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Evans O Odhiambo

M.Sc. (Animal Breeding and Genetics), Department of Animal Science, P.O Box 536-20115 Egerton, Kenya

Dr. Paul A Onjoro

Ph.D. (Animal Nutrition), Department of Animal Science, P.O Box 536-20115 Egerton, Kenya

Epimeletic behaviour in farm animals: Evolution from wild ancestors through domestication to modern systems

Evans O Odhiambo and Paul A Onjoro

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Abstract

Epimeletic behaviour refers to the social behaviour which provides care and nurturing that is not self-directed and it plays a crucial role in animal offspring survival and group fitness and social bonding across various animal species. This comprehensive review traces the evolutionary trajectory of these complex care-giving systems in modern livestock and poultry, analysing their divergence from wild ancestral patterns to their current state under intensive production systems. The millennia-long process of domestication was characterized by intense artificial selection, which systematically favoured production traits such as high yield and docility over intrinsic parental investment (PI). The continuous selective pressure has led to the genetic reduction and neurobiological deterioration of advanced epimeletic behaviours. Therefore, this review comparatively examines the distinct developmental paths of this behaviour among key agricultural groups, including ruminants, swine, and poultry, illustrating how species-specific ecological histories dictated the nature of behavioural compromise. The main subject focuses on how modern systems developed evolutionary problems because standard management methods including early neonate separation and confinement and changed social interactions lead to major clashes with natural maternal instincts. The conflicts lead to major welfare issues because they inhibit animals from performing their natural maternal activities like porcine pre-parturient nest building and they break the essential bond between cattle mothers and their offspring. The analysis provides a framework to study the ongoing gap between natural caring behaviours and industrial work settings which helps create better animal care standards for farming operations.

Keywords: Epimeletic behaviour, domestication, parental investment, animal welfare, livestock management

1. Introduction

Epimeletic behaviour refers to care-giving actions expressed by one individual toward another, often directed to offspring, injured, or distressed conspecifics (Hafez & Bouissou, 2005). Animals perform et-epimeletic behaviours when they seek help from others through vocalizations and approach behaviour. The two elements serve as essential components which enable social species to maintain social cohesion and survive in their environments.

Animals show epimeletic behaviour through their natural instinct to lick and groom as well as their actions of nursing, protecting and brooding their young ones. These behaviours developed through evolution to improve offspring survival rates and create stronger social bonds which maintained herd stability. They directly impact animal production and newborn survival and welfare outcomes in farm animals (Fraser & Broom, 2022) ^[16].

Domestication defined as the sustained multi-generational relationship between humans and animals where humans control breeding and living conditions has profoundly affected animal behaviour. Although domestication preserved many caregiving instincts, intensive management systems have increasingly constrained their expression (Price, 2002). The study of epimeletic behaviour evolution from wild ancestors to domestic animals requires this knowledge to develop welfare-friendly livestock management systems.

Corresponding Author:

Evans O Odhiambo

M.Sc. (Animal Breeding and Genetics), Department of Animal Science, P.O Box 536-20115 Egerton, Kenya

Domestication and Behavioural Evolution

The process of domestication started during the period from 11,000 to 3,000 years ago and resulted in behavioural and physiological and morphological transformations which scientists call the domestication syndrome.

Early domesticated animals such as sheep and goats were initially managed in semi-natural conditions, allowing expression of full maternal and social behaviour. The process of selective breeding for docility and productivity and fast

growth rates over thousands of years led to unintentional decreases in epimeletic responses among certain species.

The ability to adapt behaviour proved essential for animals to become successfully domesticated. The selection process favoured animals which exhibited lower fear responses along with better social behaviour and ability to stay in confined spaces. The changes brought about modifications to maternal vigilance and protective aggression and allogrooming behaviour in the animals.

