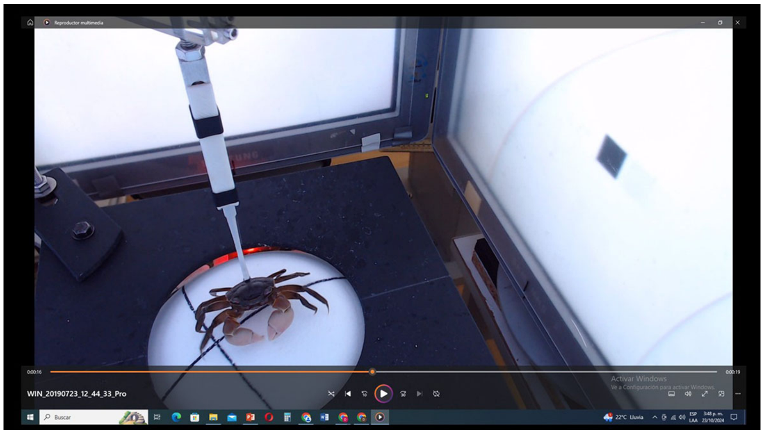
INSIDE JEB

Motion-sensitive neurons help mudflat crabs decide to freeze or flee



A mudflat crab (*Neohelice granulata*) on the spherical treadmill that allows them to run in any direction, with a black square (shown on PC screen on right) simulating an approaching object. Photo credit: Daniel Tomsic.

A predator is bearing down and you have to make a split-second decision: flea to safety or freeze and hope that the attacker passes you by. But make the wrong decision and the risk could be fatal. The stakes are high. Encased in armour, mudflat crabs (*Neohelice granulata*) might not seem conventionally vulnerable – it takes a tough opponent to take one on – but even they freeze like a deer in the headlights when a potentially carapace-crushing object hurtles into view. The question was at which point in a predator's approach would a crab freeze, instead of making a run for it? Fortunately, Damian Oliva (Universidad de Quilmes, Argentina) and Daniel Tomsic (Universidad de Buenos Aires, Argentina) already had a good handle on what makes a mudflat crab run for its life, so they turned their attention to when a mudflat crab decides to stay stock still as a predator approaches.

But for a crab to be spooked into freezing, it has to be on the move already, so Oliva, with Matias Gültig and Alejandro Cámera (both from Universidad de Buenos Aires), set up a crab treadmill, where the crustacean could scamper in any direction. Next, they positioned screens around the treadmill, so they could show the crab a series of expanding squares – simulating solid objects – that ranged in size from 17 to 128 cm wide, projecting an angle of 1.9 to 14.5 deg on the crab's eyes at a distance of 5 m, and closed in at speeds from 0.36 to ∼3 m s^{-1}. Then, they filmed each crab's reactions as the squares loomed toward them.

Initially, as the expanding squares began the approach, the crabs continued to meander. However, as the simulated square objects drew closer, the crabs froze, remaining still to avoid attention until the object looked close enough to the crab to trigger it into fleeing. And when the team calculated the point at which the crabs froze, they realised that it was when the size of the square on the crustacean's eyes increased by 1.4 deg. But how were the crabs making the decision to freeze in order to evade detection?

Knowing that type 1 motion sensitive giant neurons in the crab's brain form a map of the surroundings, keeping track of where objects are, the team painstakingly inserted a tiny electrode into these neurons in several crabs and recorded the electrical signals fired off as they replayed the looming square movies to the crabs. Knowing that the neurons would only fire intermittently while the looming object was distant, the team calculated the number of nerve signals fired during a brief time window until the number of electrical spikes reached a threshold that caused the crabs to freeze. They realised that the crabs stopped moving 135 ms after two electrical spikes had fired off within the preceding 200 ms. This must be part of the complex signal that causes the crabs to freeze.

However, the team points out that the ability to freeze as a distant creature approaches would also be helpful for mudflat crabs that want to avoid being noticed by the smaller crabs upon which they dine. The predator can then resume stalking its prey when the victim is closer, or flea if the 'victim' turns out to be something more threatening. And they explain that type 1 motion sensitive giant neurons also trigger the crabs into running for safety when a threat approaches, making them key players in the crab's decision to freeze or flee.

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