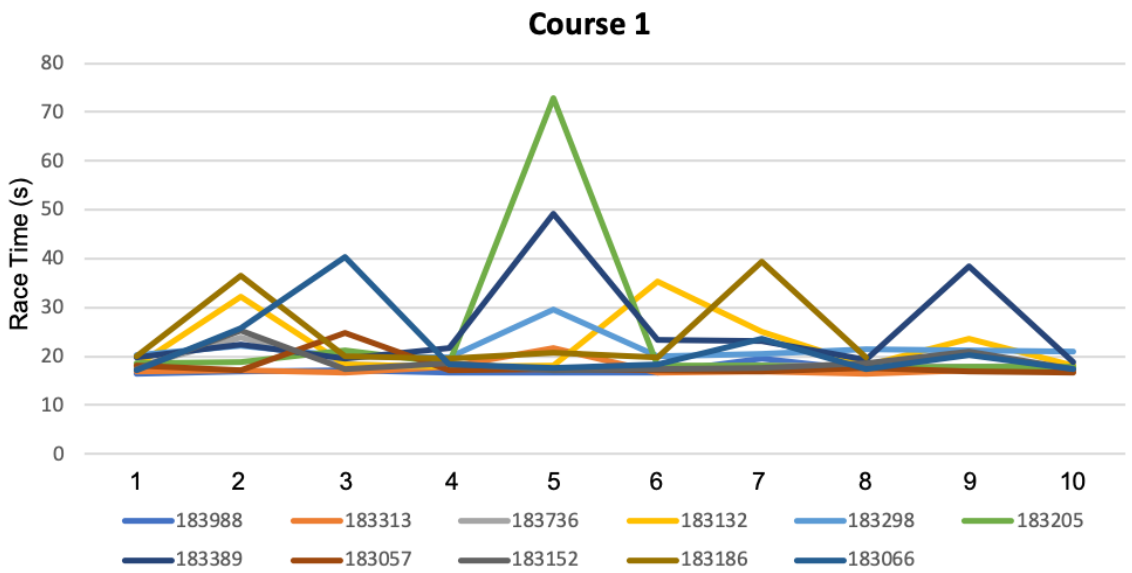
- No difference in race time was found across the clear goggle trials on either course
  - **Skiers could maintain a consistent race pace**
  - **Average race time of clear goggle trials = BASELINE**
    - Calculated for each course
  - All simulated impairment trials compared to baseline time (per course)

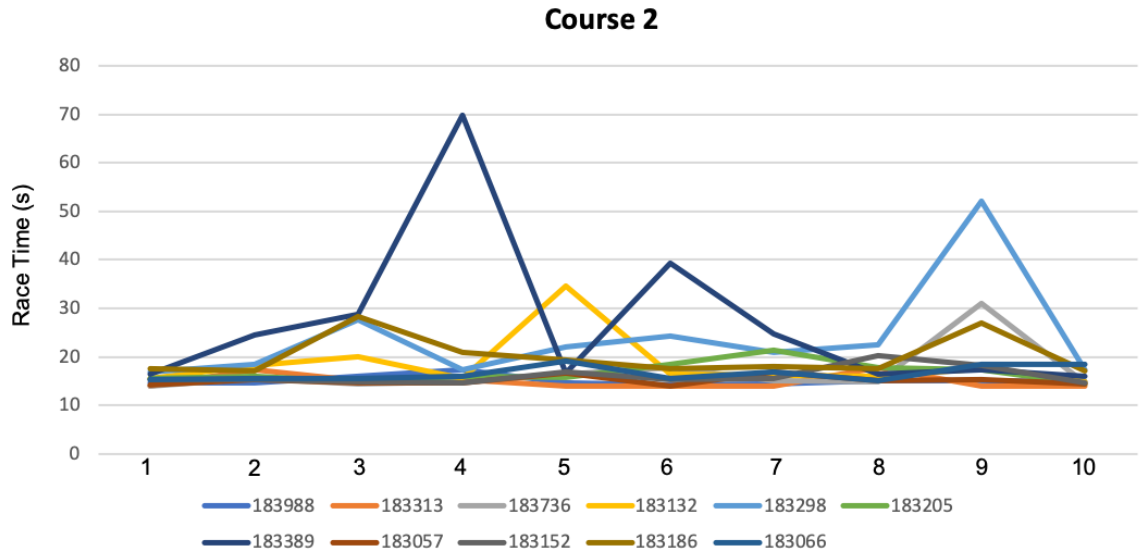




ORDER EFFECTS

- There was a significant order effect found on Course 2 only
  - Fifth and ninth runs on course 2 were significantly slower than other trials ($p<0.01$)
    - Proportion of severe impairments was much higher on these two runs (64% vs. ≤46%)





