"Plant Intelligence" Is Programmed, Not Intrinsic

Earlier this month, Wesley Smith warned against anthropomorphizing plants and ascribing intelligence -- even personhood -- to flowers and trees. But like responsive robots, plants can have smarts programmed into them. "So sure, investigate how plants interact with their environment," he advises. "But use proper, non-personal language. They are plants." Let's do that, and look at some of the superior programming that makes plants look smart because their design is smart.

Leaf Recycling

Science Magazine notes that "leaf recycling is a two-step process." Leaves don't just curl up and die on a cold day. That algorithm would be too simplistic, and potentially harmful to the tree if warm sunny days follow. Actually, two signaling molecules -- strigolactone and ethylene -- can work independently to begin the process of leaf senescence, but together, they work in synergy. "This multistep process probably preserves leaves when possible, only carrying through to leaf senescence when the stress becomes too much." (Emphasis added.)

Nitrogen Fixing

Separating molecular nitrogen's triple bond requires a lot of energy and pressure when humans do it, but some plants do it with ease, utilizing the capabilities of nitrogen-fixing bacteria. These bacteria have an enzyme called nitrogenase that so far has defied our attempts to understand it or duplicate it. Even though legumes outsource the work, they regulate their symbiotic partners' activity depending on nitrogen availability in the soil, according to researchers at Chapman University. This does not require plants to be sentient. We are all familiar with machines like thermostats, rheostats, and governors that can adjust their work depending on environmental conditions.

Climbing

Some plants and animals produce tentacles (in plants, tendrils) that can grab things. At Iowa State University, scientists are attempting to create (so far with only partial success) artificial
tentacles that can wrap around delicate objects. The tendrils in ivy and other climbing plants are touch-sensitive. Contact changes the concentration of hormones in the tendril so that growth is accelerated on the far side, producing curvature. As a result, the tendril wraps around the object so that the plant can anchor itself to something firm. Time-lapse photos of ivy growing up a wall might look like the action of an intelligent agent. We see from Iowa State's biomimetic experiments, though, that the intelligence is imposed by the agent. It's a matter of programming with the right materials.

**Watching the Clock**
Every living thing keeps time, and plants are no exception. In fact, they have two clocks, [Duke University](http://www.duke.edu) says:

*Time management isn't just important for busy people -- it's critical for plants, too.* A Duke University study shows how [two biological clocks work together](http://www.duke.edu) to help plants deal with intermittent demands such as fungal infections, while maintaining an [already-packed daily schedule](http://www.duke.edu) of activities like growth.

The anthropomorphic language might make it seem that plants are like people, but time management regulation can be programmed, as we know from our own machines that contain timers or sun sensors. Researchers at Duke showed this by chemically altering the circadian rhythms in *Arabidopsis* plants to see how the "morning" clock and the "evening" clock interacted. In the process, they identified a regulating gene named NPR1 that links the two clocks. Their work is published in [Nature](http://www.nature.com):

Mathematical modelling and subsequent experiments show that [NPR1 reinforces the circadian clock without changing the period](http://www.nature.com) by regulating both the morning and the evening clock genes. This [balanced network architecture](http://www.nature.com) helps plants gate their immune responses towards the morning and minimize costs on growth at night. Our study demonstrates how a sensitive redox rhythm interacts with a robust circadian clock to ensure proper responsiveness to environmental stimuli without compromising fitness of the organism.

**Separating Behavior from Intelligence**
Intelligent agents can exhibit behavior, but not all behaving entities are intelligent agents. For example, the Curiosity rover on Mars might look to an alien visitor like a sentient being acting autonomously. Its behavior, however, has been programmed into it. Some of its behavior runs from embedded instructions in its software; some of its actions are controlled by sentient beings millions of miles away. It would be fallacious to call Curiosity "intelligent" or a "person."

This is the fallacy Adrian Barnett toyed with in his book review for [New Scientist](http://www.newscientist.com) that Wesley Smith wrote about. Barnett stated that "plants are smart" as if they conjured up their
intelligence by themselves; it's only our "serious parochialism" that makes us unable to appreciate "intelligence not as we know it."

