

Response to Reviewer 1 Comments

1. Summary

Thank you for your valuable feedback and suggestions regarding our manuscript (insects-3665047). We have fully incorporated all of your recommendations. All modifications made in response to your comments are clearly highlighted **in red within the resubmitted manuscript files**. We have also specifically addressed the points raised by the reviewers as follows:

- (1) **TEM Image Descriptions:** We have carefully re-examined all TEM images and have revised their descriptions based on the typical characteristics observed in each image. We believe these updated descriptions resolve the previous points of confusion.
- (2) **SEM Images of Internal Compound Eye Morphology:** We acknowledge that the quality of these specific SEM images was insufficient and raised questions. Consequently, we have removed these images. We maintain that their removal does not affect the overall results presented in the text, as the key findings are clearly substantiated by the TEM data. Further, we have also added new TEM images in the resubmitted files.
- (3) **Updated Methodology for Facet Analysis:** We have discontinued the outdated replica methodology using nail polish (referencing Ribi et al., 1989) for facet counting and distribution pattern analysis. Instead, we have reverted to using SEM to observe the compound eye surface. All relevant images and associated measurement data are now provided in the Supplementary Materials (see files: Facet number and diameter.zip and measurement data.xlsx).
- (4) **Image Abbreviations:** We have meticulously reviewed all figure abbreviations throughout the manuscript to ensure accuracy and clarity. Detailed definitions for all abbreviations are now provided, and we confirm their correctness in the resubmitted files.
- (5) **Discussion Section:** We have thoroughly revised the Discussion section. The revised text provides a clearer summary and focuses the discussion more concisely on the interpretation of our specific results, reducing reliance on comparisons with previous work by other authors where appropriate. We believe this results in a more accurate and focused discussion.

Finally, we appreciate the opportunity to improve our manuscript and hope these revisions fully address the reviewers' concerns. Please find our detailed revisions in the resubmitted files.

2. Questions for General Evaluation	Reviewer's Evaluation	Response and Revisions
Does the introduction provide sufficient background and include all relevant references?	Can be improved	We have incorporated essential research background detailing the unique role of the fig wasp visual system. These modifications are highlighted in red within the resubmitted manuscript files.
Are all the cited references relevant to the research?	Yes	While reviewers did not request changes to references, we conducted a thorough review of all cited sources central to our research.
Is the research design appropriate?	Must be improved	We have replaced the outdated replica methodology using nail polish (Ribi et al., 1989) with SEM observations, which provide more precise results for facet counting and distribution pattern analysis.
Are the methods adequately described?	Yes	We optimized the experimental methods within the Materials and Methods section to better reflect the study's integrated design.
Are the results clearly presented?	Must be improved	We recognize that previous confusion may have stemmed from either the presentation of images/result descriptions or the inadvertent omission of a key figure in the

		initial submission. All such issues have now been resolved: errors were corrected, missing image restored (Figure 9), and result descriptions comprehensively rewritten. These revisions are labelled red in the resubmitted files.
Are the conclusions supported by the results?	Must be improved	In accordance with the new description, we have corrected all of the conclusions in the resubmitted files.

3. Point-by-point response to Comments and Suggestions for Authors

Comments 1: *Line 19: "neurons (retinula cells)" no need to simplify, just retinula cells*

Response 1: *Thank you for your feedback. In the resubmitted files, we have replaced "neurons" with retinula cells at line 19. Additionally, we have corrected some specific errors in the abstract section on lines 16-17. Please review these changes.*

Comments 2: *Line 21: ommatidial core – what is it? Maybe authors mean the basal matrix.*

Response 2: *We apologize for the spelling error; as correctly noted by the reviewer, this should be basal matrix at line 20.*

Comments 3: *Line 38: the same "ommatidail core".*

Response 3: *Thank you for your feedback. We have made the necessary revisions accordingly at line 38.*

Comments 4: *Materials and methods: Need a section on the principle of retinal cell numbering.*

Response 4: *Agree, we have added the following description at lines 198-200: "Retinula cell counts followed standardized Drosophila numbering, while morphology (R8 positioning, basal cells, axonal projections) was evaluated according to Friedrich et al. (2011) [13] ". Please review it in the resubmitted files. Thanks.*

Comments 5: *The scan of the internal structure of the ommatidia seems pointless. All discussion and interpretation of the images is questionable.*