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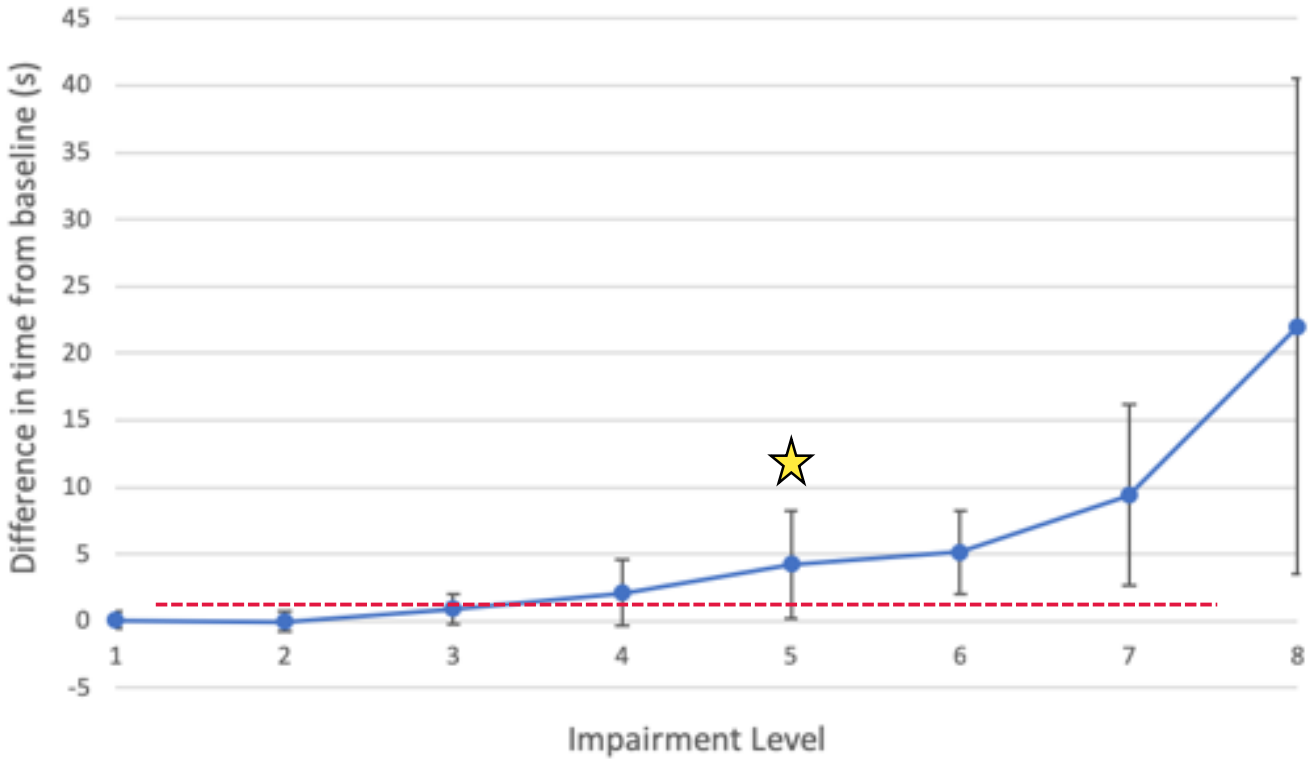
VISUAL ACUITY & CONTRAST SENSITIVITY

- Skiing performance decreased gradually with increasing impairment
  - Significant decrease in performance ($p<0.05$) from Level 5
    - VA: **1.20 logMAR**
    - CS: **0.60 logCS**



