

Effects of light spectrum on health and behaviour of growing-finishing pigs

Alice Scaillierez

Sofie van Nieuwamerongen - de Koning, Iris Boumans, Rik van der Tol, Eddie Bokkers

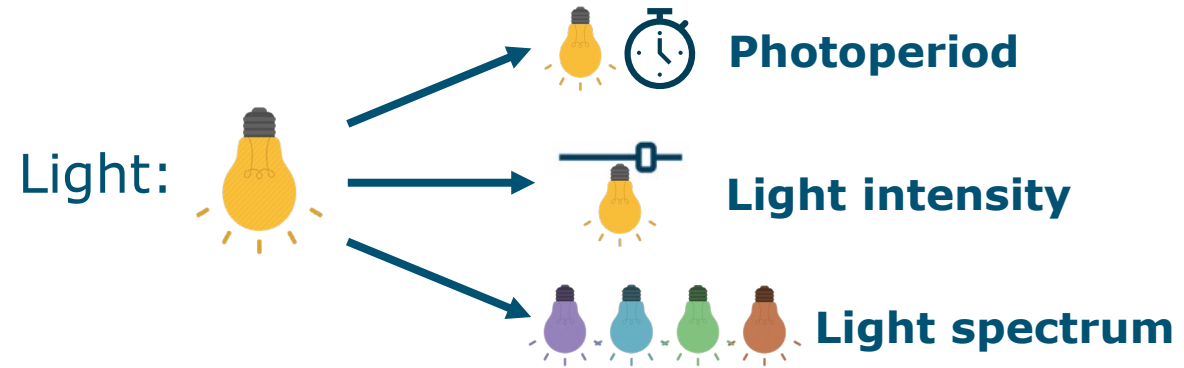
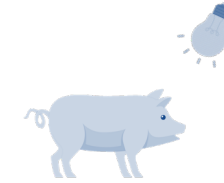
EAAP

02/09/2024

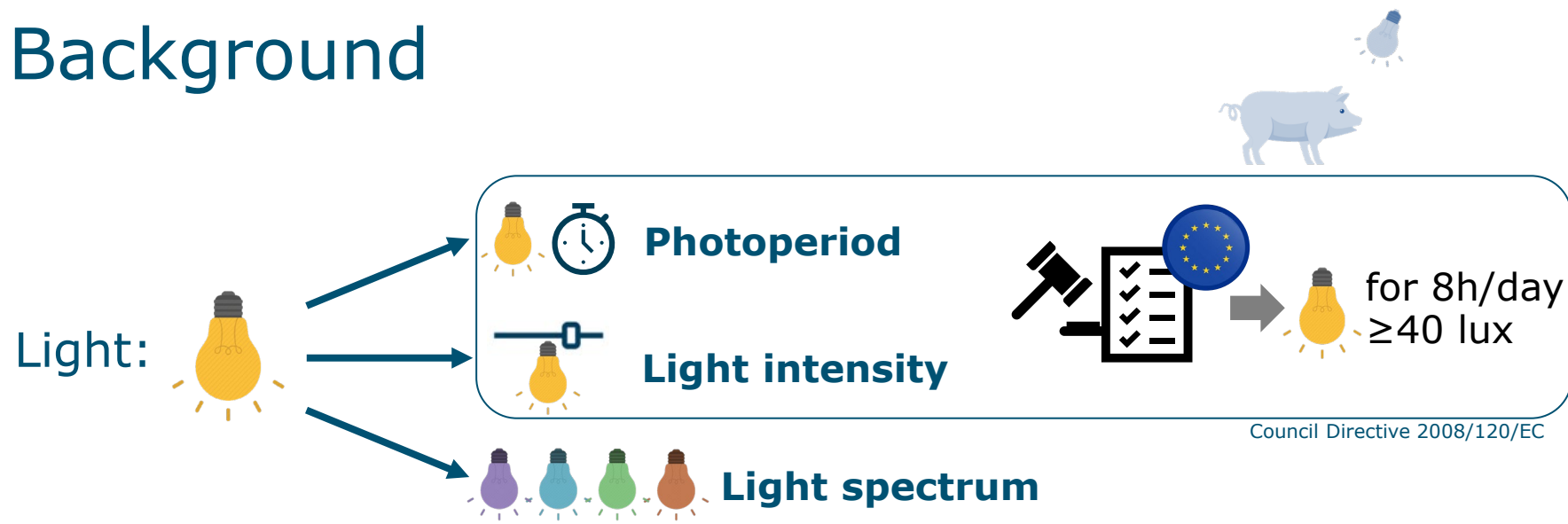




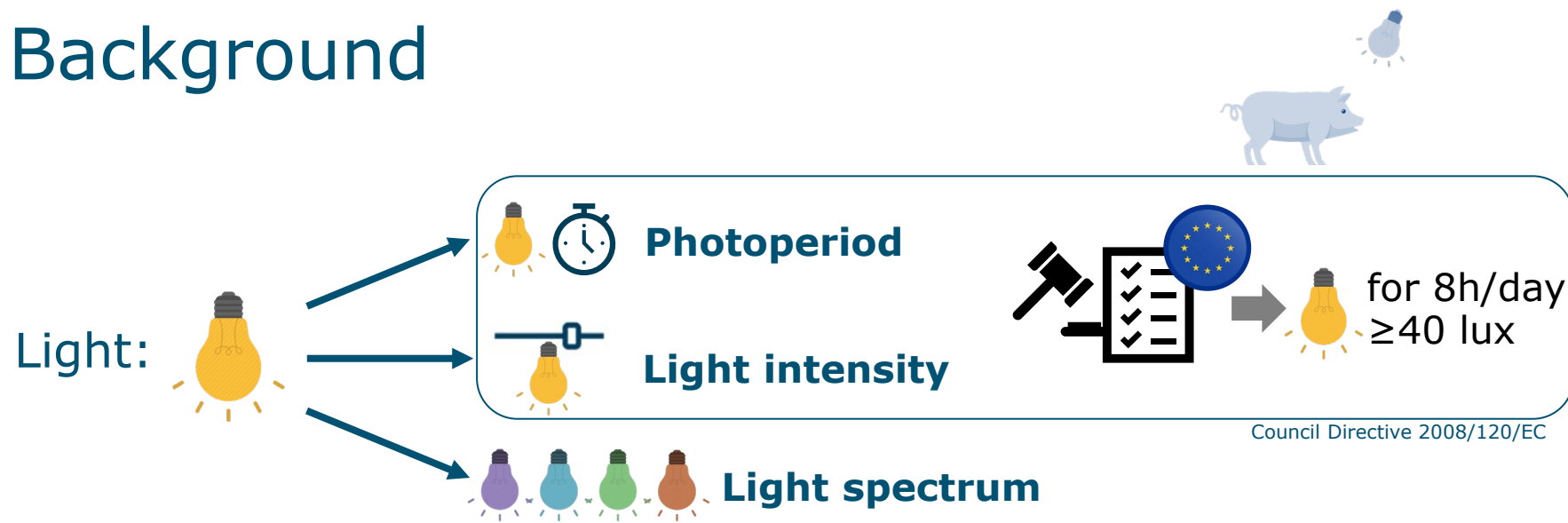
Background



Background

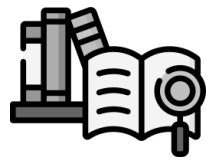
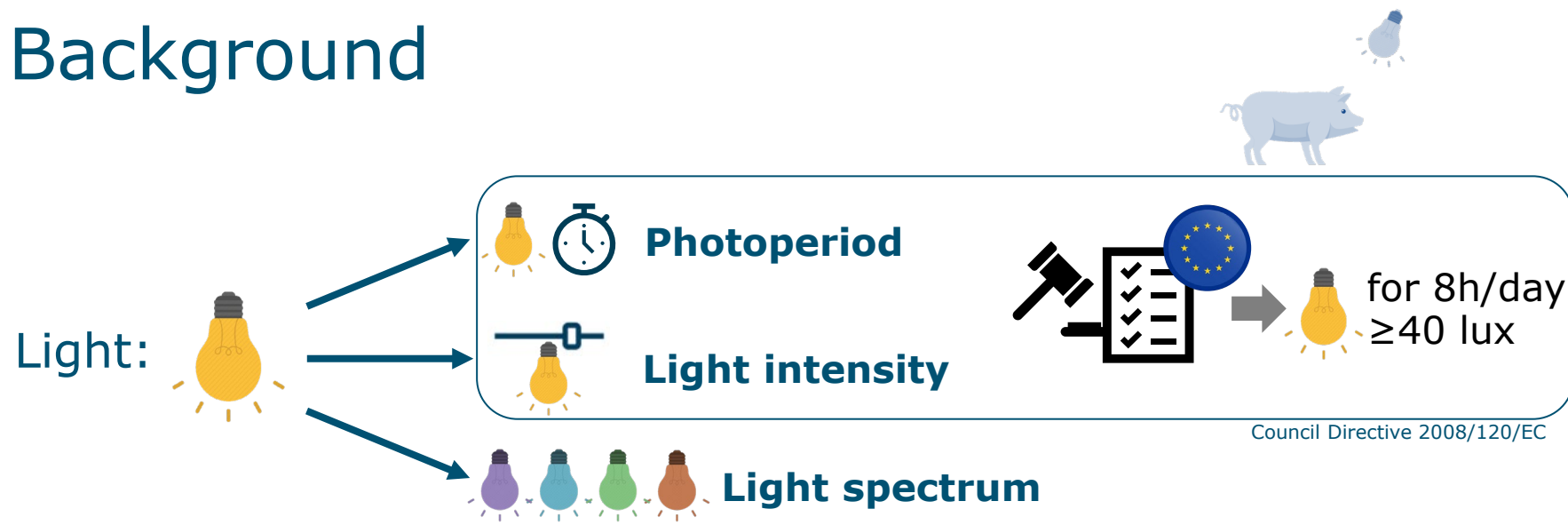


Background



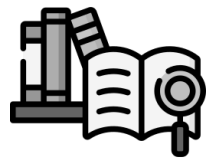
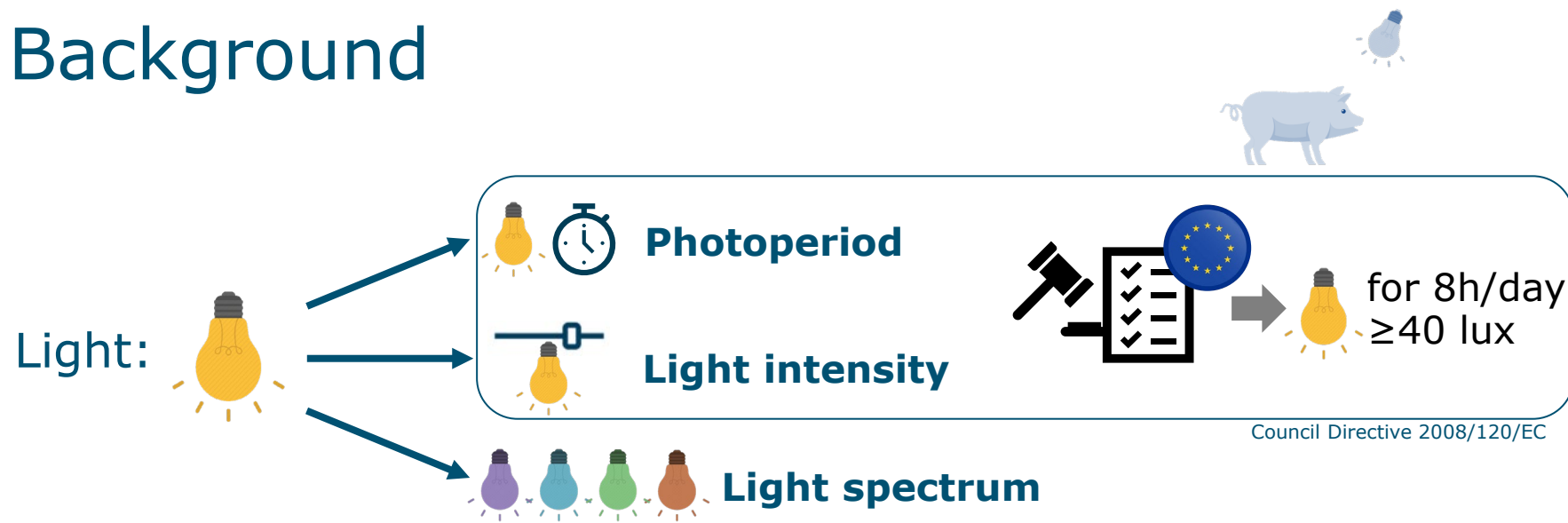


