



KATHOLIEKE UNIVERSITEIT
LEUVEN

Comparison of race parameters in swimmers with visual impairment

J. Martens¹, I. Einarsson², D. Daly¹

¹ KU Leuven

² University of Iceland



Introduction



Classification:



3 S, SB, SM classes

- **S11** : No light perception up to light perception but inability to recognise the shape of hand at any distance
- **S12** : Ability to recognize shape of hand up to visual acuity of 2/60 and/or visual field of less than 5 degrees.
- **S13** : Visual acuity above 2/60 up to 6/60 and/or visual field of 5 – 20 degrees.

Introduction



Determined by IPC 2 approved ophthalmologists

Introduction

- Visual Acuity
- Contrast Sensitivity
- Visual Field
- Peripheral Awareness
- Colour Vision
- Motion Perception

	VA	VF	MP	PA	CV	CS
Athletics	++	++	+	++	+	+
Swimming	+++	+	+	-	-	++
Alpine Ski	++	+++	++++	+++	++	++++
Nordic Ski	+	++	++	++	+	++

Introduction

Previous studies :

- 2001, Malone : Based on 1996 Paralympics freestyle and backstroke finals

"Performance and competitiveness decrease in all aspects of race with increasing visual impairment."



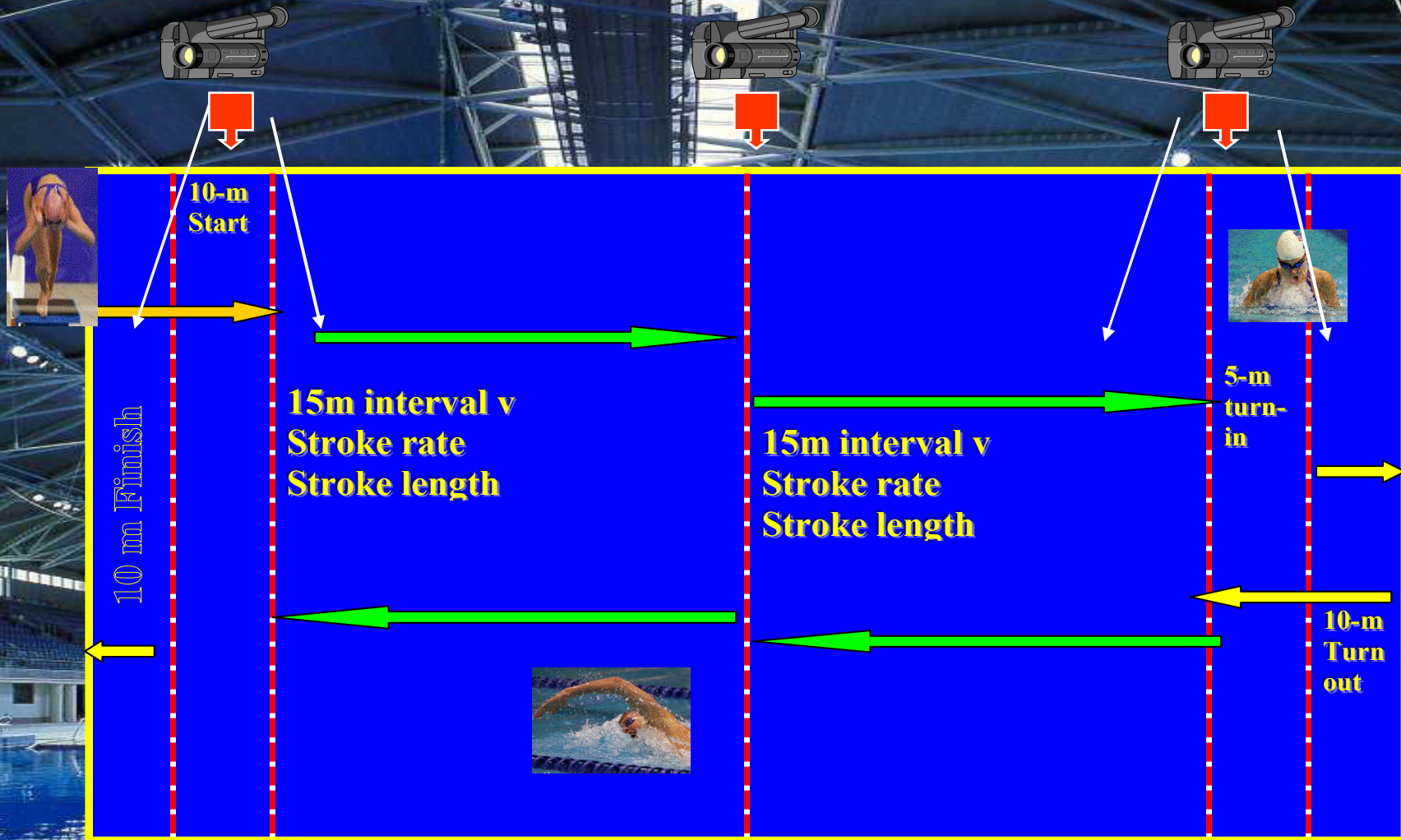
- 2009, Daly : Based on 2000 Paralympic freestyle finals

