A survey of play behaviour in domestic lambs out on pasture

En kartläggning av lekbeteende hos domesticerade lamm på bete

Samantha Augustsson

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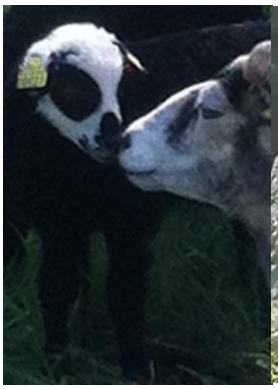

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Summary

Play has been recorded in a wide variety of animal species and presents itself at different ages in different species. It has been reported that the occurrence of play behaviours can be affected by factors in the animal's environment, such as housing, feeding and management. Thus play might be used as a measure of animal welfare. The purpose of this study was to examine play in lambs in a semi-natural environment out on pasture, by observing the lambs during their first months of life from a qualitative as well as a quantitative perspective.

Three different groups of lambs, from two different farms, were observed: Gute sheep, Texel sheep and crossbreeds (Swedish Fine Wool, Dorset and Suffolk). The observations took place over the course of 6 weeks on pastures around Uppsala, Sweden, and no induction or stimulation of play was implemented. One observer was involved and the observations were divided into two sessions- one in the morning (8 to 10 am) and one in the evening (6 to 8 pm). Two types of methods were used: focal sampling and scan sampling. The focal method involved systematic and continuous observations for 10 minutes for 8 focal lambs. Following each focal session, two minutes of scan sampling followed where the entire group was observed instantaneously.

It was found that lambs perform several different behavioural patterns that could be interpreted as play. A total of 10 play behaviours were recorded. It was concluded that type and prevalence of play changed over time, and became less frequent as the lambs grew older. At 12 weeks of age play had greatly reduced, and it became rare at 4 months of age. Object play was almost only seen during the first three weeks. Social play, on the other hand, continued throughout the study, perhaps because it is a play category of a more complex nature that needs to be more finely-tuned. The most distinct play peak was identified at 2nd to 4th week of observations, which corresponds to 51-75 days of age. When it comes to their diurnal play cycle, the lamb played substantially more in the morning and evening, and the evening was somewhat preferred over the morning. This play cycle could possibly be connected to the lambs' evolutionary background and the activity patterns of their predators at that time. There were clear contrasts between genders; ram lambs represented the main part of play occurrence, mainly in the form of social play such as mounting, pushing and butting. Conversely, ewe lambs performed more locomotor play, particularly jumping and pivoting. Lastly there were substantial differences between the breeds, where the Gute lambs displayed

the highest amount of play, followed by the crossbreeds and then the Texels. These differences can presumably be a consequence of both age, considering that the breeds varied in age (about 2 months between youngest Gute lamb and oldest Texel lamb), and breeding for specific traits.

Hopefully the knowledge from this study can provide material for assessing the level of play in lambs, and hence promote the usage of play as a measure of animal welfare.

Sammanfattning

Lek har registrerats hos en mängd olika djurarter och uppenbarar sig i olika åldrar hos olika arter. Det har rapporterats att förekomsten av lekbeteenden kan påverkas av faktorer i djurets miljö, såsom boende, utfodring och förvaltning. Således skulle lek kunna användas som ett mått på djurens välbefinnande. Syftet med denna studie var att undersöka lek hos lamm i en seminaturlig miljö ute på bete, genom att observera lammen under sina första månader i livet från ett kvalitativt såväl som ett kvantitativt perspektiv.

Tre olika grupper av lamm, från två olika gårdar, observerades: Gutefår, Texelfår och korsningar (Svensk finull, Dorset och Suffolk). Observationerna skedde under loppet av 6 veckor på betesmarker runt Uppsala, Sverige, och ingen induktion eller stimulering av lek genomfördes. En observatör var inblandad och observationerna fördelades på två tillfällen- en på morgonen (kl. 08-10) och en på kvällen (kl. 18-20). Två typer av metoder användes: fokalobservation och totalobservation. Den fokala metoden involverade systematiska och kontinuerliga observationer under 10 minuter avseende 8 fokala lamm. Efter varje fokal omgång för respektive djur följde två minuter av totalobservation, där hela gruppen observerades momentant.

