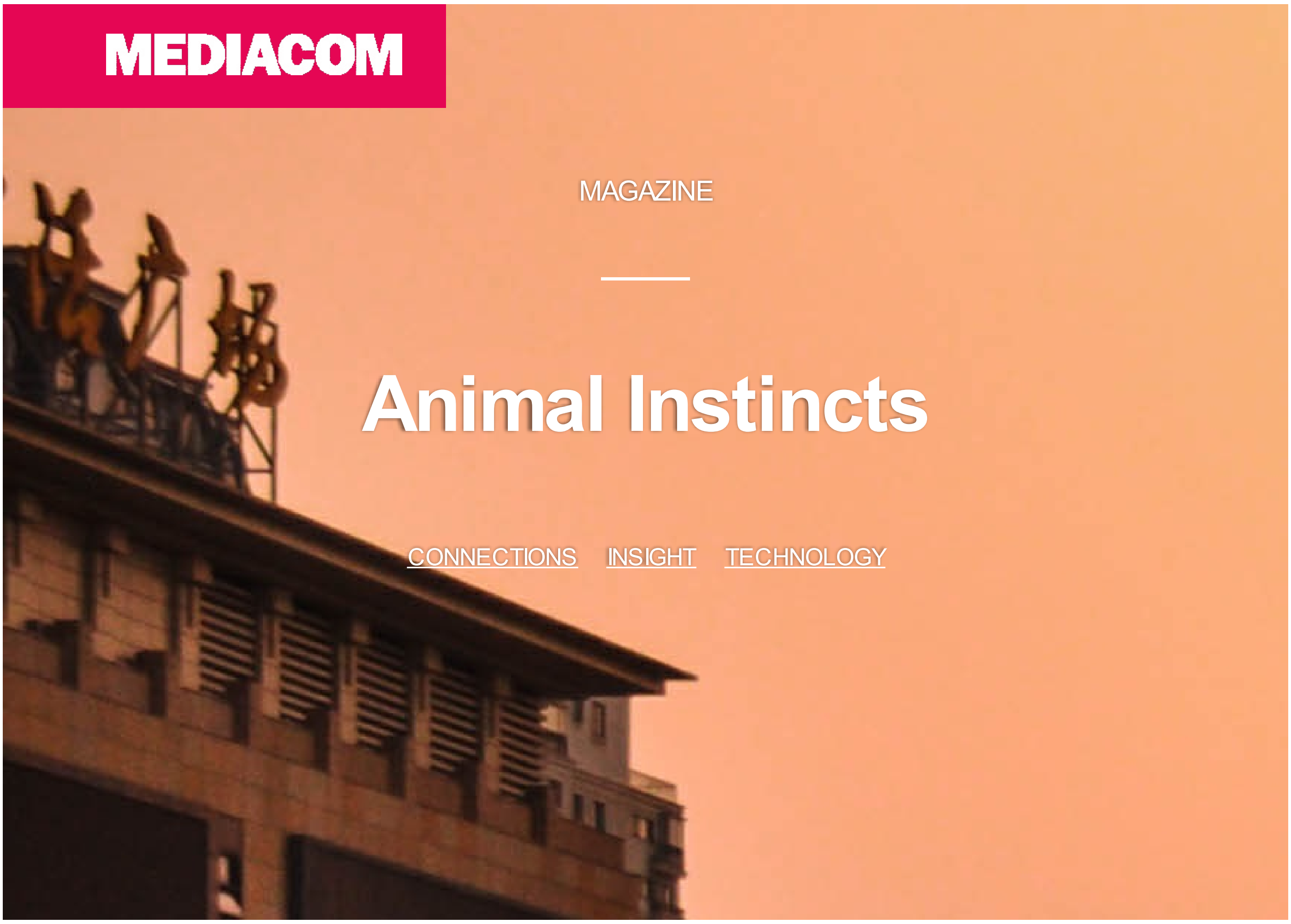

MAGAZINE

# Animal Instincts

CONNECTIONS INSIGHT TECHNOLOGY

KAY DOHNKE 30 JUL 2013

**Traffic jams are an everyday fact of life. In search of answers, researchers are studying the behaviour of ants, as their roads are never congested. And Volkswagen is already working on communication systems to improve traffic dynamics.**