"S11 class swam slowest and was least competitive. Classes S12 and S13 did not differ in this respect."

Aim of this study :

Compare race parameters between VI classes at 2009 European Championships on 100 freestyle and breaststroke

Race results = Time (Start + Swimming + Turning + Finish)



Start 5m
Turn
Finish

10m

25m

40m

Methods

The screenshot displays the Dartfish Analyzer software interface. The main window shows a video of a swimmer in a pool. Two semi-transparent text boxes are overlaid on the video:

- Top box: **Speed = time over 10m**
(reference = head)
- Bottom box: **Rate = time for 4 arm cycles**
(e.g. crawl = right hand – right hand)

Yellow lines are drawn from the corners of the top text box to the swimmer's head. A red circle highlights the video player's progress bar, which shows a current time of 00:04:58.0 and a total duration of 00:22:50.0. The interface includes a file browser on the left, a menu bar at the top, and a timeline at the bottom.

Methods

- **Subjects**
 - All visually impaired swimmers at 2009 European Championships in Reykjavík
 - 100 freestyle : 26 male, 23 female
 - 100 breaststroke : 18 male, 13 female

- **Race parameters determined**

Parameter	Source
Final Time	Official competition results
Stroke Rate (= strokes per minute)	$60 / (\text{time for 4 cycles} / 4)$
Stroke Length	$= \text{speed} / (\text{stroke rate} / 60)$
Clean Swimming Speed	Speed over 10m in middle of pool
Start Time	0 – 15m
Turn Time	5m before wall, 10m after wall

Results

100m freestyle men

	S11 (n=11)	S12 (n=7)	S13 (n=8)
Start time 15m (s)	7,98 (0,65)	6,61 (0,51)	6,72 (0,48)
Clean swimming speed (m/s)	1,35 (0,25)	1,63 (0,34)	1,62 (0,31)
Stroke rate (str/min)	51,3 (2,9)	49,7 (2,1)	49 (4,8)
Stroke length (m)	1,57 (0,15)	1,97 (0,29)	1,99 (0,21)
Turn time (s)	9,77 (0,74)	8,04 (0,49)	8,04 (0,44)
Final time (s)	69,57 (2,91)	57,74 (0,65)	57,74 (0,61)

Significant difference between S11 and S12 + S13 (95% CI)

Results

100m freestyle women

	S11 (n=7)	S12 (n=12)	S13 (n=4)
Start time 15m (s)	9,34 (0,81)	6,61 (0,42)	6,72 (0,53)
Clean swimming speed (m/s)	1,23 (0,22)	1,63 (0,15)	1,62 (0,11)
Stroke rate (str/min)	50,1 (4,1)	49,7 (5,8)	49 (3,5)
Stroke length (m)	1,48 (0,19)	1,97 (0,32)	1,99 (0,24)
Turn time (s)	11,18 (0,41)	8,04 (1,11)	8,04 (0,45)
Final time (s)	77,2 (2,47)	66,5 (0,66)	66,57 (0,34)

