THE ADAPTIVE SIGNIFICANCE OF HUMAN SCLERAL BRIGHTNESS. AN EXPERIMENTAL STUDY.

JUAN PEREA GARCÍA[1], DARIUSZ DANEL[2,], ZDZISŁAW LEWANDOWSKI[3], SLAWOMIR WACEWICZ*[4]

*Corresponding Author: wacewicz@umk.pl
[1] National University of Singapore, Singapore
[2] Hirszfeld Institute of Immunology and Experimental Therapy, Wrocław, Poland
[3] University School of Physical Education in Wrocław, Poland
[4] Center for Language Evolution Studies, Nicolaus Copernicus University, Toruń, Poland

1. Objective

Several of the most influential language evolution scholars (e.g. Tomasello et al. 2007, Knight and Lewis 2017, cf. also e.g. Hare 2017) have opined that the emergence of the homogeneously pale sclera characteristic of modern humans was a prerequisite for, and turning point in, the evolution of language. However, the understanding of the exact role and origin of this trait has remained highly speculative, with initial investigations suggesting that it evolved to facilitate eye-gaze following by conspecifics. It is unlikely that our species went from the typically pigmented sclera of most other primate species to its current state in the absence of proximate functions that made partial depigmentation adaptive. The literature (see esp. Danel et al. 2020) enumerates several non-mutually exclusive proximate functions that could have mediated the transition from pigmented to depigmented sclerae. These functions include the signaling of:

- attractiveness and health (e.g. through symmetrical depigmentation that affords the perception of changes in vasculature or pigmentation),
- reliability and trustworthiness (e.g. by facilitating the perception of one's gaze and emotions and, thus, intentions),
- reduced emotional reactivity (possibly sharing proximal mechanisms with self-domestication).The aim of our study was to investigate whether partial scleral depigmentation could have been adaptive by signaling reduced aggressiveness, attractiveness, trustworthiness, health, and age.

2. Stimulus and procedure

STIMULUS. We morphed and photo-edited images of the faces of a range of reconstructed hominin species, to create realistic facial images of 20 individually distinct hominins with relatively diverse facial morphologies. We adjusted the brightness of the scleral areas of each individual to achieve a perceptually (i) "humanlike" bright sclera and (ii) "generalised apelike" dark sclera version of each individual. PROCEDURE. 250 demographically diverse participants, recruited via Prolific, rated 10 bright-sclera and 10 dark-sclera hominins randomly presented with online software, by moving sliders between the left (0) and right (100) extremes for each trait. ANALYSIS. We fit separate generalized mixed models (GLMM) for each of our dependent variables (except *Age*, see below) with our manipulation (dark/bright sclerae) as an independent variable. For age, we fit a linear regression model (LM). We included stimuli pairs and participants as random effects in all our models. We predicted that bright-sclera hominin faces would be rated as less aggressive, more attractive, more trustworthy, healthier, and younger than the same faces with a dark sclera. Our study was pre-registered at https://aspredicted.org/TM4_PSK

3. Results

All models found statistically significant differences between pairs of stimuli in the predicted direction (Table 1).

Table 1. Summary of the LM (Age) and GLMMs (the remaining dependent variables) for "dark-sclera" vs "bright-sclera" pairs of hominin faces.

	Intercept	*Dark-Bright difference*	*t/z value*	*p*
Age (LM)	63.13	4.03	5.30	<0.01
Aggression	-0.44	0.28	38.369	<0.01
Attractiveness	-0.19	-0.37	-50.76	<0.01
Health	0.51	-0.39	53.17	<0.01
Trustworthiness	0.24	-0.31	-43.25	<0.01

4. Conclusions

Our results show that partial scleral depigmentation in hominins may have been adaptive for signaling functions that possibly predate the deictic function of eye-gaze. Further studies are required to evaluate the role of the familiarity (i.e. human-likeness) of the stimulus in the effects detected in our study.

References

Danel, D. P., Wacewicz, S., Kleisner, K., Lewandowski, Z., Kret, M. E., Żywiczyński, P., & Perea-Garcia, J. O. (2020). Sex differences in ocular morphology in Caucasian people: a dubious role of sexual selection in the evolution of sexual dimorphism of the human eye. Behavioral Ecology and Sociobiology, 74(10), 1-10.

Hare, B. (2017). Survival of the Friendliest: Homo sapiens Evolved via Selection for Prosociality. *Annual Review of Psychology* 68:1, 155-186.

Knight, C., & Lewis, J. (2017). Wild voices: Mimicry, reversal, metaphor, and the emergence of language. *Current Anthropology*, 58(4), 435-453.

Tomasello, M., Hare, B., Lehmann, H., & Call, J. (2007). Reliance on head versus eyes in the gaze following of great apes and human infants: the cooperative eye hypothesis. *Journal of human evolution*, 52(3), 314-320.