In This Issue

Democracy encourages broadly beneficial institutional choices

Although humans are typically willing to punish so-called free riders—people who use public resources without contributing to them—most people balk at sanctioning community members who refuse to punish others. Modern societies usually address this threat to collective action by installing central authorities such as police and judicial systems that punish both free riders and individuals who refuse to punish, such as tax evaders, whose actions undermine the central authority. Christian Hilbe et al. (pp. 752–756) present a mathematical model that addresses a seeming paradox in this real-world paradigm: How do individuals who refuse to sanction offenses like tax evasion, known as second-order punishment, strive for an authority that does? According to the authors, when test participants were allowed to choose institutions by migrating between communities with and without second-order punishment, they exhibited bias for institutions that do not punish tax evaders. However, when participants were required to vote for institutions and accept the decision of the majority, they preferred a society with institutionalized second-order punishment. The findings suggest that democracy prompts individuals to consider the broad community and make institutional choices that enhance the welfare of all, according to the authors. — T.J.

Limitations of acellular pertussis vaccines

Pertussis' resurgence as a public health concern in recent decades has led some researchers to hypothesize that current acellular pertussis vaccines, which replaced whole-cell vaccines in the 1990s, may have played a role in the disease's reemergence. To test this hypothesis, Jason Warfel et al. (pp. 787–792) inoculated two groups of baboons—one with the whole-cell vaccine, the other with the acellular version—at ages 2, 4, and 6 months. When challenged with active *Bordetella pertussis* bacteria at age 7 months, an unvaccinated group of baboons contracted the disease, whereas neither vaccinated group developed pertussis symptoms. But bacterial cultures from the baboons' noses revealed that the infection persisted in both unvaccinated and acellular-vaccinated monkeys for up to 6 weeks. In contrast, whole-cell immunized baboons were infection-free within 3 weeks. Further, the authors found that acellular-vaccinated baboons were still able to transmit the infection to uninfected cagemates. The authors suggest that the difference in vaccine efficacy may be due to different immune responses, with the whole-cell vaccine spurring a response more similar to that produced by the live bacterium, compared with the acellular vaccine. Although acellular vaccines prevent disease symptoms, combating pertussis might require a vaccine that prevents colonization and transmission to protect sensitive members of the population and achieve herd immunity, according to the authors. — P.G.

Human foraging patterns

Many animals forage for food in a random walk pattern, consisting of mostly short steps with occasional longer travels. This strategy aids in finding unevenly located resources without knowledge of the pattern of resource distribution. To determine whether this pattern, called a Lévy walk, also describes human foraging behavior, David Raichlen et al. (pp. 728–733) observed the foraging patterns of the hunter–gatherer Hadza people of Tanzania. The authors fitted 44 Hadza with GPS units and tracked their movements over 342 foraging bouts, monitoring both Hadza men and women, who predominantly hunt for game and plants, respectively, from two camps during both rainy and dry seasons. The authors report that 42% of foraging bouts were best described by the distributions of Lévy step lengths, defined as the distance traveled before pausing or turning more than 40°. Both Hadza men and women used Lévy walks, suggesting that use of this pattern does not depend on the resource being sought. The results suggest that humans, with cognitive and memory advantages over other animals, still follow the same foraging pattern when searching for heterogeneous resources of unknown distribution. Superdiffuse foraging may have allowed early hominins to explore farther, and may also explain human movement patterns in urban settings, according to the authors. — P.G.

Hadza hunter–gatherers survey the Tanzanian landscape.

Dust exposure may protect against allergies

The composition of human gut bacteria, established beginning in early infancy, can influence immune responses, including the development of disorders such as asthma and allergy. Reduced risk for the same disorders has been associated with early exposure to dogs. Kei Fujimura et al. (pp. 805–810) investigated how common house dust generated by dogs affects both the gut microbiome and airway immune response of mice. Mice orally gavaged with dust from a dog-owner's home produced fewer airway T cells and less mucus in response to a cockroach allergen than did unexposed mice. Compared with unexposed mice, the dust-exposed mice also harbored a different gut microbial population that included enrichment of the bacteria *Lactobacillus johnsonii*. The authors supplemented the gut microbiome of a separate group of mice with *L. johnsonii*, and then challenged the mice with either cockroach allergen or respiratory syncytial virus. The authors report that the mice appeared to be protected from both agents, with fewer inflammatory cytokines in the airways of the mice supplemented with bacteria than in unsupplemented animals. Dog dust–exposed mice, however, showed better airway protection than supplemented mice, suggesting that *L. johnsonii* is one of several species involved in airway immune protection. The results suggest a gut microbiome–airway axis that may be modified by environmental microbial exposure in a manner that can protect against airway insults, according to the authors. — P.G.

