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Kinship Between the Kingdoms: Quorum Testing

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Kinship Between the Kingdoms: Quorum Sensing

Quorum Sensing: A biological sensory mechanism that allows organisms to detect population density and respond appropriately.

Darrin Shultz

What is smaller than dust and undetected when alone, but, in large groups, puts on a light show more spectacular than all of the glow parties on East Lorain Street combined? *Vibrio fischeri* (pronounced fisher-eye), the bacterium, of course!

These tiny flecks of life swim every ocean in solitude, feeding off even more insignificant specks of dead fish flesh and whale poop. Seemingly boring, *Vibrio fischeri* are hot commodities to many marine organisms. Glowing fishes, squids, and corals all selectively recruit *V. fischeri* to live temporarily in specialized organs in their bodies.

These fleshy homes provide the bacteria with nutrients and a safe environment to multiply rapidly. In return, our bacteria friend offer the host luminence. By sending molecular "triggers" to its colony of *V. fischeri*, the host makes them glow in patterns of short flashes or sustained subtle emissions. Known as bioluminescence, these emissions can function to illuminate prey, communicate with other fish of the same species, and even keep squid from casting shadows as they hunt. Remember the glowing blue lantern that tried to eat Dori and Nemo? That was *Vibrio fischeri* living in a female anglerfish host.

How do the bacteria know to only luminesce when living in their hosts? Well, the bacteria constantly secrete a molecular signal into their surroundings. Think of a dirty sock. You wouldn't smell one sock in a large room, but if several million friends threw their socks in also, the stench would be overwhelming. Similarly, the bacteria have receptor proteins that only cause luminescence when the "stench" of the signaling molecules reaches a threshold.

This phenomenon is known as quorum sensing. Different species throw their proverbial dirty socks around in order to sense how many similar organisms there are in the area, knowledge which aids in many biological processes. As humans, we perform this task with our eyes while bacteria, plants, individual cells, *et cetera* must accomplish this through other means.

Ben Garfinkel

Remember when you were little and the clothes you bought only a year prior had become awkwardly tight against your fast-growing frame? Believe it or not, this phenomenon is quite common in the world of social insects. Take, for example, honeybees (*Apis mellifera*). By way of quorum sensing, groups of these backyard foragers annually vacate their long-settled nest for greener pastures when life at the colony gets too cramped.

Finding a new nest is not easy, and it takes significant teamwork. Every spring, colony fission occurs wherein the queen and half of her colony split off in order to seek out a new home. The scouting party starts by forming a cluster on a nearby branch that will serve as their home base for the expedition.

Then, scouts fly near and far looking for good nesting locations. If a suitable location is found, they will return and deliver the news in the form of a "waggle-dance", which communicates the site's location relative to the sun, via a series of wiggles and circular motions. The more the scout likes the site, the longer it will dance, thereby increasing its chances to recruit other bees to investigate the site for themselves.

It is here where quorum sensing plays an important role. By keeping track of time between meeting other bees, these insects are able to sense the density of their dancing counterparts. Based on this calculation of density, uncommitted bees are either recruited by a dancer to investigate the site, or go out and scout again. If a site is popular enough to reach a threshold of 10-20 dancers, the scouting party will move as a collective to their new home. Even as a relatively simple physiological event, quorum sensing is crucial to the success of this decision making process and the eventual relocation to an area with more safety or better resources.

Recent research argues the inner-workings of honeybee communities may lead to new insights in cognitive science, as the way in which each bee affects each other's behavior can be equated to the neural interactions in primate brains. Bee colonies work as a single functional "mind" by way of thousands of participatory organisms working together, similar to the intermingling neural networks of more complex organisms, like humans.