Det konstaterades att lammen utförde flera olika beteendemönster som skulle kunna tolkas som lek. Totalt 10 lekbeteenden registrerades. Typen och förekomsten av lek förändrades över tid, och blev allt mer sällsynt i takt med att lammen blev äldre. Vid 12 veckors ålder hade leken minskat kraftigt, och sågs knappt efter 4 månaders ålder. Objektlek observerades nästan enbart under de första tre veckorna. Social lek, å andra sidan, fortsatte under hela studien, kanske för att det är en lek kategori av en mer komplex karaktär som måste finjusteras mer för att fungera framgångsrikt. Den tydligaste lektoppen identifierades mellan 2: a till 4: e observationsveckan, vilket motsvarar 51-75 dagars ålder. När det gäller deras dagliga lekmönster så lekte lammen betydligt mer på morgonen och kvällen, och kvällen tycktes föredras något framför morgonen. Lekmönstret i fråga kan möjligen kopplas till lammens evolutionära bakgrund och rovdjurens aktivitetsmönster. Det fanns tydliga kontraster mellan könen; bagglamm stod för huvuddelen av leken, främst i form av social lek såsom ridning, knuffning och stångning. Omvänt engagerade sig tacklamm mer i rörlig lek, särskilt hoppning och pivot. Slutligen noterades betydande skillnader mellan raserna, där Gutelammen representerade den största lekförekomsten, följt av korsningarna och sist

Texellammen. Dessa skillnader kan vara en följd av både ålder, med hänsyn till att lammens ålder varierade en del (det var ungefär 2 månader mellan yngsta Gutelammet och äldsta Texellammet), och avel för särskilda egenskaper.

Förhoppningen är att resultaten från denna studie kan ge underlag för att bedöma lekförekomsten hos lamm, och därmed främja användningen av lek som ett mått på djurens välbefinnande.

2. Introduction

2.1 Background

Play is considered to be an under-researched aspect of social behaviour (Špinka et al., 2001; Nelson & Fijn, 2013), and among the studies that have been carried out there has been disagreements about several basic issues (Power, 2000). Some, as Lazar & Beckhorn (1974) argue that the term "play" should be omitted and replaced with the broader term "play-like behaviour", and thus developmental investigations of behaviour will be less restricted. Others (e.g. Špinka and Held, 2011; Oliveira et al., 2010; Chaloupková et al., 2007) press on the significance of play, and have identified play behaviour in animals as an important aspect of animal welfare. It has been observed that the frequency and type of play are affected both by the type of housing and feeding routines, and a reduction or absence of play could be a sign of unsatisfactory circumstances (e.g. Krachun et al., 2010; Mintline et al., 2013; Oliveira et al., 2010, Špinka and Held, 2011, Sutherland et al., 2014). Oliviera et al. (2010) share the same view and conclude that animals play if they are healthy and well-fed, but do not engage in play if they are hungry, ill (Oliviera et al., 2010), fearful or consider their environment too stressful (Špinka, 2009). Weaning (abrupt) can serve both as a change regarding feeding as well as a typically subsequent change in housing and breaking of the social bond with the mother/parents, and should therefore be considered as a stressful event which can reduce the occurrence of play (Krachun et al., 2010).

Additionally it has been reported that a reduction in play can be a good indicator of negative physical experiences such as pain; a study targeting the changes in play as a consequence of disbudding in dairy calves, saw that locomotor play was reduced because of the pain caused by the disbudded horns. Moreover calves provided with more pain relief medication played more compared with calves that did not receive any medication or a lesser amount (Mintline et al., 2013). The same correlation between pain and a reduction in play has been observed in newly castrated lambs. Thornton & Waterman-Pearson (2002) found that castration caused 1 week old lambs to gambole significantly less, during the three days following the procedure.

Another motive to study play behaviour is the numerous positive effects that can be derived from play. For example a heightened ability in piglets to handle the stress that accompanies

mixing with strangers after weaning (Donaldson et al. 2002). In a broader sense, play can be considered as an essential piece of the learning process, where the young animal gathers critical information about different objects, appropriate social behaviours and the right feed to eat and a lot more. And the fact that the animal gets to learn these things in a playful context, instead of under real, unforgiving, circumstances, is deemed to be crucial for its success as an adult (Heinrich and Smolker, 1998).

The measurement of animal welfare has principally focused on the negative aspects, which includes aspects that should be prevented. However Yeates & Main (2008) argue that the same focus needs to be devoted to the positive aspects, where animals display pleasurable interactions and behaviours such as play. Without the positive aspects the ethological and physiological parts will be overlooked, and hence the "enjoyment" of the animals' existence (Yeates and Main, 2008). Even Charles Darwin associated play with something joyous by stating in 1871: "Happiness is never better exhibited than by young animals, such as puppies, kittens, lambs, &c., when playing together, like our own children" (Darwin, 1871, cited by Bekoff, 2001).

The majority of studies targeting play behaviour are carried out in an experimental setting, where the animals are put in situations to promote play. For instance various stimuli, such as sawdust, stones or feed, are introduced in combination with spatial variations (Sutherland et al., 2014; Rushen and de Passillé, 2014; Sachs and Harris, 1978), or novel objects in the form of balls, chains and tunnels are provided during a limited amount of time in play arenas (Chapagain et al., 2014), to observe the effects on play behaviour. Sachs & Harris (1978) began each observation session by filling the feeding troughs, placed at the edge of the pens, with grain to encourage play. But to my knowledge no study has previously been done on domestic lambs purely to systematically observe play behaviour and the ontogeny of play in a semi-natural environment, out on pasture, devoid of human influence. Albeit there is a study conducted by Hass & Jenni (1993) that indeed did carry out ontogenetical field-observations, without any provided play stimuli. Though it should be pointed out that the study used a different level of methodology seen to the systematic aspect of the observations; the length of observations varied from 3 to 8 hours and no definite schedule was followed. Additionally, the environment in which the study was done, with steep hillsides in the prairie, might perhaps not be comparable with a pastoral environment. Lastly, they study the wild sheep breed, Bighorn sheep (*Ovis canadensis*), whereas this present study targets domestic lambs.

