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## Honeybees flying over a mirror crash irremediably

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# Honeybees flying over a mirror crash irremediably

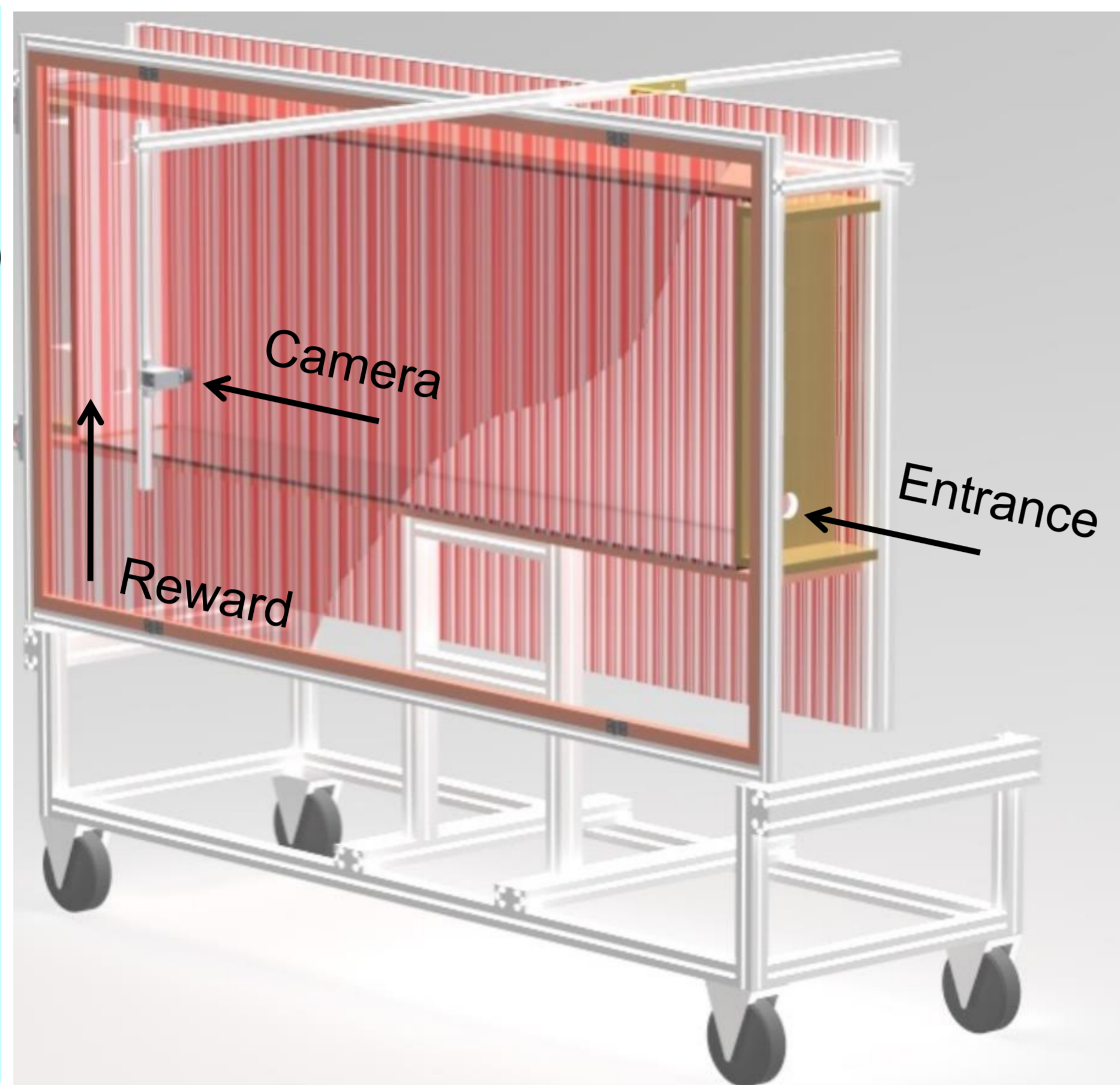
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**Aim:** To investigate if the ventral optic flow is crucial to control honeybees' altitude (*Apis mellifera*)

## Experimental set-up

- Flight tunnel: 25x71x200 cm
- 1.3 first meters recorded
- 100Hz DALSA Genie HM640
- 4 groups of honeybees
- 15 honeybees per group
- 5 distinct optical contexts