Significant difference between S11 and S12 + S13 (95% CI)

Significant difference between S11 and S12 (95% CI)

Results

100m breaststroke men

	S11 (n=4)	S12 (n=4)	S13 (n=10)
Start time 15m (s)	9,17 (0,39)	8,55 (0,54)	8,24 (0,51)
Clean swimming speed (m/s)	1,15 (0,19)	1,25 (0,21)	1,26 (0,25)
Stroke rate (str/min)	47,4 (4,8)	46,6 (3,8)	44,4 (2,9)
Stroke length (m)	1,46 (0,17)	1,61 (0,16)	1,71 (0,09)
Turn time (s)	11,75 (2,4)	9,68 (1,9)	9,58 (2)
Final time (s)	81,83 (3,1)	74,04 (3,9)	73,01 (3,4)

Significant difference between S11 and S12 + S13 (95% CI)

Significant difference between S11 and S13 (95% CI)

Results

100m breaststroke women

	S11 (n=8)	S12 (n=3)	S13 (n=2)
Start time 15m (s)	10,68 (0,74)	10,23 (0,65)	10,41 (0,55)
Clean swimming speed (m/s)	1,03 (0,15)	1,12 (0,23)	1,11 (0,14)
Stroke rate (str/min)	44,2 (5,1)	44,3 (2,9)	45,1 (2,7)
Stroke length (m)	1,39 (0,24)	1,51 (0,34)	1,47 (0,18)
Turn time (s)	12,42 (1,5)	11,58 (1,2)	14,97 (2,9)
Final time (s)	90,86 (8,1)	84,33 (5,1)	88,51 (4,1)

No significant differences (95% CI)

Discussion

- No statistical differences on any parameter in freestyle or breaststroke, men or women between S12 and S13



the current classification system however assumes decreased performance with decreased visual function

- Differences found between S11 on one hand, and S12/S13 on the other hand in some parameters



- seeing nothing affects race patterns and outcome
- seeing only a little bit is enough to swim the race in an optimal manner

