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# Un dispositif expérimental pour découpler des invariants optiques dans le contrôle de l'altitude des abeilles

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**Main question:** Perceiving a complex visual environment, what optical invariant does *Apis mellifera* focus on to stabilize its altitude?

## Bases and aims

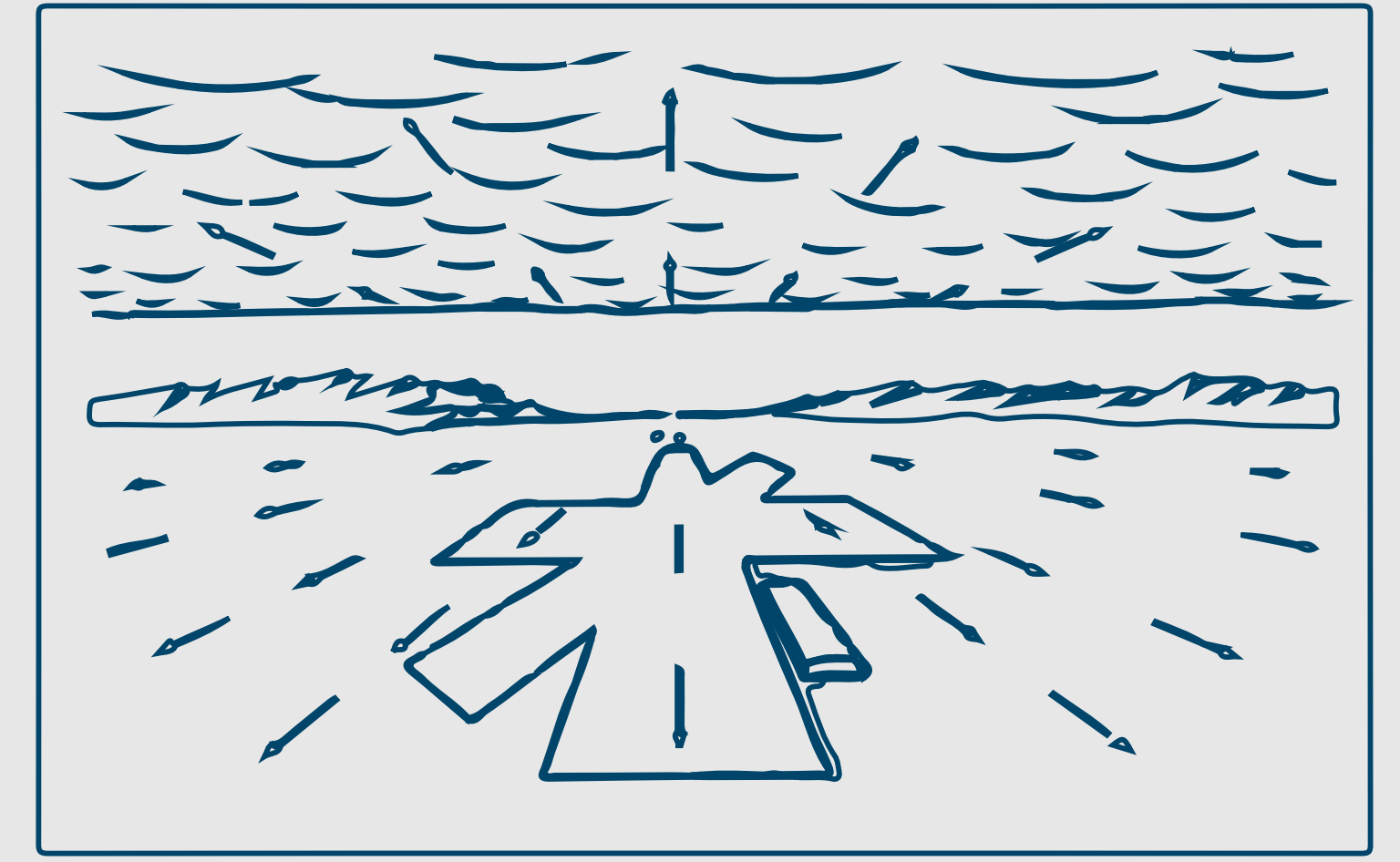
**Optic flow:** vector field of the apparent motion of objects, surfaces, and edges in a visual scene caused by the relative motion between an agent and the scene.