Response 5: *We fully agree and have removed these images. Their exclusion does not affect the core conclusions, as key findings are robustly supported by the TEM data. We have additionally included new TEM images in the resubmitted manuscript.*

Comments 6: *on lateral (side?) of the head.*

Response 6: *We agree that a descriptive error was present and have revised line 210 in accordance with the reviewer's recommendation.*

Comments 7: *It seems that there is a mismatch in the drawing. At fig 2C dorsal/ventral is mixed up with anterior/posterior. If so, some sections should be rewritten based on the correct orientation. For example, in discussion 458-459.*

Response 7: *To more accurately represent head orientation, we have annotated Figure 2C. We attribute previous misinterpretations to the unique morphological adaptations of pollinating fig wasps. These insects exhibit an elongated head morphology (see new Figure 2C in resubmitted files), an adaptation for traversing the fig ostiole, with their dorsal surface bearing two rows of sclerites. This provides a reliable diagnostic feature (see Figure 1 below). Additionally, facet size and distribution patterns in female *C. graveleyi* (Figure 3 in resubmitted files) offer further identification cues. Collectively, this evidence confirms the accuracy of Figure 2C.*

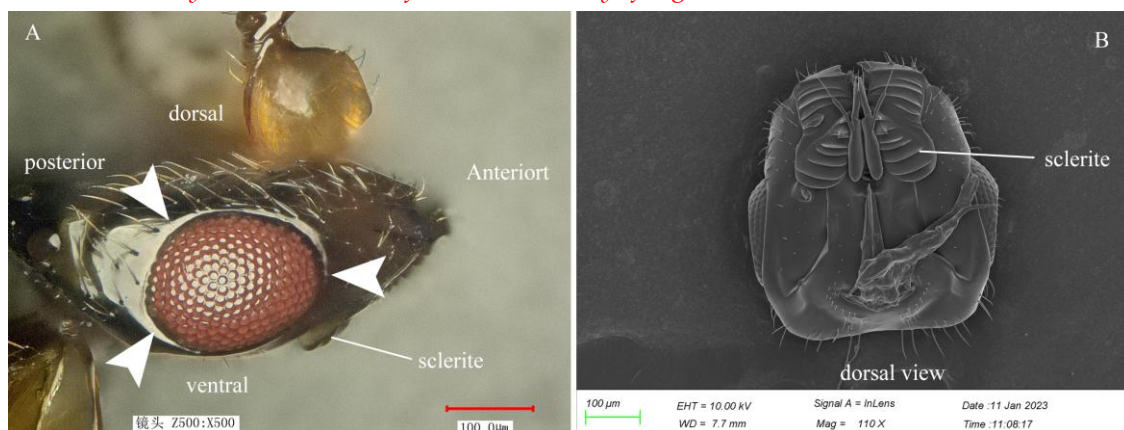


Figure 1 Head morphology and orientation in a female pollinating fig wasp. Note the subtle anterior extension of the compound eye compared to posterior regions (arrowhead).

Comments 8: *The caption to Fig.2 C.graveleyi should be highlighted in italics -> *C. graveleyi**

Response 8: *We agree and have implemented this correction at line 227, with the relevant text now clearly labeled. Thank you for your feedback.*

Comments 9: *Fig.4 SPC boundaries are absent. Do they have projections to the BM or not? What are the dots in the picture along the entire ommatidium?*

Response 9: *Completely agree. We have redrawn Figure 4 in new files and corrected all errors, including the cone cell projection and black dotted circles. The latter were previously labeled as errors in the previous figure. We sincerely apologize for my omission.*

Comments 10: *Fig. 5 lacks explanation of abbreviations for the figure*

Response 10: *Yes, we have added the abbreviations relevant to Figure 5. Furthermore, we have included all abbreviations involved in all figures within the new text.*

Comments 11: *All sections need to be redone taking into account the exclusion of scan illustrations, on which nothing is visible, and the replacement of some illustrations fig 9, on which what is*

described is also not visible)

Response 11: Yes. The original Figure 9 illustrated changes in retinula cells and rhabdoms within the compound eye of female *C. gravelyi*. Regrettably, during manuscript revision, the corresponding author inadvertently deleted a key image set. This omission exacerbated confusion in our initial submission. We have now included a new Figure 9 in the resubmitted files that accurately presents these morphological changes. We sincerely apologize for this oversight and respectfully request the reviewer's examination of the revised descriptions in the updated text. Thank you for your attention to this matter.

