STANDARD DEVIATIONS: Perception vs Deception

Greetings,

Sometimes we're fooled by what we see.

A rare species of orchid has evolved an elaborate scheme to entice a pollinator. It attracts male beetles to its flowers by imitating a female so closely that the beetle is fooled into copulating with the plant.

{Orchid, *Disa forficaria*; the species was believed extinct.}

Beetles (*Coleoptera*) are the most diverse order of animals on Earth (~25% of all known animal species). They are pollinators of dozens of plant families and >77,000 beetle species visit flowers. This orchid attracts one specific longhorn beetle, *Chorothyse hessei.*

Orchids, on the other hand, are a small family of plants that occupy a miniscule realm but have survived through ingenious biochemical and morphological adaption. Our orchid (*Disa forficaria)* was thought to be extinct; it had not been seen for forty years. Altogether, the study only observed pollination for eight days in March of 2016 and four days in March of 2018 (and then this particular plant disappeared).

For longhorn beetles, *Disa forficaria's* deceit seems to be both physical and chemical. When a beetle lands on the orchid, the purple inner structure fits perfectly underneath it. The beetle

bites and strokes the petals beneath it, while inserting its aedeagus—essentially a penis—into a cleft at the other end of the flower; behavior that is similar to the actual mating behavior described for other longhorn beetles.

The beetle gets drawn in by the flower's best imitation of a female's sex pheromone. Scientists noticed beetles were most likely to land on the flower right after it opened, when it is suspected the orchid's fragrance is at its strongest. The insects were not looking for flowers, but for females, and they were totally fooled.

{*Chorothyse hessei.* Fooled by perception.}

About 400 orchid species have evolved to take advantage of the male beetles' single-mindedness by releasing their own versions of specific species' sex pheromones to attract a pollinator.

Floral morphology, as well, seems to play an important role in stimulating copulatory behavior once the beetles located a flower. The beetle's perception is hijacked.

The beetle is so misguided it actually mates with the flower. Even though its efforts are fruitless, the beetle carries pollen forward to another orchid.

{Pollen attach to the beetles' sternum and are carried to the next flower.}

The single orchid plant in this study was the first of its species seen in a half-century, and then it disappeared. The study group found three more longhorn beetles in 2019 with pollen that was genetically identical indicating that the orchid was still thriving in the wild. Its sexual deception may have the advantage that it allows plants to achieve pollination even when at very low population densities.

Sometimes we're fooled by what we don't see.

Certain crab spiders of the family *Thomisidae* are carnivores that catch unwary prey by changing color to avoid detection.

{*Misumena vatia,* the goldenrod crab spider or flower (crab) spider.}

Crab spiders catch insects by mimicking the color of the flowers they hide in. Typically they are a bright yellow from a pigment (kynurenine) they produce in their outer cell layer. They lie in wait among daisies and sunflowers.

{Insects are more attracted to flowers with spiders; it's still not understood why.}

The baseline color of the spider is really white. Glands under the outer cell layer are filled with white, crystalline, guanine, and the yellow pigment is excreted when the spider needs to change (it takes several days). This allows the spider to hide among white flowers and also use the way arthropods see color to hide. It again stores pigment when it needs to change back to yellow.

{Discarding its yellow pigment, crab spiders are actually white.}

{Arthropods see the white form of the spider only as a dark shape against a dark background when it sits on pink flowers.}

Sometimes we're fooled by perception and sometimes by deception.

On the bench we face similar challenges. We can be fooled by seeing things we shouldn't and we can be fooled by not seeing things we should.

Too often we see growth in microbiology that we assume to be innocuous but is potentially infectious. We mistakenly put ourselves at risk by handling the organisms without proper precautions (using MALDI-TOF and/or not using a biosafety cabinet). We're deceived by perception.

Our bloodborne pathogen training tells us that risk exists even where we don't see it. Every blood sample (and some other sample types!) threatens us with pathogens lurking unseen. Our universal precautions protect us from deception.

Recent outbreaks of Ebola in Africa bring this foolishness into perspective.

Ebola is very often perceived as a different malady, like malaria or typhoid fever. This leads to exposures of healthcare workers, family, relatives, and traditional healers who all become part of the transmission chain; deception by perception.

The finding of Ebola virus from tissues (e.g. semen) where it languishes dormant for years, illustrates a deception by concealment. We don't recognize the risk because we can't see it.

