Notes and highlights for

How Dogs Work

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2. What Makes Ethologists Tick?

Highlight (yellow) - Location 467

The final count on our livestock-guarding dogs was some fifteen hundred animals that we used for observational studies and experiments. Many of the guardian dogs ultimately went to cooperating farmers as working guardians across the United States and abroad.

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Studying the livestock-guarding dogs took us around the world. We found countries from Portugal to Italy to Turkey to Tibet that had one or more “landrace” populations of working dogs (local, naturally adapted varieties of dogs) that are sometimes pridefully called breeds (intentionally “designed” products of artificial selection). Written records suggest that people in these cultures had used landrace livestock-guarding dogs for several thousand years.

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It was a dream project. We (a group of Hampshire College students and their professors) traveled to the great sheep pastures of Mediterranean Europe and Asia with the goal of bringing back a breeding stock that could be used to produce a population large enough to be systematically studied on farms and ranches in the United States, as well as back in our lab. We collected livestock-guarding dog pups in Turkey, Yugoslavia, and Italy, carefully trying to buy pups in each of those countries that had been born on the same day (fig. 5) so we could control not only their developmental environment but also their rearing and training. On the way home, we stopped in Scotland and went to herding-dog trials, talked with handlers and farmers, and finally bought six dogs from working stock; four of them had been born on the same day as the livestock-guarding dog pups that we had just acquired. Over the years, data from our lab and from cooperating farmers across the country have helped us learn a great deal about how “nature” and “nurture” play out in the behavior of these dogs. Further on, we’ll discuss what we found in more detail, from many different perspectives, about all these dog varieties. For the moment we’d like to take a brief closer look at one small observation of a livestock-guarding dog behavior “in the field,” and then explore how ethologists go about the work of describing and explaining it.

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You shouldn’t be dismayed to find that there could be so many different (and sometimes contradictory) ways of looking at and questioning one simple piece of dog behavior. When

scientists investigate any kind of natural phenomenon it's almost always possible— and in fact desirable— to come up with multiple hypotheses. The heart of doing science is the creative activity of framing hypotheses and then testing them against carefully made and measured observations about the world. Arguing about and testing competing hypotheses is a great part of the fun and excitement of science.

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Niko Tinbergen, one of the founders of modern ethology, argued that it's necessary for biologists to think about the "why" of behavior in at least four different ways. These have become known, famously among ethology students, as Tinbergen's four questions. Here is how Tinbergen himself posed these questions in a 1968 article in the journal Science: 1 In what way does this phenomenon (behavior) influence the survival, the success of the animal? 2 What makes behavior happen at any given moment? How does its "machinery" work? 3 How does the behavior machinery develop as the individual grows up? 4 How have the behavior systems of each species evolved until they became what they are now?

3. The Shape of a Dog Is What Makes It Tick

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Animals also have extraordinarily complex internal shapes— the inner workings of the machine— and individuals as well as breeds (and species) can vary significantly in the details of those component structures, too. For example, one of our former students and now colleague, Cynthia Arons (along with neurophysiologist W. J. Shoemaker), compared the brains of sled dogs, guarding dogs, and herding dogs (see fig. 10). She discovered that in four brain regions these three types of working dogs differ significantly in the amount of dopamine found in the neural tissue. Dopamine is a neurotransmitter that is known to mediate general arousal and motor activity. Not surprisingly, frenetic and hyperactive Border collies, which are expected to chase after and change the direction of large groups of sheep, show as much as four times the dopamine level of stolid, slow-moving Maremmas, whose job is to simply to stay with a flock.

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Just as you can't "teach" a cube to roll because the geometry of its shape restricts its movement— just as you can't train a dachshund to run like a greyhound— you can't teach a guarding dog to herd sheep— because, among other things, its brain shape doesn't support the right kind of motor activity.