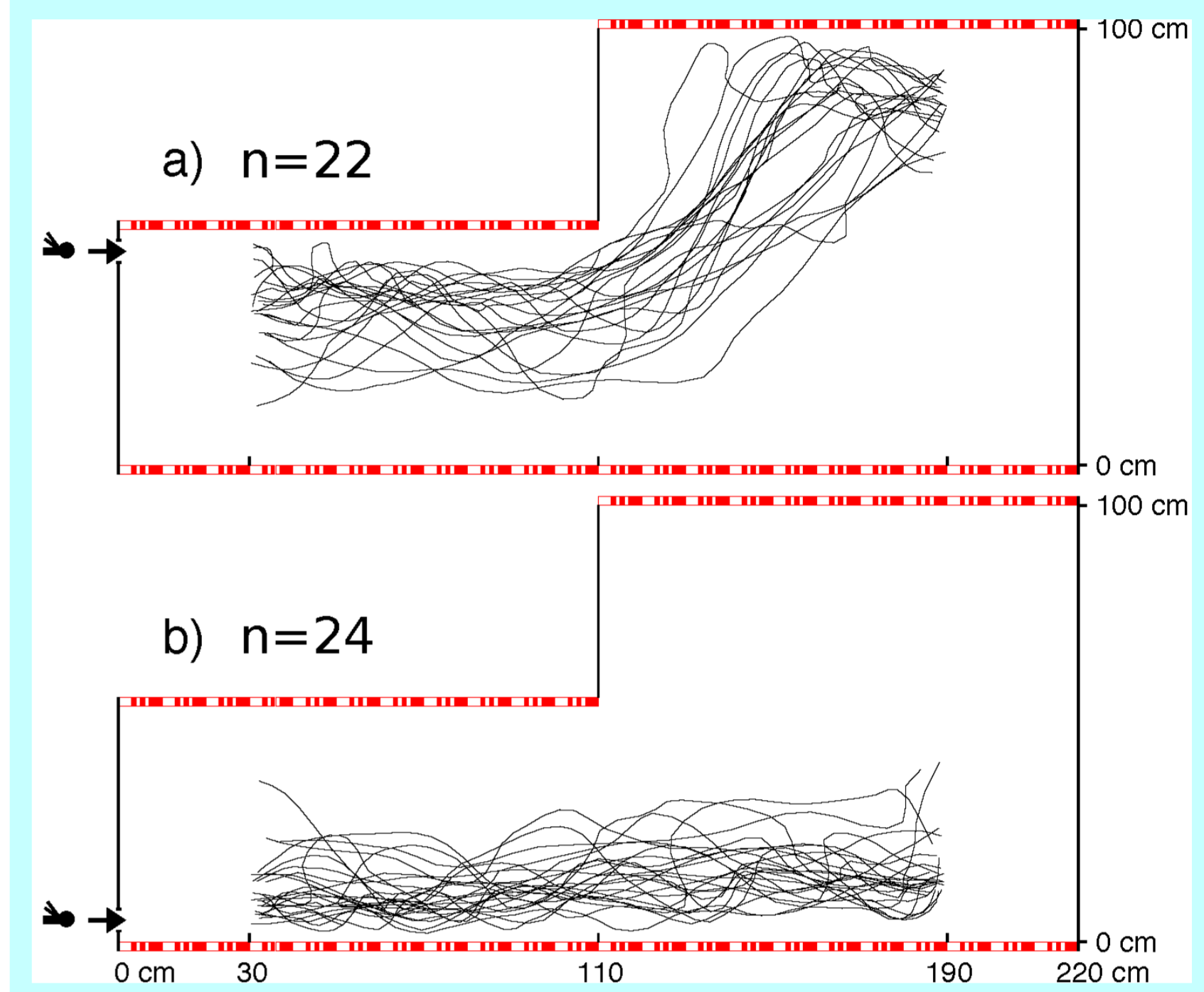


## "Preferred optic flow pattern" Hypothesis

- Honeybees follow surface in tunnel, such as the floor (or the ceiling).
- Honeybees adjust their altitude to restore a ventral (or dorsal) optic flow set-point.
- A ventral (or a dorsal) optic flow pattern seems to be learned by honeybees during the training session.

