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Influence of Evalglare methods and parameters on discomfort glare prediction accuracy for daylighting

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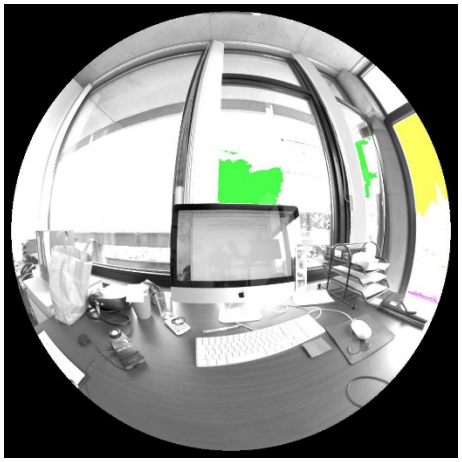
Evalglare

INPUT

HDR image

Glare source(s)



OUTPUT

Glare metrics

DGP = 0.27
DGI = 17.46
UGR = 21.1
VCP = 49.6
CGI = 25.17
etc.

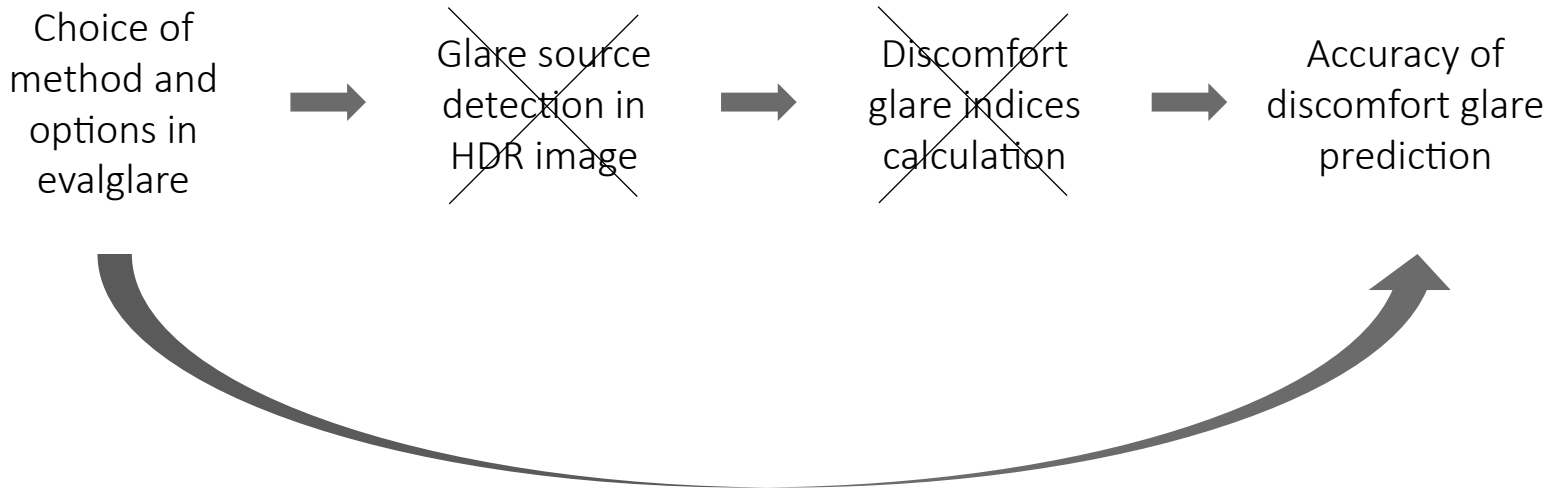
<u>Glare source detection algorithm</u> based on:

- a chosen method
  - factor method ($L\downarrow s > K * L\downarrow ave$)
  - threshold method ($L\downarrow s > T$)
  - task area method ($L\downarrow s > K * L\downarrow task$)
- chosen options
  - background luminance definition
  - search radius
  - task area size
  - smoothing

➔ Which and how to choose?

Aim of the study

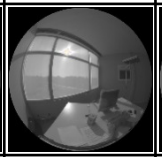
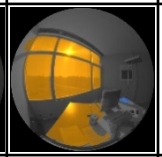
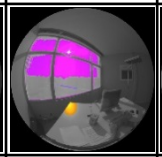
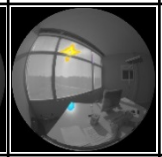
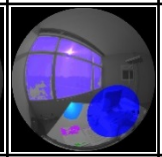
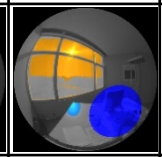
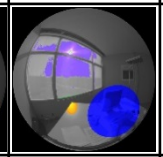
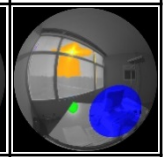
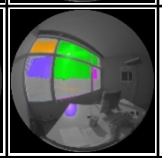
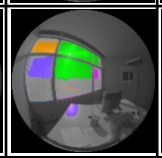
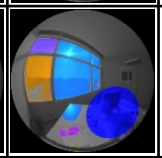
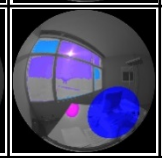
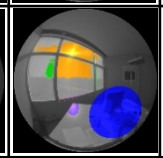
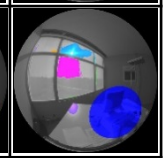
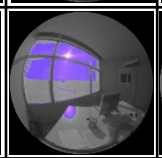
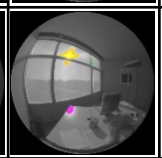
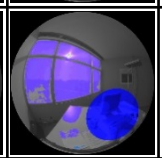
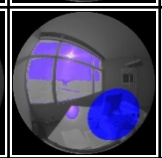
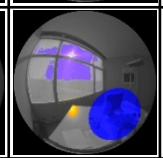
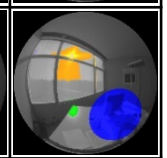
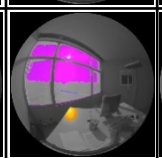
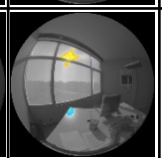
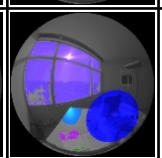
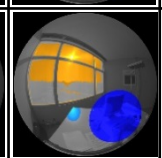
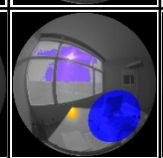
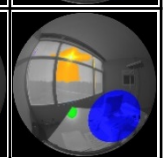
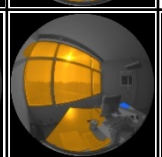
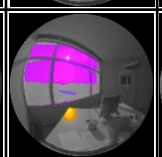
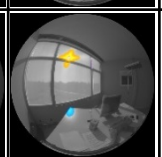
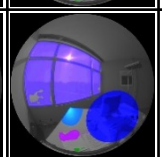
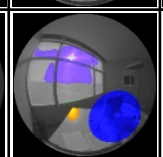
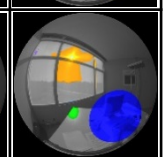
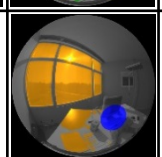
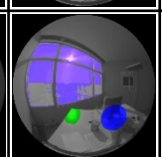
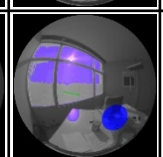
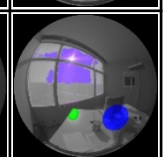
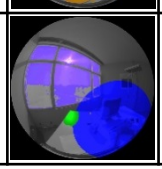
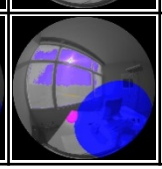
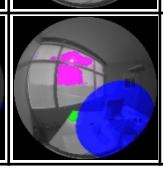
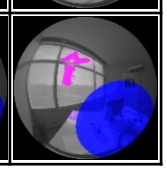
Investigate the effect of **evalglare methods/options** on the accuracy of **discomfort glare prediction**



