

# Directionality: an important light factor for human health to consider in lighting design

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**4TH INTERNATIONAL CONFERENCE  
ON ARTIFICIAL LIGHT AT NIGHT**

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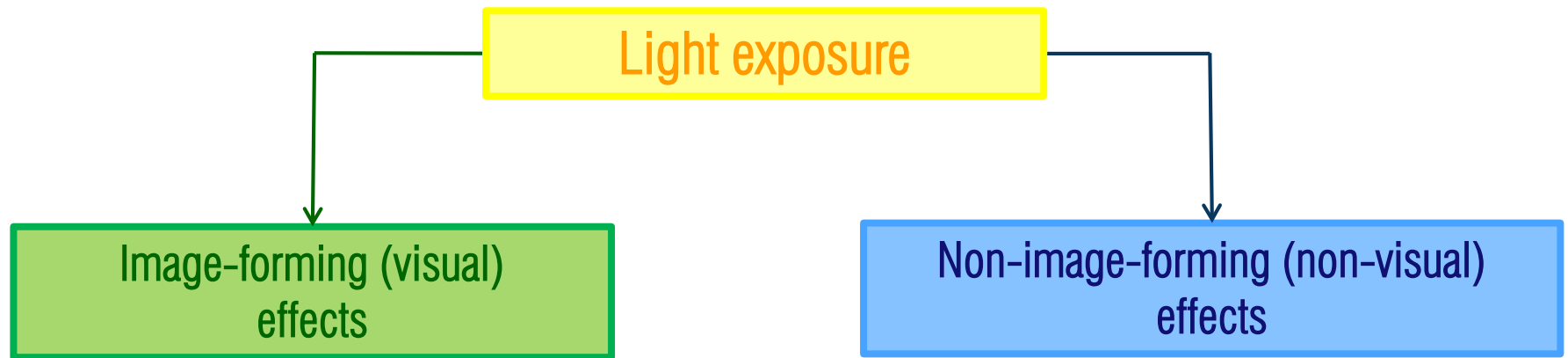
**Where innovation starts**

# Presentation outline

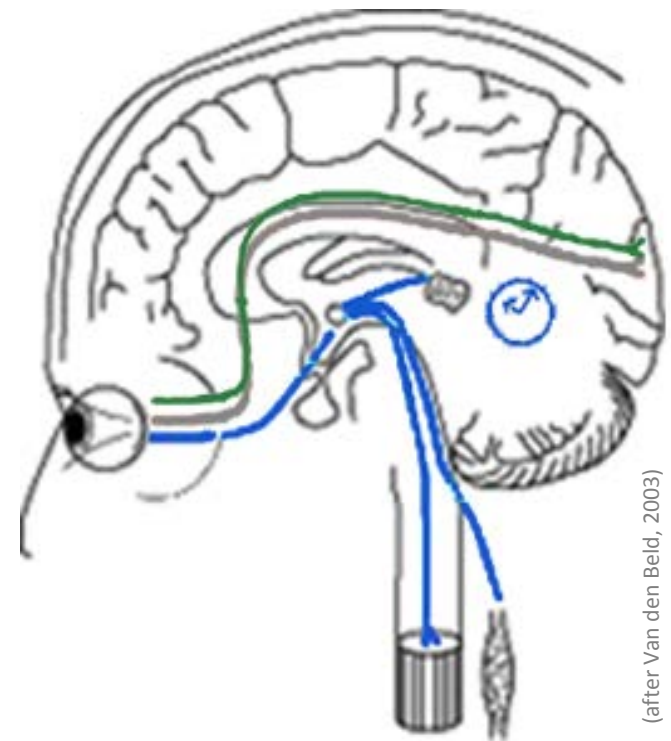
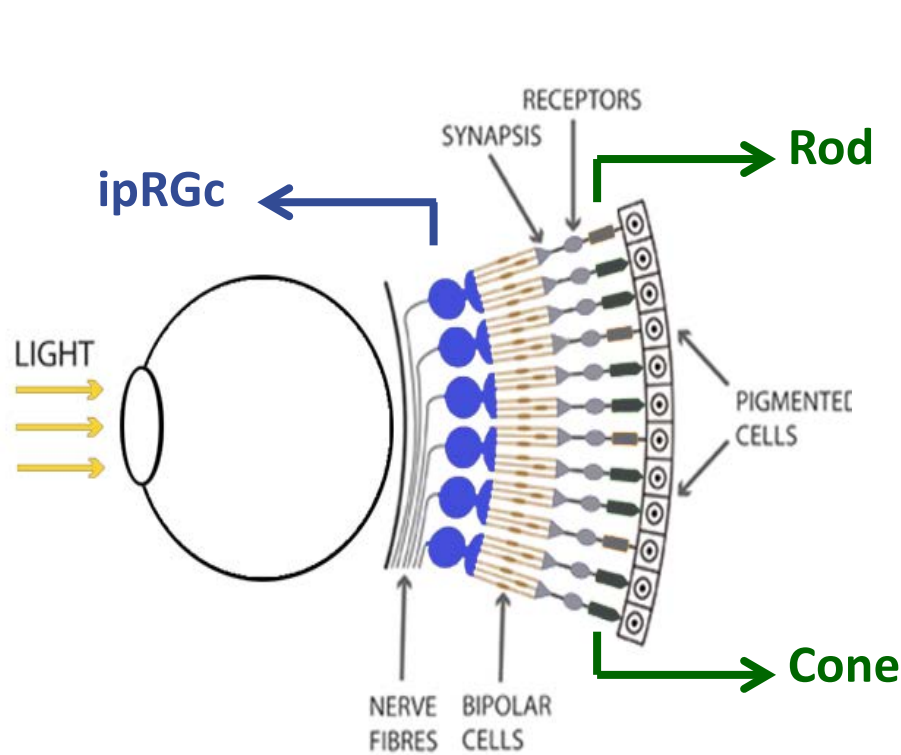
- **Background** (benefits of light)
- **Directionality of light**
- **Literature review**
- **Conclusion**