5. The Rules of Foraging

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A great example of this was evident when we kept large pens of livestock-guarding dogs (Anatolian shepherds, in this case) and herding Border collies at our Hampshire College lab. We used to feed both groups of dogs with stillborn calves that we obtained from local dairy farms. The livestock-

guarding dogs never exhibited the DISSECT motor pattern, which normally occurs toward the end of the canid predatory sequence. Large chunks of meat can't be swallowed whole, and successful foraging requires the prey to be torn apart before it can be consumed. When we provided calves to the Anatolian shepherds, we had to cut them open ourselves so that the dogs could feed, otherwise the calves would rot and the guarding dogs would go hungry. They simply couldn't get them open. Border collies, however, would tear open and eat dead calves with abandon.

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Finally, the "prey" object to which a behavior is directed can differ, too. Border collies displayed EYE > STALK > CHASE to conspecifics (other dogs) and also to different species, such as sheep. Most European sheep-guarding dogs (e.g., the Great Pyrenees, Maremma, and Anatolian shepherd) do not display these predatory sequences to non-conspecifics, or they display them only rarely.

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Castro Laboreiros cluster statistically with the herding dogs. Their motor patterns are more similar to Border collies than to Maremmas or Anatolian shepherds. And as it eventually turned out, when the Castros came back to our lab, we could not get them to reliably and consistently play the working role of a livestock-guarding dog. Of one

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hundred Castros that we put out on our cooperator program (sheep ranchers helping us to see whether the dogs would effectively control predators) only 20 percent turned out to be successful guardians— the rest were sheep chasers. This contrasts dramatically with a 70 percent success rate in other guarding breeds. In spite of what local people may call these dogs (or wish they were like), an ethological analysis paying careful

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Our experimental work has shown that there is a specific environment in which a livestock dog needs to be raised. If you don't raise the dog in that setting, you ruin its future as a livestock guardian.

7. Accommodation and Behavior

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Two Maremma parents will produce pups with a characteristic behavioral shape— which is, as we'll see shortly, missing most of the predatory motor-pattern sequence that we observe in other canids.

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biologists have understood that canids have a critical period for social bonding and socialization— how animals recognize and interact with one another (fig. 28). Just how long it lasts, and what animals are sensitive to during this period of growth, remain the subject of lively debate and

research. Basically, it's a matter of how dogs come to deal with other animals as well as novel objects and events in their environment. Exposure to novelty during the critical period results in long-term familiarity and a lack of (or reduced) fear or avoidance responses. Socialization in the critical period no doubt also plays a role in the development of proper species identification in wild canids. And in captive animals (and house pets), exposure during this period to other species such as humans can result in interspecies social attachment, not unlike the imprinting phenomenon that Lorenz discovered. Kathryn Lord has argued that the critical period for socialization in dogs begins at four weeks with the ability to approach and investigate environmental novelties and ends at eight weeks with the avoidance of novelty. Scott and Fuller suggested that the offset of this critical period in dogs is later, perhaps at twelve weeks. Their conclusion may be due to differences in the breeds that were studied, idiosyncratic individual differences, or simply differences in observation and measurement.

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Lord studied dog pups raised in kennels who have little or no direct contact with people for the first eight weeks of life, she found that, like wolves that haven't undergone intensive taming, they also generally tend to be very wary of human beings. Without the right social input at the right time, these dogs become "spooky" and may also be shy of new sights, smells, and sounds as well as people.

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We and our students raised weaned livestock-guarding dog pups in pens they shared with lambs, "cross-fostered" by sheep ewes; they received very little human handling. As adults, these dogs tend to be very shy of (and sometimes aggressive toward) people— but they are highly attentive to and gentle with sheep. Indeed, like Lorenz's geese, guarding dogs can be quite unselective in their bonding behavior during the critical period. The Maremmas we studied in the Abruzzi mountains of Italy generally preferred to attend to and follow sheep, and as we saw they will sometimes go off with sheep and abandon the shepherd. Interestingly, however, we observed some dogs that did neither: they balked at going out with their shepherd and stayed "home" when sheep were brought out to graze. Why? We concluded that these animals had actually bonded with milk cans. When they remained behind at the base camp, alongside milk cans and other articles of the sheep-milking business, they would stay close to the equipment and bark at approaching intruders just as they would if they were guarding sheep. Remember that much of the social bonding process in canids is done with the nose— and milk cans can smell as much like sheep as lambs do. Fig. 29 Most mammals and