2.2 Play behaviour

2.2.1 Definition of play

A variety of definitions have been brought forth by different authors to identify or describe play behaviour in animals. Bekoff (1984) targeted the difficulty of shaping a precise definition of play only by examining what the animal does structurally and the assumed functions of play, since different species of animals may carry out different behaviours with contrasting purposes and nonetheless they can be characterized as play behaviours. He also emphasizes the current dubious situation, where the actual word "play" may be included when defining play.

Kaufmann (1974) discussed the trouble of defining play as well, and concluded that authors generally share the opinion that play involves activities that lack an obvious adaptive function, or in any case not the same function as when the activities are conducted by adults. Another definition simply states that animal play entails any purposeless motor activity with patterns from other contexts such as mating or stalking (Balcombe, 2007). However it can be conflicting to address play as activities without purpose, because then the definition of purposeless in this context has to be examined (Heinrich and Smolker, 1998). Burghardt (2005) uses another approach by requiring that five criteria needs to be fulfilled to label a behaviour as play:

- The behaviour is not fully functional, neither in form or context, when expressed.
- The behaviour is pleasurable, rewarding, spontaneous, intentional, reinforcing, or autotelic (i.e. "done for its own sake").
- The behaviour is disconnected from the "seriousness" of execution of typical behaviours in the specie's repertoire regarding at least one of the following: it is exaggerated, awkward, incomplete, precocious or contains behaviour patterns of altered sequencing, form or targeting.
- The behaviour is carried out repeatedly in a similar form throughout parts of the animals' ontogeny, without being considered as stereotypic.

- Lastly the behaviour is initiated when the animals is perceived as being satisfied (i.e. appropriately fed, healthy, relieved from stress) and relaxed (i.e. liberated from intense competing systems such as feeding, predator avoidance and feeding).

To define play behaviour in animals on a more superficial level it can plainly be construed as "having fun", which is used to describe analogous behaviours in humans. This "fun" can present itself in a number of ways, some which are in common in many different species and some which are more or less specific for a certain species (Špinka et al., 2001). For instance in piglets play can manifest itself in behaviours such as head tosses, pivots, scampers[1], pawing and non-injury inflicting bites (Donaldson et al., 2002). In calves play can involve running, head to head contact with either a pen mate or surrounding objects, bucks[2] (Mintline et al., 2013), jumps (Sutherland, et al., 2014) and mounts (Duve & Jensen, 2011). In horses, a variety of play behaviours have been observed, and a minor selection of these are paws, kicks, mounts, frolics[3], bucks, jumps and running (McDonnell and Poulin, 2002). Thus a number of behaviours are in common for all three mentioned animal species, such as bucks, mounts and some form of jumping, though notably numbers of specific play behaviour patterns differs between the species.

The motor activities involved in play are, as mentioned by Burghardt (2005) often perceived as exaggerated and uneconomical. In addition it can be construed as being composed of self-handicapping, since animals involved in play move in a way that is less stable or efficient than normal. Additionally they carry out fast angular and rotational manoeuvres of the head or tangled and contorted postures, which debilitate their spatial and sensory orientation (Špinka et al., 2001). However it is not always obvious how to separate play from stereotypical behaviours, considering that stereotypies generally contain the same elements as play, by lacking a clear purpose and being repetitive. Though something that is specific for stereotypical behaviours is that they develop over the course of an animal's lifetime, whereas play occurs early in life. Also research conveys that stereotypies are more frequent in inferior environments, while play is promoted by a satisfactory setting (Burghardt, 2005).

[1] A minimum of two forward hops right after one another, often combined with ear flapping.
[2] The hindhooves are elevated off the ground and are commonly kicked outwards.
[3] A simultaneous elevating of the ground by both fore- and hindlegs, combined with bucks, twists and head shakes.

Play is generally preceded by signals which convey either the initiation of play or, if produced during the ongoing play bout, encourage the play to continue (Broom and Fraser, 2007), and signals allow the animals to discriminate actually aggressive behaviours from playful ones. Without these signals, that should be easily understood by all participants, there would risks regarding misinterpretations of the behaviour. For instance, in canines there is as a play signal termed the *play bow*, described as a species specific ritualized movement where the animal crouches on the forelegs combined with standing hindlegs and possibly barking and tail wagging. This signal is performed to encourage the other canine to participate in social play (Bekoff and Allen, 1998). In rats play is presumably signalled through 50-kHz ultrasonic vocalizations; the utterance of several such calls during play helps to maintain a playful temperament (Kisko et al., 2014).

