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Pupillometry: Psychology, Physiology, and Function

Sebastiaan Matht

Discussion Research ID	DPR-2026-1233
Year	2018
Field	Neuroscience
DOI	10.5334/joc.18
Author ORCID	0000-0003-3379-8584
Licence	CC-BY
Original source	Journal of Cognition
Permanent link	https://discussionpublishers.com/research/9aa910c1-dc59-46f4-8cf7-eb2d0c050c0d
Publisher	Discussion Publishers discussionpublishers.com

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Cite as: Sebastiaan Matht (2018). Pupillometry: Psychology, Physiology, and Function. Discussion Publishers, DPR-2026-1233.

Abstract

Pupils respond to three distinct kinds of stimuli: they constrict in response to brightness (the pupil light response), constrict in response to near fixation (the pupil near response), and dilate in response to increases in arousal and mental effort, either triggered by an external stimulus or spontaneously. In this review, I describe these three pupil responses, how they are related to high-level cognition, and the neural pathways that control them. I also discuss the functional relevance of pupil responses, that is, how pupil responses help us to better see the world. Although pupil responses likely serve many functions, not all of which are fully understood, one important function is to optimize vision either for acuity (small pupils see sharper) and depth of field (small pupils see sharply at a wider range of distances), or for sensitivity (large pupils are better able to detect faint stimuli); that is, pupils change their size to optimize vision for a particular situation. In many ways, pupil responses are similar to other eye movements, such as saccades and smooth pursuit: like these other eye movements, pupil responses have properties of both reflexive and voluntary action, and are part of active visual exploration.

Keywords: pupillometry, pupillary light reflex, pupil dilation, arousal, cognitive effort, neural pathways, vi

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