Background



Limited research on light spectrum for pigs Scaillierez et al., 2024

Background



Limited research on light spectrum for pigs

Scaillierez et al., 2024



Preference for specific behaviours

Götz et al., 2020



Physiological processes and response to emotional stimuli

Even et al., 2008, Vandewalle et al., 2010, Iskra-Golec et al., 2012, Christoffersen, 2011



WAGENINGEN
UNIVERSITY & RESEARCH

Background

Light:



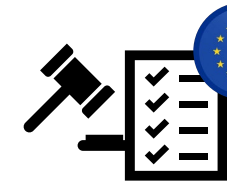
Photoperiod



Light intensity

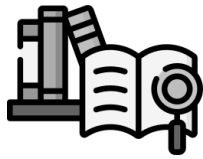


Light spectrum



for 8h/day
 ≥ 40 lux

Council Directive 2008/120/EC



Limited research on light spectrum for pigs

Scaillierez et al., 2024



Preference for specific behaviours

Götz et al., 2020



Physiological processes and response to emotional stimuli

Even et al., 2008, Vandewalle et al., 2010, Iskra-Golec et al., 2012, Christoffersen, 2011



Synthesis of vitamin D from natural and artificial UVB

Scaillierez et al., 2024



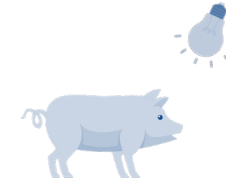
+ : bone formation, immune system and possibly serotonin and dopamine

Kühn et al., 2024, Holick 2011, Holick, 2016



WAGENINGEN
UNIVERSITY & RESEARCH

Research questions



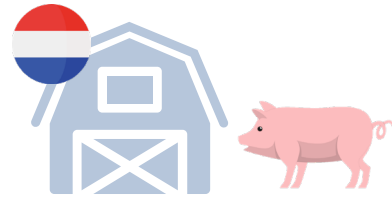
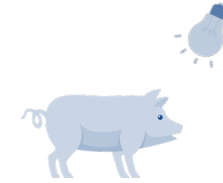
Can light spectrum influence pig welfare?



Does adding UVB light improve pig welfare?

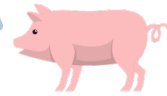
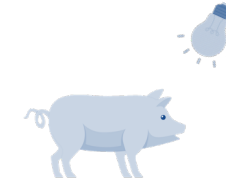


Experimental design

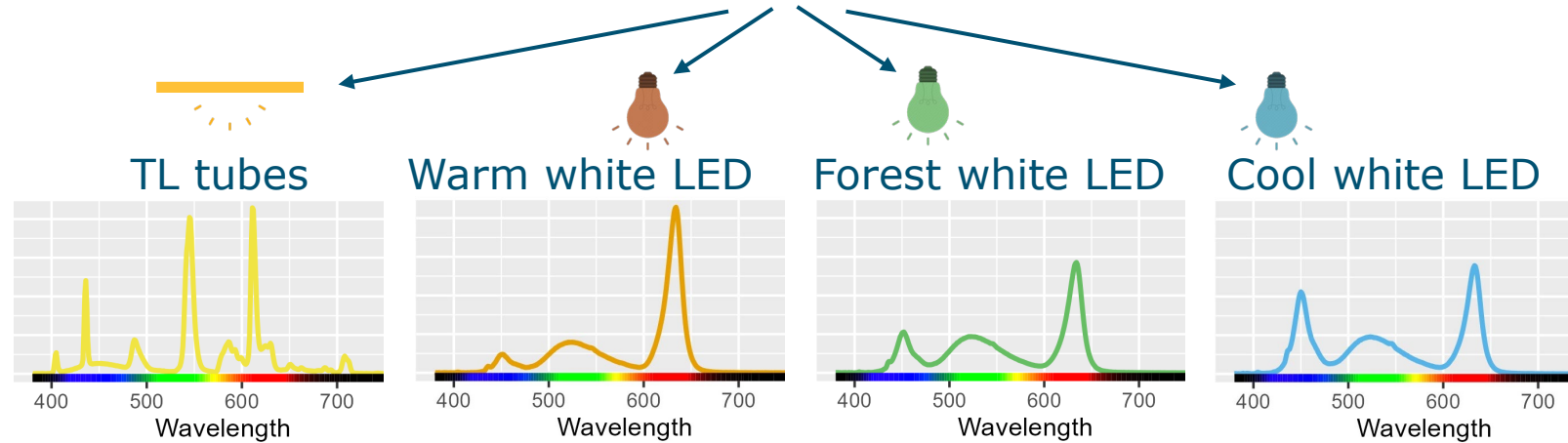


448 growing-finishing pigs in pens of 7 for
12 weeks

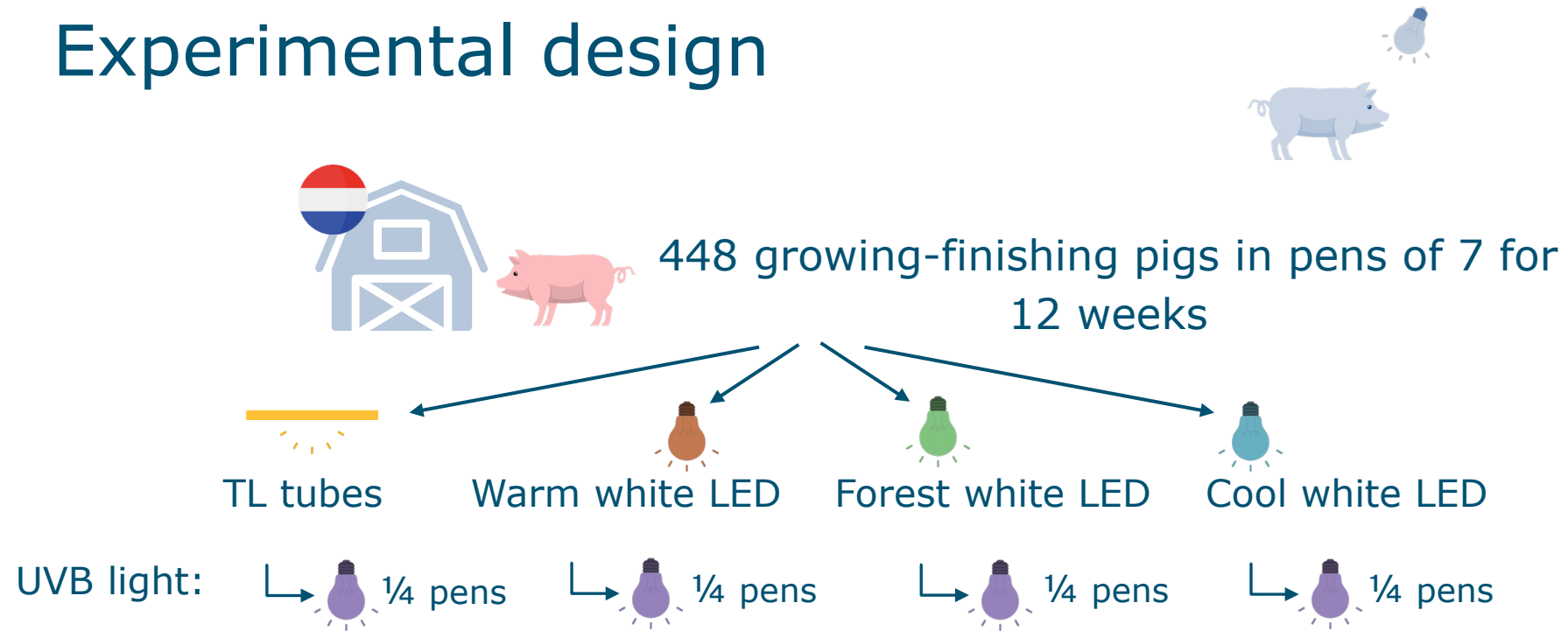
Experimental design



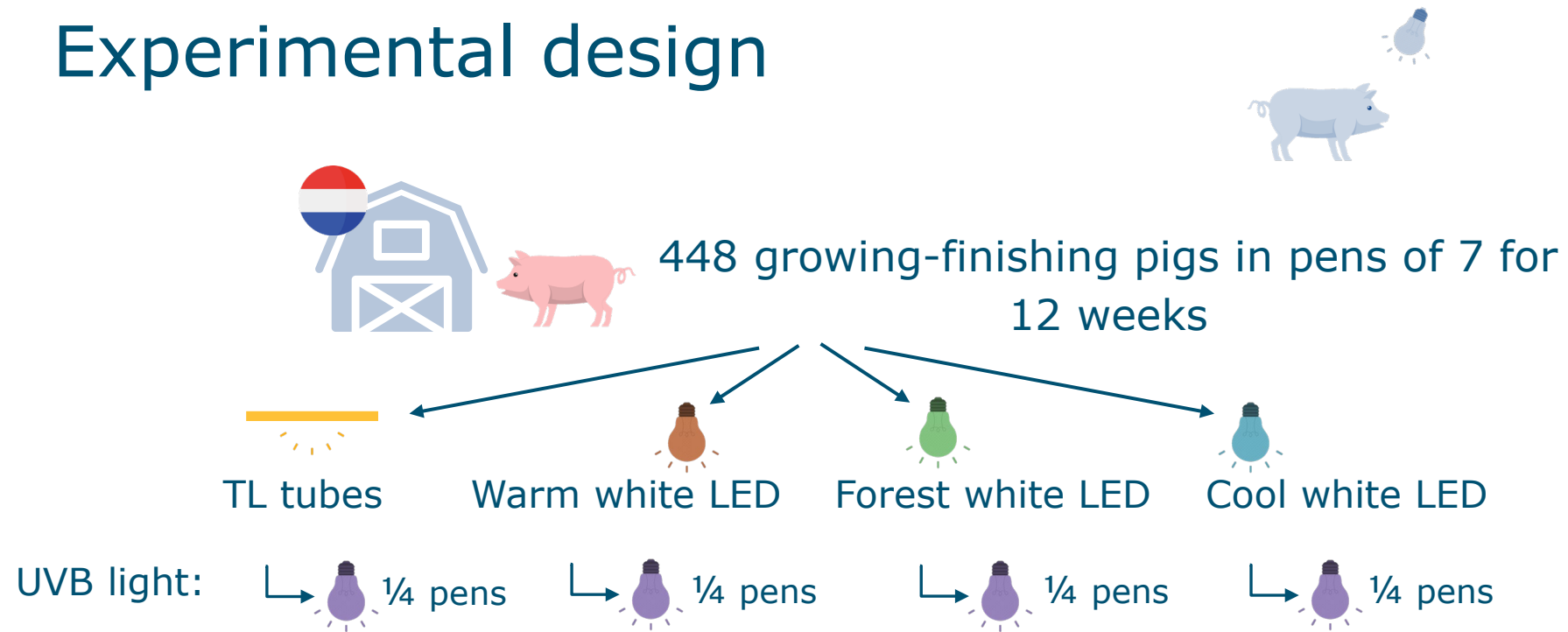
448 growing-finishing pigs in pens of 7 for 12 weeks