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An individual bout of play behaviour does commonly just last for a brief time. For example a study examining locomotor play in dairy calves saw that the mean running duration was 10.3 seconds (Luu et al., 2013). In another study the focus lay on social play in laboratory rats, and the results show that close to half of all the play bouts lasted 10 seconds or less and just 14.1 % of bouts lasted over 30 seconds (Hole, 1988). Further evidence that support the very limited duration of play can be seen in free-ranging meerkats, where the pups' play represented approximately 3 % of their days (Sharpe et al., 2002).

2.2.2 Function and ontogeny of play

It has not yet been verified with certainty which species engages in play behaviour. Marc Bekoff has stated: "Incredibly, we still do not know if most animals do or do not play, and our knowledge of the distribution of play in other vertebrate classes is weaker still" (Balcombe, p.68, 2007). Mammals and birds are generally most confirmed regarding the distribution of play, however the potential for play in nonavian reptiles have previously been surveyed but without producing any valid proofs other than anecdotal testimonies. That is not to say that no

other animal species play, but only that further research is needed to provide consistent statistics (Burghardt, 1998).

Play behaviour originally presents itself at very different ages in different animal species, and the same applies to the age at which play begins to decline and eventually more or less stops. Although the majority of animals have in common that play occurs only during a limited time of juvenile life (Bekoff and Byers, 1998). In dogs it has been observed that puppies begin to play from about week 3 in the form of social investigation, entailing licking, orally investigating or sniffing the littermates, and thereafter other kinds of play develops in the following order: play-fighting at week 4 and play-mounting at the end of the same week, object-play and aggressive play at week 5, and lastly pseudo-sexual play at week 6. Eventually social investigative play decreased from starting from week 9, and all other play behaviours lessened from week 10 (Pal, 2010). In Baboons (*Papio anubis*) young animals engage in play to a greater extent of their lifetime than most animals; play behaviours such as jump, climb, run-to, run-from and hang appears from week 4, and these behaviours peaked at around 16-20 weeks of age. Finally mouth-and-wrestle reached its peak at 2-3 years of age (Chalmers, 1980).

Another example is Golden hamsters (*Mesocricetus auratus)* the first obvious incidence of play is seen quite early on, in conjunction with the development of basic motor coordination by week 3. At that age hamsters start to engage in play fighting, and by week 6 male pups begin to mark-mount (Goldman and Swanson, 1975). According to Deville et al.(2003) play-fighting changes following sexual maturity, which they reach at about 35 days of age (Diamond and Yanagimachi, 1970), into adult aggressive behaviour (Deville et al., 2003). This behaviour modification coincides with the fact that mothers abandon burrows inhabited by her pups, when the pups are 5 weeks old (Kayser and Stubbe, 2003). An animal in which play presents itself from the first day of life is the pig. The piglet plays progressively until around week 3, and from then on play gradually decreases (Špinka, 2009). Conversely kittens begins to play vigorously from week 4; at first they play mostly includes their littermates and by week 7 it proceeds to involve both objects and social aspects in a distinct manner. The object play teaches the juvenile to adopt a variety of patterns that are later on implemented into adult hunting behaviour to effectively catch their prey (Bradshaw, 2009).

Noteworthy is also that play is not solely reserved for juvenile animals; it has also observed in adults such as grown dogs. However Bradshaw et al. (2014) hypothesises that play in adult dogs has developed as a result of selective processes during domestication to fulfil human needs. Pigs tend to play as adults as well; by adding fresh straw sows have been found to be stimulated to exhibit play behaviour (Špinka, 2009). Another animal to mention is sheep, that is said to play as fully grown when they as a group experience a positive energy balance (Lynch et al., 1992). In mature animals with a more complex behavioural repertoire, a display in object play can also be seen. It is questionable if adults play with object for "fun", or if it enables the animal to further improve already learned motor skills. Even if the animals has reached maturity age-wise, it still can exhibit loud excited sounds when playing and the behaviours are associated with highly arousing behaviours. As opposed to juvenile animals it is difficult to find a function of adult play, since it seems to lack a structurally corresponding behaviour that could be advantageous in a "real" situation (Hall, 1998). Though Lynch et al. (1992) suggest that the function may be to extendedly develop skills required for social and sexual interaction, as well as retain maintenance. Moreover adult play is believed to play a part in the formation and preservation of lifelong bonds in groups of 2 to 3 male cheetahs (Balcombe, 2007).