Accuracy of discomfort glare prediction: discomfort glare index ~ subjective glare rating

Methodology

Choice of method and options in evalglare → Accuracy of discomfort glare prediction

Total = 63	Factor 5	Factor 6	Factor 7	Factor 8	Threshold 1000	Threshold 2000	Threshold 4000	Task area 3	Task area 4	Task area 5	Task area 6
default											
r = 0.06											
r = 0.3											
math. Lb											
smoothed											
ta = 30°											
ta = 90°											

Methodology

Choice of method and options in evalglare → Accuracy of discomfort glare prediction

discomfort glare index ~ subjective glare rating

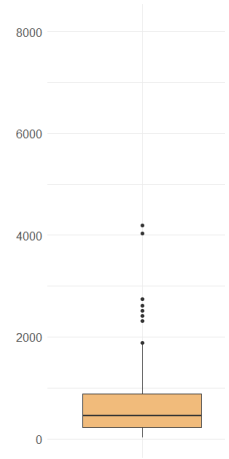
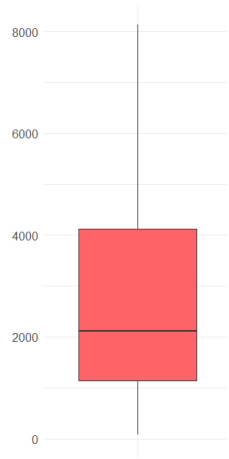
Daylight Glare Probability (DGP)
Discomfort Glare Index (DGI)
CIE Glare Index (CGI) ~ 4-point glare scale (or binary transformation)
modified Discomfort Glare Index (DGI_{mod})
Unified Glare Probability (UGP)

3 indicators

Spearman correlation coefficient (ρ)	Area Under the ROC Curve of a binary logistic regression (AUC)	Corrected Akaike's Information Criterion of an ordinal logistic regression (AICc)
min ρ : worse accuracy max ρ : best accuracy	min AUC : worse accuracy max AUC : best accuracy	max AICc : worse accuracy min AICc : best accuracy

/!\ Bonferroni correction: p-value < 0.05/63 = p-value < 0.00079

Data

2 different datasets:	FIELD EXPERIMENT	LABORATORY EXPERIMENT
Location	Louvain-la-Neuve, Belgium	Freiburg, Germany
Period	2017	2008-2011
Subjects	82	41
Men/Women (%)	43/57	73/27
Mean Age (SD)	36 (11)	26 (3)
Glare evaluations	141	180
4-Point Glare Scale	No discomfort A small discomfort A moderate discomfort A large discomfort	Imperceptible Noticeable Disturbing Intolerable
Vertical illuminance at eye level (lux)		