Discussion

- Less or no statistical differences found in breaststroke, especially in women



low number of participants

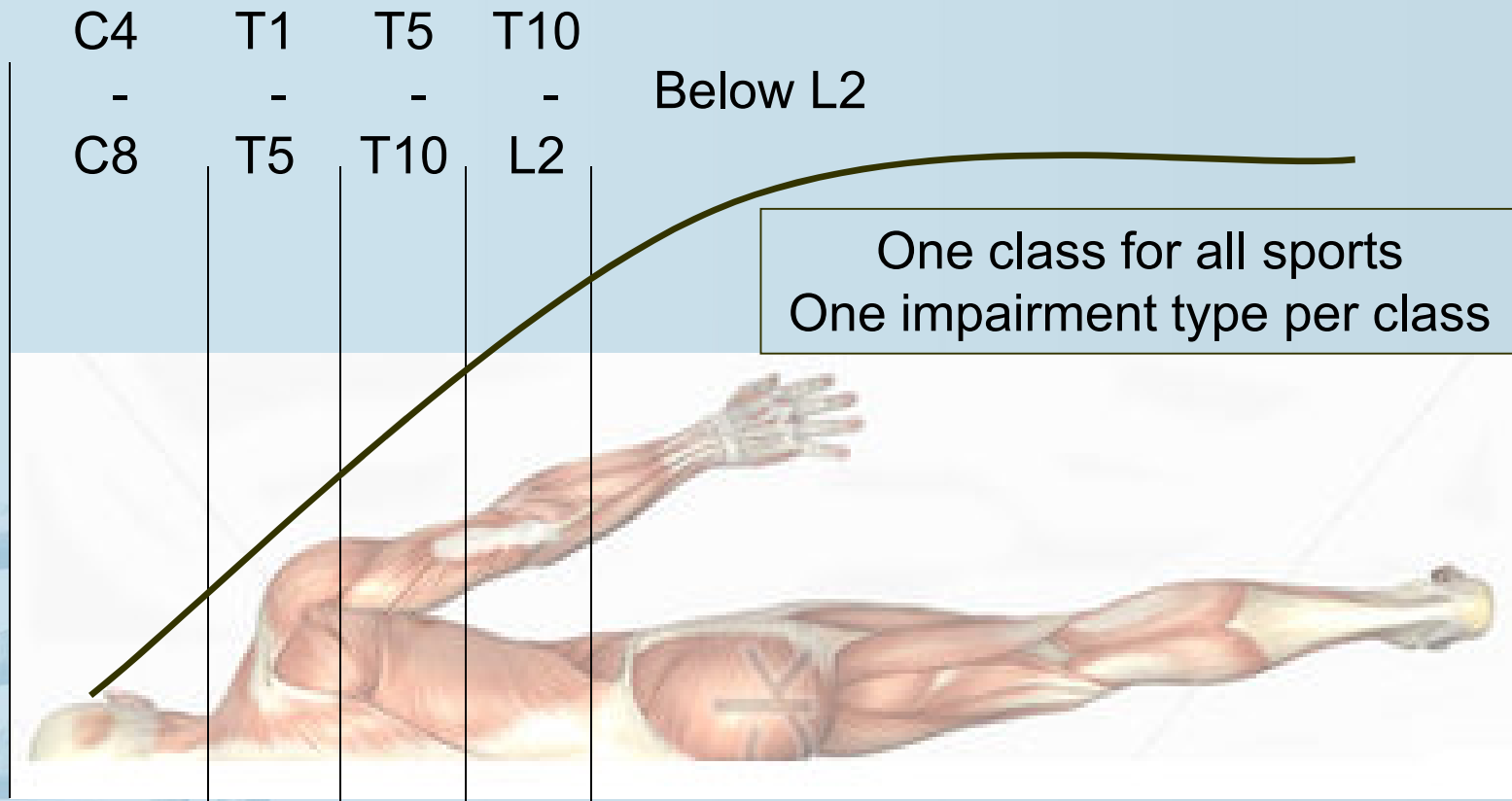


Future

- From a medical system...
... to an evidence based system
- Philosophy of classification :
minimizing the impact of impairment on the outcome of competition by classifying impairments by the activity limitations they cause