# Background – selected benefits of light



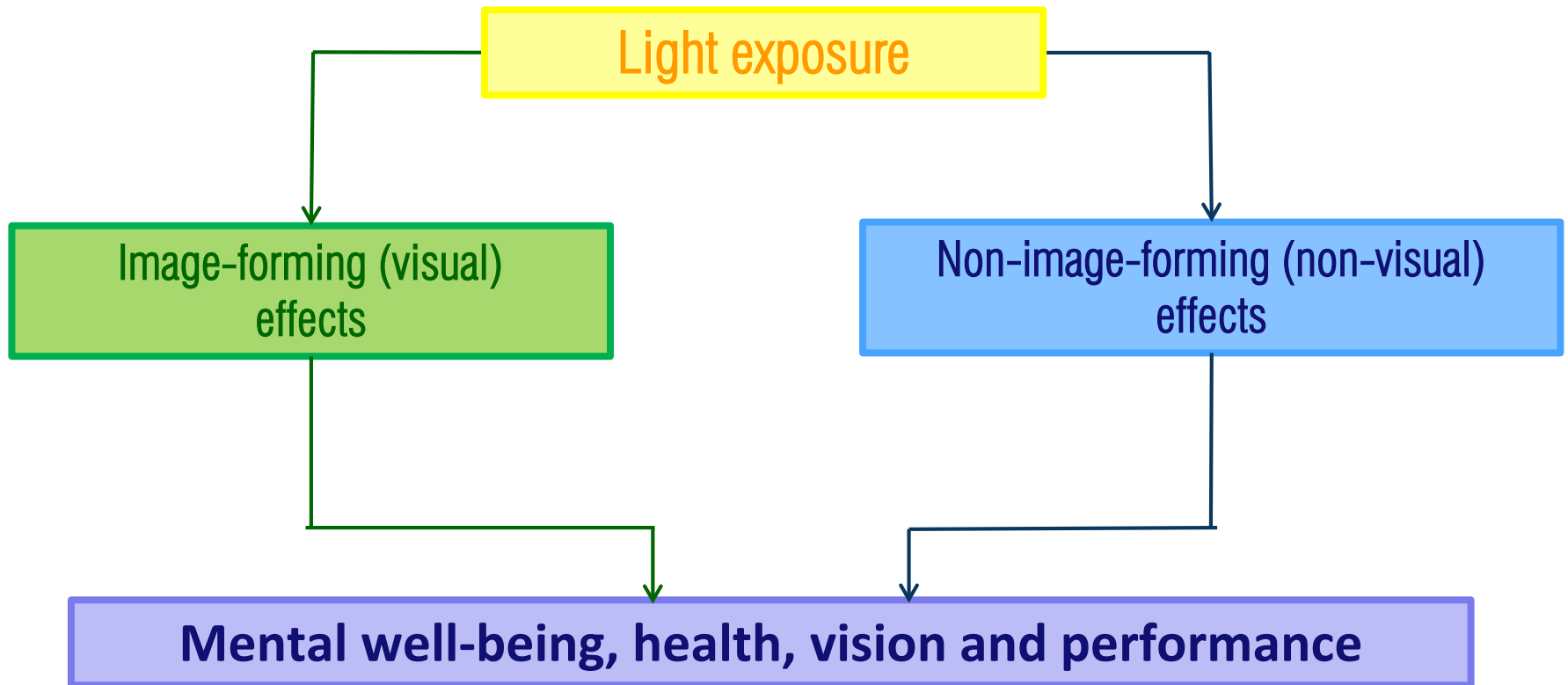
# Background – third photoreceptor



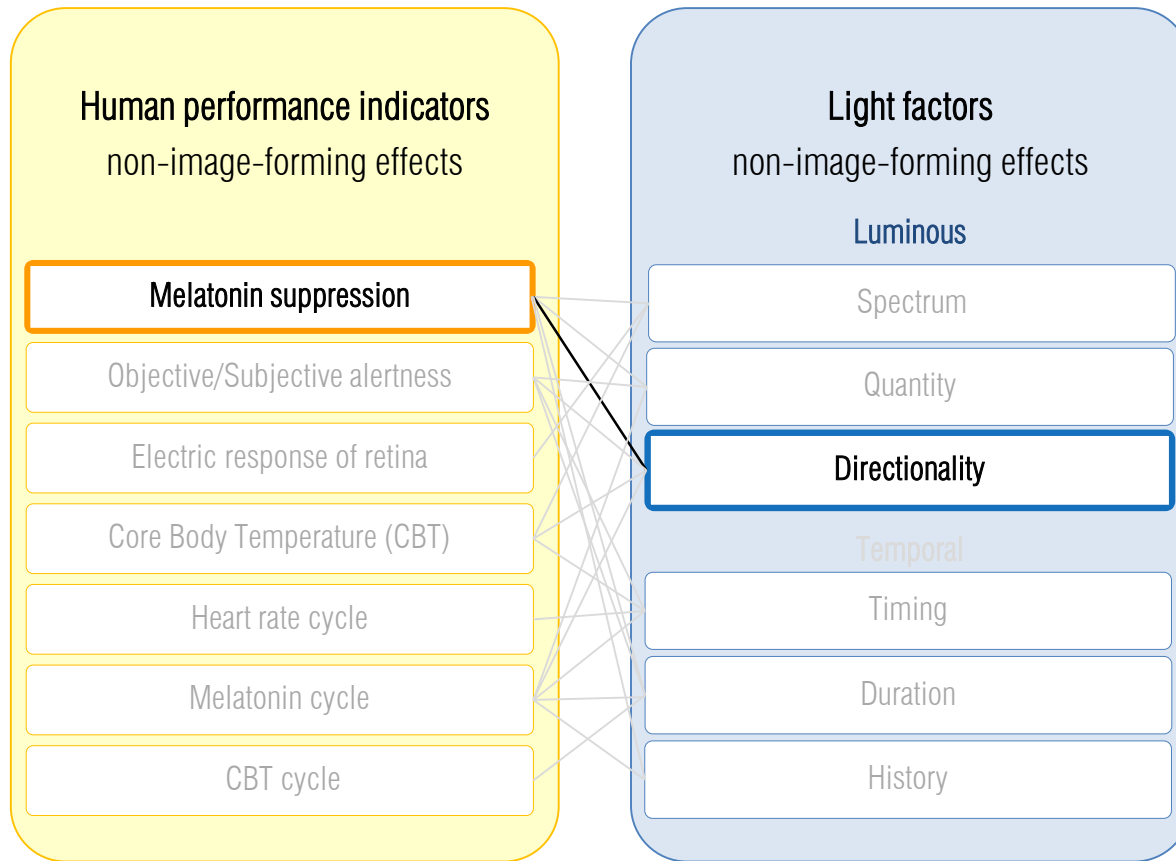
(after Van den Beid, 2003)

(Brainard et al. 2001; Thapan et al. 2001)

# Background – selected benefits of light



# Directionality of light



- Khademagha et al. (2016), DOI: 10.1016/j.buildenv.2016.08.035.