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The bottom line is that if you raise a Maremma together with lambs it will pay close attention to sheep and stay close to the flock without disturbing them— and it won't have to be trained to do its job (fig. 29). The working behavior of a guarding dog is neither a product of learning nor an explicit genetic "blueprint." Nor were the individual behaviors (or lack of them) that make for a good livestock-guarding dog the target of intentional selective breeding. Rather, their useful behavioral shape arises as a result of accommodation between the dog's intrinsic motor-pattern repertoire and its early environment during a critical period in development. The overall accommodative shape—

the right mix of intrinsic rules, the timing of development, and how those intrinsic properties respond to environmental inputs— can then be favored by selection, whether artificial or natural. Agriculturalists in sheep-raising cultures around the world have been producing good livestock-guarding dogs in just this way since time immemorial.

8. Emergent Behavior

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much of an animal's behavior— the movement of its shape in space and time— is driven by intrinsic motor patterns, species-specific adaptations that are stereotyped products of natural selection and, as we like to say, critical parts of the shape of the "ticking mechanism" of the animal. A second idea is that some intrinsic patterns can undergo accommodative changes in shape that are due to developmental and environmental inputs. Taken together, we think these two ideas provide a pretty good general explanatory account of a lot of the behavior of dogs and other animals.

9. Play

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It's not implausible to think that it is adaptive for an animal with an overly rich food supply to have to "run it off."

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We've had problems with ranchers who overfeed their livestock-guarding dogs. Normally such dogs would sit placidly on guard, not moving much but looking large and threatening to potential predators. The overfed dogs, however, would end up poking around and bothering sheep,

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Working livestock-guarding dogs are not supposed to have any of the predatory motor patterns, and indeed ours did not display any of them throughout the months they spent in the pen.

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The play groups were determined not by personality or individual preference for a playmate but by their differing available behavioral repertoires. The Border collies played games incorporating EYE, STALK, and CHASE; they ran after one other and jumped at falling leaves and grasshoppers in the pen. The guarding dogs were another story entirely. They never chased one another or stalked imaginary prey. Instead, they sat in furry piles playing mouth games, pulling on one another with teeth and tongues, licking faces, nipping and chewing on the body parts of their companions.

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Since there would be no onset of STALK and CHASE (or subsequent predatory motor patterns) in the guarding dogs, their play is apparently less rich than what we see in Border collies. It's not a matter of having a less happy and playful disposition but, rather, a more limited behavioral repertoire. Different styles of play emerge depending on which "simple parts" interact.

Highlight (yellow) - Location 2875

When a motor pattern isn't used, it's often the case that it disappears entirely from the behavioral repertoire. Infant SUCKLING is a good example. If a newborn pup or lamb doesn't find the mother's teat and begin to nurse in the first few hours of life, it will never be able to do it. The unused motor pattern drops out of the system. We saw a related phenomenon in our livestock-guarding dogs. Some of them (atypically) began to exhibit CHASE as very young pups; if it persisted and linked up with EYE/ STALK or GRAB-BITE, which have later onsets, the pup turned into an untrustworthy and ineffective guardian. When cooperating farmers and ranchers in our long-term study told us they had problems with CHASE in young pups, we advised them to house the dogs where they could see and smell sheep but could not run. Often CHASE would disappear. When the motor pattern wasn't exercised sufficiently, it dropped out of the repertoire entirely. We think that an important indirect adaptive benefit of play is that it keeps intrinsic motor patterns "alive" and functioning until the entire adult sequence is in place.

10. Minding the Dog

Highlight (yellow) - Location 3220

Some dogs chase things and some don't. You'll recall that livestock-guarding dogs won't go after a ball that is tossed in front of it— simply because they don't have the CHASE motor pattern. We assume that their visual system, common to all dogs, is certainly capable of detecting a ball. So when one rolls past a Maremma and the dog simply watches it go by, we wonder if the animal has established and maintained any stable representation of the object at all. As far as the Maremma's behavior is concerned, the ball might just as well have disappeared.