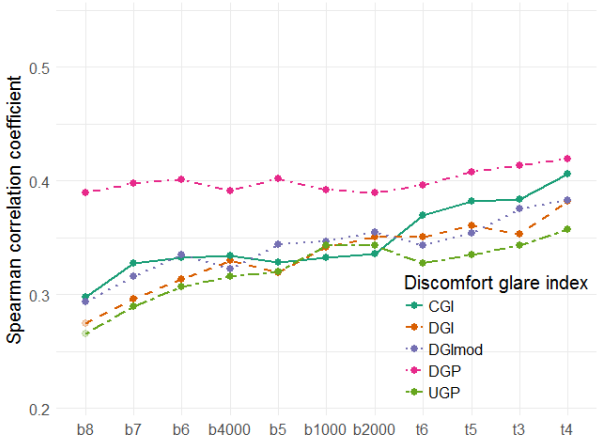
Results: evalglare methods

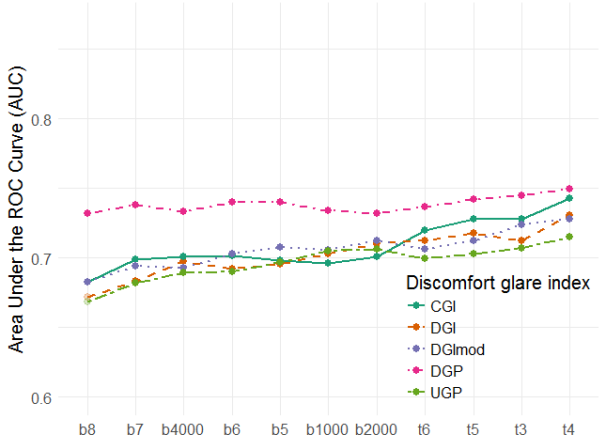
ρ

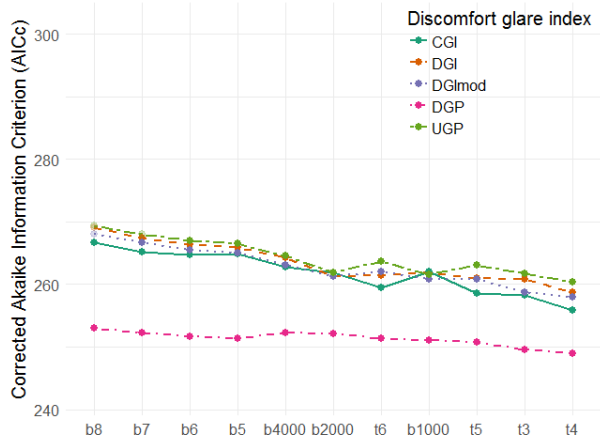
AUC

AICc

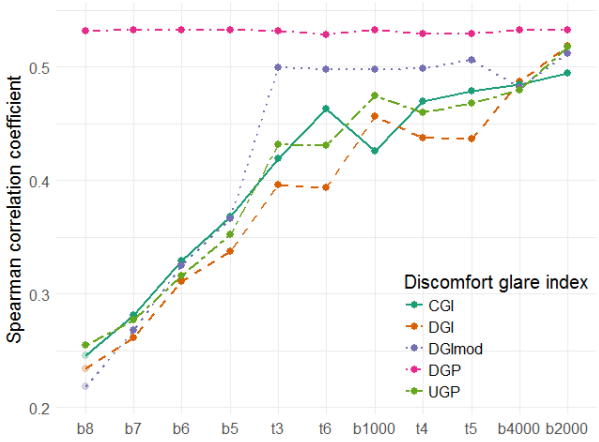
FIELD EXPERIMENT

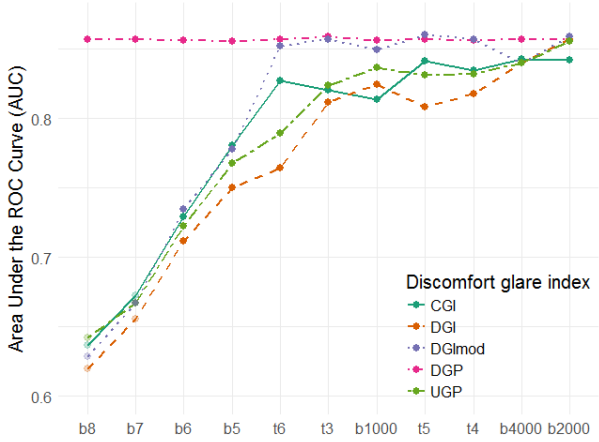


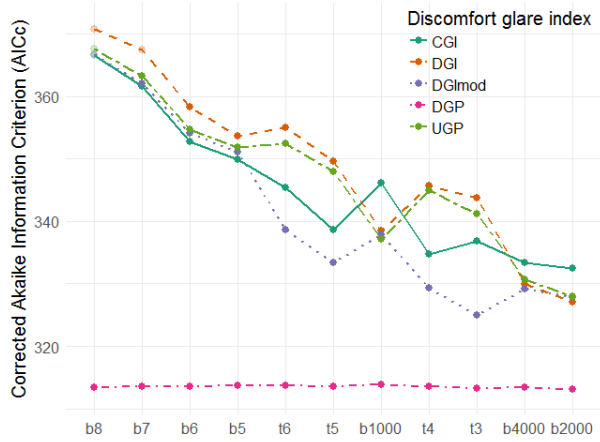




LABORATORY EXPERIMENT







Results: evalglare methods

Problematic factor method:

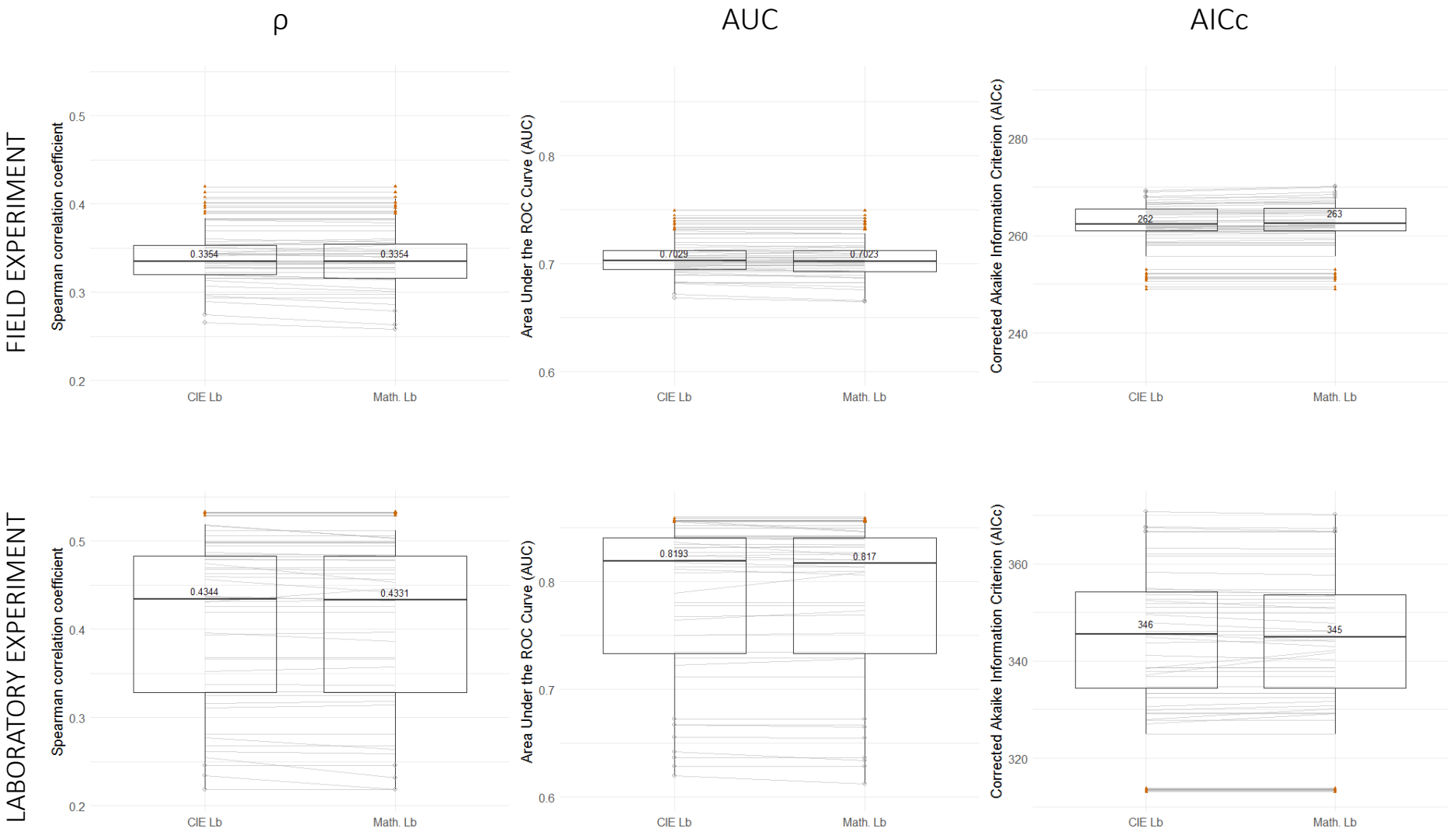
➔ over-detection for dim light scenes

➔ under-detection for bright light scenes

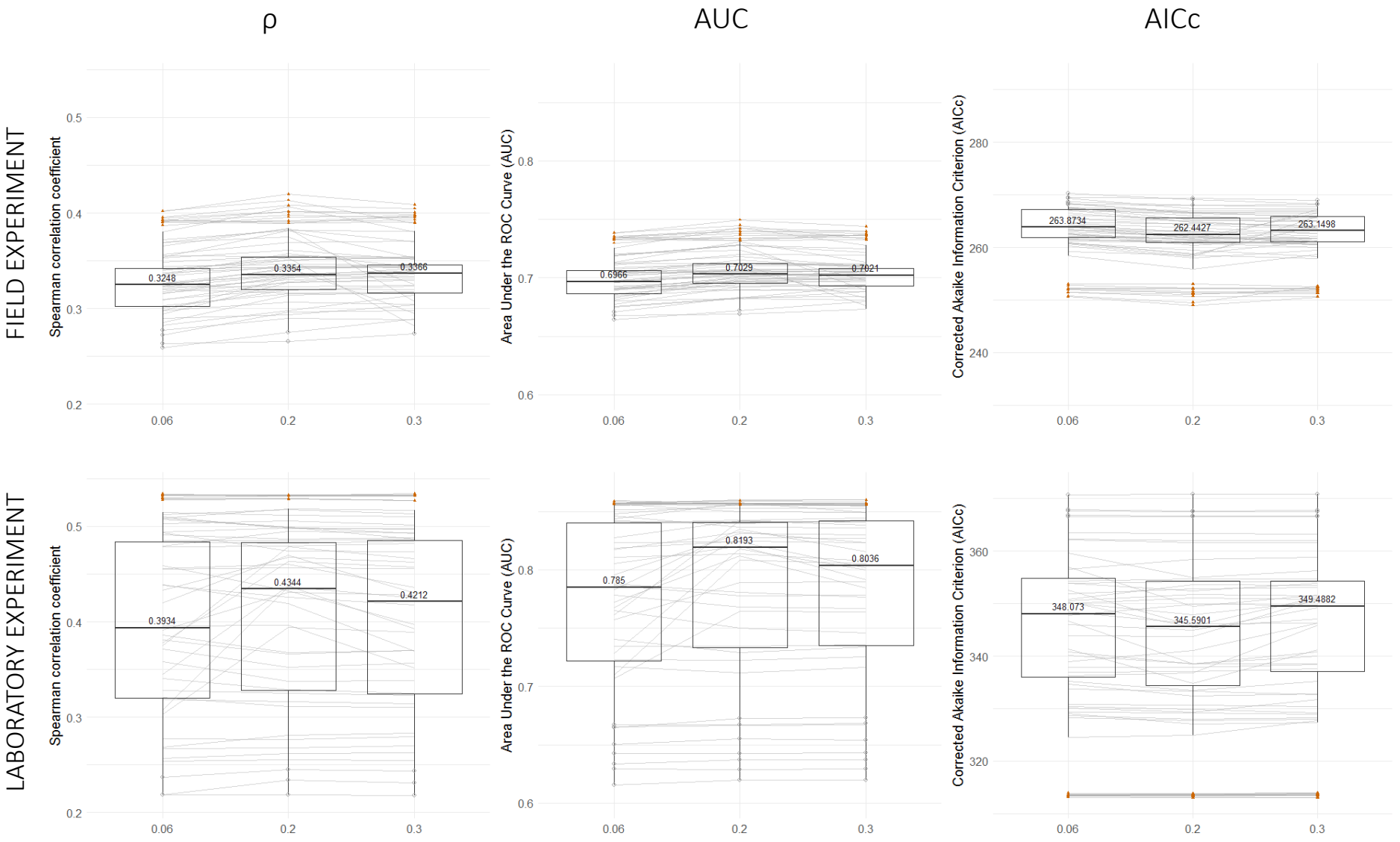
e.g. dim light scene (factor 5)
rated as «No discomfort»

e.g. bright light scene (factor 7)
rated as «Disturbing»