# Literature review – overview

## In situ (human subjects)

Glickman et al. (2003)

Lasko et al. (1991)

Rüger et al. (2005)

Visser et al. (1999)

## In vitro (animals)

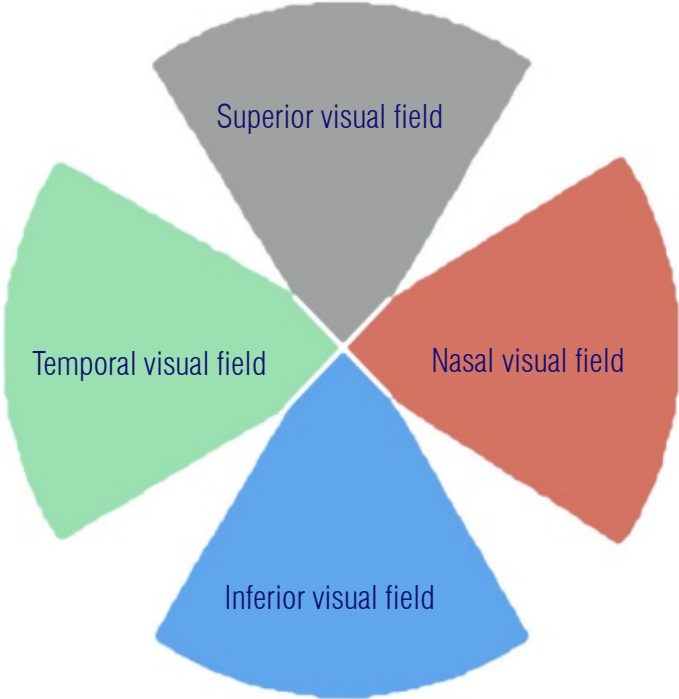
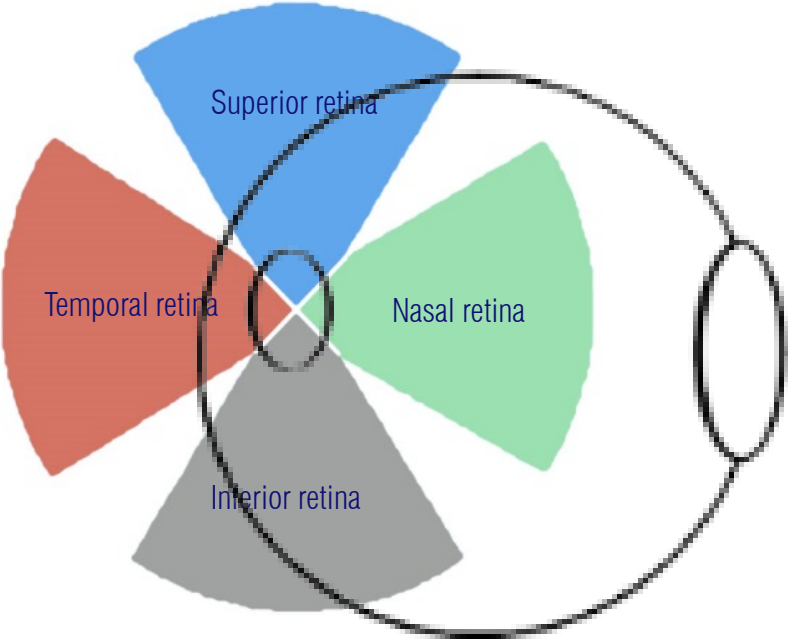
Decay et al. (2005)

Glindo-Romero et al. (2012)

Hannibal et al. (2002)

Hattar et al. (2002)

