THINKING SHEEP:

A Review of Cognition, Emotion, and Social Complexity in Domestic Sheep

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Table of Contents

Residents at Farm Sanctuary's New York shelter head into the barn during a summer rain.

I. Counting Sheep

"Mary Had a Little Lamb," "Baa Baa Black Sheep," Sherry Lewis's Lamb Chop, and the Serta mattress sheep are all examples of how sheep and lambs live in popular consciousness when it comes to thinking about *Ovis aries*. Images of happy lambs frolicking in fields are, for many people, the stuff of greeting cards, symbols of spring, and Easter.

Sheep stereotypes are also reflected in language, especially metaphor. Humans who blindly follow leaders are like "lambs to the slaughter," and a "wolf in sheep's clothing" is a cunning, deceitful person pretending to be gentle and obedient. A "sheepish grin" is worn by those who want to appear guiltily submissive. Sheep have come to be used in language to refer to people who have "no mind of their own," are naïve, ineffectual, and ready to please.

Lorelai stands outside of Farm Sanctuary's New York sheep barn.

How do these popular misconceptions and metaphors about sheep impact how we treat them?

Unfortunately, these popular mythologies about sheep can serve as justification for their use as one of the most commoditized and exploited species on the planet. Sheep are used for food,[1,2] clothing, and biomedical research[3] and are not protected by the Animal Welfare Act.[4]

Do these expressions and metaphors accurately characterize sheep?

Are sheep dumb, bleating animals who walk passively behind each other with few thoughts and feelings of their own? Can sheep ever be as cunning as a wolf? Are sheep always meek and eager to do our bidding? They are more complex than popular expressions would lead us to believe!

II. Aims and Scope

The purpose of this paper is to answer questions about *who* sheep are. Scientific research can help us separate fact from fiction. Therefore, in this white paper we discuss a range of findings from our peer-reviewed scientific paper on sheep cognition, emotions, personality, and social complexity.[5] We focus on identifying evidence for complex psychological capacities in sheep that may be surprising to the general public but are shared with other animals we have little trouble perceiving as more complex and intelligent than sheep.

We also want to encourage future research to shift away from a focus on how to use sheep more efficiently in applied settings (for meat, wool, and genetics) to that which asks questions about their psychology in naturalistic and non-invasive settings and ways, and on their own terms.

Residents at Farm Sanctuary's New York shelter on their way out to pasture.

III. Evolution and Domestication

Before delving into the minds of modern day domestic sheep it is helpful to consider the journey they have taken over time from their origins and the kinds of basic adaptive sensory capacities they have maintained that shape how they come to know the world.

Sheep are one of the earliest species of animals to be domesticated and the record takes us back at least 10,000 years to Mesopotamia.[6] They are grazing herbivores and like other prey species possess sharp vision and hearing to detect predators. In fact, the field of vision in sheep is so wide they can literally see behind themselves without turning their heads![3] Sheep also have a keen sense of smell and use it to find mates, locate their young, as well as establish good locations for foraging.[7]

Sheep can live as long as 20 years and ewes (females) closely bond with their lambs, who are naturally weaned at 6 -10 months of age.[8] Mothers encourage their babies to follow them with low-pitched bleats that lambs recognize at a very early age.[9] Mothers and lambs become distressed when separated even for a short time.[10] This is just one of the many ways sheep remind us that all mothers and their children – not just humans – share a familiar bond.

Julie with her baby Erin.

“Sheep can live as long as 20 years and ewes (females) closely bond with their lambs, who are naturally weaned at 6 -10 months of age. Mothers encourage their babies to follow them with low-pitched bleats that lambs recognize at a very early age.”

Katie and her twins Josie and Maple.

IV. Cognition

Cognition refers to the mechanisms by which an individual acquires, processes, stores, and acts upon information; it includes learning, memory, and decision-making.

Sheep and lambs remember, and are particularly adept at spatial navigation such as working through a maze.[11] They also learn to discriminate between various flavors and generalize knowledge on the basis of flavor.[12] In fact, they are able to discriminate between edible plants in order to self-medicate when they are ill.[13]

"Sheep can perform 'executive' cognitive tasks that are an important part of the primate behavioral repertoire.