Results: background luminance definition



Results: distance of search radius



Results: task area size

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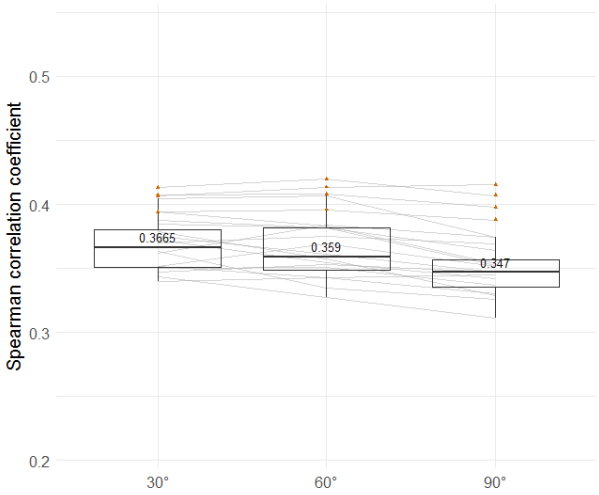
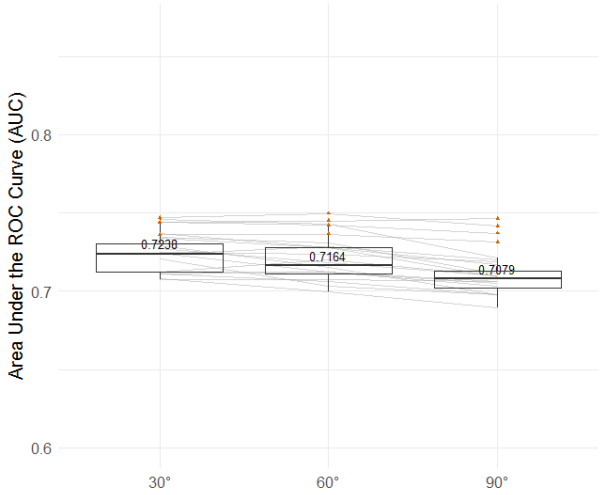
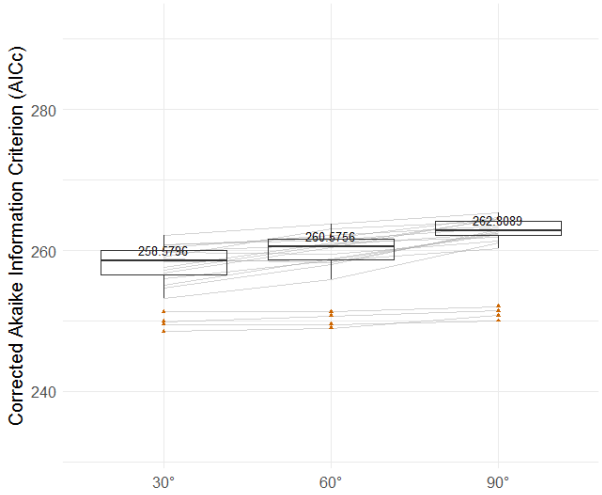
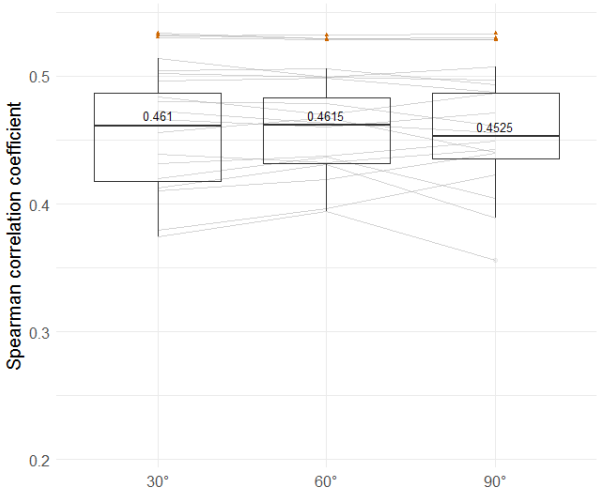
FIELD EXPERIMENT