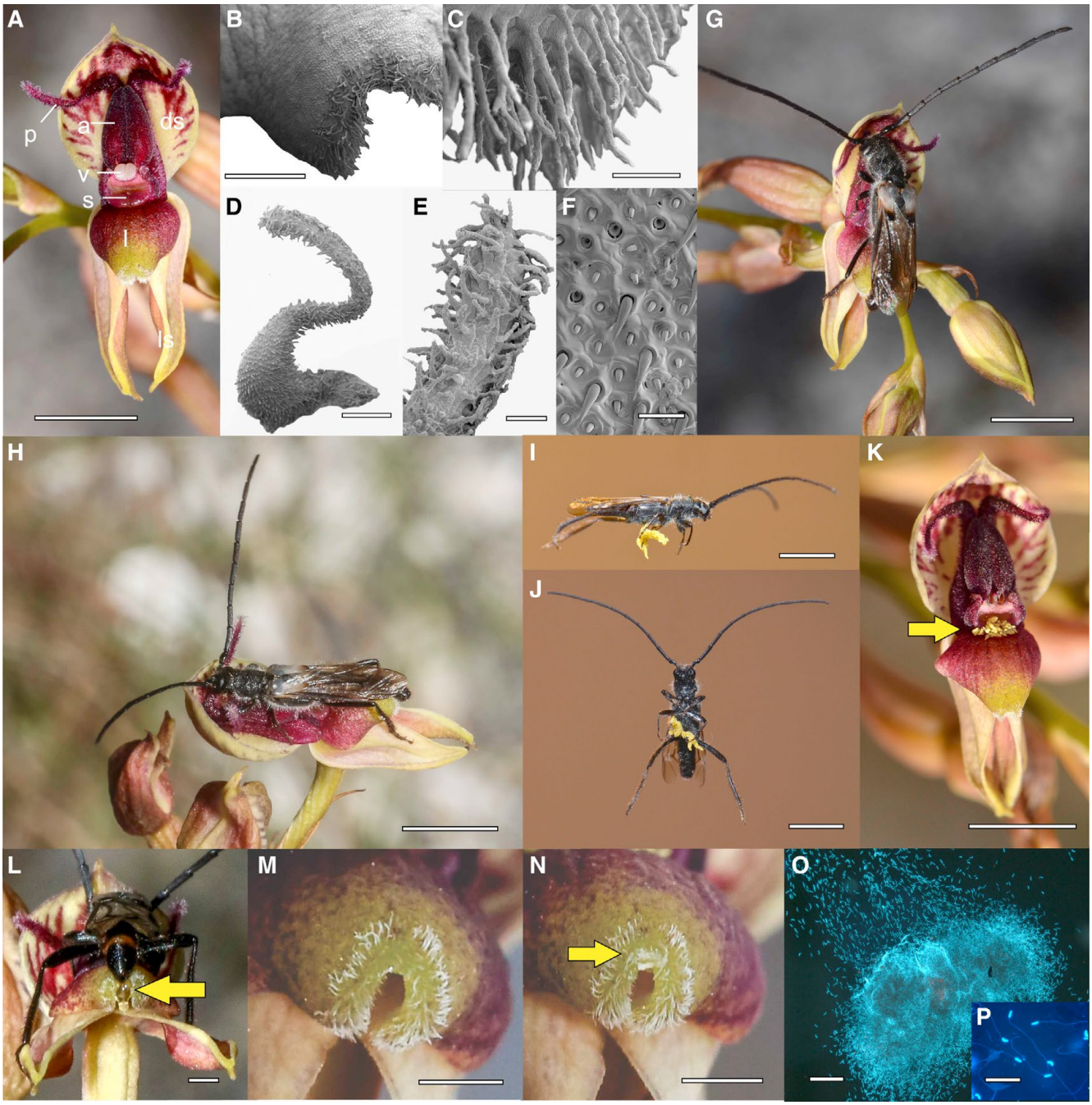
Safety in the laboratory requires us to anticipate that we will be fools. Some risks occur because we see things incorrectly and some because we can't see them at all. Risk assessment and our biosafety mitigations are meant to keep us safe even when we are fooled.

Have a great week and be safe,

Bryan

Cohen et al., Sexual deception of a beetle pollinator through floral mimicry, Current Biology (2021), https://doi.org/ 10.1016/j.cub.2021.03.037

p.s. Here is another graphic from the orchid study:



(A) Unpollinated flower. p, petal; a, anther; ds, dorsal sepal; v, viscidium; s, stigma; l, labellum (=lip); ls, lateral sepal.

(B) Labellum tip showing cleft.

(C) Hairs on the cleft at the tip of the labellum.

(D) Petal.

(E) Hairs on petal.

(F) Sensilla on the antennae of the longhorn beetle *Chorothyse hessei*.

(G and H) *Chorothyse hessei* biting petals of *D. forficaria* and extending the tip of its abdomen into the labellum cleft.

(I and J) *Chorothyse hessei* with pollinaria of *D. forficaria* attached to the sternum.

(K) Flower of *D. forficaria* with pollen massulae (arrow) adhering to the stigma immediately after a visit by *C. hessei*.

(L) *Chorothyse hessei* extending its aedeagus (penis) into the labellum cleft.

(M) Labellum prior to beetle visit.

(N) Same labellum after a beetle visit with freshly deposited sperm (arrow).

(O) Mass of *C. hessei* sperm removed from the labellum.

(P) Individual *C. hessei* sperm.