When it comes to the function of play, i.e. the value it has for animals, there is, as mentioned previously, the learning aspect where the animal gains knowledge, skills and motor ability essential for their survival as adults (Heinrich and Smolker, 1998). Although it is important to point out that nothing is really certain about the concrete benefits retrieved from play. But a presumption is that play may work as practise for an array of activities in adult life, involving everything from how to handle their surrounding environment, how to behave socially in order to be triumphant in courtship and to know when to appease or be competitive (Weary and Fraser, 2009). Moreover Špinka et al. (2001) bring forth the theory that play improves the versatility of the animal's movement pattern, to be able to recover quickly from unexpected scenarios that results in loss of balance and falling over (Špinka et a., 2001), so that they for instance can uphold their balance on a slippery surface (Weary and Fraser, 2009). They also hypothesise that play betters their mental capability to handle unforeseen stressful situations (Špinka et al., 2001).

Something that requires both the ability to read social signals, master unexpected situations, sufficient motor skills and high fitness is fighting in grown animals. One can speculate if play

fighting, as brought up above in e.g. kittens, hamster pups and juvenile baboons, improves the ability to fight as grownups, and if more play fighting means more skilled adult fighters. These speculations target the *application of play*, and just as with the application of other types of play there is no definite answer (Burghardt, 2005). Even so something that is certain is that play fighting is considered as the kind of play that most transcends to humans in a similar form, particularly regarding primates. But in humans it is called *rough-and-tumble play*. Hence play fighting has a very substantial claim for an evolutionary origin (Burghardt, 2005). Despite the effects play fighting may have on adult fighting abilities, it can lead to other things such as the development of hierarchy relationships within litters. Additionally, fighting in pups might enable them to better control and modify their behaviour appropriately (McLeod and Fentress, 1997).

There may furthermore be more short term profits of play that translates into an instantly rewarding psychological pleasurable experience by the release of opioids, which consequently makes the animals feel well (Held and Špinka, 2011). This theory has been tested in for example rats; in one study they used an in vivo autoradiographic procedure to visually localize potential fluctuations in the occupancy of brain opioid receptors in juvenile rats. A portion of the rats were subjected to social isolation before testing which resulted in an increase of social play behaviour, and this subsequently led to changes in the brain opioid receptor binding in areas involved reward processes. (Vanderschuren et al., 1995). In another study conducted by Normansell and Panksepp (1990) rats were trained to navigate through a T-maze, and the reward consisted in the opportunity to play with another juvenile rat. They observed that rats that had previously been injected with morphine, which is an opioid receptor agonist, played more than the other rats. Both these studies speak for an opioid involvement in play behaviour.

As outlined before play could function as a welfare indicator, but something that could dispute that function is the fact that during socially stressful periods, such as shortly before feeding, and competition animals may perform play behaviour as a coping mechanism (Palagi et al., 2006). An increased frequency in play can also be observed when a new male is being introduced in the group. Then play could be considered as an ice-breaker to familiarise animals to one another (Antonacci et al., 2010).

2.2.3 Environmental effects

Several factors in the environment surrounding the animals can have an impact on its tendency to play. One important factor is space allowance; multiple studies, with piglets as well as calves, have concluded that space expansion results in an increased occurrence of play behaviour (Jensen and Kyhn, 2000; Chaloupková et al., 2004). Moreover, it has been seen that confinement in smaller areas increases the motivation to perform play behaviour (e.g. Jensen, 1999; Chapagain et al., 2014; Sutherland et al., 2014; Rushen and de Passillé, 2014). Jensen (1999) recognized that calves that had been kept in confinement for 1-4 weeks before being tested, galloped and bucked more compared to control calves during the open-field test. Sutherland et al. (2014) reported similar results with their calves; animals reared at 1.0 m^2/animal engaged in more locomotor behaviour in the test arena, than animals reared at 2.0 m^2/animal. In the same study they examined the effects of different rearing substrates on play behaviour, consisting of either stones or sawdust, and they noted that calves reared on stones played more in the test arena than calves reared on sawdust. They propose that this difference could be explained with the "rebound effect", which entails that a behaviour may increase as a consequence of restriction of that specific behaviour because of a build-up of internal motivation (Sutherland et al., 2014). However it is important to keep in mind that play occurring during the first arena test, may possibly be considered as an exploratory response to novelty, and not necessarily connected to the change in spatial restriction (Rushen and Passillé, 2014).

Whether or not the housing environment is enriched in some way can also have an effect on the performance of play. In domestic pigs, Chaloupková et al. (2007) reported that an enriched crate, with straw and 20% larger, lead to a display of more locomotor as well as social play, in comparison with a standard farrowing crate with no straw. Corresponding results regarding enrichment has been witnessed in minks (*Neovison vison*); when mink kits were provided with a water bath they spent more time involved in locomotor play by swimming and diving, and later in the season when the water was partially frozen they engaged in object play with ice blocks (Ahola et al., 2011). Vinke et al. (2005) confirmed the results in their study, and suggested that swimming water should be considered as biologically relevant for the evolvement of play in minks.