Table 1: Approximate Domestication Periods and Centres [Beja-Pereira *et al.* (2006)]^[3]

Species	Wild Ancestor	Domestication Period (Years BP)	Region of Domestication
Sheep (<i>Ovis aries</i>)	Asiatic mouflon	11,000-9,000	Fertile Crescent
Goats (<i>Capra hircus</i>)	Bezoar ibex	11,000-10,000	Zagros Mountains
Cattle (<i>Bos taurus/indicus</i>)	Aurochs	10,000-8,000	Fertile Crescent / Indus Valley
Pigs (<i>Sus scrofa domesticus</i>)	Wild boar	10,000-9,000	East Asia & Near East
Chickens (<i>Gallus gallus domesticus</i>)	Red junglefowl	8,000-7,000	Southeast Asia
Donkeys (<i>Equus asinus</i>)	African wild ass	6,000-5,000	Horn of Africa
Horses (<i>Equus caballus</i>)	Wild Eurasian horse	5,500-4,700	Eurasian steppes
Camels (<i>Camelus spp.</i>)	Wild camelids	4,000-3,000	Arabia and Central Asia

Species-Specific Trajectories of Epimeletic Behaviour

Cattle (*Bos taurus*, *Bos indicus*)

In wild and feral bovine populations, cows give birth in relative isolation and immediately start providing postpartum care. A newborn calf is licked and nuzzled by its mother, which helps them recognize each other (Beja-Pereira *et al.*, 2006)^[3]. The cow keeps the calf hidden at first for about a week and then gradually introduces it to the herd. After this period, calves form crèches; these are communal nurseries guarded and sometimes cared for by several adults in the herd. Wild aurochs, the ancestors of domestic cattle, displayed similar alloparental care. They collectively defended calves against predators and allowed mother-offspring bonds to form in a social setting.

With domestication, these maternal behaviours initially continued under traditional pastoralism. However, the increase in intensive dairying led to a conflict between milk harvesting and maternal care. Modern dairy farms often separate calves from cows within hours of birth, frequently less than 24 hours, abruptly removing maternal contact. Studies show that this forced early separation causes intense distress vocalizations in both cows and calves and leads to abnormal searching behaviour (Johnsen *et al.*, 2016)^[20]. In contrast, cows allowed to stay in contact produce more affiliative calls and show fewer signs of stress. Beef cattle systems usually keep cow-calf contact for weeks (Fraser & Broom, 2022)^[16]. Calves raised with their mothers tend to be calmer and show better thermoregulation and weight gains. While traditional herding maintained natural care patterns, modern systems, especially in dairy farming, have significantly reduced the duration and intensity of maternal care.

Sheep (*Ovis aries*)

In wild sheep, like the mouflon, ewes develop strong bonds with their lambs. Right after birth, the ewe licks and grooms each lamb while making soft bleats. This behaviour cleans and warms the lambs. It also helps the lambs recognize their mother's scent, creating a special memory. Lambs call out to find their mothers. Ewes and their lambs quickly learn to recognize each other's voices. Playback experiments show that sheep can distinguish calls based on basic sound cues. By the time they're one day old, lambs choose their own mother's voice over others. In modern pastoral grazing systems, these

maternal behaviours persist. Lambs stay close to their mothers for weeks, which helps with temperature regulation and survival.

Domestication has not changed these instincts, but modern farming practices can disrupt them. Intensive commercial lambing, with crowded spaces and multiple births, can overwhelm ewes. This can lead to mismothering, where some lambs are abandoned or rejected. High-yield breeds often have twins or triplets that the ewe cannot fully care for, making interventions like fostering necessary. However, the basic bond sequence of licking, bleating, and recognition remains intact in domestic settings. Researchers point out that any disruption, such as excessive handling or separation within the first 4 to 6 hours, can harm attachment. In contrast, calm, low-intervention lambing promotes natural bonding and better growth for the lambs.