**Optical invariants:** particular properties of the optic flow unaltered when the agent is moving.

Two optical invariants are particularly relevant for a ground-following task:

- **optical speed rate of change  $\dot{\omega}$**  [used by bees and pilots]
- **splay angle rate of change  $\dot{s}$**  [used by pilots]

- Aims:**
- (1) To determine if bees also use splay angle rate of change for performing ground-following tasks
  - (2) To set the priority and weight system by which bees use these two optical invariants to control their altitude



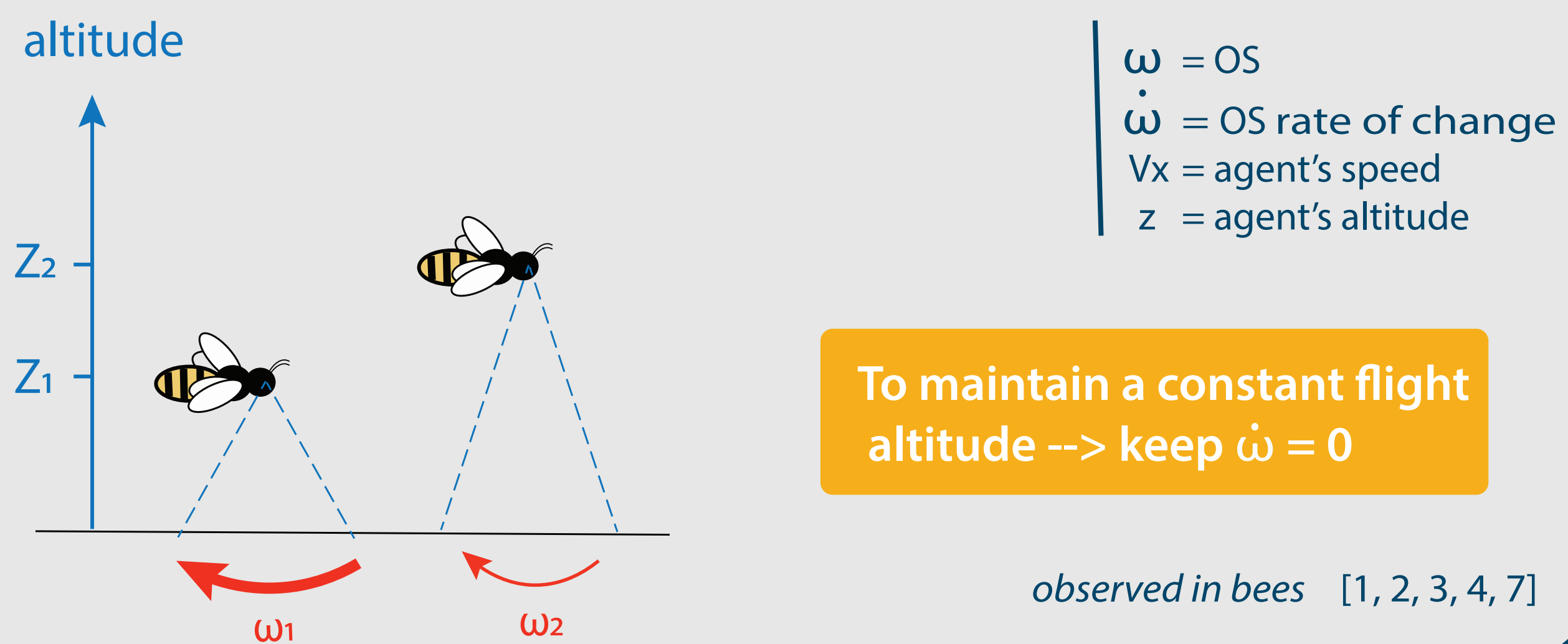
Optic flow field perceived by a flying agent (Gibson 1950, 1979)

### Optical speed (OS) experienced by a flying agent

OS ( $\omega$ ) is the speed of environment's image scrolling the retina when an agent is moving.