See references [1-5]

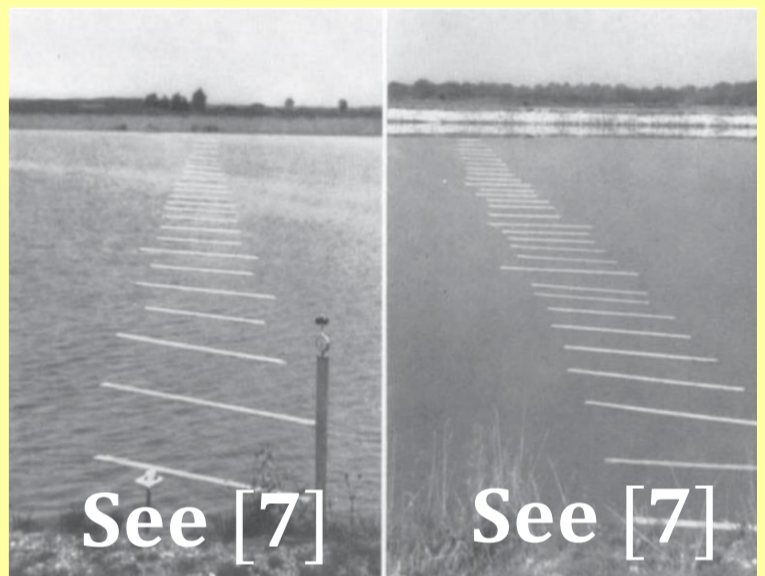
*Are still honeybees able to fly without ventral optic flow?*