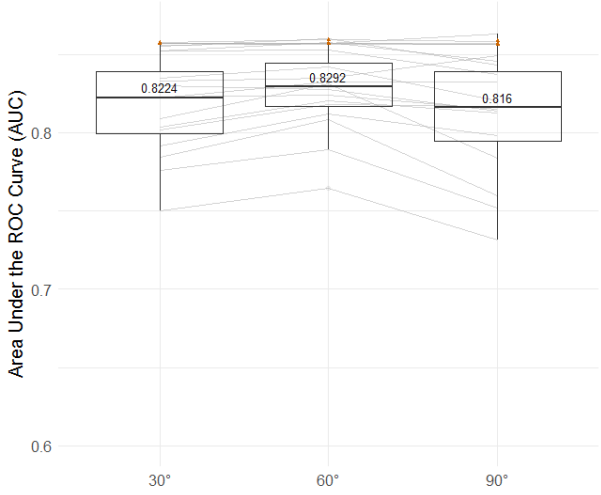


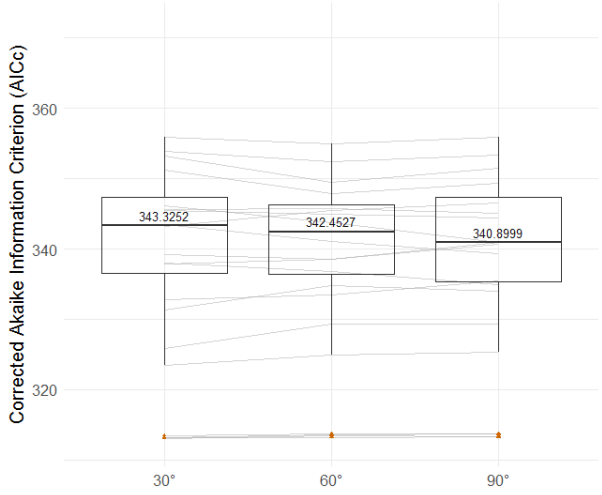




LABORATORY EXPERIMENT



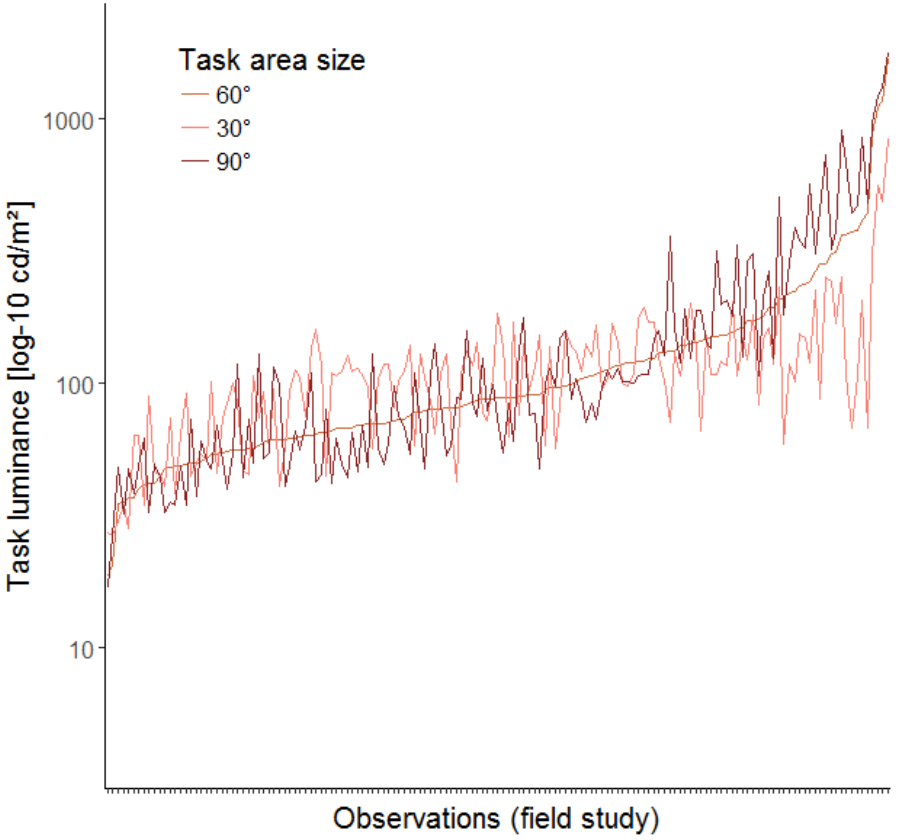


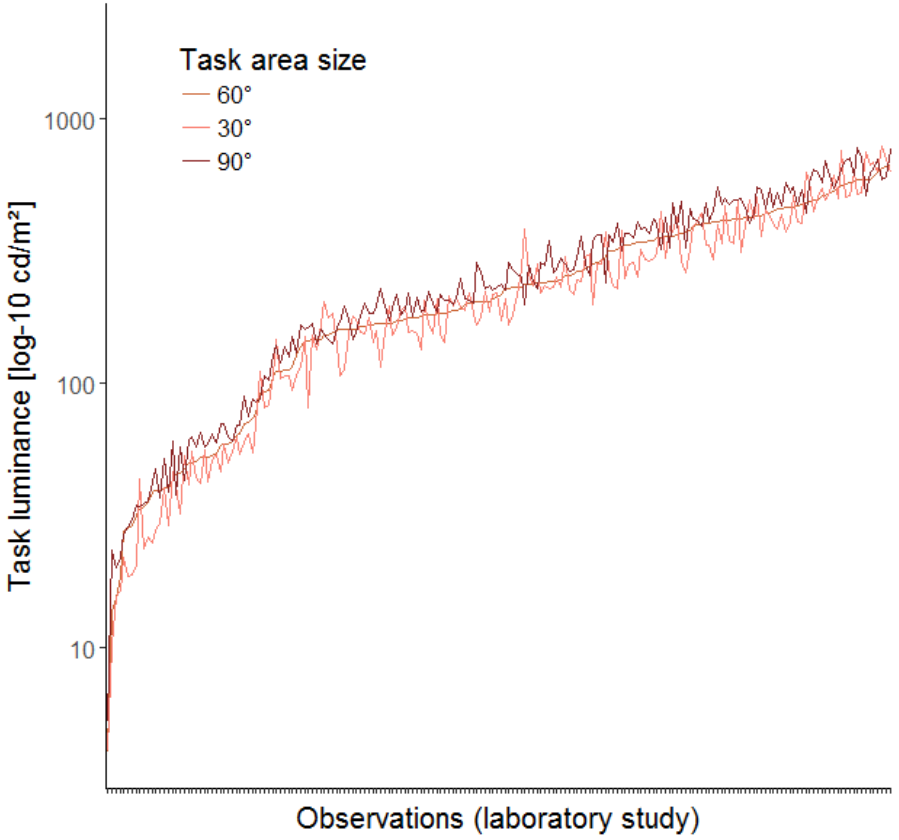


Results: task area size

Variation of task luminance according to task area size

➔ in field study, small task area size leads to a slightly more constant task luminance





Results: smooth option

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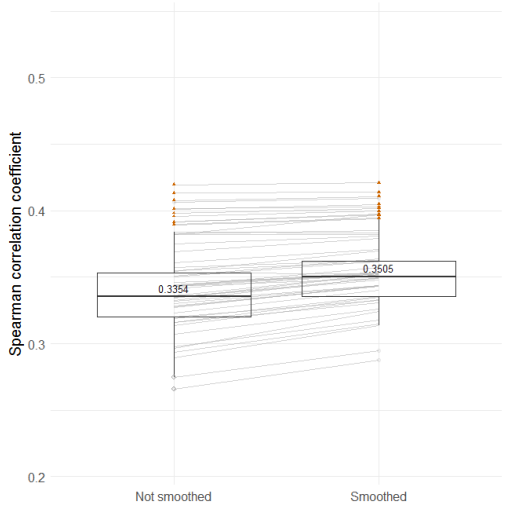
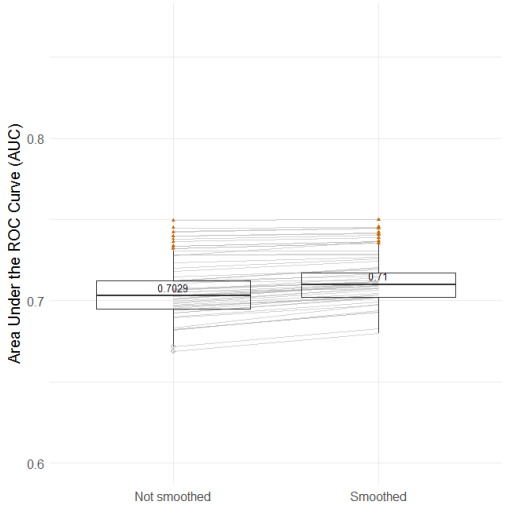
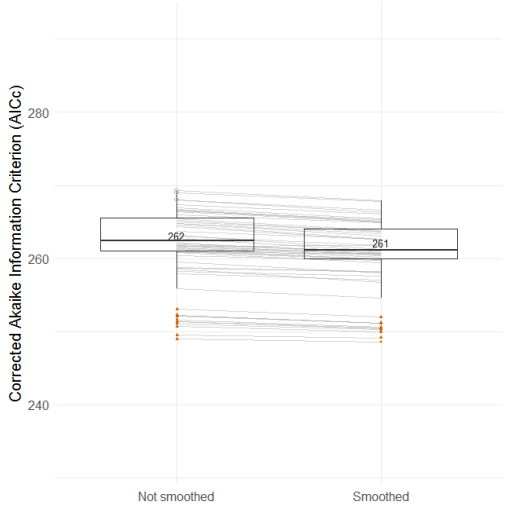
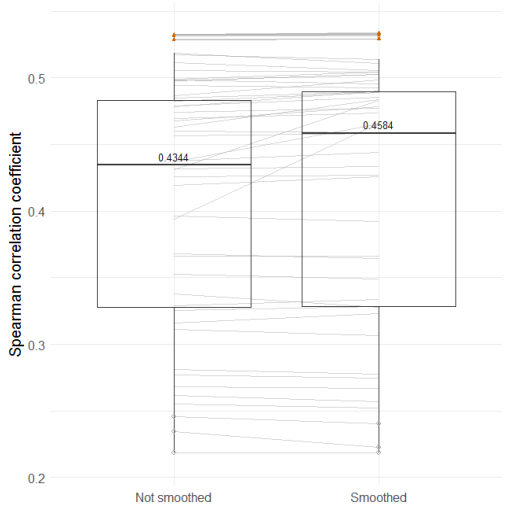
FIELD EXPERIMENT