- OS increases for an agent going down ( $\dot{\omega} > 0$ )
- OS decreases for an agent going up ( $\dot{\omega} < 0$ )

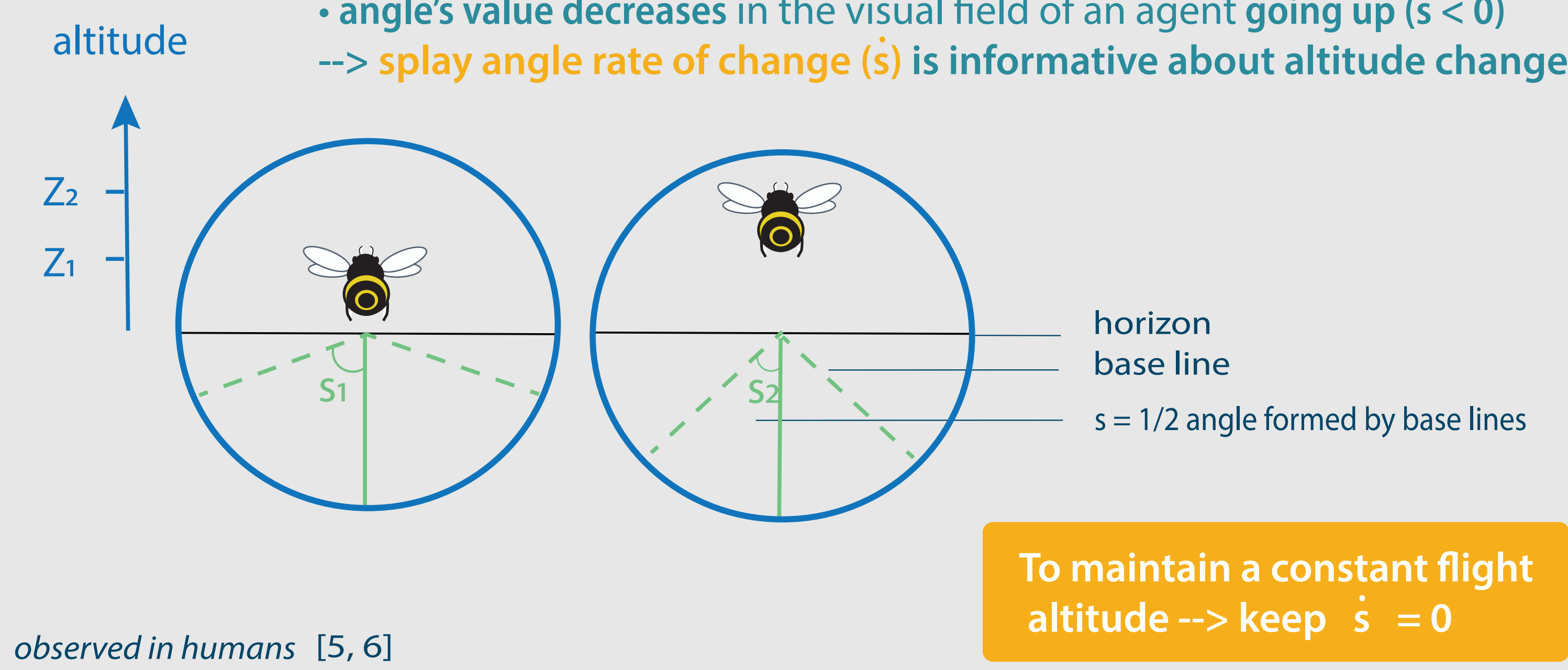
--> **optical speed rate of change ( $\dot{\omega}$ )** is informative about altitude change