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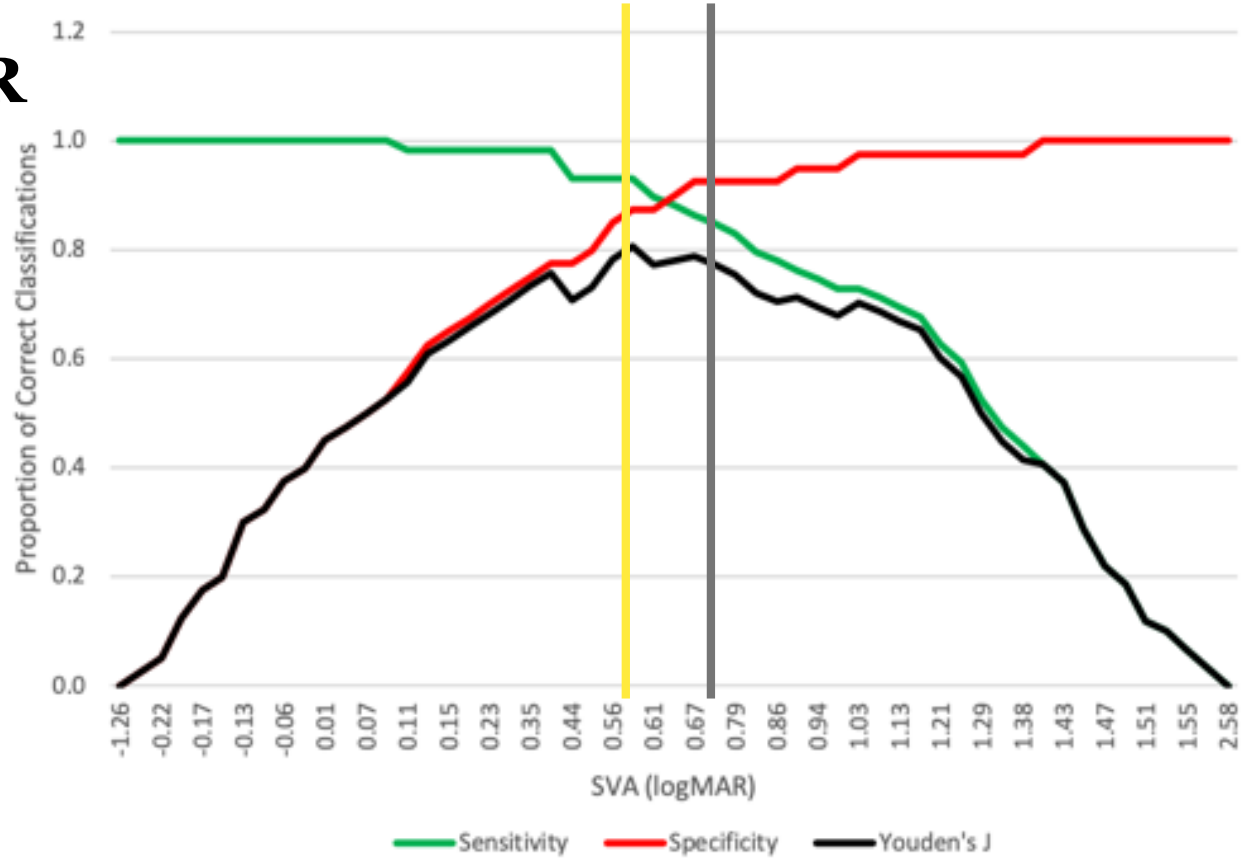
VISUAL ACUITY

- Max Youden's J = **0.81 at 0.59 logMAR**
  - Sensitivity = 0.93, Specificity = 0.88
- Youden's J = 0.70 @ B3 (1.0 logMAR)
  - Sensitivity = 0.73, Specificity = 0.98