Goats (*Capra hircus*)

Goats, like sheep, inherit strong maternal behaviours from their wild ancestors, such as the Bezoar ibex. Around the time of giving birth, a doe seeks a hidden spot and gives birth in privacy. She immediately licks and sniffs her kid, marking it with her scent. Within hours, she forms a bond with her kid through recognizing its smell. Controlled studies of domestic goats show that mothers lick their newborns actively and quickly establish a bond through this scent recognition. Within four hours, they can recognize their offspring's appearance and sounds. Wild kids often stay hidden for their first week of life and join the herd only after they have suckled safely. Domesticated goats keep these instincts; small-scale herding systems let them stay with their kids for weeks. Only in intensive dairy systems are kids removed early, breaking the normal grooming and nursing process. In low-input or traditional systems, does still nurse, groom, and guide their kids much like wild does do, promoting strong social learning and survival.

Pigs (*Sus scrofa domesticus*)

Nest-building and strong maternal defence are key traits of pigs inherited from wild boars. A pregnant sow leaves her group about a day before giving birth and digs a shallow nest, collecting branches, grasses, and bedding. She usually finishes the nest 6 to 12 hours before birth, arranging natural materials into place. This nest gives comfort, warmth, and a

safe spot for the piglets. Wild sows guard the nest vigilantly. If a predator approaches, they grunt or growl to chase it away, while piglets flatten themselves in the nest for camouflage.

Domestic sows still have a strong nesting instinct and care for piglets fiercely, though domestication has made them less aggressive toward humans. In farrowing crates, introduced in the 1960s, sows cannot turn or walk, which stops them from nesting. This confinement often frustrates them: sows in crates become restless and have longer farrowing times. In contrast, loose-housed sows with straw can nest normally and have shorter farrowing periods. Studies of enriched farrowing pens show that providing nesting materials restores natural digging, reduces stress-related behaviours, and can improve piglet survival by encouraging immediate nursing, compared to bare crates.

In modern farming, piglets are generally separated from their mothers after weaning. In traditional pastoral or smallholder settings, like with feral or free-range pigs, piglets typically stay in the nest for one to two weeks, nursing often, usually every 15 minutes, until weaning.

Chickens (*Gallus gallus domesticus*)

The ancestor of the domestic chicken, the Red Junglefowl, shows full maternal care. A broody hen incubates her eggs in a nest, then cares for the newly hatched chicks. She leads them to food and shelter while warning them of danger. In natural broods, the mother and chicks stay closely bonded for 5 to 12 weeks. Even before hatching, embryo chicks make distress calls that prompt the hen to respond, helping the chicks recognize her voice after they hatch. Once chicks are hatched, a broody hen uses special calls to keep her family together: "food calls" and "cluck" calls gather chicks when it's time to eat, while alarm calls warn of predators. Chicks imprint on the mother's appearance and cluck calls during their first days of life.

Domestication initially maintained this maternal behaviour, but selective breeding has changed it greatly. Commercial layers have been bred to reduce broodiness, so hens rarely build nests or raise chicks. In industrial flocks, eggs go into incubators, and the chicks do not receive maternal care. However, heritage and backyard hens still have these instincts. When given the chance, they will brood eggs and care for their chicks naturally. These observations show that the genetic potential for maternal care is still there, even if modern production systems usually suppress it.

Horses (*Equus caballus*)

Wild horses live in family groups with strong mare-foal bonds. Foals in this species are able to stand and nurse within the first hour of life. Mares and foals form immediate bonds. If a mare moves away, the foal follows her closely. If the foal lies down, the mare stands guard. Foals nurse frequently, often every 15 minutes during their first month, and mothers reject any alien foals. Mares groom their foals and show protective behaviour toward threats. For the first month, foals mainly interact with their mothers, starting to explore and play with other horses only later. Mares may nurse their offspring for a year or more if left undisturbed.

Domestication has not eliminated these instincts. Foals of domestic mares still follow and nuzzle their mothers, and mutual grooming and social learning happen in pastured horses. However, human management often cuts short natural care. Most foals are weaned at 4 to 6 months, much earlier than the natural weaning age of 10 to 11 months, and are regularly handled by humans. Horses can form bonds with

other adults and develop friendships, such as mutual grooming between mares, even in domestic settings. There are anecdotal reports of horses responding to distressed humans or forming bonds with other species, indicating their strong social instincts remain, but these events have mostly been noted by horse owners rather than through formal research.