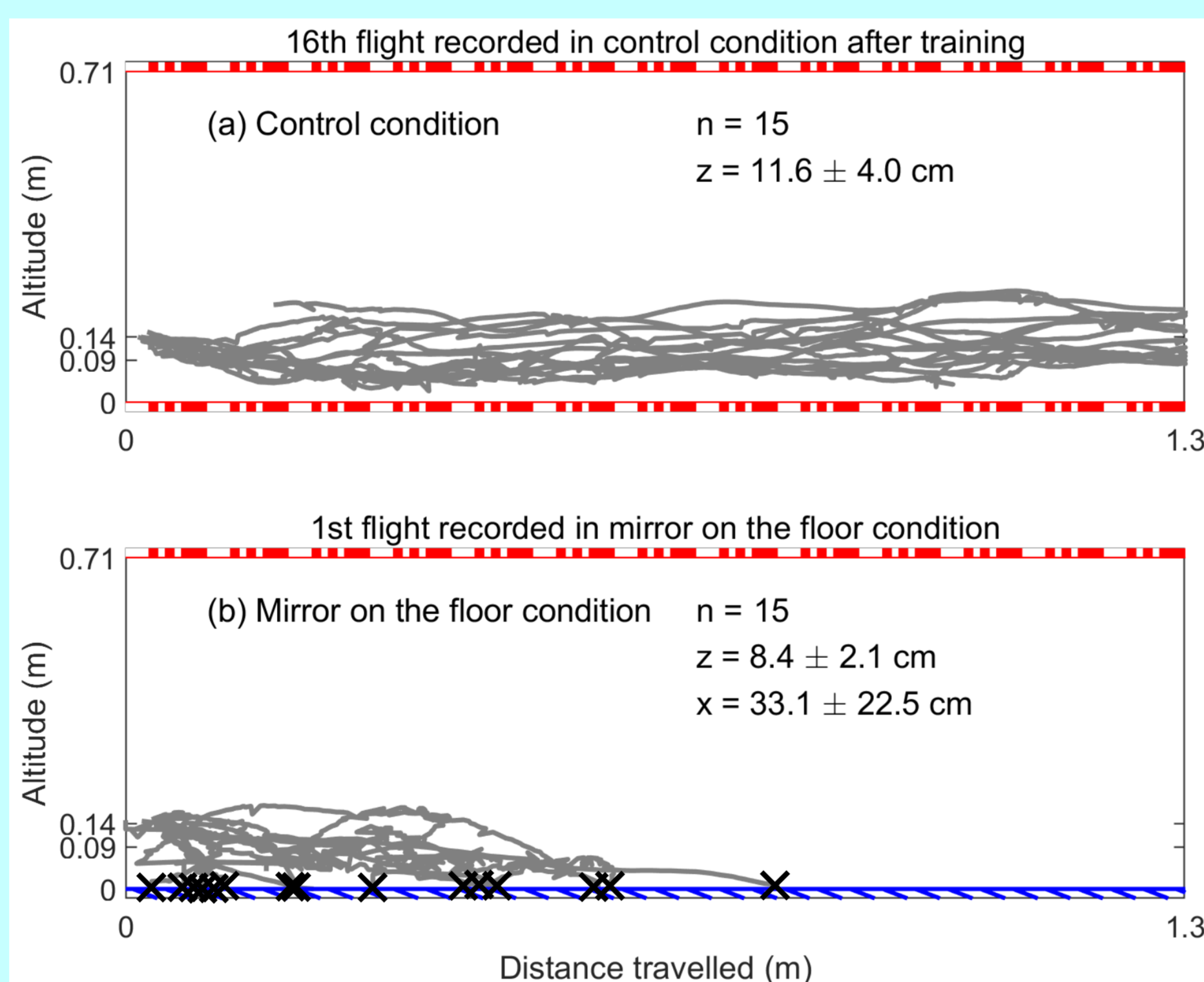
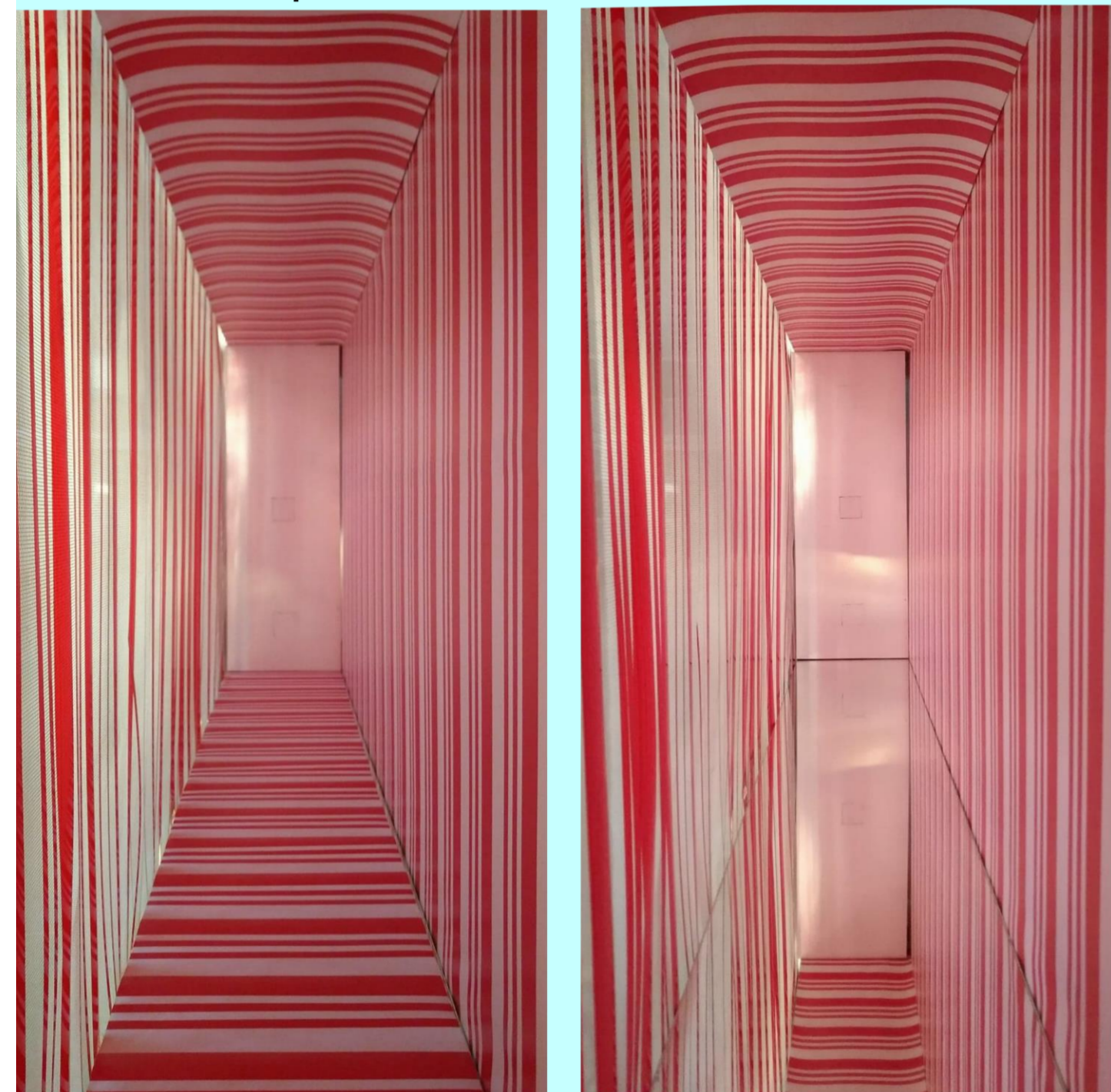
See Portelli, Serres & Ruffier (2017) [3]