Experimental design



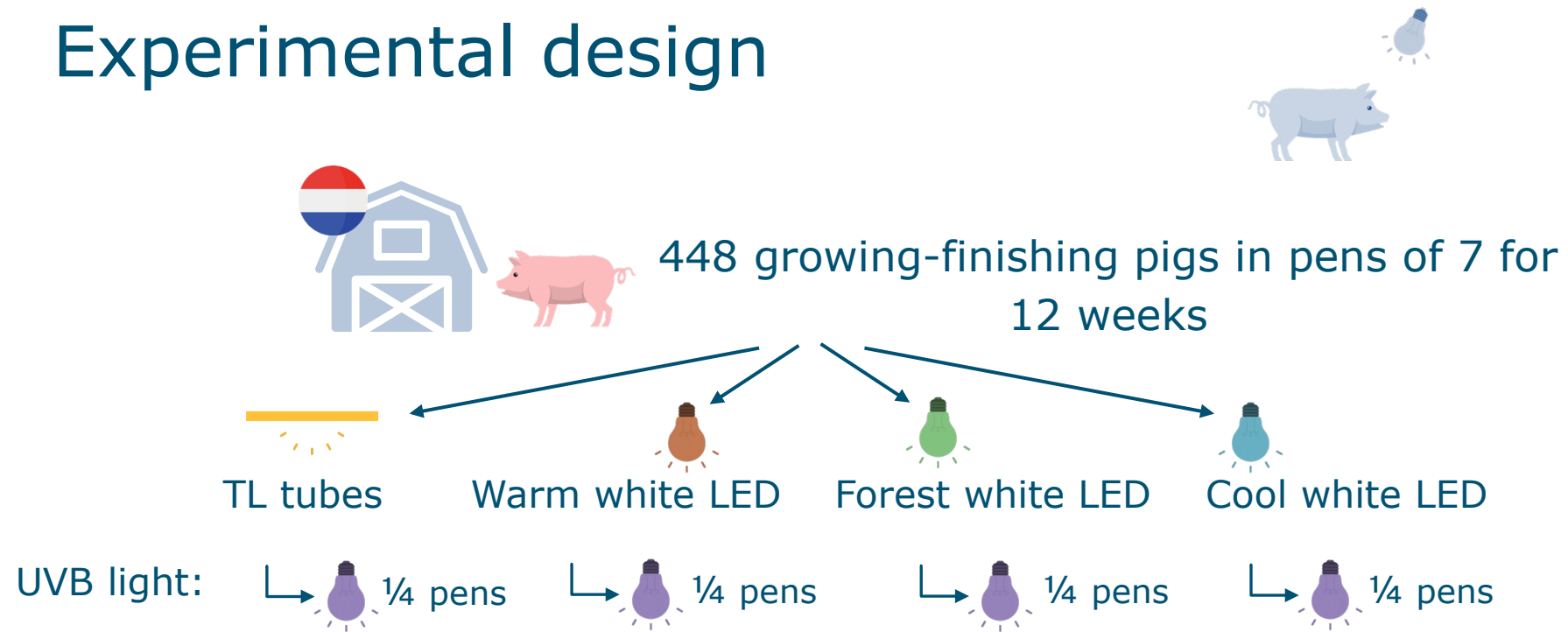
Experimental design



UV: dose of 1 SED* daily over 11h per day

* $\approx$ 10 minutes of sunlight exposure (midday in the summer)

Experimental design



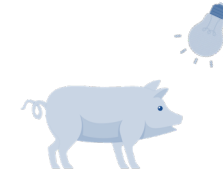
UV: dose of 1 SED* daily over 11h per day

* $\approx$ 10 minutes of sunlight exposure (midday in the summer)

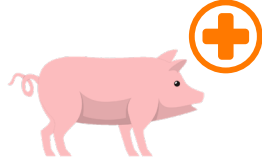
Other light parameters kept equal:

-   11h of light per day
-  $\approx$ 70 lux
-  absence of daylight

How to assess pig welfare?



Health



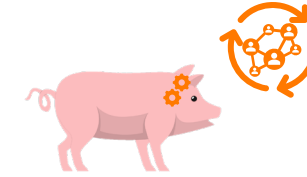
On-farm:

- Weekly health assessment
- Growth

At slaughter:

- Abnormalities on carcasses
- Blood parameters

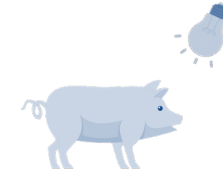
Behaviour



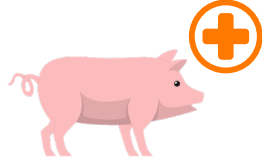
Video observations:

- Exploration
- Positive social interactions
- Negative social interactions
- Play
- Damaging behaviour

How to assess pig welfare?



Health



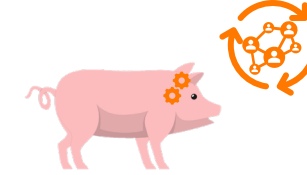
On-farm:

- Weekly health assessment
- Growth

At slaughter:

- Abnormalities on carcasses
- Blood parameters

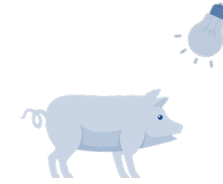
Behaviour



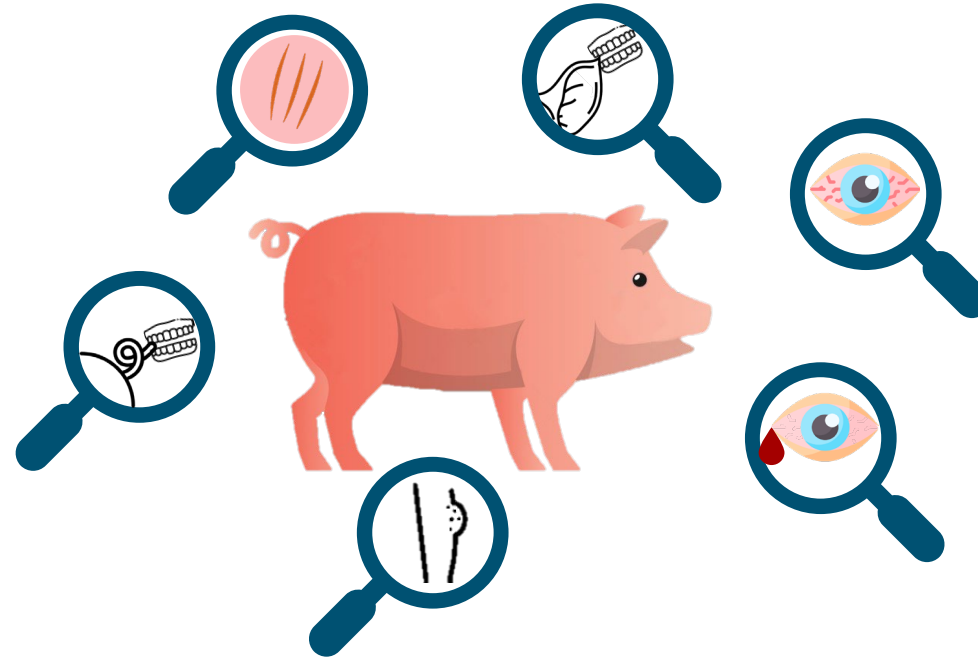
Video observations:

- Exploration
- Positive social interactions
- Negative social interactions
- Play
- Damaging behaviour

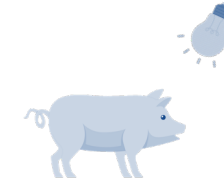
Health assessment - method



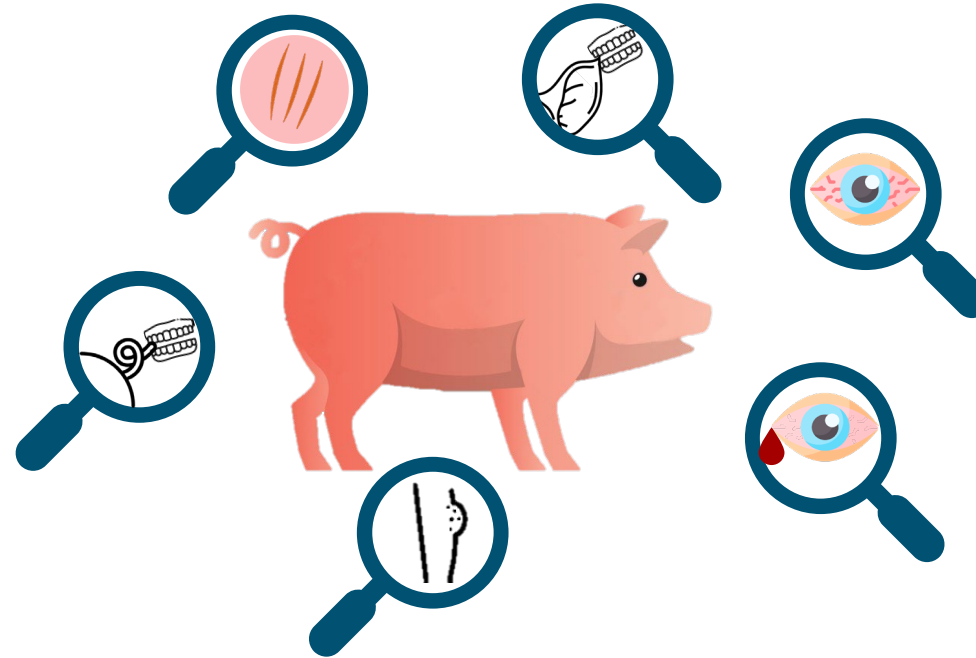
- 0-1-2 scores on health indicators (from absence, minor to severe)



Health assessment - method



- 0-1-2 scores on health indicators (from absence, minor to severe)



- Data analysis: generalised linear mixed models
 - Main effects: Light spectrum, UV, Week
 - Interaction: Light spectrum*Week, UV*Week, Light spectrum*UV

