Dirty dancing: dung beetles get down to walk the line

The meticulous insects pirouette atop their dung balls to get their bearings and correct navigational errors.

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As a dung beetle rolls its planet of poop along the ground it periodically stops, climbs onto the ball and does a little dance. Why? It's probably getting its bearings. A series of experiments published in the January 18 issue of PLoS ONE shows that the beetles are much more likely to perform their dance when they wander off course or encounter an obstacle. Until now, no one had any idea what a jitterbugging dung beetle was up to.

Emily Baird of Lund University in Sweden and her colleagues study how animals with tiny brains—such as bees and beetles—perform complex mental tasks, like navigating the world. The dung beetle intrigues Baird because it manages to roll its dung ball in a perfectly straight line, even though it pushes the ball with its back legs, its head pointed at the ground in the opposite direction. If the six-legged Sisyphus can't see where it's going, how does it stay on its course?

Every now and then, a dung beetle stops rolling, mounts its ball and pirouettes. Baird noticed that dung beetles do not dance as often in the lab, where they roll around on flat surfaces, as they do in the field, where the terrain is rough and rocks and clumps of grass often obstruct the beetles' paths. She guessed that by climbing onto a ball of dung four or five times its height, a beetle gets a pretty good vantage point from which to correct any navigational mistakes. But it was only an intuition—she needed evidence.

At a farm in South Africa Baird collected adult Kheper nigroaeneus (a species of dung beetle that "rolls") and placed them in plastic tubs with soil and fresh cow dung. Once the beetles balled up some dung, Baird transferred them to smooth terrain and placed a plastic tube in their paths. A lightweight door hung from one end of the tube, like a tiny cat-flap. Sometimes Baird allowed the door to swing freely as the beetles pushed their ball through the tube; other times Baird secured the door so the beetles could not pass. All 22 beetles in the first experiment mounted their balls and spun around when they encountered a locked door, whereas only one beetle danced when the door swung open. In a similar test, Baird created a small drop-off in the beetles' paths with tubes of different heights. Fifty percent of the beetles that dropped from one tube to the other danced on their dung balls, whereas only 8 percent of the unimpeded beetles danced. Baird thinks that hitting a roadblock triggers the beetles to survey their surroundings and double-check that they are still moving away from the dung pile in a straight line.

To test whether beetles dance if they sense they are off-course, but do not encounter an obstacle, Baird changed the direction the beetles were rolling with semicircular tubes. 17 of 21 beetles that found themselves veering off track stopped to dance on their dung balls. Only two of 21 beetles that Baird left alone danced.

In one of two especially telling experiments, Baird waited for beetles to enter the plastic tubes and then quickly flipped the tube 180 degrees so the beetles were moving in the opposite direction from which they entered the tube. Nineteen of 40 beetles danced after the switcheroo and 18 of those 19 started pushing their dung balls in the original direction, correcting for the flip. Still, Baird had not figured out exactly how dancing helps dung beetles stay their course. Her final experiment offered a clue: The top of a dung ball may be the best place for a beetle to check its progress in relation to the position of the sun. Baird shadowed the beetles from the sun with a wooden board and reflected sunlight onto the beetles with a mirror to simulate a shift of the sun's position by 180 degrees. Nineteen

of 32 beetles danced when subjected to the mirror illusion and 15 of those 19 started rolling in the opposite direction.

From previous research, Baird knows that dung beetles can see polarized light and that when she places tiny hats on the beetles to block their view of the sky, they become extremely disoriented. She thinks that the beetles rely on visual cues in the sky to keep in a straight line and that when they climb onto their dung balls, they take "snapshots" of the sky and compare what they see to snapshots stored in their memories. "If you want to maintain a straight line, you can't really use landmarks nearby because they can seem to change a huge amount even if you move slightly," Baird says. "You need a cue that is very far away and extremely reliable. The sun's position and polarization patterns are compass cues of the sky. Even on an overcast day, you can still use polarization patterns as compass cues."

In two weeks Baird is returning to South Africa to study dung beetles in the field. This time, instead of confining beetles to the lab, she wants to see how far beetles roll outdoors before they stop to dance. She is particularly interested in how long beetles keep rolling on flat ground. Rather than construct an expensive outdoor arena free of pebbles and grass, Baird plans to use the local tennis court.

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