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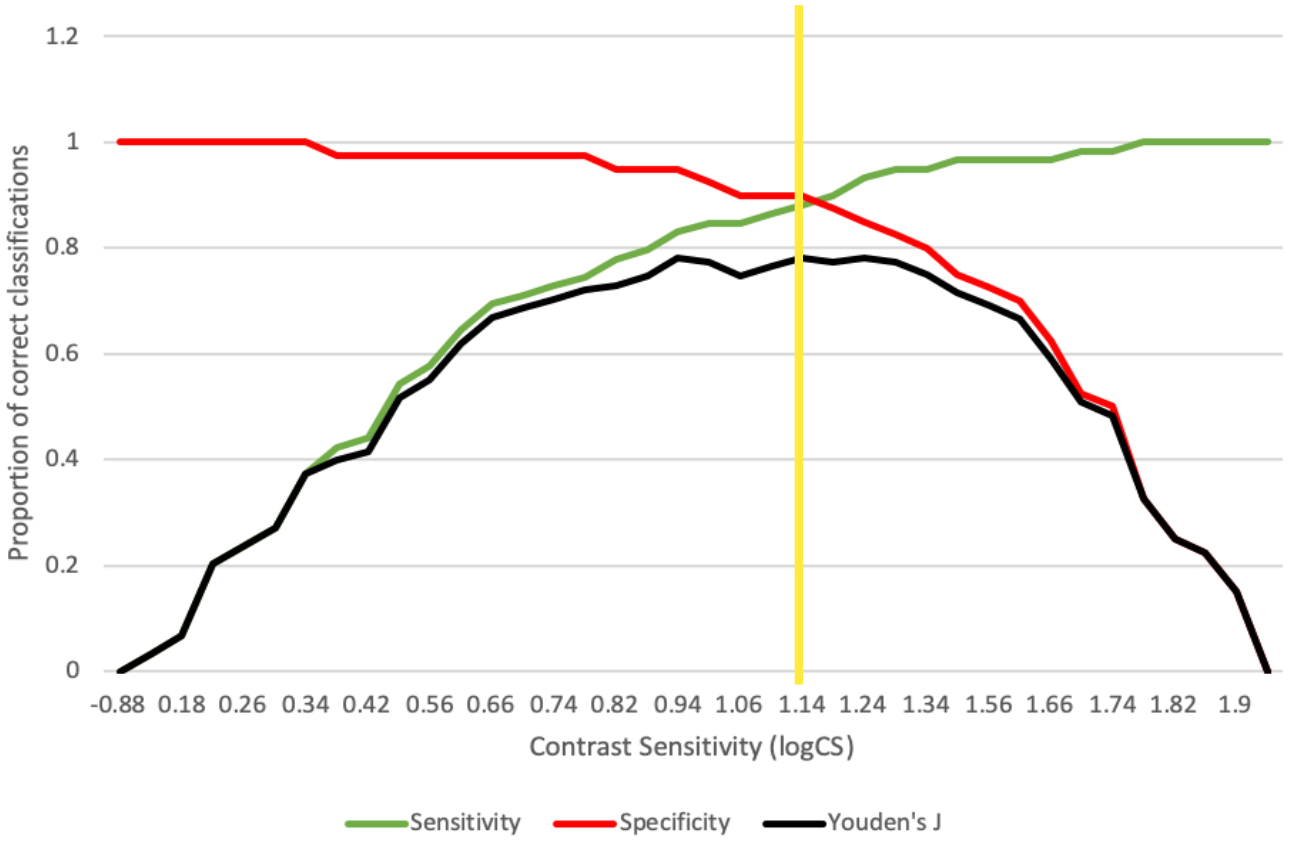
CONTRAST SENSITIVITY

- Max Youden's J = **0.78 at 1.14 logCS**
  - Sensitivity: 0.81, Specificity: 0.74



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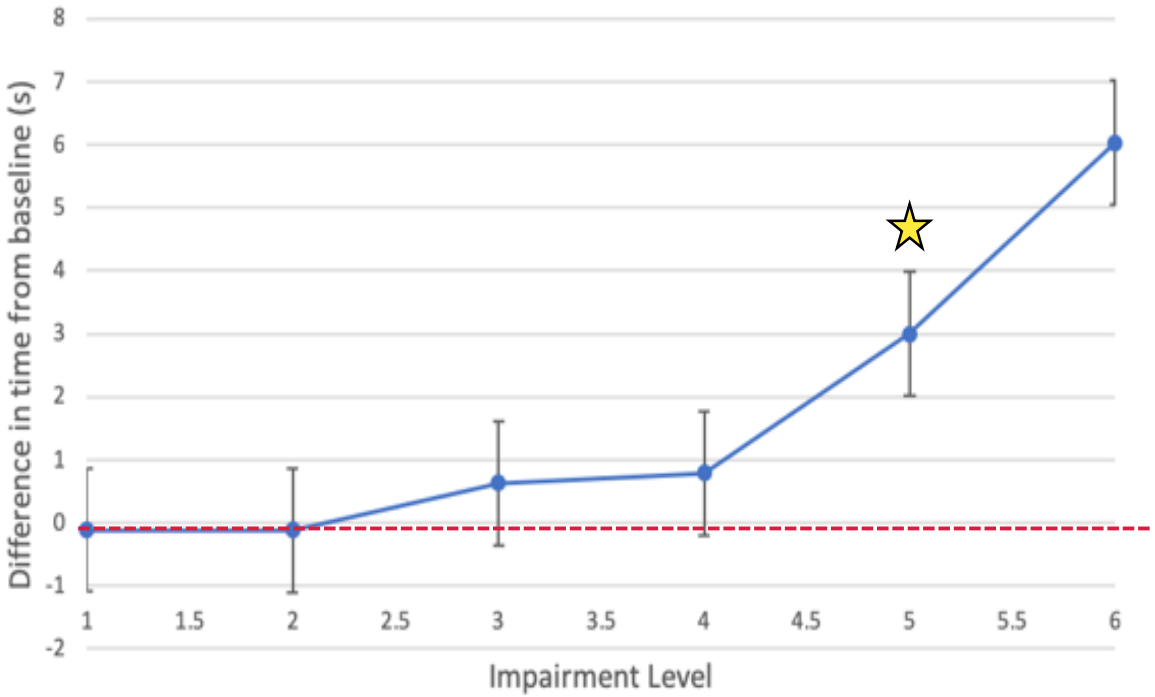
VISUAL FIELD