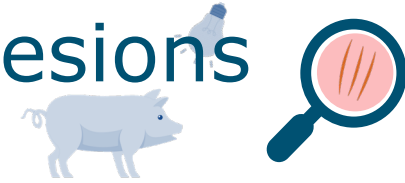


Health assessment – UV & Body lesions

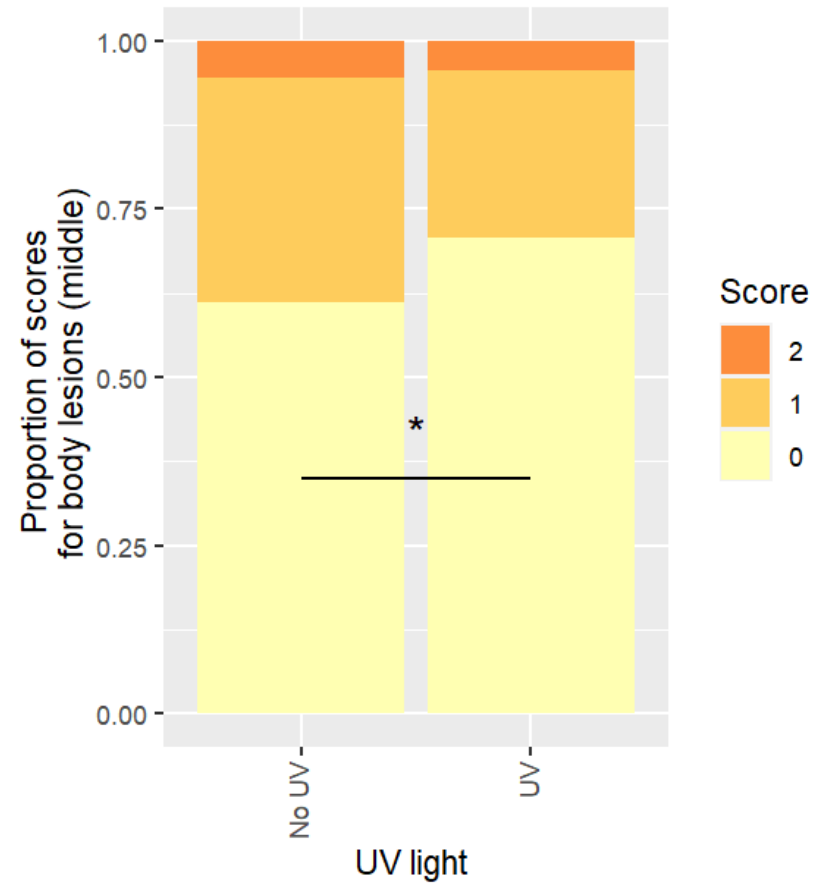


$p=0.031$

Health assessment – UV & Body lesions



$p=0.031$

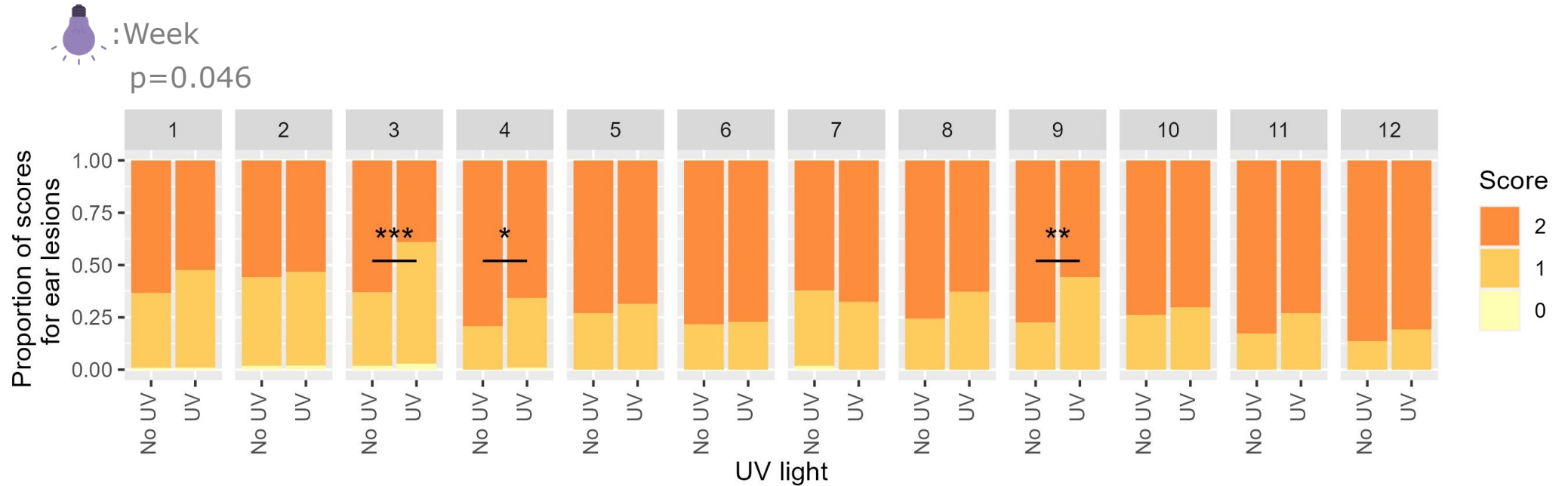
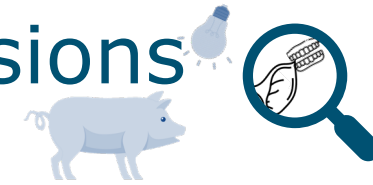


Health assessment – UV & Ear lesions

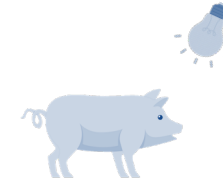


 :Week
 $p=0.046$

Health assessment – UV & Ear lesions



Behaviour observation - method



- 2*20 minutes – every 2 weeks
- Observation method:
0-1 sampling every minute for each pig