## Results: Without ventral optic flow, honeybees crash irremediably on the floor

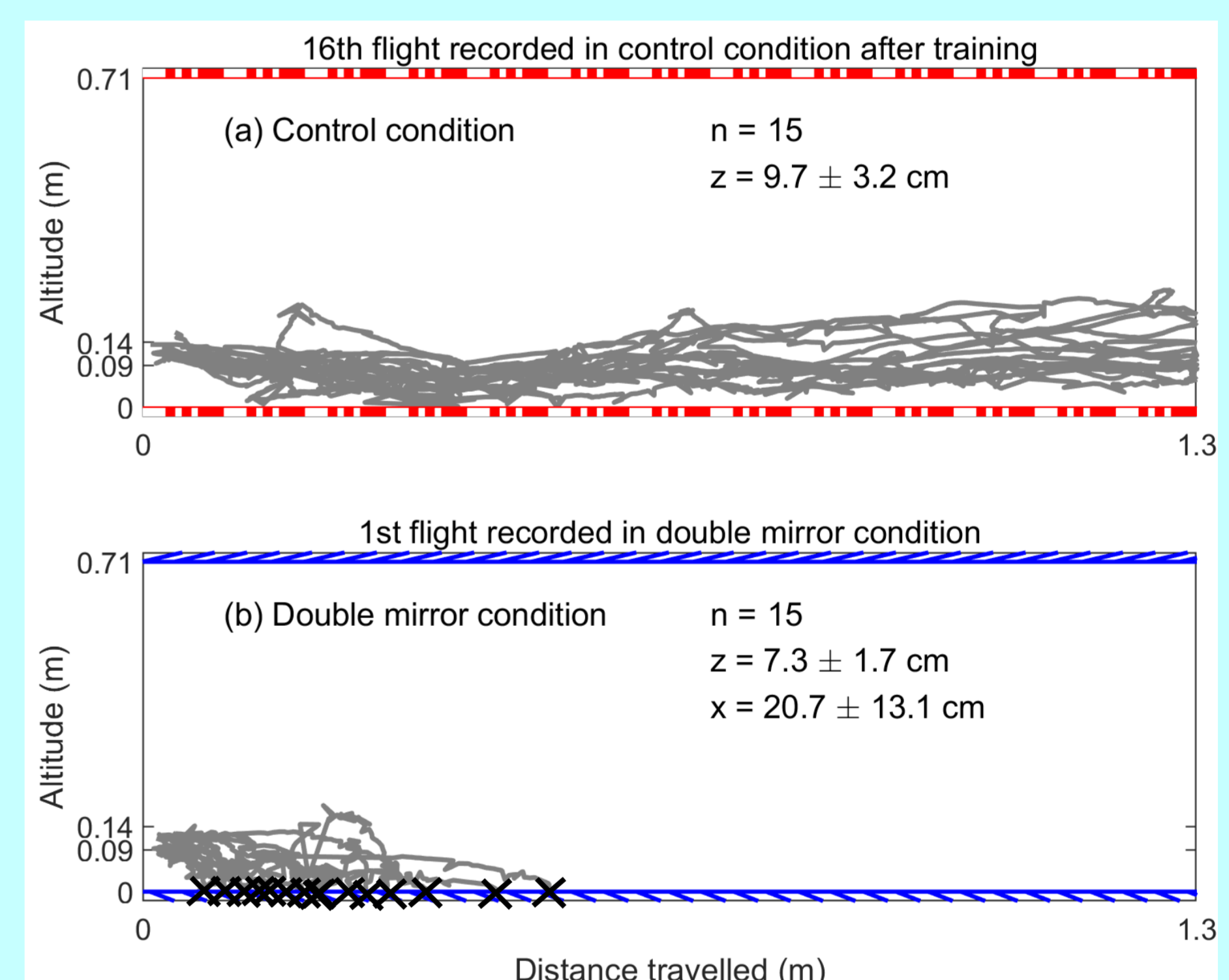
- A pair of mirrors on the floor and ceiling can be independently uncovered to suppress any ventral/dorsal optic flow.
- The double mirror condition reproduces the visual uncoupling condition in connection with the work of the Duchon & Warren (2002) [6]. The honeybee's visual informational support can be therefore uncorrelated between the horizontal and the vertical planes.
- Our study reproduces the seminal experiment of Heran & Lindauer (1963) [7]. They trained honeybees to fly above a water surface. When the water surface was provided a visual contrast, honeybees were able to cross the lake. Otherwise, they drowned.