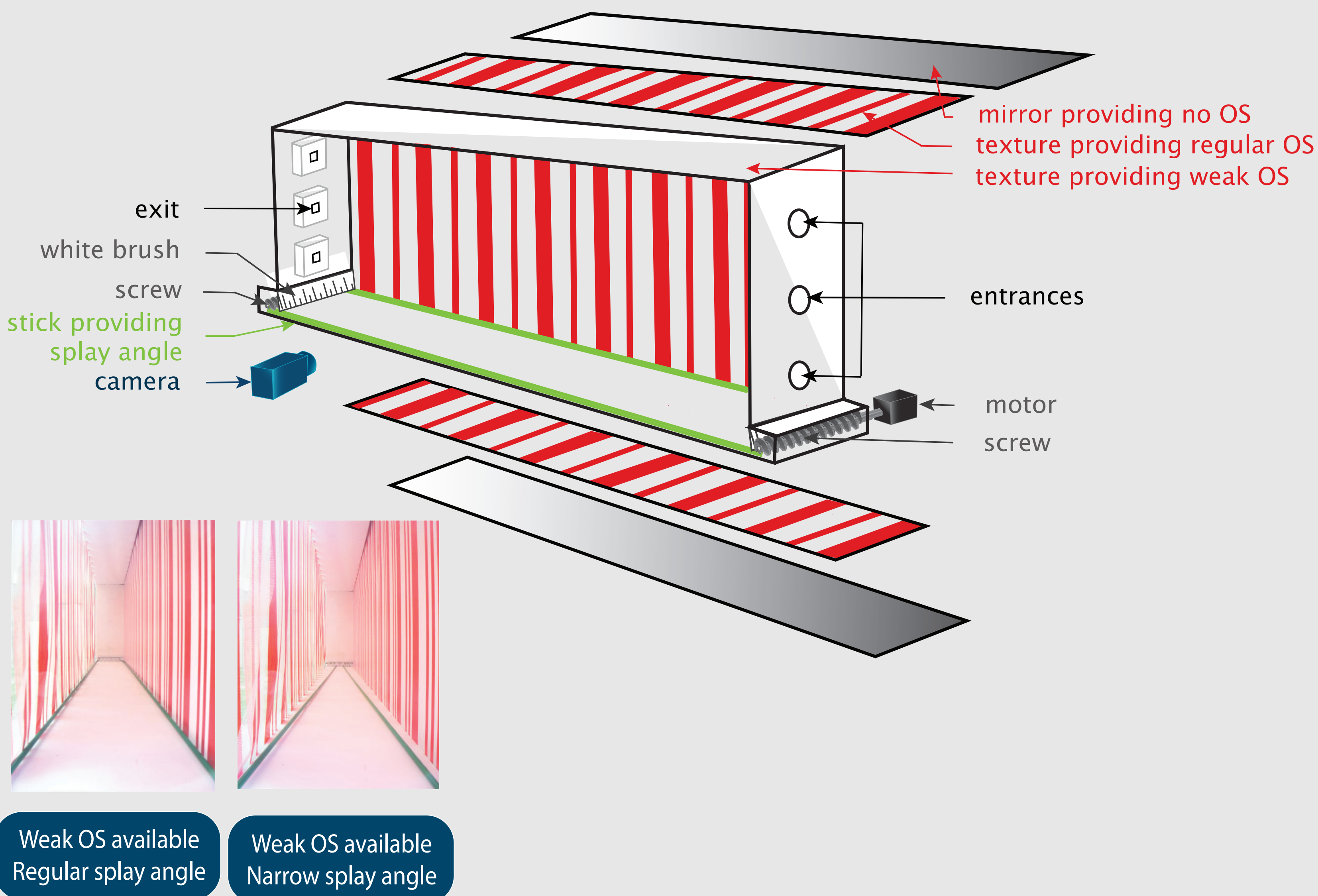
### Splay angle rate of change experienced by a flying agent

Base lines join at the image's focus of expansion forming the **splay angle ( $s$ )**:

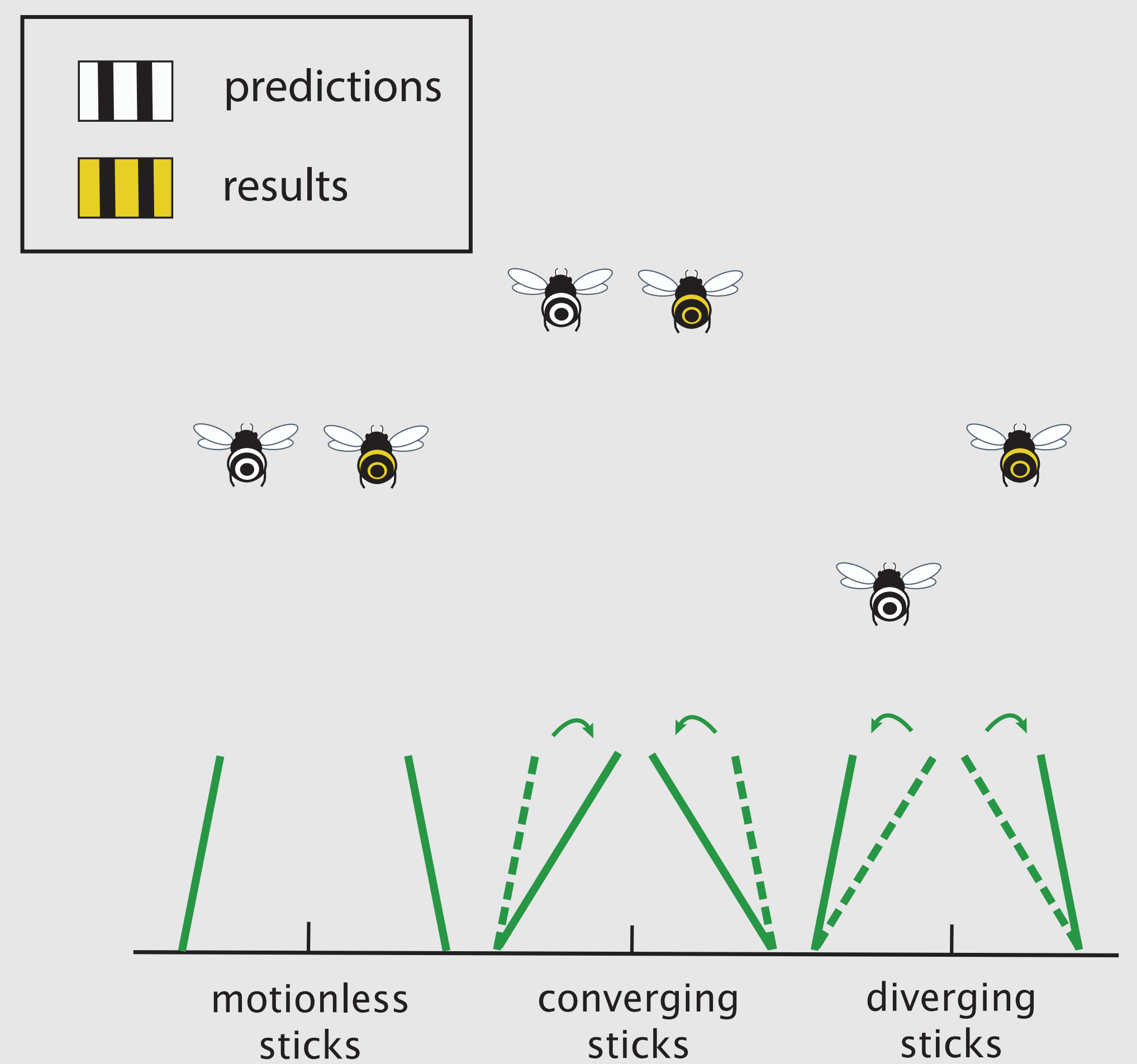
- angle's value increases in the visual field of an agent going down ( $\dot{s} > 0$ )
  - angle's value decreases in the visual field of an agent going up ( $\dot{s} < 0$ )
- > **splay angle rate of change ( $\dot{s}$ )** is informative about altitude change



## Experimental setup



## Predictions and results



• A bee perceiving a **splay's enlargement** will interpret a **loss of altitude**, so it will **go up** to maintain a null splay angle rate of change ( $s=0$ ). ✓

• A bee perceiving a **splay's narrowing** will interpret a **gain in altitude**, so it will **go down** to maintain a null splay angle rate of change. ✗

• A bee perceiving **weak OS** will take into account splay angle's rate of change in priority so it will show **broader altitude changes**. ?

## Highlights

- An experimental setup was designed to investigate whether the splay angle rate of change is implicated in bees' altitude control
- A flight tunnel was built enabling specific manipulations of two optical invariants
- Splay angle rate of change is used by bees to control their altitude in a ground-following task

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