# Literature review – retina areas



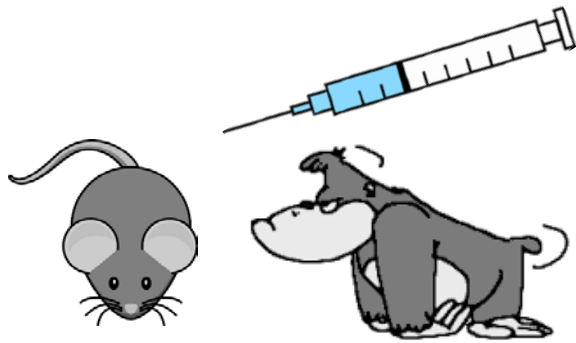


# Literature review – in situ studies

	Performance indicator	Light duration	Light quantity	Control of directionality	Retina areas
Glickman et al. (2003)	Melatonin suppression	1.5h (dilated pupils)	100 lx 200 lx (same photon flux)	Helmet with shields	Superior <b>Inferior (p,0.05)</b> Full retina
Lasko et al. et al. (1991)	Melatonin suppression	2h	500 lx	Moving light source (23 degree above and below view gaze)	Superior <b>Inferior (p,0.05)</b>
Rüger et al. (2005)	Melatonin suppression Melatonin cycle Core Body Temperature Subjective alertness	4h (dilated pupils)	100 lx	Helmet with shields (for nasal and temporal)	<b>Nasal</b> Temporal
Visser et al. (1999)	Melatonin suppression	2h	500 lx	Helmet with shields (for nasal and temporal)	Superior <b>Inferior</b> <b>Nasal (p,0.05)</b> Temporal

The results suggest that the inferior and nasal retinal areas are either  
 (i) more sensitive to light stimuli when non-image-forming effects of light are concerned, or  
 (ii) contain a higher density of the ipRGCs.

# Literature review – in vitro studies

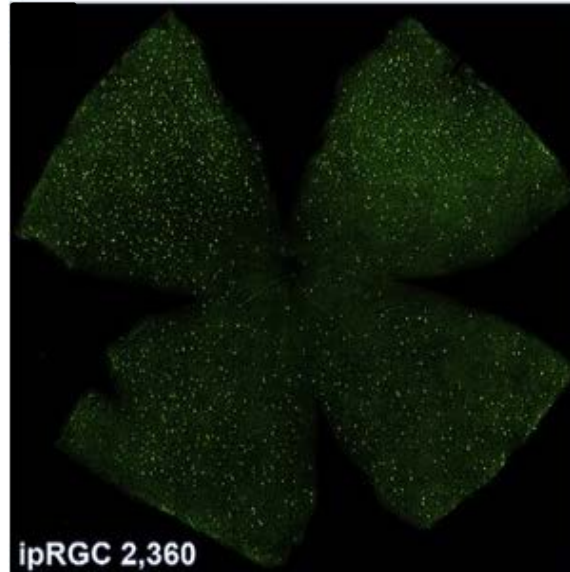


A cell-tracer is injected into different retino-recipient brain centers (e.g. Sci)

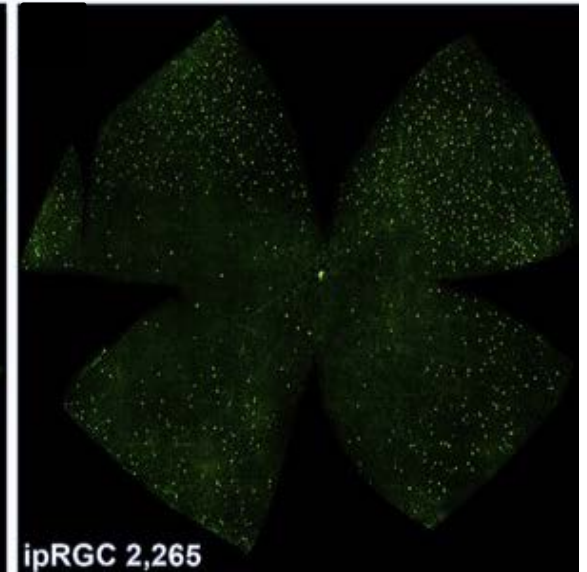
ipRGCs are infected



Right retina



Left retina



The results show that the ipRGCs are denser in the superior-temporal area.

(Taken from Glindo-Romero et al., 2012)

# Conclusions

- Literature on the influence of light directionality is rather limited.
- Human studies suggest that inferior and nasal retinal areas are either (i) more sensitive to light stimuli when non-image-forming effects of light are concerned, or (ii) contain a higher density of the ipRGCs.
- Animal studies show that the ipRGCs are more densely packed in the superior-temporal retinal area.
- Regardless of differences, all studies reveal a non-homogenous distribution for the ipRGCs and thus highlight the importance of light directionality on human health.

# Take home message

One can positively influence the building occupant's health and well-being by choosing the right position for luminaires and daylight openings depending on the magnitude of the influence one is looking for.



Thank You!

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