Numerous other environmental factors could potentially influence play behaviour, and among them is the degree of satisfactory light conditions; it has been demonstrated that rats accustomed to dim light conditions experienced a reduction of social play behaviour, in the form of pinning, play fighting and chasing, when subjected to intense light conditions. It was not possible to increase social play through habituation to the intense lights. Hence it is possible to assume that bright light suppresses play behaviour (Vanderschuren et al., 1995).

2.3 Sheep breeds in the study

Gute sheep

Sheeps of the breed Gute sheep, stems from the Gotland pelt breed from the Swedish island of Gotland, which belongs to the category Swedish Landrace breeds, that in turn originates from the North European short-tailed sheep. The history behind today's Gute sheep stretches back to the 1930s and 1940s, when a couple of horned Gotland pelt's were selected and grouped. These animals represents the start of the present Gute sheep, and no breeding for a certain colour or wool quality has been performed on the animals in question (Näsholm, 2007).

Both ewes and rams have horns (Lärn-Nilsson et al., 2007), and the colouring of the wool is multifaceted, with a spectrum including white-grey, black, a mixture of colours or brownish tones (Näsholm, 2007). They are described as good and protective mothers with easy births. Adult ewes weight about 45-60 kg and rams 70-100 kg. They are considered to be very hardy, and work as excellent maintainers of semi-natural landscapes, by feeding on not only grasses and herbs but also bushes and other plants found in woodlands. Behaviour-wise Gute sheep have a good flock unity, which facilitates their handling by humans, and the bond between ewe and lamb is strong (Edberg, 2006).

The use of Gute sheep are traditionally prioritised according to the following ranking: meat, wool, skins and lastly milk (Dýrmundsson and Niznikowski, 2008).

Texel sheep

The sheep breed originates from the Dutch Island of Texel, and can presently be found in several different countries and it arrived in Sweden in the early 1960s (Näsholm, 2007). It is currently the biggest meat breed in Sweden with 1 700 ewes registered (Svensk

Texelförening, 2014). The breed's appearance can be depicted as white in colour and of medium size, with a broad and quite short build (Näsholm, 2007). They have an excellent feed conversion rate (Svensk Texelförening, 2014) and the slaughter yield is impressive seeing as the sheep have a good percentage of meat combined with a late onset of fattening (Näsholm, 2007). Though they require more nutritional pastures than for example wool sheep (Källander and Ögren, 2005). Grown ewes weigh about 80-90 kg and rams 110-130 kg (Näsholm, 2007).

They have a favourable behaviour by being generally undemanding and calm (Näsholm, 2007). In addition they have a trusting nature which contributes to making the sheep very tame when handled, and they are considered to be among the most effortless to handle during fencing (Svensk Texelförening, 2014).

Crossbreed: Swedish Fine Wool, Dorset, Suffolk

It can be beneficial to apply crossbreeding to be able to unite their respective favourable traits. For example Swedish Fine Wool can be crossbred with a heavier breed such as Dorset, to improve the fertility. It is also common to crossbreed to adapt the animal material to specific conditions of the farm in question (Källander and Ögren, 2005).

The crossbred breeds in this study includes Swedish Fine Wool, Dorset and Suffolk. Swedish Fine Woolhave typically has a high fertility with an average of 2.5 lambs (Källander and Ögren, 2005). Other desired traits are good maternal behaviour and a high milk yield (Näsholm, 2007). However the breed has a comparatively lower meat percentage and hence it is crossbred with other breeds, as mentioned (Källander and Ögren, 2005). The breed is described as having a shiny, soft and somewhat curly wool in brown, black and white. The weights of the adult animals are 80-100 kg for rams and 50-70 kg for ewes (Näsholm, 2007).

Dorset is a heavy, white coloured breed of British descent, which has a high growth rate although an early onset of fattening as well (Lärn-Nilsson et al., 2007). There are Dorsets either with our without horns, and their uses consist of meat, wool and milk (Näsholm, 2007). The breed is particularly advantageous in crossbreeding because of its ability to reproduce all year around (Källander and Ögren, 2005) and on top of that it has very good maternal traits. Fully grown ewes weigh about 80 kg and rams 100 kg (Näsholm, 2007).

Suffolk is also of British origins and is described as hornless and white, with its head and legs coloured in black. Additional traits are lean carcasses with a good meat percentage and a high growth rate. Adult ewes weigh approximately 75-85 kg and rams 90-110 kg (Näsholm, 2007).

2.4 Play in lambs

Lambs can be observed playing as early as within the first hours after birth, though some differences have been observed depending on the type of breed. From there on the performance of play increases, both regarding the frequency and the diversity of play (Dwyer, 2009). Though there are some various contrasting assessments as to when play becomes sporadic and more or less ceases. Dwyer (2009) relays that play is infrequent after 9 weeks of age, while Hass & Jenni (1993) concludes that social play rapidly decreases a little later on, at 12 weeks, and Sachs & Harris (1978) as well as Lynch et al. (1992) notes that play occurrence drops from about week 10. All these estimations corresponds to the results of Guilhem et al. (2006) that report that interactive activity in lambs, in both sexes, decreased during the second and third months. Eventually, as lambs grow more and more play becomes increasingly sparse, and ultimately is rare when lambs have reached 4 months of age (Broom and Fraser, 2007).