Behaviour observation + social interactions

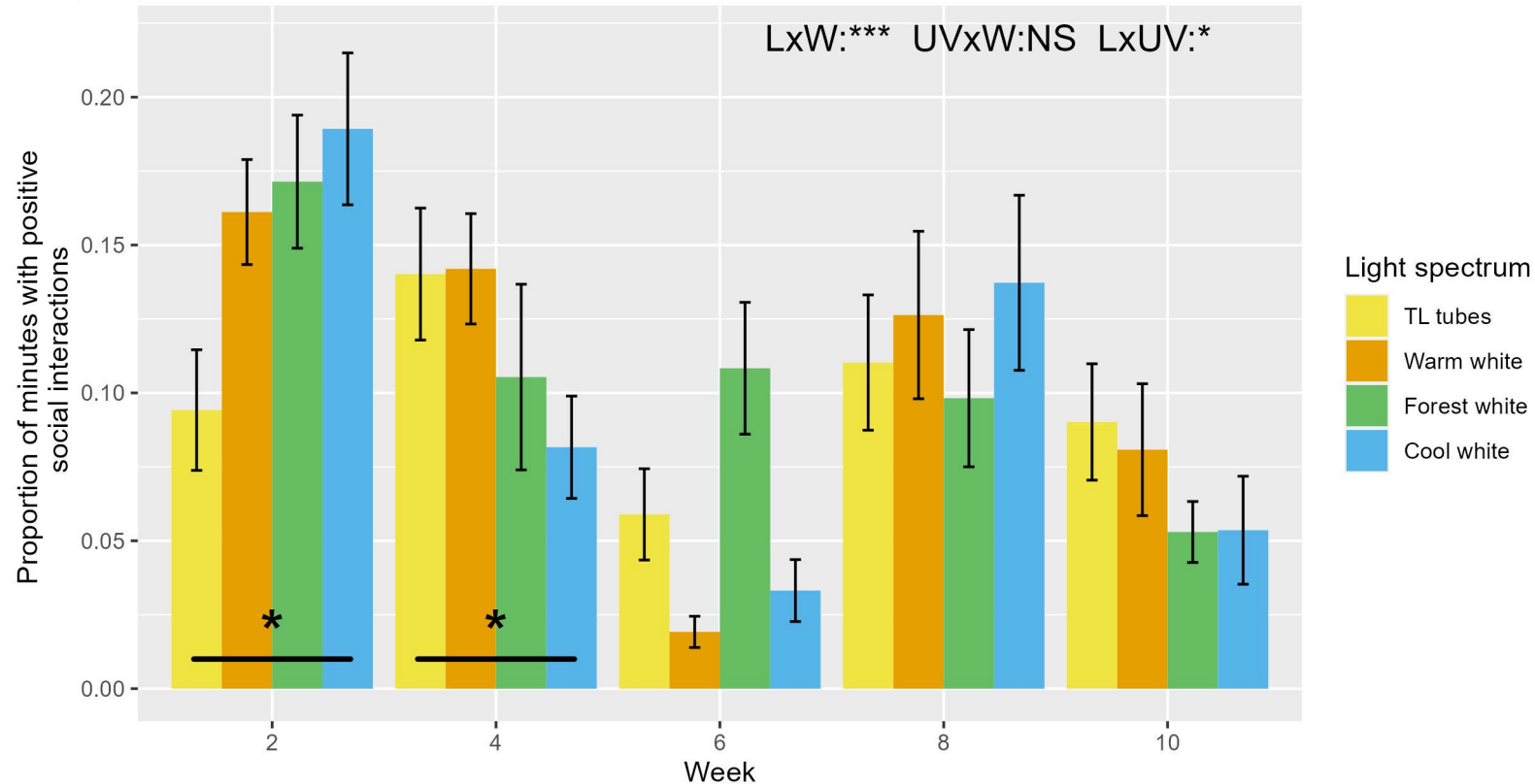


 : Week $p < 0.001$

Behaviour observation + social interactions



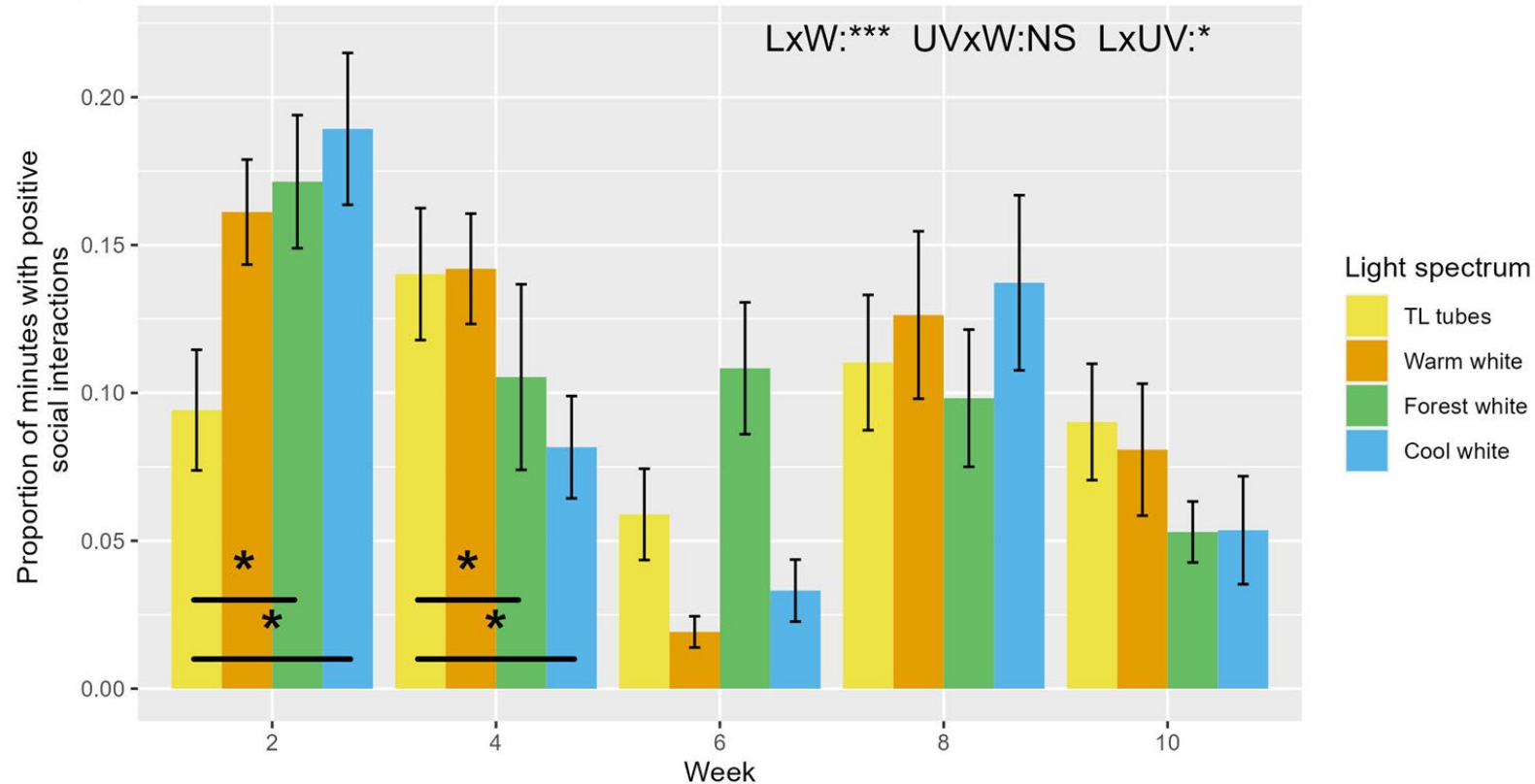
: Week $p < 0.001$



Behaviour observation + social interactions



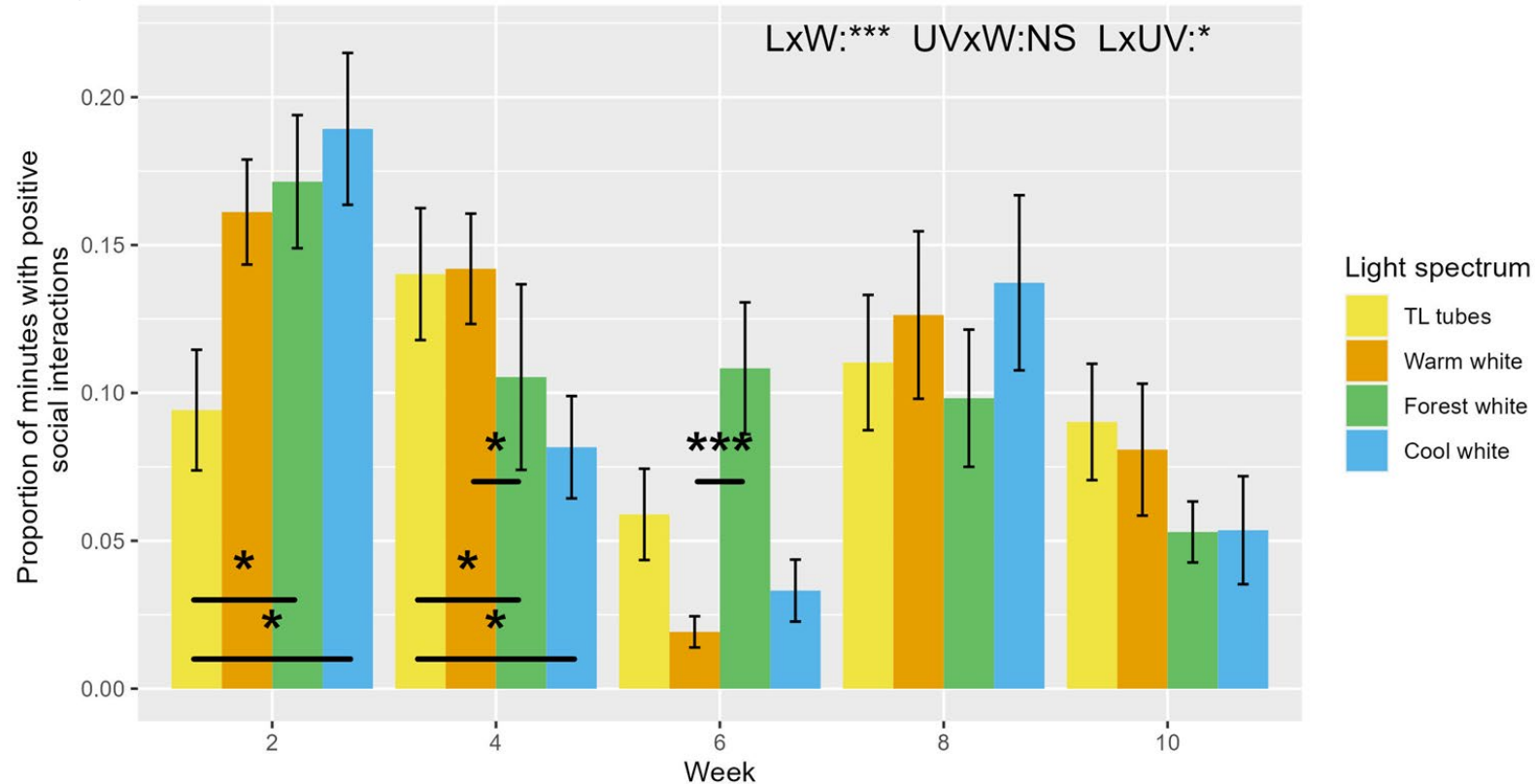
: Week $p < 0.001$



Behaviour observation + social interactions



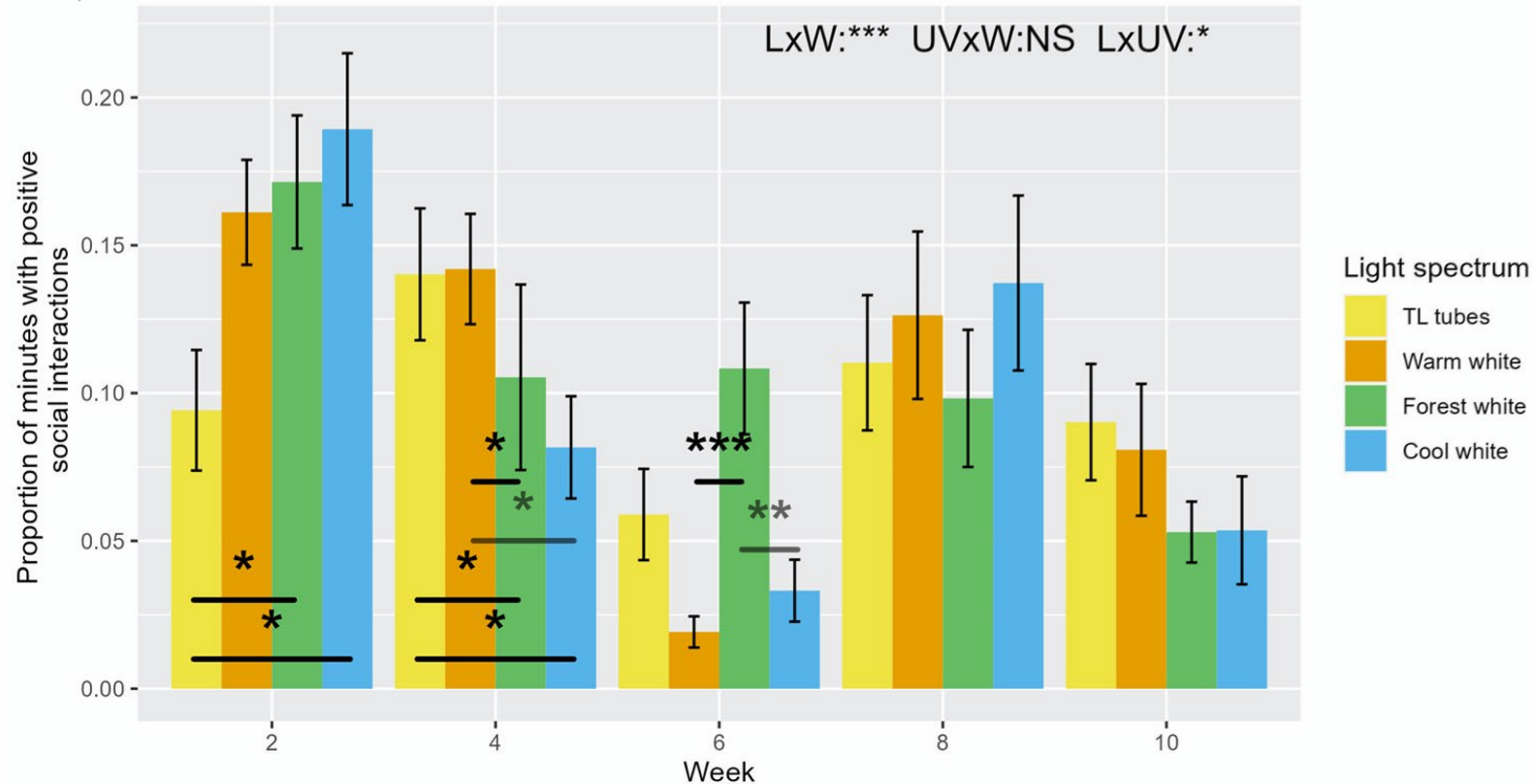
 : Week $p < 0.001$



Behaviour observation + social interactions



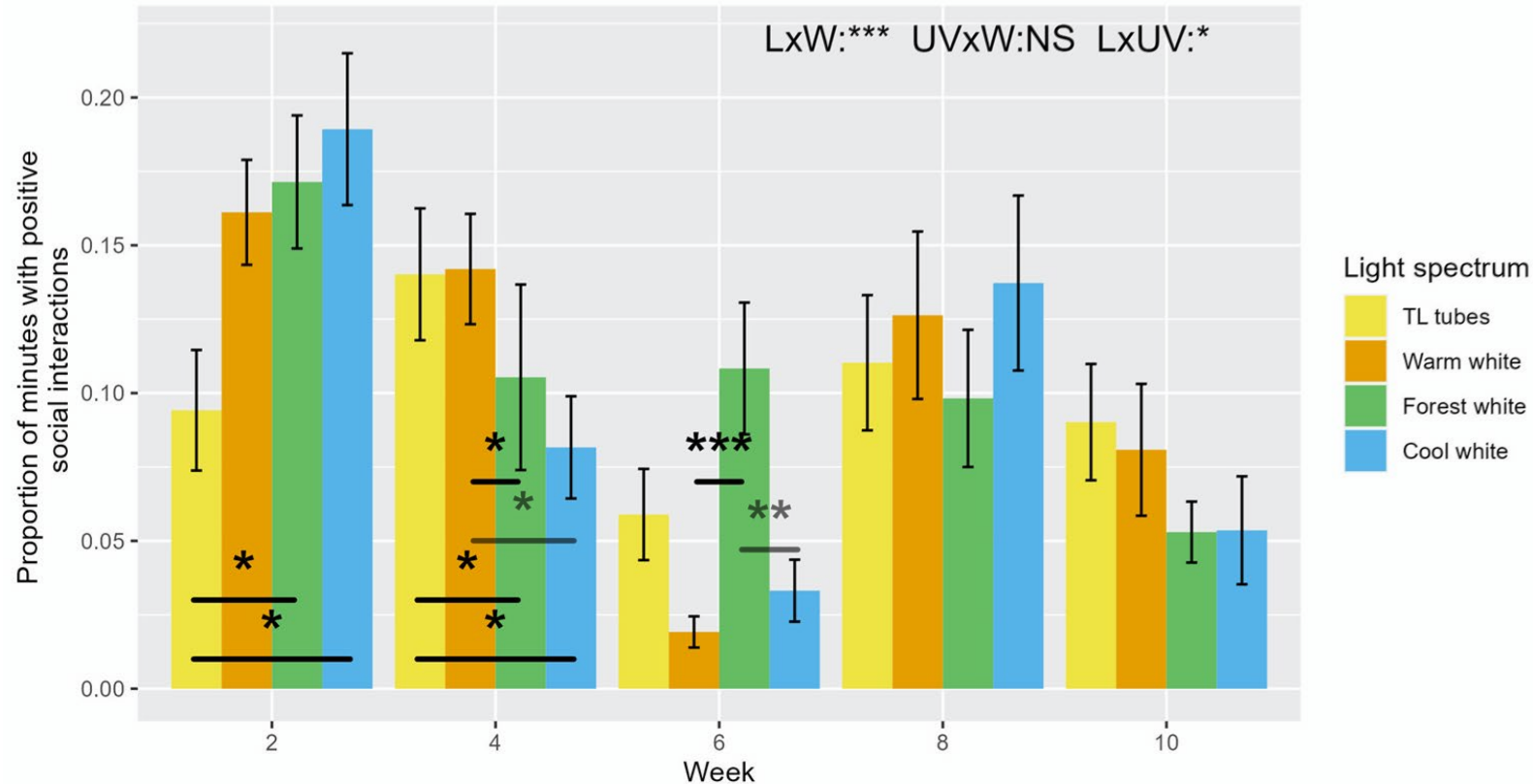
: Week $p < 0.001$



Behaviour observation + social interactions