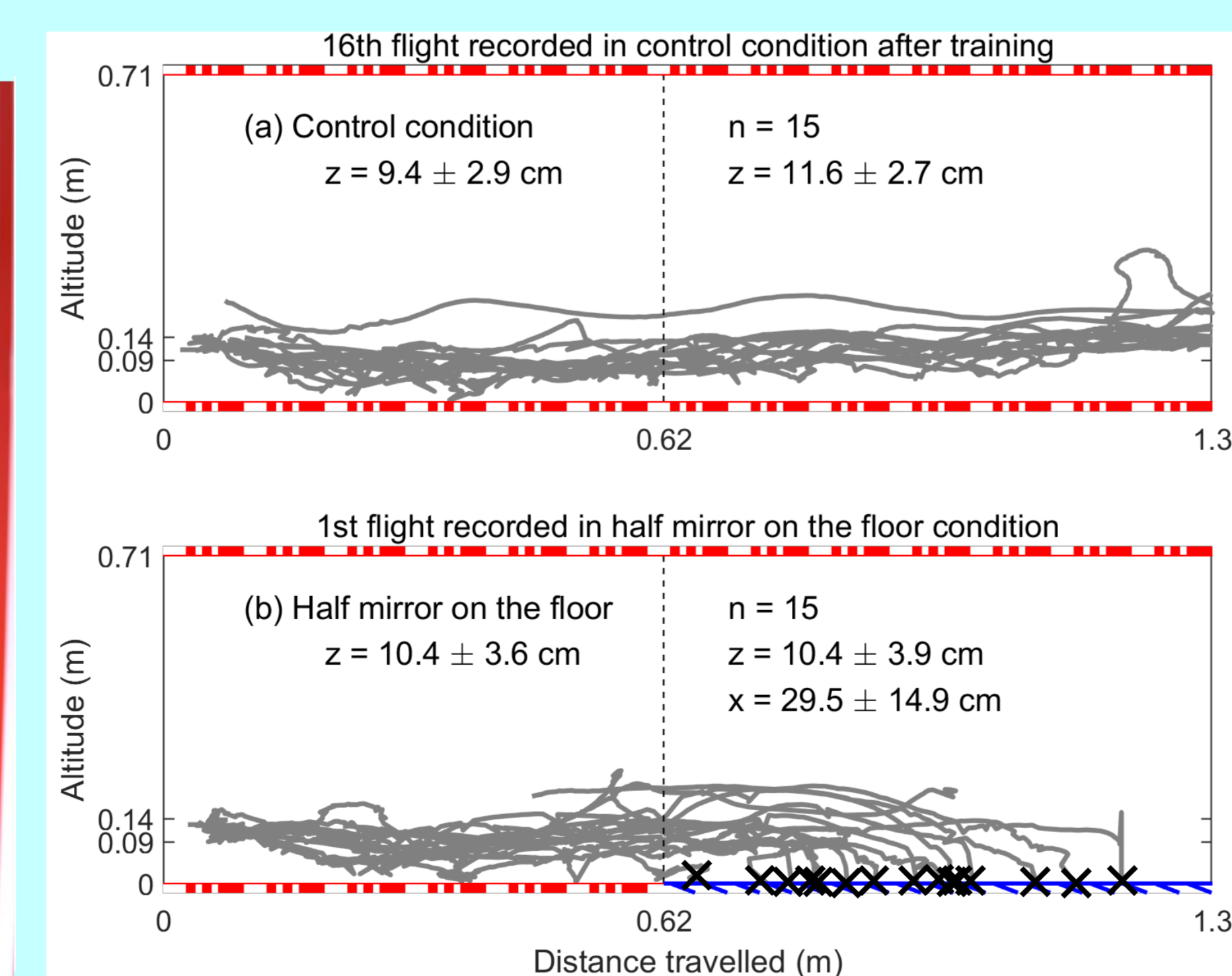
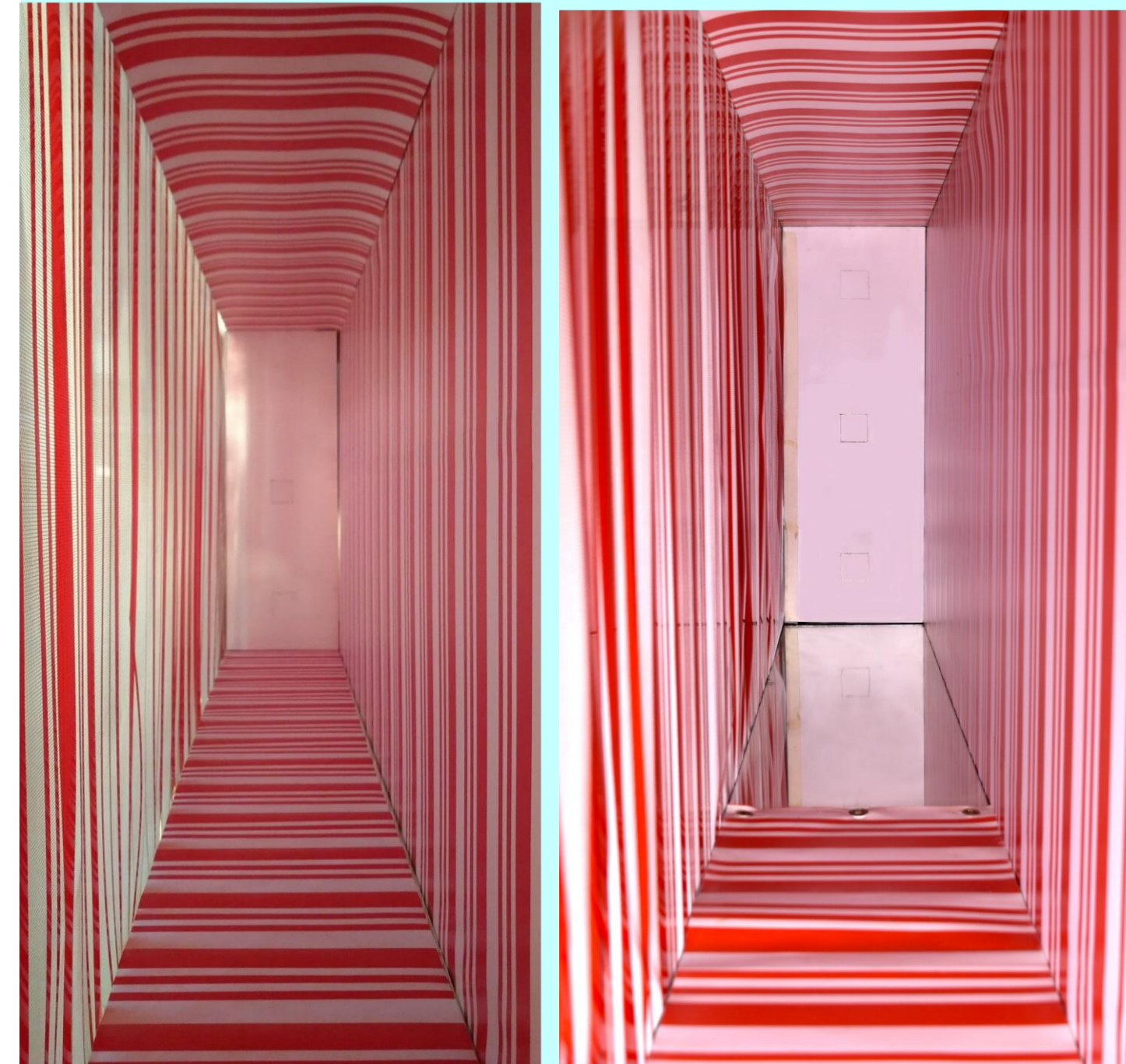
### Control experiment