Comments 12: Line 286-288: pores are not visible in the picture

Response 12: Agree. We believe this issue was caused by the SEM images of internal compound eye morphology. We have removed this image set from the new files. Thank you.

Comments 13: Fig.6. A - the boundaries between the cells are subjective.

Response 13: Yes, we have removed this image set from the new files. Thank you.

Comments 14: Fig.7 there are no legends in the figure captions. The abbreviations on the figures are not visible (D- PAL) and what is pal? The shape of the fragment D is not the same as lined in B.

Response 14: Yes, we have now regrouped these images in the updated text (see new Figure 6F-G). We believe that this new image set can better demonstrate the accuracy and performance of the dioptric apparatus in *C. gravelyi*. Additionally, we have explained why Figure 7D was chosen in the previous text, as the longitudinal section provides a clearer view compared to the magnified version of the same image. This new image demonstrates the same result as the previous Figure 6D, as shown below: it displays the cone cell's proximal region (left) and its structural details (right). Thank you.

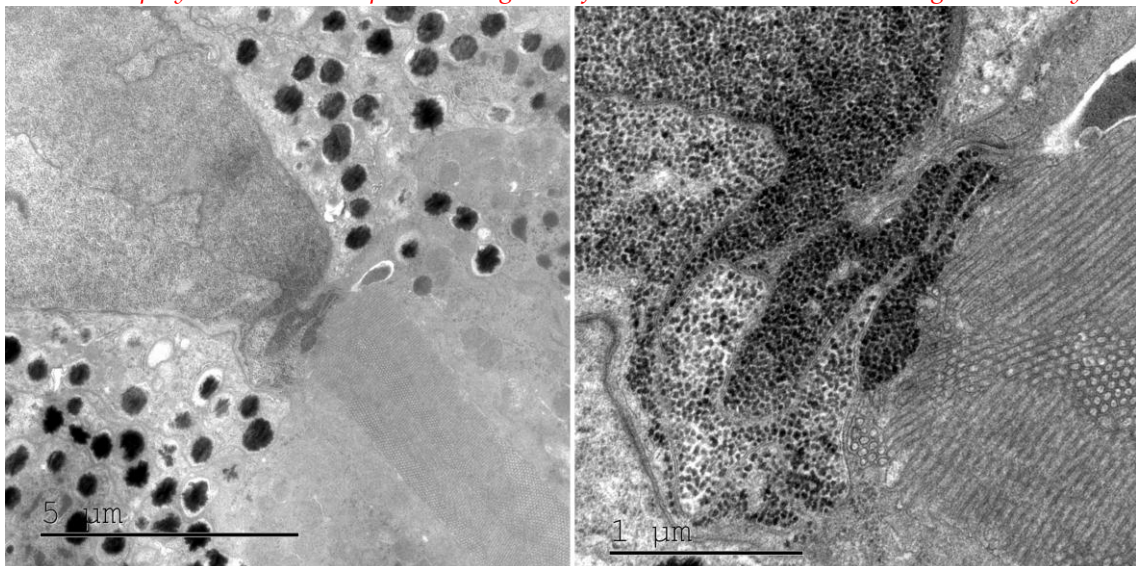


Figure 2 Longitudinal section of the cone cell's proximal region and its basal structural details.

Comments 15: Line 317: Dotted lines delimit cells, not organelles.

Response 15: Please see the above reply. This revised image set provides an accurate representation of the dioptric apparatus in *C. gravelyi*, enhancing both clarity and analytical value. Thank you.

Comments 16: *Line 327-329: there should be any symbols or arrows on the picture to clarify which of these are projections of PPC*

Response 16: *Yes, the previous description raised some questions. Based on the new image set, we have redescribed the results in the updated manuscript. Please review it at lines 312-316.*

Comments 17: *Line 340: there should be mitochondria in SPC!*

Response 17: *We fully agree and have implemented this correction in the revised manuscript, supplemented with new supporting images. Thank you.*

Comments 18: *Line 327-329: there should be any symbols or arrows on the picture to clarify which of these are projections of PPC*

Response 18: *We have incorporated these symbols into the updated manuscript's images. Thanks.*

Comments 19: *Line 340: there should be mitochondria in SPC!*

Response 19: *Yes, the SPC have typical mitochondria, which are labeled in Figure 6D of the updated file. Please review it. Thanks.*

