

INSIDE JEB

Robber flies combine approaches to simplify airborne interceptions

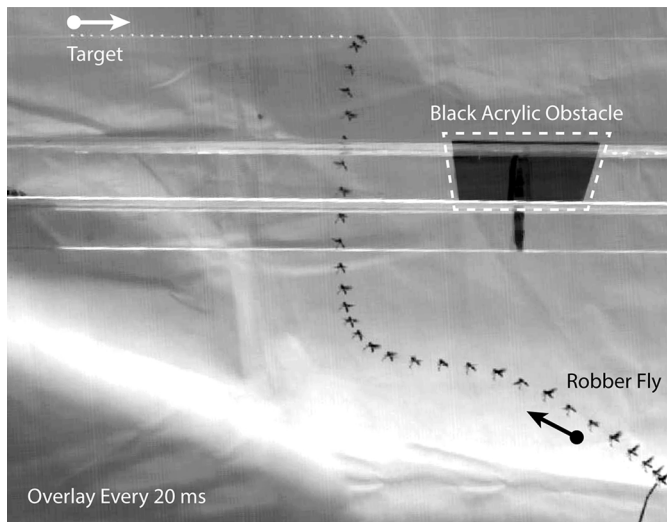


Photo montage of the flight path of a robber fly (*Holcocephala fusca*) avoiding a black bar to intercept a moving bead. Photo credit: Samuel Fabian and Fly Systems Laboratory, UMN.

While many flies are content to land on pieces of fruit or carrion, robber flies (Asilidae) engage in mortal combat. Intercepting smaller insects on the wing, robber flies dine on anything they can subdue. When the view is clear, the aerobic hunters maintain the same line of sight – adjusting it as their target twists and turns – to intercept their quarry; and they do so at extraordinary speed with a brain the size of a grain of sand. Yet, the dogged insects often have to seize prey in complex cluttered environments. ‘Navigating to targets and avoiding bumping into things along the way are tasks that we would hope to achieve in our everyday lives’, says Samuel Fabian from Imperial College, London. So how do robber flies cope with clutter? Fabian, Trevor Wardill and Paloma Gonzalez-Bellido from the University of Minnesota, USA, decided to find out how the predatory insects adjust their interception strategy to deal with distractions.

‘We used *Holcocephala fusca* because of its predictable interception path’, says Fabian, who joined Mary Sumner from

the University of Minnesota, in York County, PA, USA, for four intensive weeks to film the determined flies in 3D while they hunted a tiny bead being pulled along a transparent fishing line. ‘Field experiments are a joy, because you get the most naturalistic behaviour from free animals’, says Fabian. Although this meant that the insects were free to move out of shot just when the cameras were ready to roll. Fortunately, they were also keen to intercept the moving bead; ‘if something is small enough, they generally seem to assume it’s food’, says Fabian. And when he and Sumner analysed the insects intercepting the bead, the animals maintained the same line of sight to the target throughout their approach to successfully capture it. ‘The flies really didn’t know it’s not real prey, even when very close’, chuckles Fabian.

However, when Fabian and Sumner partially obscured the flies’ views, with either a wide (5 cm) or narrow (2.5 cm) bar of black acrylic, as they approached the moving bead, the flies took evasive action and even abandoned the

interception when the broader band obscured their view for more than 0.1 s. Yet, when the bar blocked their line of sight for briefer periods, the flies veered away dramatically until they had passed it, before swerving back and resuming their interception course. On other occasions, when the visual obstacle remained in sight but did not obscure the fly’s view, the insect still veered away from the bar as they approached the bead, even though there was no need to swerve as the bead remained in sight the entire time.

So how was the fly controlling its approach? Fabian, Gonzalez-Bellido and Wardill compared the robber flies’ flight paths and the paths they would have taken if there was no obstacle, and realised that the flies were using a very simple obstacle avoidance strategy; ‘the faster the obstacle is getting larger in their field of view the more they turn away from it’, Fabian explains. However, once the fly has passed the obstacle and it begins to grow smaller, the fly is then drawn back toward it, resulting in the veering flight paths that Fabian and Sumner recorded, even when the fly’s view wasn’t obstructed.

The flies are simultaneously using a combination of the obstacle avoidance strategy and the conventional interception paths used when their view is unobstructed, resulting in a simple hybrid approach that allows them to intercept their prey while avoiding distractions and obstacles in their paths. ‘They are paying attention to their surroundings even when focused on the target’, Fabian concludes.

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Fabian, S. T., Sumner, M. E., Wardill, T. J. and Gonzalez-Bellido, P. T. (2022). Avoiding obstacles while intercepting a moving target: a miniature fly’s solution. *J. Exp. Biol.* **225**, jeb243568. doi:10.1242/jeb.243568.

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