Differential axon terminal spread and synapse numbers amongst afferent neurons onto a locust's movement detector

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Background incl. aims
The locust giant movement detector neurons, LGMD1 and LGMD2, faithfully signal impending collisions by summing up information about changes in light levels across the compound eye. These changes in light levels are transmitted by trans-medullary afferent neurons that correspond to the thousands of facets of the locust's eye. It is known that the afferent neurons preserve anatomy, so each afferent transmits signals from a defined facet and reaches a defined area on the LGMDs dendritic tree, but anatomical studies of afferent neurons are very rare, with the exception of two full length – reconstructions from a fourth larval instar (reference). In order to detect differences in afferent anatomy, spread of their terminal arbour along the LGMD, and synapse numbers between neighbouring afferents and between the LGMD1 and LGMD2, we are 3D - reconstructing the terminal arbours of afferents of both the LGMD1 and LGMD2.

Methods
Tissue taken from adult locusts is chemically fixed, contrasted and embedded and either one of two 3D Scanning electron microscope methods are employed : either the tissue is serially sectioned within the chamber of a scanning electron microscope and the block face scanned (serial block face SEM), or series of sections are produced using an automated tape collection ultramicrotome (ATUMTome SEM), which are later scanned using Zeiss Atlas software in a Zeiss Gemini SEM.

Results
Surprisingly, in the LGMD2, we found two types of trans-medullary afferent neurons: first, second, other neurons that were rarer had a significantly larger spread of neurites and significantly more synapses among. Retinotopy appeared to be preserved for both neuron types.

Conclusion
The fact that some afferent neurons exhibit larger spread of arbours and more synapses onto the LGMD2 is surprising and has consequences for signal transduction. We assume that for the larger neurons, signal strength is increased at the cost of resolution.
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Wernitznig S et al., J Comp Neurol 2022, 530:518