What are executive functions?

They are the ability to mentally play around with ideas and concepts in order to solve problems and plan ways to achieve goals. This is a pretty heady capacity and sheep do as well as monkeys and humans do on many tasks probing executive function. Here is an example. Give a sheep a task where she has to discriminate between two colors. Sheep are very good at this simple task because they learn the rules of the game. Choosing a yellow bucket means a reward and a blue one means no reward. Then shift the rules so that the opposite is true – now blue is the rewarding bucket. Sheep move fluidly through this kind of task without skipping a beat. Now introduce a different kind of choice – between two different shapes – while keeping the colors. Now shape is important for reward and color must be ignored. This is called attentional set shifting because now one needs to shift one's attention to shape while ignoring color. If this all sounds really complicated, that's because it is! And yet, sheep can perform these tasks as well as monkeys and college students.[14]

Sheep can recognize and distinguish between human faces.

Sheep Remember Faces

The ability to tell individuals apart is the basis of all social relationships and facial cognition is a large part of that. Faces are highly complex stimuli and represent identity, emotion, gaze, and attraction and it is an equally complex cognitive task to discern all of these dimensions of information from a face. Dogs, pigs, and primates are very good at facial recognition but sheep are the face processing geniuses of the barnyard!

Studies show that sheep can remember up to fifty different individual sheep for over two years[15] and can even distinguish sheep faces from photographs of individuals at different ages and in different poses.[16]

Sheep can be celebrity watchers too! In a recent study it was demonstrated that when presented and familiarized with the faces of four people – who in this study happened to be actress Emma Watson, former U.S. President Barack Obama, newsreader Fiona Bruce, and actor Jake Gyllenhaal – they could distinguish those faces from novel, unfamiliar ones and could do so even when the faces were displayed in different orientations.[17]

When it comes to reading emotions on a face, sheep, like humans, prefer to look at sheep faces that are calm, rather than ones that are frightened or startled. All of this facial acumen in sheep has led one researcher to suggest: "This does open up the possibility that [sheep] have much richer emotional lives than we would give them credit for."[18]

V. Emotions

Cindy shares a smile with the camera.

Speaking of emotions, sheep, like many other farm animals, experience complex emotions that they communicate to other sheep with their faces and other parts of their bodies.

“How we interpret ambiguous stimuli or situations depends upon whether we are depressed or anxious or feeling on top of the world. Sheep experience this too.”

The Glass is Half-Empty or Half-Full

One example familiar to all of us is cognitive judgement bias, also known as optimism and pessimism. We all know the feeling of being able to take on the world when bolstered by good experiences and praise. Unfortunately, we also know what it feels like to “give up” when we are pummeled by bad experiences. Cognitive bias is a deviation in judgement as a result of emotional experiences. How we interpret ambiguous stimuli or situations depends upon whether we are depressed or anxious or feeling on top of the world. Sheep experience this too. When they are treated roughly or experience loud sudden noises that are uncontrollable, they perform very poorly on discrimination tasks that are quite easy for them under normal circumstances. They either show lack of motivation to try to complete the task, or may even see formerly ambiguous stimuli as negative (a sign of punishment or lack of reward).[19] In other words, after a tough life they view the world through the opposite of rose-colored glasses. Sound familiar?

“Don’t Let Me Down”

Just like us, sheep do not like to be disappointed. If they have expectations about a certain level of reward during a task and are “let down” with a lesser reward, they become emotionally upset. Just like us, they form expectations and do not like when those are violated. This is called appraisal theory and it shows sheep are capable of forming mental representations of expected rewards and comparing those to actual rewards.[20]

Mother-Child Attachment

When it comes to emotions, there are none as intense as the bond between mother and child. In nature, lambs are weaned at six months old but in factory farms, where ewes are separated from their lambs at the tender age of one to two months they let out high-pitched vocalizations, pace, and even urinate.[21] And studies suggest that early separation from the mother has negative psychological impacts on the lambs through different phases of their social development. They become very anxious adults.[22]

Play and Positive Emotion

Play is a reliable indicator of positive mood and emotions in mammals and sheep are “play monsters!” After about the first week of life,

Frankie playing in the field.

lambs form play groups and sex differences become apparent. Males tend to play more rambunctiously, headbutting and mounting each other (“boys will be boys!”), while females tend to engage in more locomotor play, such as gamboling and frolicking.[23] Both males and females perform exaggerated and exuberant body movements like “bucking,” spinning, and whirling around[24] in a “happy dance” of wild abandon just like any kid exploring their own movement and environment.