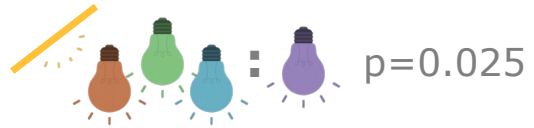


 : Week $p < 0.001$



Inconsistent differences between treatments over weeks

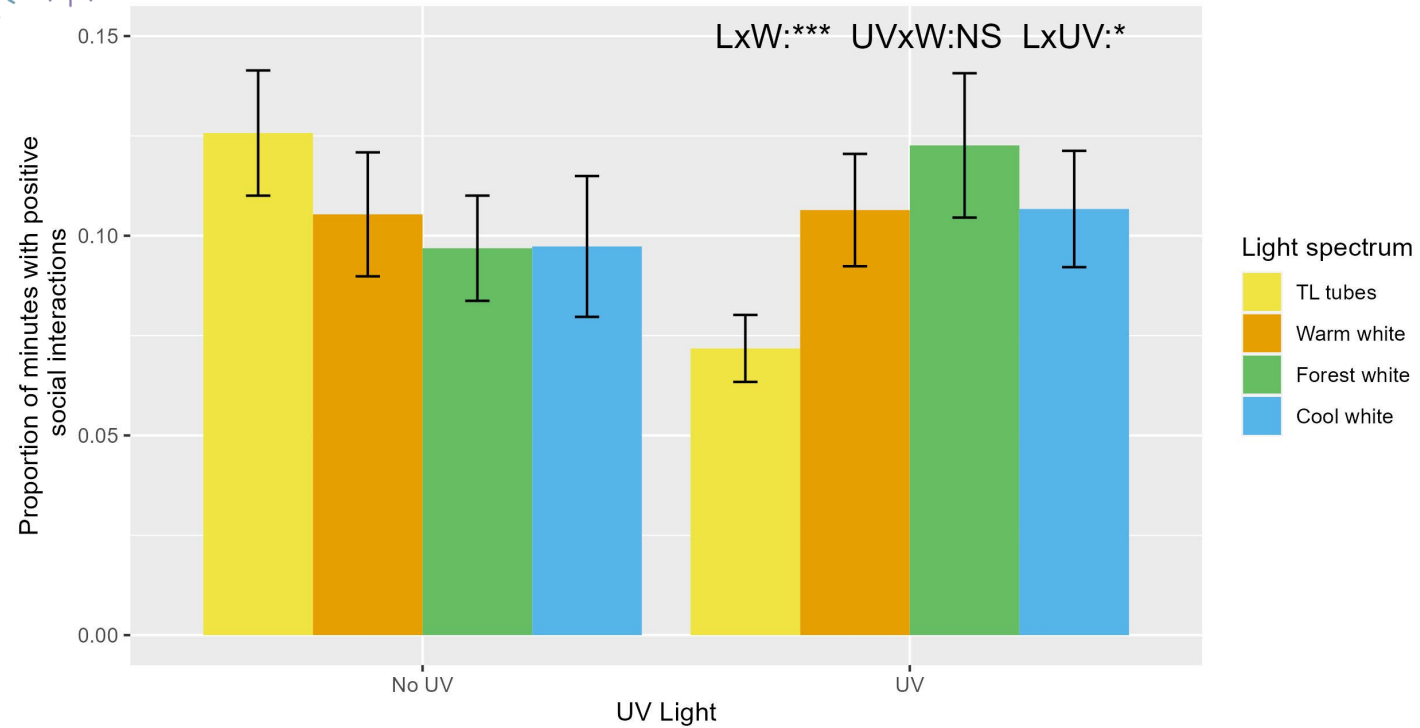
Behaviour observation + social interactions



Behaviour observation + social interactions



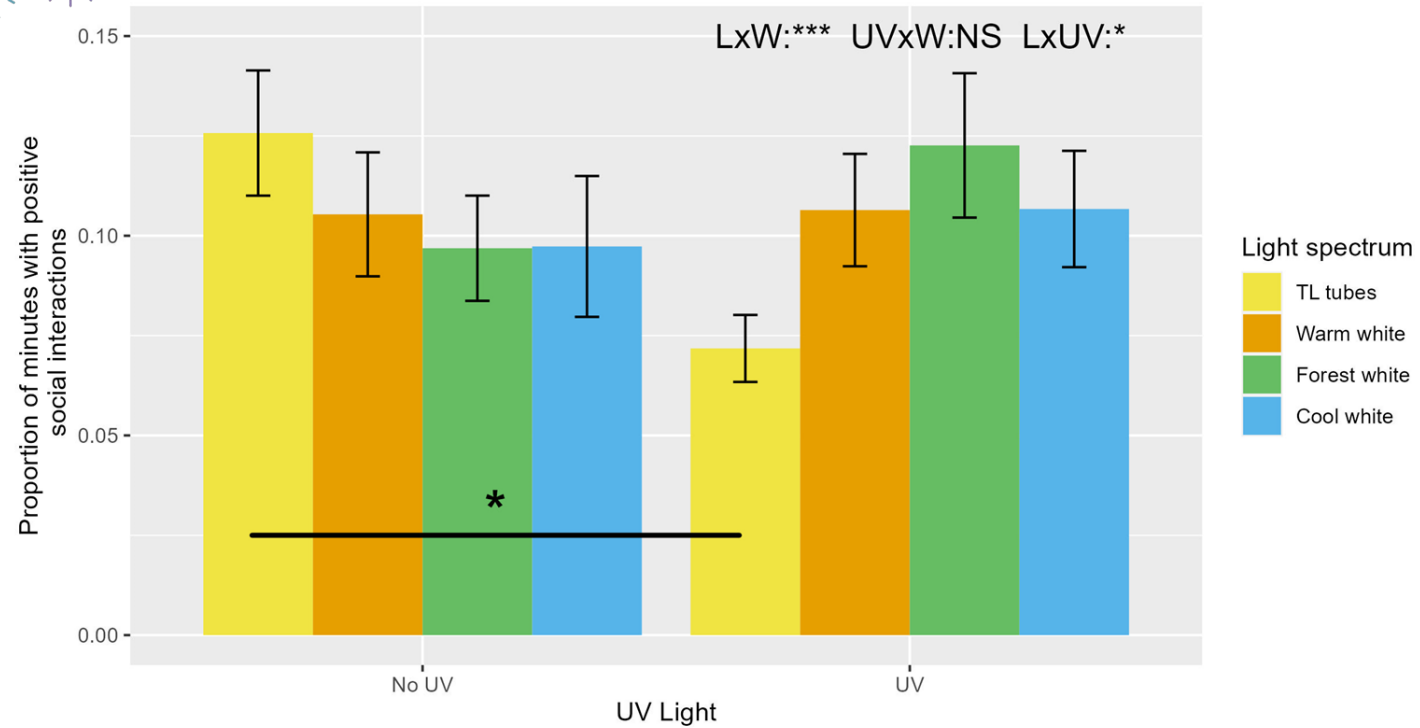
p=0.025



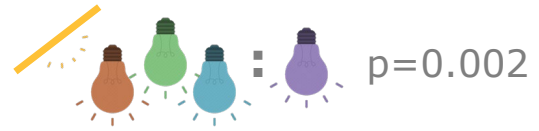
Behaviour observation + social interactions



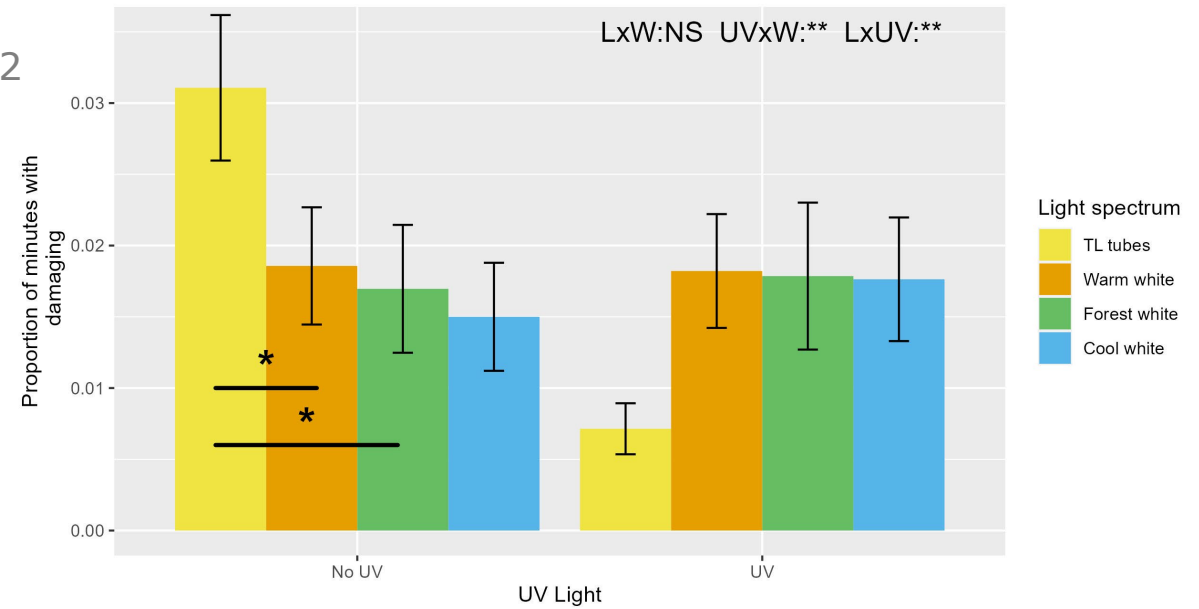
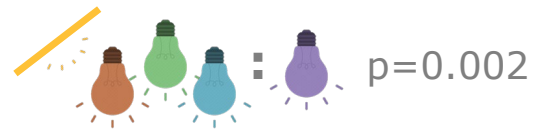
$p=0.025$



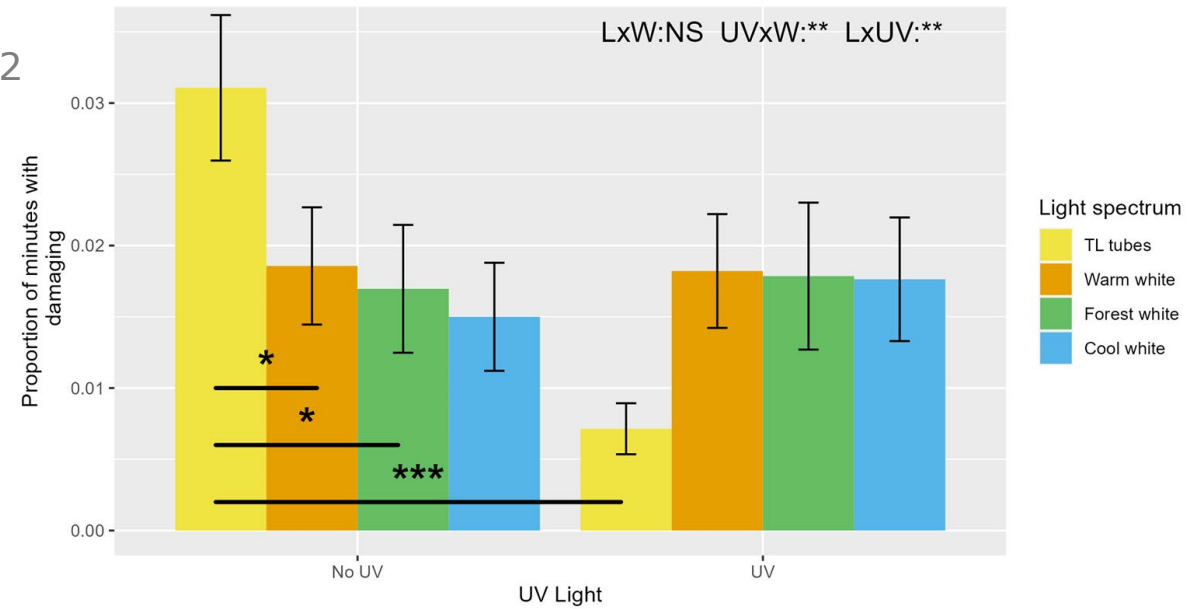
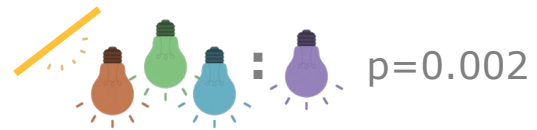
Behaviour observation – Damaging