The development of play is said to follow a bimodal course, that alters between peaks to troughs. During the initial week of life a minor amount of play is performed. From day 7 to 12 (Sachs and Harris, 1978) or around day 10 to 14 (Dwyer, 2009) the occurrence of play increases considerably in spring lambs, and this marks the first peak. A second peak arrives during 37 to 54 days of age. In the time between the peaks there is troughs with a significant decline in play frequency; the lowest play display is seen during week 3 to 5 (day 19-36) (Sachs and Harris, 1978). Sachs & Harris (1978) draws parallels between today's domestic sheep and their ancestors, whom presumably inhabited mountains and elevated plateaus located in the Middle East, and propose that the low play occurrence during the first week of life can be explained by the importance to stay nearly immobile to avoid the dangers in the surrounding mountains. The first peak coincides with the time that the ancestral lambs started to socialize more with other lambs, in so called nursery bands. The initial trough can be compared to the period in which the ancestors moved from winter to summer grounds, that called for the importance of energy conservation and hence avoid play. At the time of the last

peak the population had arrived at their summer grounds, with more stable circumstances that allowed for play to increase again (Sachs and Harris, 1978). This evolutionary theory follows the framework of Fagen (1977) suggesting that the evolution of for example life-history strategies plays an imperative role in the evolution of play. The same study conveys that the ontogeny of play in lambs can adopt a bimodal age pattern, if the cost of play fluctuates from high to low to high again (Fagen, 1977). A supplementary explanation for the bimodal play course could be based on an increased energy cost, as a consequence of a parent-offspring conflict related to the reduced access to milk. The conflict in question starts at about week 4, when ewes produce less milk, and it is also around that age the greatest trough in play frequency takes place (Fagen, 1980).

The play commonly takes place when lambs associate with other lambs in peer groups, separated with some distance from their mothers (Dwyer, 2009). However according to field observations the lambs usually do not stray any further than 10-20 meters from their mothers, and only rarely the distance exceeds 50 meters (Morgan and Arnold, 1974; Broom and Fraser, 2007). These groups begins to form at 3-9 days of age (Morgan and Arnold, 1974), and at 6 weeks more than 50% can be found in peer groups. Then at 7 to 9 weeks of age this has increased to 65%, and afterwards it declines to 45% at week 15. The number of lambs in each peer group fluctuates from around 2 to 16, where smallest groups are documented after 14 weeks of age (Arnold and Grassia, 1985).

Play has been divided into many various categories by different authors (Randle, 1993). Firstly there is the very broad division into male and female play; play fighting and mounting is considered as male play, whereas locomotor play is reported be more connected to female play. Since object play is commonly performed equally be both males and females, no gender-distinction is made (Burghardt, 2005). For lambs the following categories have sometimes been used: 1) *superfluous activity* (exaggerated movements e.g. gambolling and leaping), 2) *aimless exploration and object play* (novel objects results in manipulations such as approaching, mouthing and sniffing), 3) *practice play* (new skills are performed repeatedly), 4) *responses to the wrong object* (stereotypic and faulty movements targeted at unsuitable objects), 5) *Social play*, and 6) *Pretend play* (attacks combined with friendly signals) (Randle, 1993). Another more general classification is based on three categories: social, locomotor and object play (e.g. Fagen, 1981), which is the same classification that will be employed in here. However it is should be pointed out that sometimes play can be hard to

clearly differentiate; sometimes social play can blend with behaviours regarded as locomotor play, as well as simultaneously using objects that belong to object play, and transitions between the play categories can be very rapid (Burghardt, 1998).

Some other behaviours in lambs that have been found to hold a play aspect to them are: front-kick, neck wrestle, threat jump, pawing, horn threat and running (Hass and Jenni, 1993). These behaviours will not be closer described below, since the focus will primarily be placed on the specific play behaviours witnessed in the present study's field-observations.

2.4.1 Social play

Social play consists of interactions between animals (Weary and Fraser, 2009), typically between peers and to a much lesser extent between juveniles and mothers (Randle, 1993). It can be divided into contact and non-contact behaviours (Burghardt, 1999). It is performed more often than both locomotor and object play (Chapagain et al., 2014), and the most frequently displayed patterns in social play behaviour matches the adult patterns in courtship and intraspecific rivalries, aside from proportional differences and advancement in repertoires (Hass and Jenni, 1993). The behaviours that are characterized as social play in lambs include contact behaviours such as butting, mounting, pushing and balancing on ewe, and non-contact behaviours; chasing and racing in a group. Although another behaviour, where the lamb walks up to a peer and places its chin on the other lams back or neck, could perhaps be interpreted as play but this is not yet confirmed (Sachs and Harris, 1978).