VI. Personality

Personality is a set of traits that differ across individuals and are consistent over time within individuals. Individual differences in personality contradict the view that other animals are one-dimensional, interchangeable units within a group, population, or species (as we often think of sheep and other herding animals such as cows). Sheep personality traits are very familiar, as they are shared with humans and other complex animals.

For instance, individual sheep can be shy or bold. As you would expect, bold sheep tend to take more risks, are more comfortable with novelty, and explore their environment more than shy sheep do.[25] Just as in humans, bold sheep tend to take more of the initiative in their social lives, acting as group leaders when, for instance, decisions about foraging need to be made.[26] Even though sheep are herd animals some tend be more gregarious than others, preferring the close company of other sheep more than some others.[27] These findings show that sheep, like other animals, cannot be characterized by a single dimension but, rather, show individual differences across a number of dimensions even within their own species.

There are likely to be many more aspects of sheep personality to be uncovered and explored in all of their richness.

“Just as in humans, bold sheep tend to take more of the initiative in their social lives, acting as group leaders when, for instance, decisions about foraging need to be made.”

Scott walking up the hillside with the rest of the herd.

VII. Social Complexity

If you come upon a pasture and see a herd of sheep grazing together you might be tempted to think that is all that is going on. But look more closely and you find the hidden complexity in their patterns of aggregation, their movements, and their interactions with each other. They are no more a random assortment of individuals than are crowds at a festival or children in a playground.

The social complexity of any species can be defined by the number of individuals and the number and kinds of different roles and relationships among them. Differentiated relationships are those that require recognizing and responding to differences across individuals (e.g., dominance roles, kinship, and other more complex multidimensional differences). That complexity plays out in how we cluster with friends versus strangers, how watchful we are of young children versus adults, and how comfortable we are with certain individuals in a group.

Sheep, too, tend to form groups based on friendships (also known as "affiliative bonds" in scientific jargon).[28] As noted above, bolder sheep tend to be social leaders in deciding where and when to forage and individuals differ even in terms of who leads the group to another pasture when moving. Among males, dominance hierarchies form and often influence the shape of the social group and its many subgroups.[29] The same group of grazing sheep form larger and smaller clusters depending upon activity level (whether they are resting or traveling, for instance).

Liam leads the herd up the hillside.

Finally, like all social animals, sheep get upset when they are separated; those forced to live in social isolation exhibit pacing and chewing, which are common signs of distress in mammals.[30] All of these signs dissipate when they are reunited.

VIII. Summary and Conclusions

We have identified a variety of findings from the scientific literature on learning and cognition, emotions, personality, and social complexity showing that contrary to popular views and representations of sheep as unintelligent and lacking in individuality or autonomy, they have several complex capacities including:

1. Sophisticated abilities to mentally play with concepts and ideas

2. Considerable talents in identifying and distinguishing faces of other sheep as well as humans

3. A range of simple to complex emotions, including optimism and pessimism

4. Distinct personalities

5. Strong mother-offspring bonds and complex social lives

Our review contradicts historical perceptions of sheep that fuel and sustain contemporary media, popular culture, farming and research practices. It is our hope that this comprehensive analysis of scientific literature will serve as the foundation for reconsidering the use of sheep as commodities in modern agricultural production and in invasive research, and will promote learning more about sheep using noninvasive research in more natural and noncoercive settings such as sanctuaries.

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Adriano at Farm Sanctuary's New York shelter.

The Someone Project is a joint undertaking by the Kimmela Center for Animal Advocacy and Farm Sanctuary to compile, review, and publish scientific evidence for cognitive and emotional complexity in farm animals and to support promising research in these areas.

Farm Sanctuary advocates observational and cooperatively designed studies with farm animals in a sanctuary setting to build upon existing research and to elevate awareness and respect for who they are as individuals and species.

Visit farmsanctuary.org/education to learn more.

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