- Skiing performance decreased gradually increasing impairment
  - Significant decrease in performance ($p<0.05$) from Level 5
    - VF: **30.8% extent**



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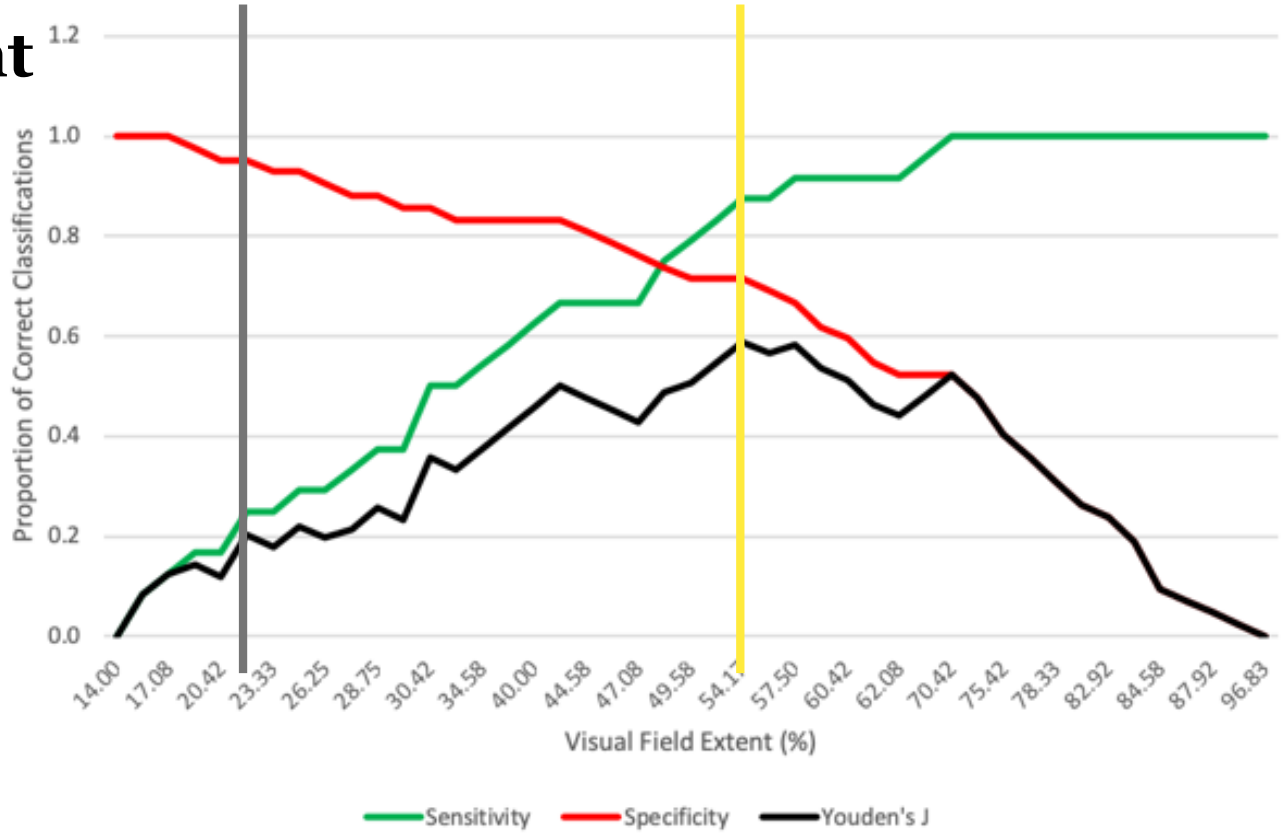
VISUAL FIELD

- Max Youden's J = **0.59 at 54.2% extent**
  - Sensitivity: 0.88, Specificity: 0.71
- Youden's J = 0.22 at B3 (21.7% extent)
  - Sensitivity: 0.29, Specificity: 0.93



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SUMMARY

- Mild reductions in visual acuity, and moderate reductions in contrast sensitivity and visual field appear to affect skiing performance
  - Visual Acuity: 0.6 logMAR
  - Contrast Sensitivity: 1.1 logCS
  - Visual Field: 54% extent
- The results of this study will help to inform the minimum visual impairment criteria for Para Alpine Skiing

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