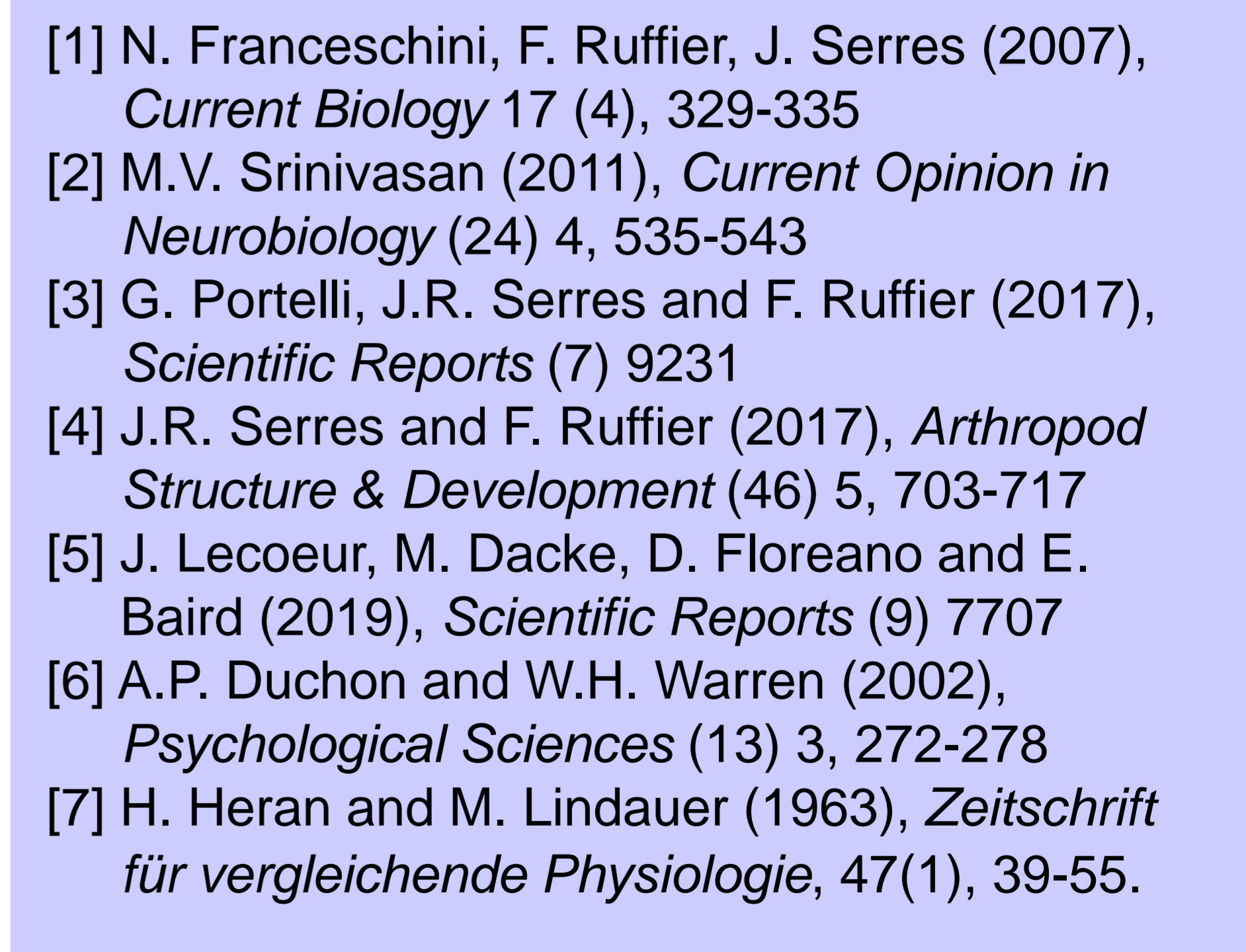
### Double mirror



### Control experiment



### Mirror on the ceiling



- [1] N. Franceschini, F. Ruffier, J. Serres (2007), *Current Biology* 17 (4), 329-335
- [2] M.V. Srinivasan (2011), *Current Opinion in Neurobiology* (24) 4, 535-543
- [3] G. Portelli, J.R. Serres and F. Ruffier (2017), *Scientific Reports* (7) 9231
- [4] J.R. Serres and F. Ruffier (2017), *Arthropod Structure & Development* (46) 5, 703-717
- [5] J. Lecoq, M. Dacke, D. Floreano and E. Baird (2019), *Scientific Reports* (9) 7707
- [6] A.P. Duchon and W.H. Warren (2002), *Psychological Sciences* (13) 3, 272-278
- [7] H. Heran and M. Lindauer (1963), *Zeitschrift für vergleichende Physiologie*, 47(1), 39-55.

## Conclusion

- Half low mirror condition reveals honeybees do not directly crash into the down mirror, but go on to fly before crashing.
- Honeybees do not rely on ventral optic flow directly at right angle to fly over the floor, but instead, rely on the overall ventral optic flow pattern.
- Lateral visual inputs alone do not allow honeybees to control their altitude. Dorsal manipulations alone do not affect honeybees' flight.