Medical classification: Spinal Cord Injury

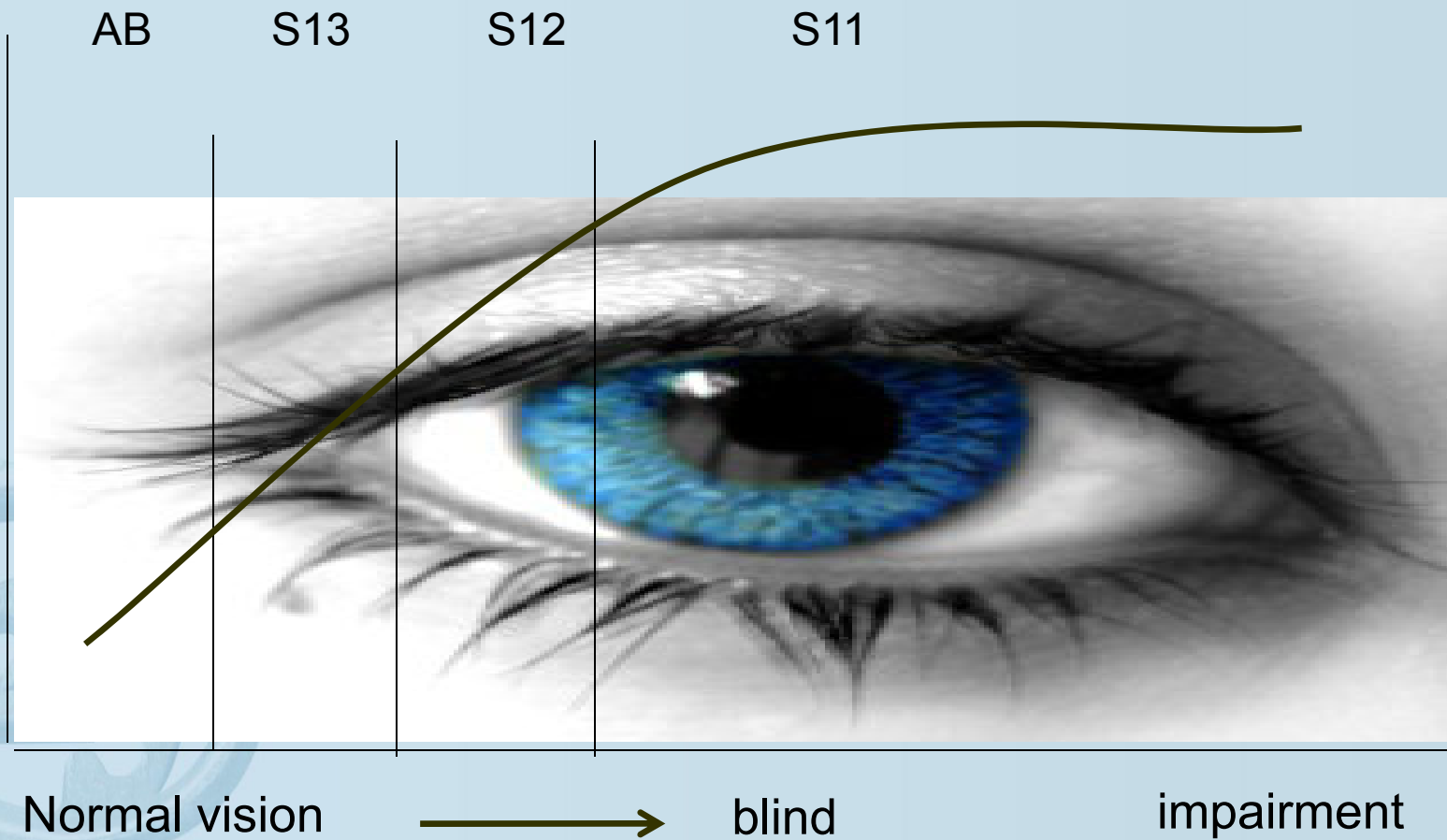
competition outcome = performance



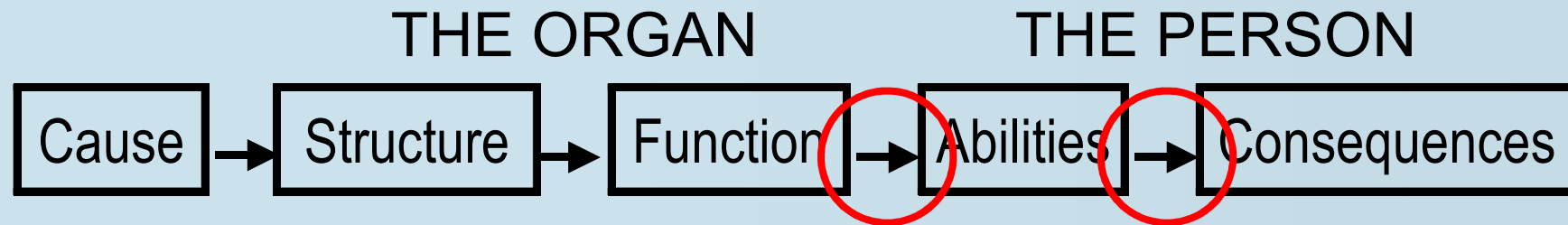
← impairment

Medical classification

competition outcome = performance
e.g. **End race time**



Aspects of visual functioning



Scar
Atrophy
Loss

Acuity
Field
Contrast
...

Dive
Swim straight
Estimate
distance to wall
...