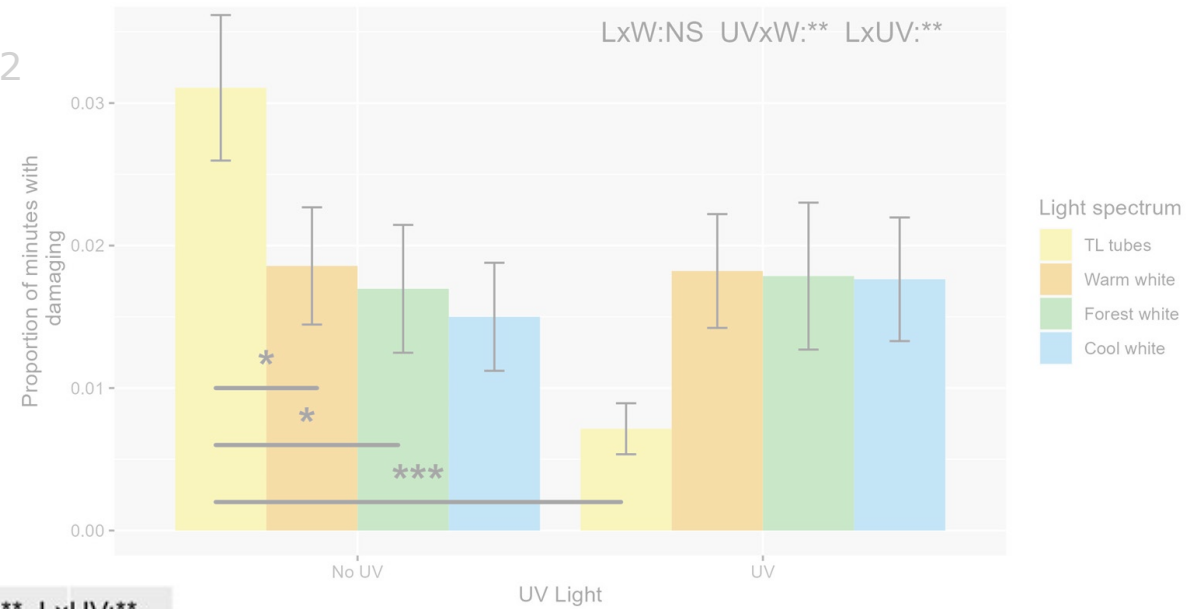
Behaviour observation – Damaging



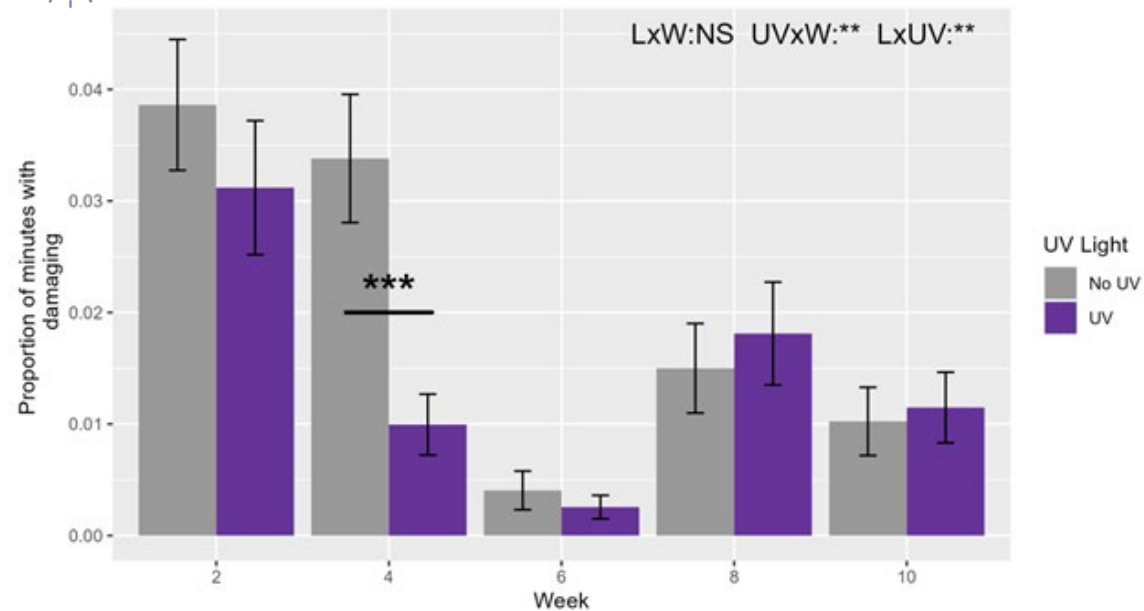
Behaviour observation – Damaging



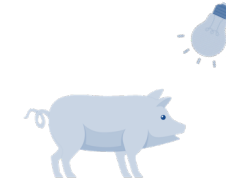
Behaviour observation – Damaging



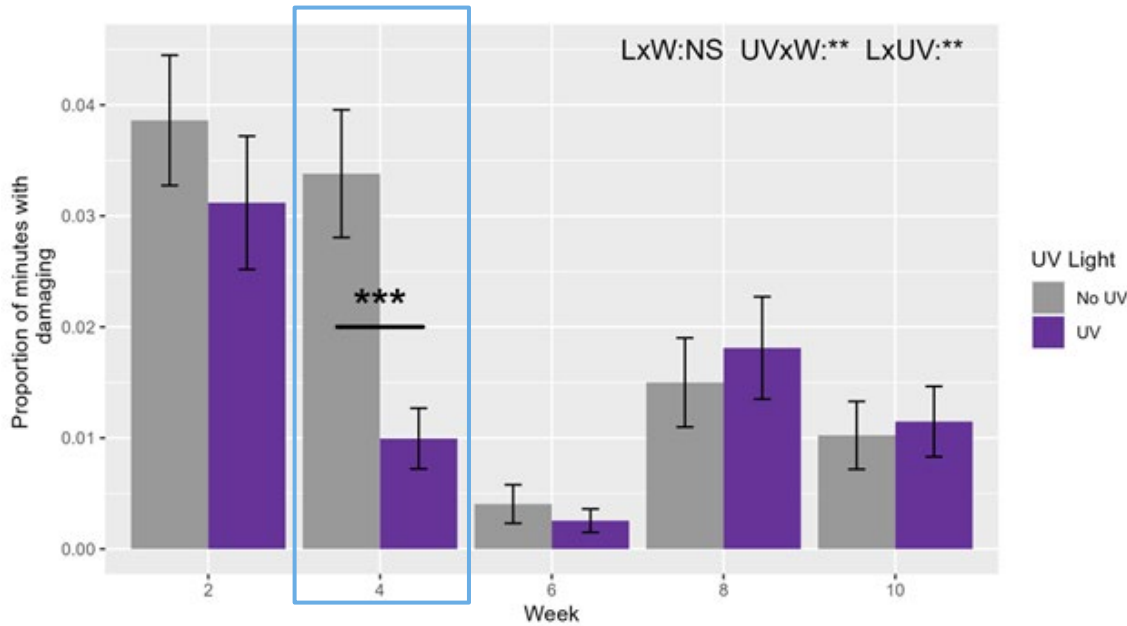
Week $p=0.004$



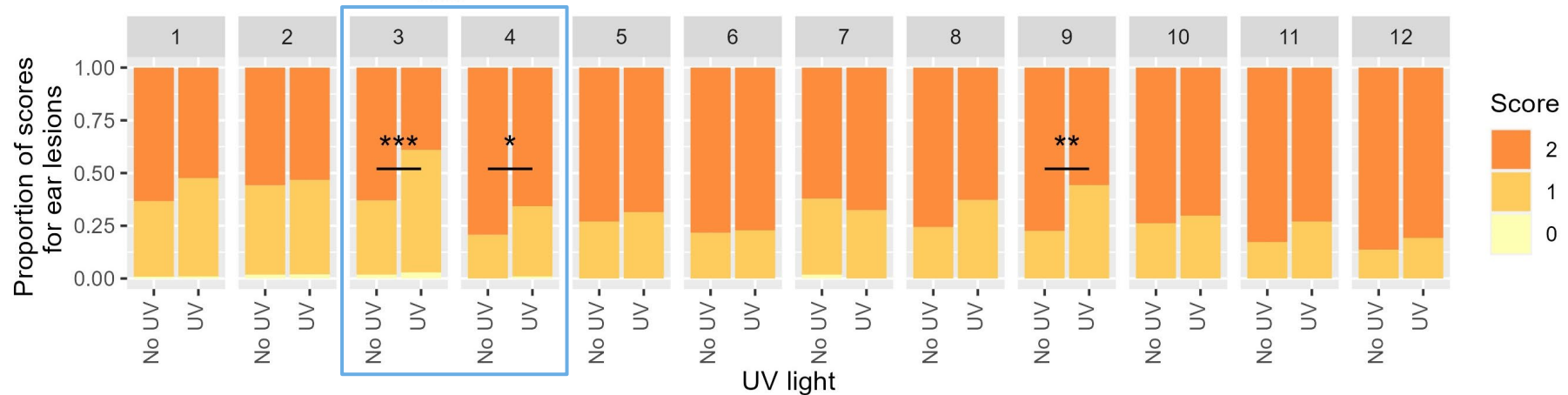
Discussion



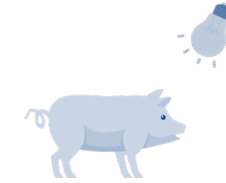
■ Damaging behaviour & ear biting lesions



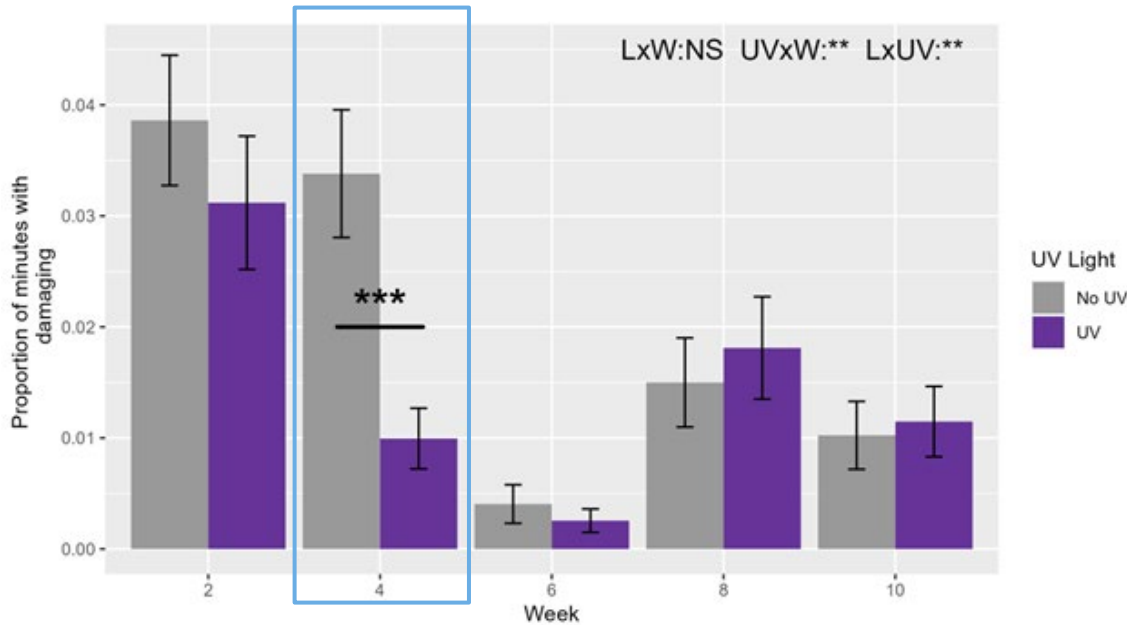
Positive UV effect on ear biting outbreak in week 4?