Comments 20: *Line 363: banded pattern should be illustrated on longitudinal sections. It is not a common organization. A banded rhabdom organization, in which layers of microvilli are arranged perpendicular to each other, is known in decapod crustaceans and in few insect species (Meyer-Rochow, 1972; Makarova, Polilov, 2018; Yang et al., 2024). The occurrence of a banded rhabdom in decapods and in some hexapod species may result from a convergence in relation to some special function in light reception.*

Response 20: *Regarding the fused rhabdom of female *C. gravelyi*, there was a significant error in our previous description. The key cause was misclassifying the longitudinal direction as transverse, which led to an incorrect characterization of the fused rhabdom as a band rhabdom. We have identified this artificial mistake and corrected these descriptions in the updated manuscript. Furthermore, we have revisited and discussed this correction in the discussion section. Please review these changes. Thank you.*

Comments 21: *Line 375: figures 6,7 do not illustrates the high density near the ER*

Response 21: *We identified some errors in the previous manuscript and have added a new image set that more clearly illustrates the changes between the perirhabdomeric and pigment granules under both light and dark adaptation. Please review these updates in the revised manuscript. Thank you.*

Comments 22: *Line 378: the alignment of pigment granules do not visible at figure 9A.*

Response 22: *Please refer to our response to comment 21. Thank you.*

Comments 23: *Fig. 8 there is no explanation of the symbols in the captions*

Response 23: *Yes, we have corrected these errors in the revised manuscript. Please review the updated Figure 7. Thank you.*

Comments 24: *Line 389: what is "central rhabdom"?*

Response 24: Yes, we recognized that the original description could be misinterpreted. This has been corrected to “Retinula cells in the central region of the micrograph are labeled lime-green; adjacent retinula cells are assigned red and steel-blue”. Please review this revision on lines 363-364 of the revised manuscript.

Comments 25: Line 396: does not show the rhabdomeric triplet

Response 25: We have added a new image (Figure 7C in the revised manuscript) to support this description. Please review this update in the revised manuscript. Thank you.

Comments 26: Line 409: change “grandules” to “granules”

Response 26: “Grandules” is now corrected to “granules” in the text. Thank you.

Comments 27: Fig 9 There is no explanation of the Abbr in the figure captions. Nothing is clearly visible on the images. The bundle of axons needs to be marked so that the boundaries are clear.

Response 27: We have corrected the abbreviation error throughout and marked the axon bundle (dotted box in Figure 7B of the revised manuscript). The updated figure better illustrates our findings. Additionally, we have included a new Figure 9 and 10 providing further evidence supporting these results. We believe these revisions address all reviewer concerns. Please evaluate the updated manuscript. Thank you.

Comments 27: In the text, either *M. mymaripenne* or *M. viggianii* is linked to the same references. For example, line 453 *M. mymaripenne* (8,9,15) and line 484 *M. viggianii* (9,15). *M.viggianii* should be indicated everywhere based on the revision Fusu, Polaszek & Polilov 2022

Response 27: We acknowledge this error, which arose because studies on this parasitoid wasp were conducted by the same author at different times. To resolve this conflict, we have cited the most directly relevant reference in the revised manuscript. Please review this correction in the updated document. Thank you.

Comments 28: Line 497: change “cpmstraints” to “constraints”

Response 28: “cpmstraints ” is now corrected to “ constraints ” in the text. Thank you.

Comments 29: Line 544-545: and how it consistent with findings on *C. gravelyi* ?

Response 29: The original manuscript may contain an inaccurate description. We always observe the subcorneal layer of *C. gravelyi* females lying immediately beneath the cornea. This has been clarified in the revised manuscript (lines 523-524): The subcorneal layer consistently appears immediately beneath the cornea in *C. gravelyi* females. Please verify this correction. Thank you.

Comments 30: Line 695: “few pigment granules” what is it mean? There are not a few...

Response 30: This inaccurate description has been corrected to “Pigment cells surround each ommatidium, with pigment granules and mitochondria localized in both pigment cells and retinula cells” (revised manuscript, lines 636-637). Please verify this revision. Thank you.

4. Response to Comments on the Quality of English Language

Point 1: The English could be improved to more clearly express the research

Response 1: *We understand that the English quality in the original manuscript could be enhanced. We have addressed and improved all language-related issues through a professional Language Service Company in China (<https://www.liwenbianji.cn/>). If you require certification for the language service, we will provide it upon request. Thank you.*