End race result

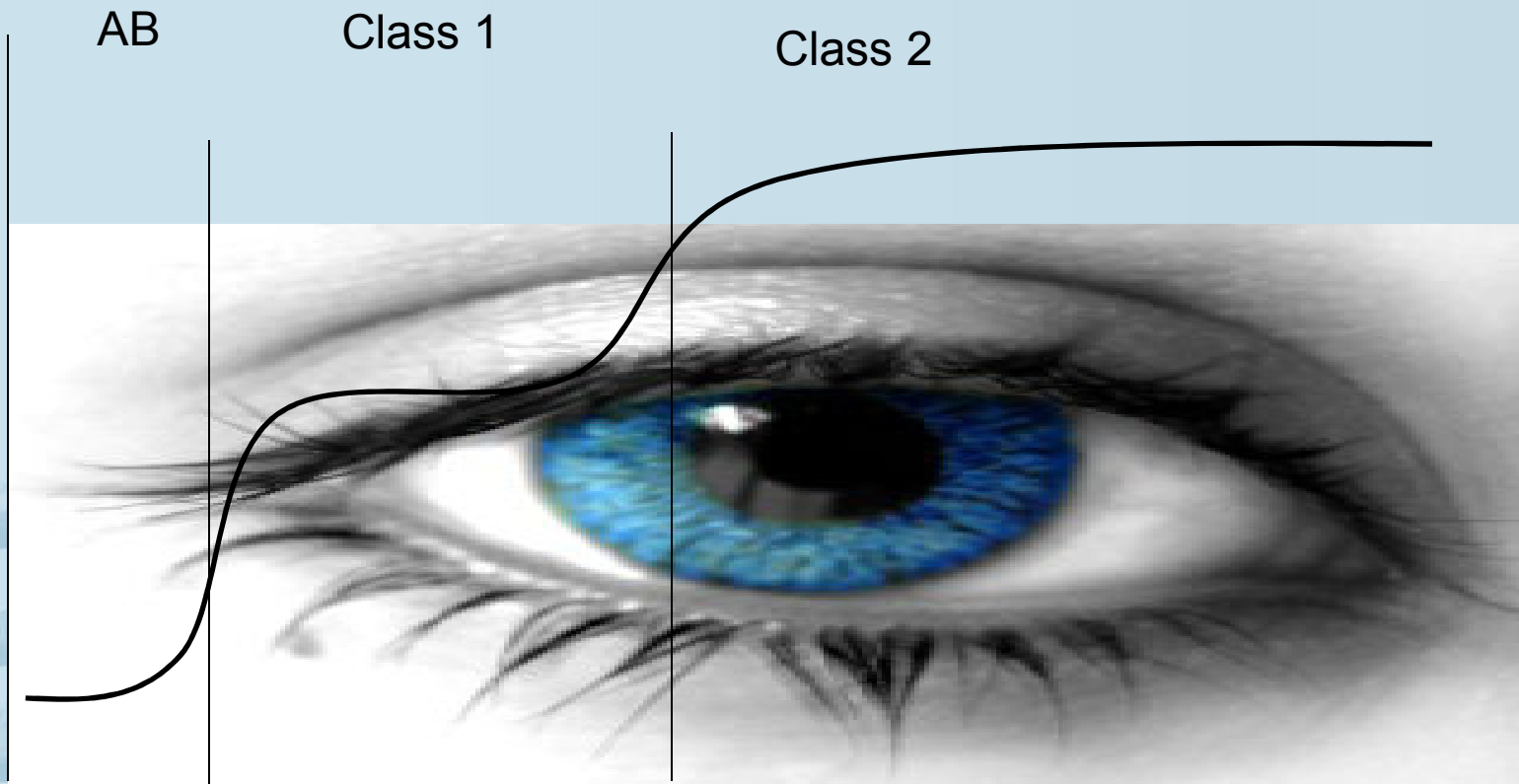
VISUAL FUNCTIONS
how the EYE functions

FUNCTIONAL VISION
how the PERSON functions

Evidence based classification

Sport-specific classification

Major determinant of performance:
Ability to estimate distance to wall



e.g. **visual acuity**

impairment

Thanks to...

- Ásbjörg Gústafsdóttir for doing all the hard work on the race analysis
- Prof. D. Daly, prof. Y. Vanlandewijck and IPC for providing some of the slides
- ... and you for your attention