Testosterone's role in immune response

Women's immune systems are generally stronger than those of men, responding more robustly to both infection and vaccination, although the cause of the difference is poorly understood. David Furman et al. (pp. 869–874) measured immune responses in 53 women and 34 men following seasonal influenza vaccines. The authors report that the women produced a higher antibody response and inflammatory cytokine count in response to the vaccine, compared with the men. The authors then tested the volunteers' blood serum responses to different influenza strains, and found that differences in gender-related immune responses were greatest for the highly virulent H3N2 strain. Searching for factors that could explain the differences, the authors identified a set of genes previously correlated with both lipid biosynthesis and poor male immune response. These genes, the authors report, appear to be up-regulated by testosterone. Further, the authors found that men with high testosterone, and thus high expression of the lipid biosynthesis genes, displayed weak antibody responses to the flu vaccine, suggesting that the genes may influence immune function. The effect of testosterone may be beneficial for males, potentially quelling uncontrolled immune responses during infection that could prove harmful, according to the authors. — P.G.

Potential prognostic tool for H7N9 influenza

The flu virus H7N9, which originated in birds and caused an outbreak along China's Yangtze River Delta in March 2013, has infected more than 130 people and led to 44 deaths due to pneumonia or acute respiratory distress syndrome. To determine why some infected people develop severe disease, Zhongfang Wang et al. (pp. 769–774) searched for links between disease progression and inflammation-related molecules called cytokines in lung fluid and blood plasma in 18 infected patients admitted to a Shanghai clinical center. The authors report that high plasma concentrations of cytokines, in particular IL-6 and IL-8, were correlated with severe lung and airway damage typical of influenza pneumonia. Further, lung fluids from three fatal cases contained 100- to 1000-fold higher concentrations of certain cytokines, compared with plasma. In addition, the authors report that patients with a defective genetic variant of a protein called IFITM3, which restricts viral replication, had higher viral loads and cytokine levels, sought medical attention sooner, suffered more severe disease, and were less likely to survive than those carrying a functional version of the protein or an alternative genetic variant; the defective variant, known as IFITM3 C/C, is moderately prevalent among East Asians. Though the study does not reveal whether the increased cytokine levels are a cause or effect of severe disease, gene sequencing and early monitoring of cytokine profiles might help determine prognosis and guide treatment, according to the authors. — P.N.

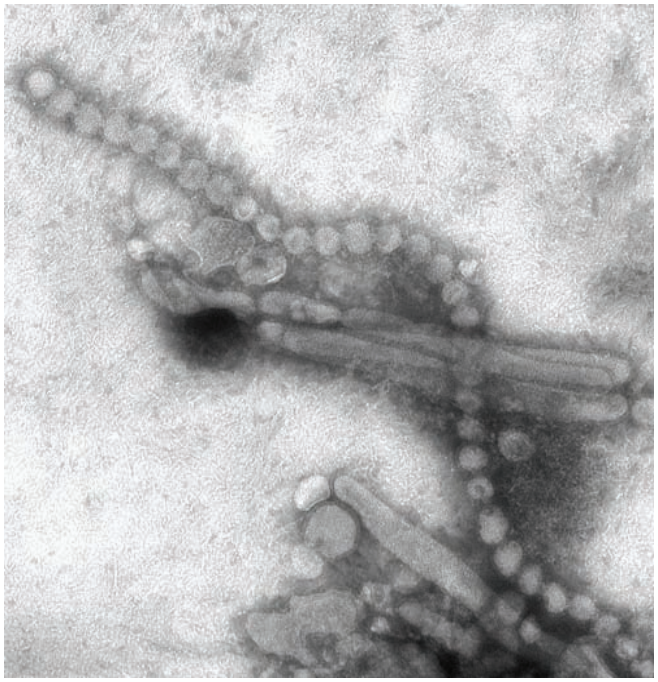

Image courtesy of CDC/Cynthia S. Goldsmith and Thomas Rowe.

Influenza A H7N9 as viewed through an electron microscope.