Donkeys (*Equus asinus*)

Donkeys come from the African wild ass, and their maternal behaviour is similar to that of horses. Jennies give birth in front of the herd and quickly form a close bond with their foals. A recent study of Somali wild asses, which are closely related, found that foals continue to nurse until they are yearlings, around 10 to 12 months old. This suggests that mothers nurse for a long time in these animals. In domestic donkeys, mares stay close to their foals and groom them at first, gradually allowing more independence. Because donkeys are rarely farmed intensively, traditional care usually lets foals remain with their mothers for many months. Recent studies confirm that wild asses have prolonged nursing and stable mother-foal interactions, suggesting that donkey maternal care has stayed mostly the same despite domestication.

Camels (*Camelus spp.*)

The available literature did not provide detailed accounts of camel maternal behaviour, so we turn to general knowledge. Wild camelids, both dromedaries and Bactrians, establish strong bonds with their calves. Calves can walk and run shortly after birth and typically stay close to their mothers for many months, nursing for more than a year. Domestication, which began about 4,000 years ago, did not remove these instincts. In pastoral societies today, mother camels usually raise one calf at a time, with extended nursing and social bonding. Some modern dairy camel farms practice partial separation, like removing the calf at milking time to boost milk production. However, nomadic herders typically allow calves to suckle freely. Overall, camels keep their long maternal nursing periods and bonding behaviours, although we could not find a direct source that provides specific details on this species.

Conclusion

Despite significant ecological, genetic, and managerial changes over millennia, epimeletic behaviour remains one of the most enduring pillars of mammalian and avian survival. This behavioural suite has remained essential to neonate viability, social cohesiveness, and reproductive success from its origins in wild ancestors where maternal attentiveness, allomothering, and protective responses evolved under intense predation pressure to its expression in contemporary domesticated species. Darwin, Lorenz, Hediger, and Tinbergen were among the pioneering ethologists who demonstrated that caregiving responses are not random instincts but rather carefully calibrated evolutionary strategies influenced by social structures, environmental limitations, and life-history traits. Even as farm animals deal with new pressures brought about by artificial selection, confinement systems, and productivity-focused breeding, current research confirms that these same evolutionary mechanisms still function.

Domestication has changed the context of epimeletic behaviour across species rather than its biological basis. The essential elements of maternal care, bonding, grooming, and distress responses are still present in cattle, sheep, goats, pigs,

horses, poultry, rabbits, and camels; however, the timing, intensity, and expression of these behaviours are increasingly deviating from ancestral patterns. Genetic selection has reduced brooding or protective behaviours in some species, like poultry and intensively selected pigs, while management interventions like early separation, artificial rearing, and restricted movement have changed the behavioural landscape in other species, like dairy cattle, small ruminants, and camels. These modifications highlight a persistent mismatch between evolved caregiving strategies and production environments, with significant implications for welfare, offspring survival, and human-animal interactions.

The body of research indicates that in contemporary farming systems, epimeletic behaviour is still a sensitive indicator of welfare, stress adaptation, and maternal competency. Its expression offers vital information about the behavioural costs of intensification and the biological boundaries of artificial selection. Future developments in precision livestock technologies, behavioural endocrinology, genomics, and ethologically informed management present previously unheard-of chances to realign production methods with the evolutionary requirements of domesticated species. Systems that maintain crucial caregiving behaviours while fostering animal productivity, resilience, and well-being will be made possible by combining these tools with a deeper understanding of past behavioural trajectories.

The health, welfare, and sustainability of farm animal populations are still shaped by epimeletic behaviour, which is a dynamic, adaptive, and evolutionarily conserved framework rather than just a holdover from ancestral instinct.

Conflict of Interest

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