Discussion

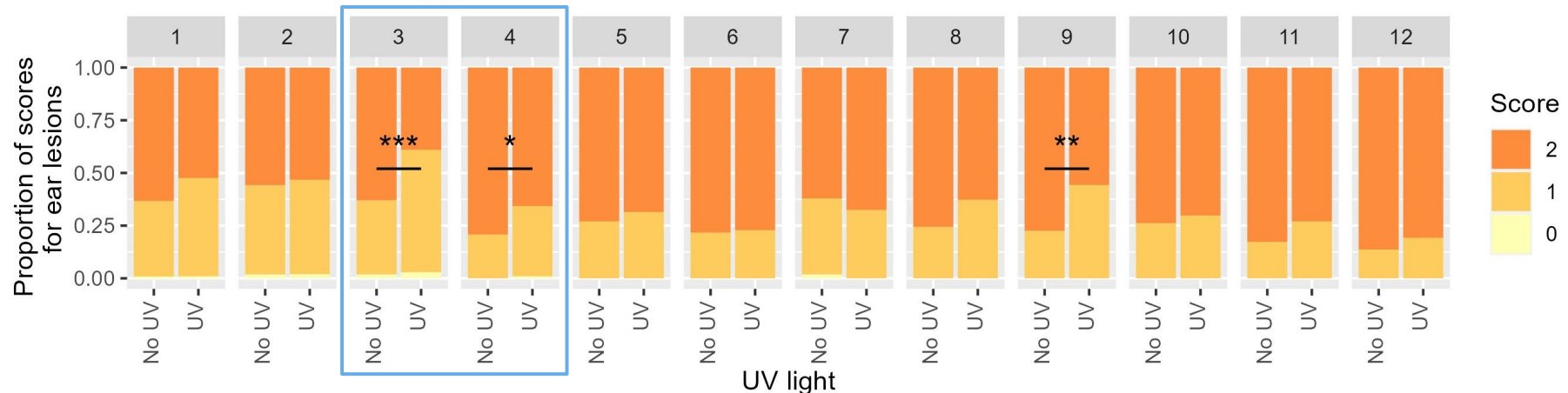


■ Damaging behaviour & ear biting lesions

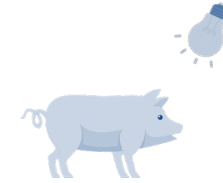


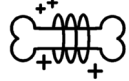
Positive UV effect on ear biting outbreak in week 4?

Week 9: happened after observation week 8?

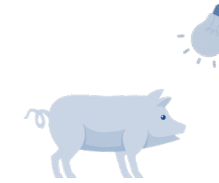


Blood parameters - method



- Blood sampled at slaughterhouse on stunned pigs
- Analysis: Vitamin D 
Bone markers: osteocalcin  and cross-laps 

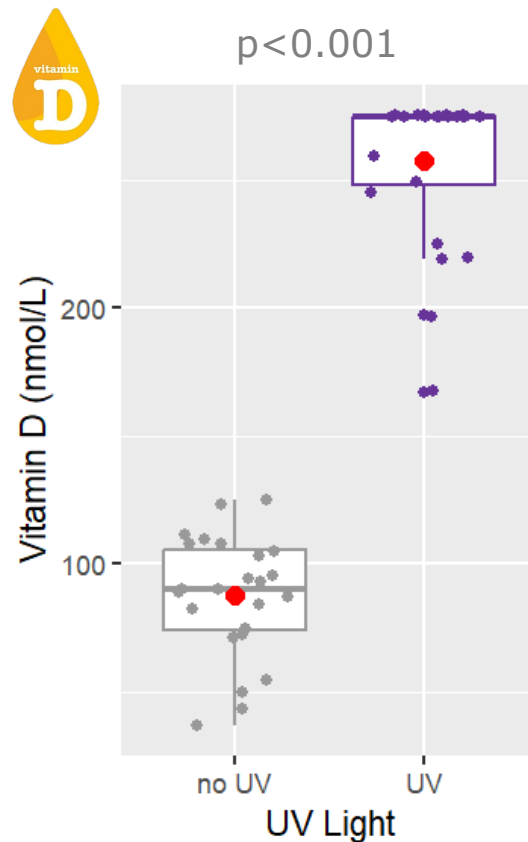
Blood parameters - results



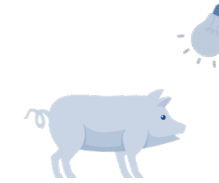
- Blood sampled at slaughterhouse on stunned pigs

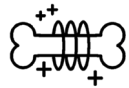
- Analysis: Vitamin D 

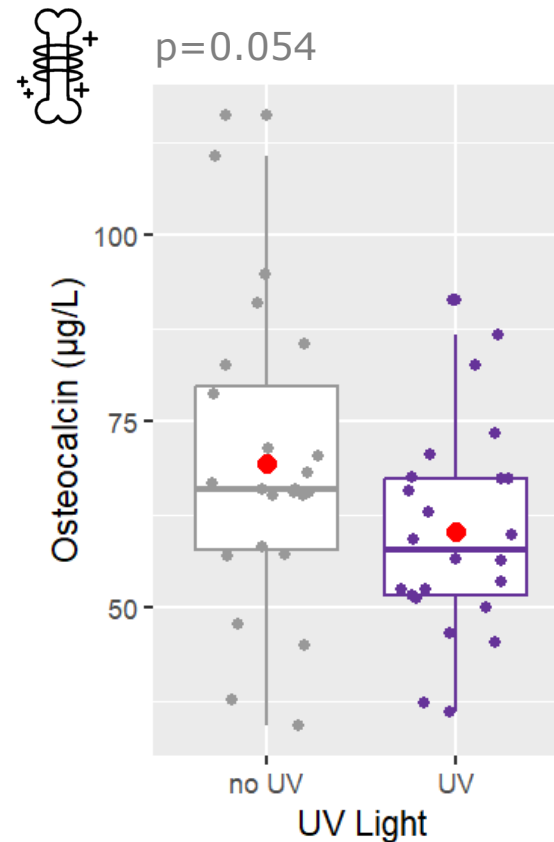
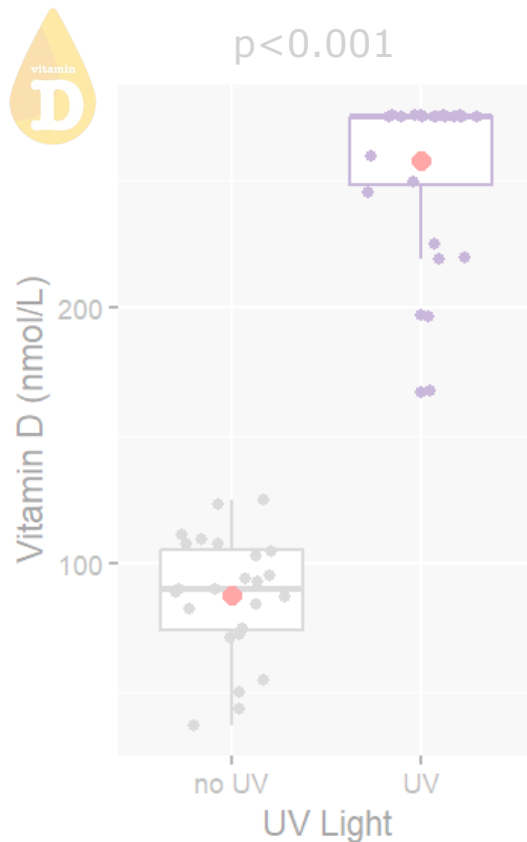
Bone markers: osteocalcin  and cross-laps 



Blood parameters - results

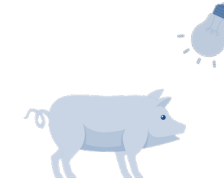


- Blood sampled at slaughterhouse on stunned pigs
- Analysis: Vitamin D 
Bone markers: osteocalcin  and cross-laps 

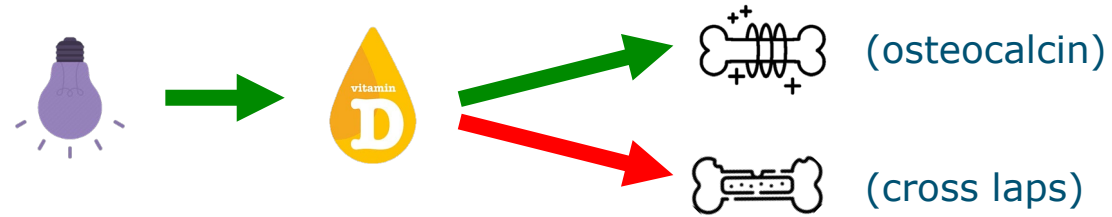


 No effect of UV on cross-laps ($p = 0.826$)

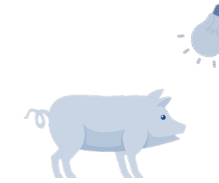
Discussion



■ Vitamin D & bone formation



Discussion



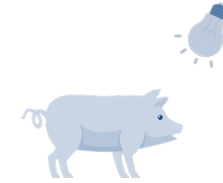
■ Vitamin D & bone formation



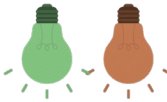
Similar finding in Kolp et al., 2017

Vitamin D to potentially inhibit gene expression of osteocalcin in rodents

Conclusion

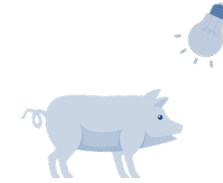


Light spectrum:

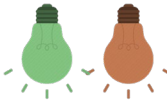
- Less damaging behaviour with  than  without UV



Conclusion



Light spectrum:

- Less damaging behaviour with  than  without UV

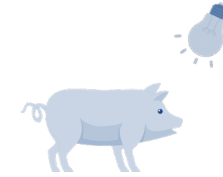


UV addition:

- Limits body and ear biting lesions
- Limits damaging behaviour with 
- Improves vitamin D status



Thank you for your attention!



Acknowledgements:

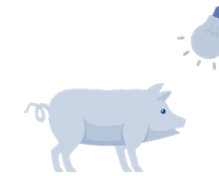
Marjon van Overveld and Noa Steendam for their help with behavioural observations

This research received funding from the Netherlands Organisation for Scientific Research (NWO) in the framework of the ENW PPP Fund, and participation in this conference is supported by the University Fund Wageningen.



UNIVERSITY FUND
WAGENINGEN

References



European Union, 2008. Council directive 2008/120/EC of 18 december 2008 laying down minimum standards for the protection of pigs (codified version). Official Journal of the European Union 54, 8.

Scailherez, A. J., van Nieuwamerongen-de Koning, S. E., Boumans, I. J. M. M., van der Tol, P. P. J., & Bokkers, E. A. M. (2024). The influence of light on pig welfare. *animal*, 101313.

Götz, S., Raoult, C.M.C., Reiter, K., Wensch-Dorendorf, M., Werner, D. and Borell, E. von, 2020. [Influence of different LED light colour temperatures on the preference behaviour of weaned piglets](#). *Agriculture-Basel* 10, 594.

Even, C., Schröder, C. M., Friedman, S., & Rouillon, F. (2008). Efficacy of light therapy in nonseasonal depression: a systematic review. *Journal of affective disorders*, 108(1-2), 11-23.

Vandewalle, G., Schwartz, S., Grandjean, D., Wuillaume, C., Balteau, E., Degueldre, C., ... & Maquet, P. (2010). Spectral quality of light modulates emotional brain responses in humans. *Proceedings of the National Academy of Sciences*, 107(45), 19549-19554.

Iskra-Golec, I. M., Wazna, A., & Smith, L. (2012). Effects of blue-enriched light on the daily course of mood, sleepiness and light perception: A field experiment. *Lighting Research & Technology*, 44(4), 506-513.

Christoffersen, J. (2011, May). The importance of light to health and well-being. In *Proceedings of the 4th VELUX Daylight Symposium "Daylight in a Human Perspective"*, Lausanne, Switzerland (pp. 4-5).

Kühn, J., Brandsch, C., Bailer, A. C., Kiourtzidis, M., Hirche, F., Chen, C. Y., ... & Stangl, G. I. (2024). UV light exposure vs. vitamin D supplementation: a comparison of health benefits and vitamin D metabolism in a pig model. *The Journal of Nutritional Biochemistry*, 109746.

Holick, M.F., 2011. Vitamin d: Evolutionary, physiological and health perspectives. *Current drug targets* 12, 4–18.

Holick, M.F., 2016. Biological effects of sunlight, ultraviolet radiation, visible light, infrared radiation and vitamin d for health. *Anticancer research* 36, 1345–1356.

Kolp, E., Wilkens, M.R., Pendl, W., Eichenberger, B. and Liesegang, A., 2017. Vitamin d metabolism in growing pigs: Influence of UVB irradiation and dietary vitamin d supply on calcium homeostasis, its regulation and bone metabolism. *Journal of animal physiology and animal nutrition* 101 Suppl 1, 79–94