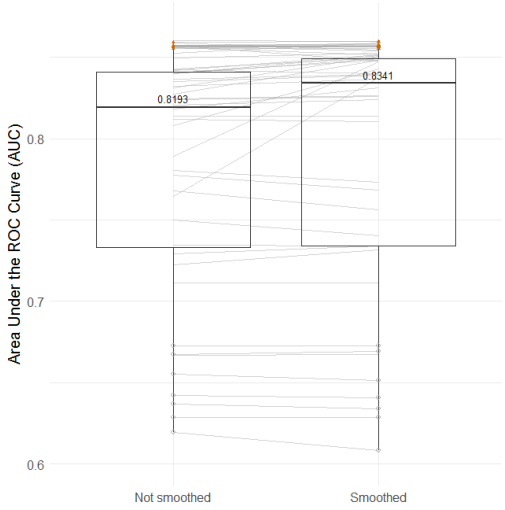


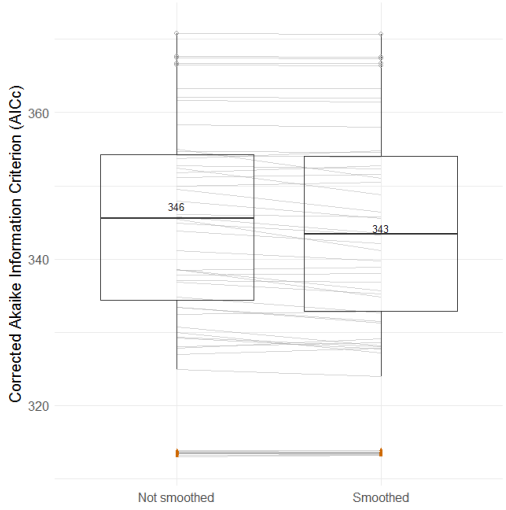




LABORATORY EXPERIMENT







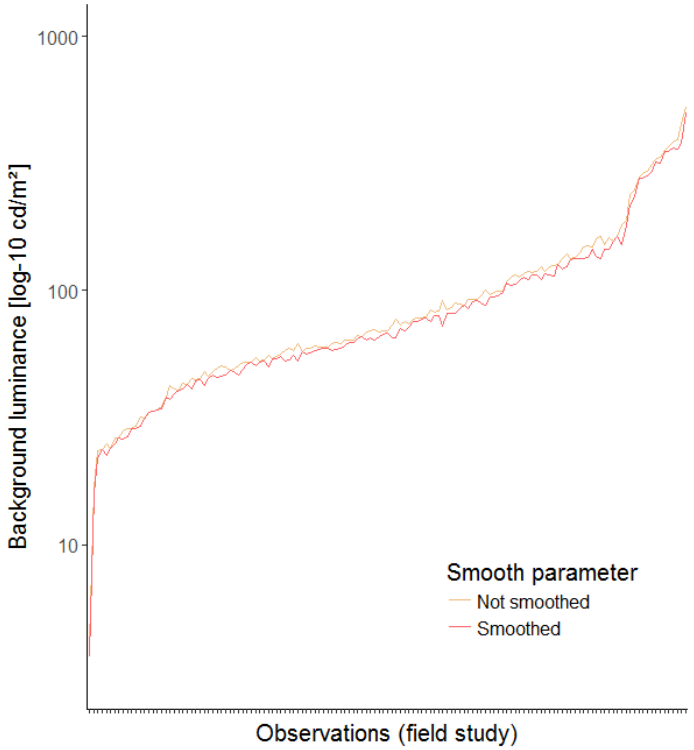
Results: smooth option

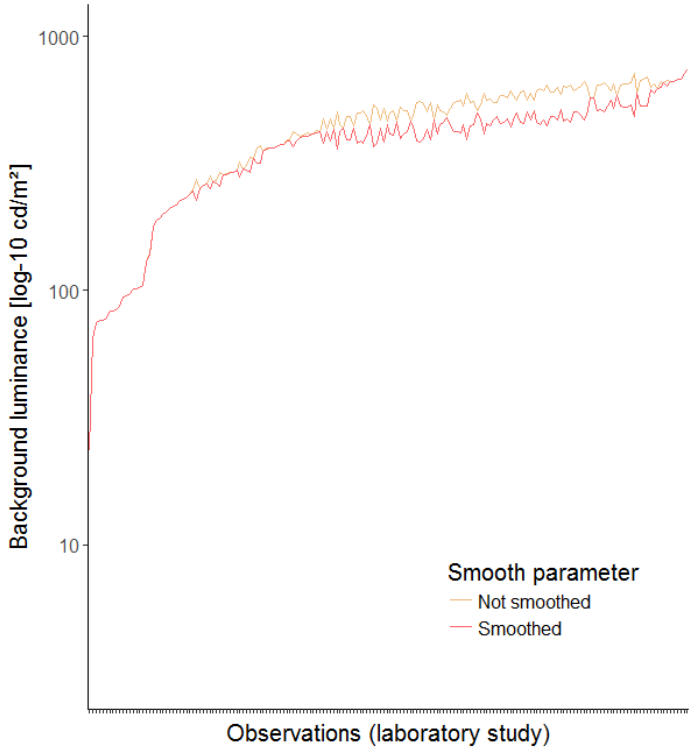
Effect of smooth option on Glare Impact?