Traffic jam ahead

Traffic is moving smoothly in a southerly direction; the motorway is moderately full. After two or three kilometers, the road approaches a wooded ridge and the strip of asphalt inclines slightly. Brake lights suddenly illuminate, and the light show moves rearwards from one car to the one behind with increasing swiftness. Traffic slows down. Soon the first cars are standing still: then all lanes are blocked. If everything is flowing up front, all is well. But if one person there brakes, the dynamics of the queue can quickly bring every car to a halt. And the flow stops. Traffic jam. Nothing moves. On the left side, one car shifts even further to the left to see what is blocking the way. Nothing is in the way; a traffic jam has formed out of thin air.

Typical driving behavior and typical errors can quickly bring traffic to a halt. Traffic jams develop not only at bottlenecks and construction zones, but also on hills, where drivers almost imperceptibly slow down and cause the vehicles behind to eventually brake. At the very same time, traffic is flowing perfectly between the trees on the hill. Up there, ants are marching to a source of food. More and more of the tiny insects join the steady procession, yet traffic never slows down or comes to a standstill. Researchers are looking at the behaviour of these creatures to gain insights that can help improve the flow of traffic on our roads. The development of traffic jams is simple physics: the more vehicles there are on a section of road, the greater the traffic density and the lower the average speed. A constant speed could then only be achieved by reducing the distance between vehicles but, for safety reasons, that is not an option. Once a critical mass of vehicles has been reached, drivers slow down to maintain the proper distance from the vehicle in front of them. “Ants behave differently,” explains Dr. Andreas Schadschneider, a theoretical physicist at the University of Cologne who studies complex systems such as pedestrian, vehicle and other flows. “Ants can significantly increase the density of individuals on their roads without slowing down.”

One goal

“The animals mark the shortest path with pheromones that the others can use for orientation.” In essence, they create invisible guard rails. Another phenomenon: “We have never observed an ant purposefully overtaking another,” Schadschneider reveals. All animals subordinate themselves to the common goal, and thus reach it with optimal efficiency. Slower animals move to the side, keeping the main avenue free. “That only works to a certain degree with cars,” as the shoulder on motorways is reserved for emergencies. Ants also have no problem with collisions. This too is an occurrence – indeed, the worst case scenario – that drivers seek to avoid at all costs by slowing down or changing lanes. When vehicle density is high, this behavior may also promote the development of traffic jams. Schadschneider adds: “Ants form themselves into small queues. After about five or six ants, they leave a gap between themselves and the preceding group.” This buffer prevents the chain reaction that occurs when a group slows down (and otherwise leads to a traffic jam); before the rear group reaches the group that has slowed down, time elapses so the first group can speed up again. All queues stay in motion.

What aspects of ant mobility can be applied to human traffic? “Their behavioral patterns result from communication,” is the lesson Schadschneider draws. “With modern technology, we can achieve the same thing for cars.” A safe increase in traffic density could certainly be increased by enabling cars to communicate regarding speeds and distances. “And the more drivers act in everyone’s interest (to enjoy smooth-flowing traffic), the better it works.”

C-to -X?!

Volkswagen has been working for some time on Car2X communication systems designed to improve traffic safety and flow. Such systems enable cars to communicate not only with each other (car-to-car), but also with fixed landmarks, such as traffic lights or sensors at intersections or sections of road (car-to-infrastructure). “Safety is the first concern, of course,” says Dr. Thomas Form, head of electronics and vehicle research at VW. “Proven assistance functions that warn drivers about the presence of a police vehicle, construction site or the end of a traffic jam (so that they can avoid rear-end collisions) are a good way to introduce the technology.”

Work on the next step is already well underway: “In this phase, vehicles exchange information about their environments as well as themselves. A car preceding another into a curve, for example, could warn the next vehicles of traffic jams or construction zones before the next drivers can even see them.” That would require more precise location systems for cars and more powerful on-board computers. For now, ‘C-to-C’ (car-to-car communication) remains a vision, although it already works in experiments.” One of the big challenges is positioning using, for example, stationary orientation points along the road,” says Form.

What is clear is that – in the future – smooth traffic flow will require technological assistance. It’s all just physics to Andreas Schadschneider, but observing ants can yield important insights into how traffic flows work.

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