Another reviewer in Nature, Ian T. Baldwin commits the same fallacy, though in a more nuanced way. A plant scientist, Baldwin reviewed three new books on plant behavior, including the one by Richard Karban that Barnett reviewed in New Scientist.

The food writer Michael Pollan, author of The Omnivore's Dilemma (Penguin, 2006) among others, wrote an article in The New Yorker in 2013 exploring why terms such as intelligence, memory and even behaviour have been contentious for plant scientists. His thesis boils down to a divide in biology that allows zoologists to use anthropomorphic terms, but denies the privilege to plant scientists. Pollan allies himself with a small band of intrepid researchers crusading against the "cerebrocentric" view that permits behaviour only to organisms with brains. He tells of collateral damage from sensationalist treatments that exaggerate plant-science findings, and of glimmers of a new sensitivity towards all life.

Pollan identifies an interesting story about the development of an emerging scientific field, and the baggage that scientists bring to their work. The idea that plants are 'smarter' than their immobility suggests is now supported by rigorous experimentation and fieldwork that are uncovering the genes and chemicals that mediate plants' environmental intelligence. We know now that much of a plant's rich behavioural repertoire is hard to observe because it is played out in a chemical arena. Plants overcome the constraints of immobility mainly by harnessing their prowess as synthetic organic chemists. For instance, floral scents contain compounds that attract pollinating animals and repel flower-eating ones. Nectar is a brew of nutrients and toxins that optimize the behaviour of pollinators. Much of the relevant literature is now synthesized in three books by leading researchers in the field: Edward Farmer's Leaf Defence, Anthony Trewavas's Plant Behaviour and Intelligence and Richard Karban's Plant Sensing and Communication.

The fallacy is obvious when you imagine him writing a similar exaltation of "rover intelligence" after observing Curiosity's behavior. Would it make any sense to praise Curiosity's "prowess as a synthetic organic chemist"?

Baldwin gave the three books varying degrees of commendation. Excited as he is by the resurgence of interest in plant behavior, he understands that these "phytomorphic" activities must be understood mechanistically and biochemically.

The root of the fallacy, though, is Darwinian thinking. It allows no room for human exceptionalism. To the evolutionist, humans differ not in kind but in degree. Animal and plant intelligence is just as self-generated as that "emerging" from our physical brains. While they can partially see how anthropomorphism is misleading, they cannot draw a divide between us
and them. That's why Baldwin praises Trewavas for thinking like a plant and avoiding animal envy:

Trewavas, by contrast, moves effortlessly from mechanistic research to invigorating insights into real-world plant behaviour. Plant Behaviour and Intelligence is a wild ride, covering ground from the origins of life to intelligent nutrient-foraging behaviour in the roots of higher plants. Trewavas's five decades of research into plants' molecular biology and physiology, and their evolution as self-organizing systems, make him fully 'phytomorphized'. He thinks like a plant, effortlessly calling on specific traits to look at how plants solve problems in similar ways to social insects -- from siphonogamy (in which pollen tubes carry sperm cells to egg cells) to highly dispersed sensory systems. He celebrates behaviour in plants while avoiding "animal envy".

Darwinian thinking unravels, though, when you see it cannot be sustained logically. For one thing, Baldwin and Barnett use their own sentience, including conscious purposeful choice, to ascribe it to plants and animals. This would be like Curiosity coming into contact with Opportunity and deciding it was an independent, autonomous, intelligent being that emerged from the Martian soil like itself.

For another logical short-circuit, Darwinians routinely ascribe motives and goals to plants and animals, even when they deny this is possible. The unguided neo-Darwinian mechanism cannot see a distant target and move toward it. Baldwin says that plant defenses "evolved primarily to thwart herbivores." He says "leaves evolved to have particular traits." Nothing in Darwinism allows the phrase "evolve to" in foresight or in hindsight. Such language is just as misleading as anthropomorphism.

The only logically self-consistent position is to see plants and animals as possessing design impressed on them by an outside intelligent cause. In this way, we can appreciate and study the rational design in plants that makes their behaviors so interesting (and often worth imitating). Our physical bodies and brains also carry the imprint of design, but we humans have the additional gift of conscious self-awareness that allows us to choose our behaviors. This sets us apart from the rest of the living world. It's the reason we use reason to study plants, but plants do not study us.