$$GI = \sum \frac{L_{s,i}^2 * \omega_i}{L_b * P_i^2}$$

- ➔ bright scenes: squared decrease in $L_{s,i}$ generally balanced by increase in ω_i
- ➔ dim scenes: squared decrease in $L_{s,i}$ not entirely balanced by increase in ω_i
- ➔ only constant variation due to smooth option is decrease in L_b

no constant effect of smooth option





CONCLUSION

Recommandations for evalglare:

- method:
  scenes with contrast glare → task area (x 4/5) method
  scenes with saturation glare → threshold (2000 cd/m^2) or task area (x 4/5) method

- background luminance definition: no influence

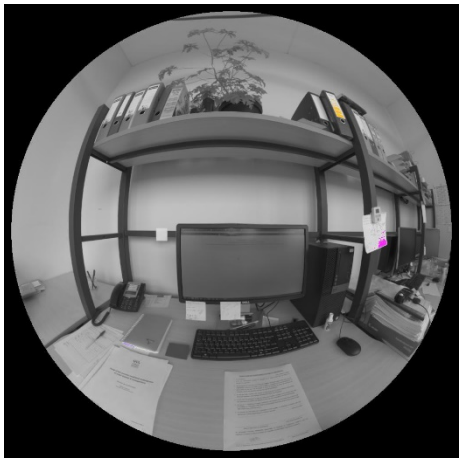
- search radius: r = 0.2 rad. (default in evalglare)

- task area size: ta = 30°→ 60°

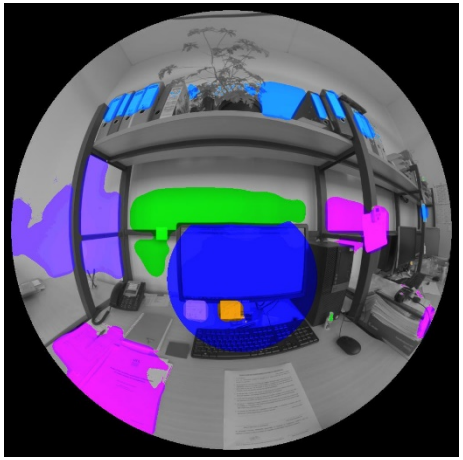
- smooth option: generate a more accurate discomfort glare prediction ➔ L_b?
  /!\ no unreasonable use of smooth option to improve discomfort glare studies results,
  but reconsideration of the Glare Impact formula

CONCLUSION

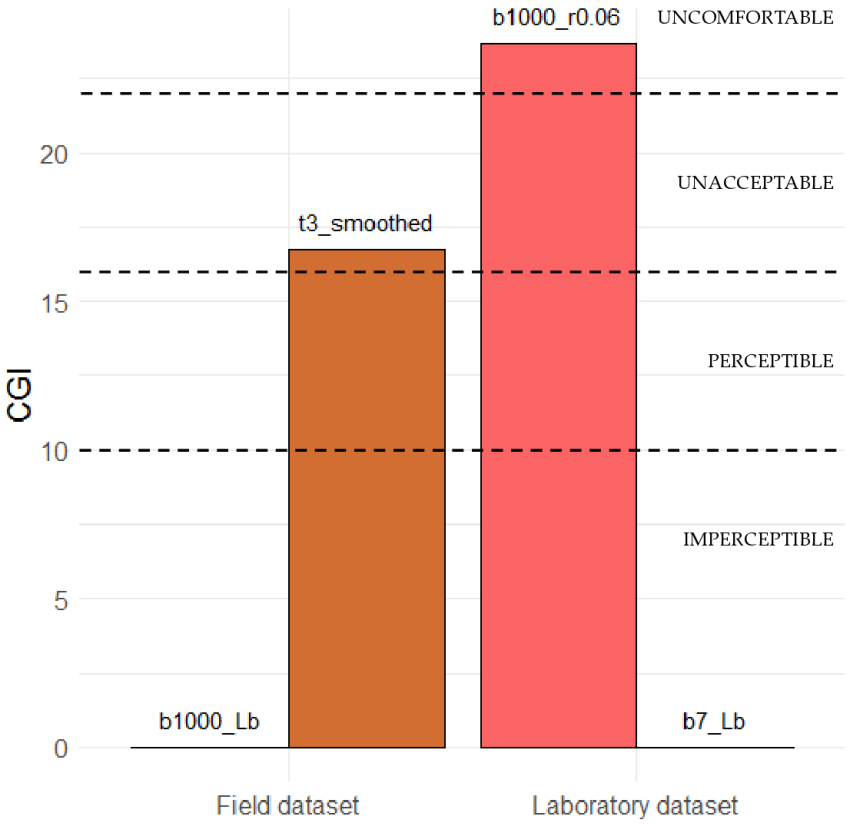
Choice of appropriate evalglare method and options is important!

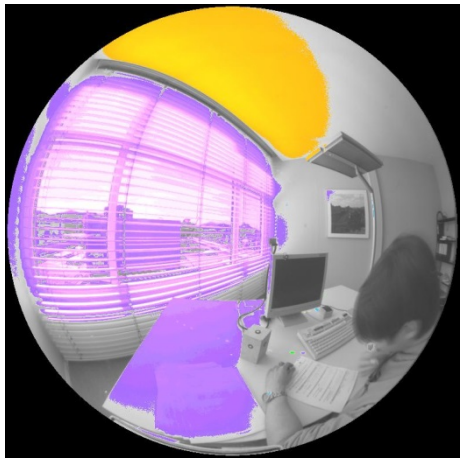


b1000_Lb



t3_smoothed





b1000_r0.06

b7_Lb

CONCLUSION

Changes in evalglare (for version 2.06):

- New default method: threshold (2000 cd/m^2)
  /!\ if task method is chosen (-t or –T), factor x=5 is default

- New default background luminance calculation: CIE-method ($L_b=(E_v-E_{dir})/\pi$)

- New option *-q method* : choose background luminance calculation

  method = 0: CIE, $L_b=(E_v-E_{dir})/\pi$

  method = 1: mathematical average background luminance

  method = 2: $L_b=E_v/\pi$ (NOT RECOMMENDED)

Thank you!

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