Figure 1. Gute lamb walks up and places its chin on the neck of a peer.

Butting is classified as a agonistic behaviour (Hass and Jenni, 1993) and can be divided into reciprocal, where both animals willingly interacts, or one-way butting, where an animal actively butts another animal without a mutual consensus (for more detailed descriptions see the ethogram in table 1) (Sachs and Harris, 1978). The butting-process can be described as follows: firstly the animal approaches a peer, paws the ground with its forelegs a couple of times, lowers its head once or several times combined with head-shaking, and lastly it lunges the forehead against the forehead or the peer (Sachs and Harris, 1978).

Figure 2. Butting: Gute lamb pawing the ground.

Figure 3. Butting: Gute lamb shaking its head.

Figure 4. Butting: Gute lamb lowers its head.

Figure 5. Butting: Gute lamb clashing their foreheads clashing against one another.

Generally male lambs are shown to exercise more social play compared to female lambs (Hass and Jenni, 1993). This correlates to the tendency in females to stay close to their mothers, whereas ram lambs spend more time away from their mothers and interact with their fellow lambs (Guilhem et al., 2006). However when it comes to reciprocal butting, the contrast between the two groups is not always as obvious; Sachs & Harris (1978) found that the total proportion of reciprocal buttings over two seasons, spring and autumn, was similar for males and females. Nevertheless the majority of studies find that male lambs are more

frequent butters, both when it comes to reciprocal and one-way butting (e.g. Vázquez et al., 2014; Dwyer, 2009). This could be connected with hormonal differences between genders, and furthermore to the importance of fighting in males to establish themselves in groups after they have reached maturity and left their original flock (Burghardt, 2005). Adult males stay in these groups, isolated from the ewe and lamb-groups for most of the year (Hass and Jenni, 1993). Pushing is also considered as an agonistic play behaviour, however it is not nearly as common as butting, and in comparison is seen as a milder interaction. While in pigs pushing, along with biting, is a major component of agonistic behaviour (McGlone, 1986).

Figure 6. One-way butting: Gute lamb butts a passive, resting peer.

Mounting, which is a sexual play behaviour, can potentially be ascribed to provide the benefit of motor training practice for adult reproductive behaviour, or may be a way to dominate its peer (Watson, 1998). Although play mountings use for actual reproduction can be challenged since mounting can be seen in animals only a few weeks old, which is far in advance of puberty (Broom and Fraser, 2007). The activity usually only lasts for a very short amount of time (Sachs and Harris, 1978), since the lamb subjected to mounts usually does not seem to be a willing participant, which is shown through escape-attempts, fighting or by pushing away the other lamb (Górecki and Kieltyka, 2012). Hence thrusting is hardly ever seen (Sachs and Harris, 1978). Albeit mounting is a male sexual play behaviour, it can be observed in both male and female lambs, and as with the other social play behaviours there is also a ram lamb dominance in mounting, i.e. males mount more than females. Interestingly differences have been recorded between breeds; milk breeds tend to engage in more mounting activity than mutton breed lambs (Górecki and Kieltyka, 2012).

Figure 7. Mounting: Texel lamb mounts its peer.

Figure 8.Mounting: Gute lambs mounting inside the stable for a brief moment at about 2 weeks of age.

The non-contact social play behaviours, also referred to as alleolomimetic behaviours (Hulet, 1975), chasing and racing, is described as early as in 1851 by Edward Thompson: "Young lambs collect together...racing and sporting with each other in the most interesting manner"(Thompson, 1851, cited by Burghardt, 2005). Racing takes place principally near dusk, in which the several lambs usually race in a group alongside the fences (Dalton, 2008) or up and down steep road cuts (Hass and Jenni, 1993). Unfortunately, during racing in lambs there is a risk of injury by falling down holes and water troughs (Dalton, 2008). Racing is also documented in goat kids, who race together in groups over rock ledges and scattered stones (Rudge, 1970), and it is quite fitting to compare goat kid and lamb play since they are deemed analogous in terms of behaviour (Dane, 1977).

Figure 9. Chasing: Gute lambs chasing each other.

The final social play behaviour to be brought up is "balancing on ewe". The animal jumps or climbs on top of the ewe's back and balances during a varied amount of time. A reason behind this behaviour, that does not necessarily associate it with play, is presented by Ewbank

(1967). He states that lambs jump on top of ewes to make them rise up from their lying position, in order to suckle. It was observed that if the ewe responded by standing up she would often nurse her lamb, however it was not always the case. Notably one lamb regularly jumped up on multiple ewes at the same time, and subsequently made them rise, but the lamb chose not to suckle the ewes in question (Ewbank, 1967). Rudge (1970) on the other hand identifies the behaviour in fact as play, in goat kids; seemingly the kids uses the ewes, when occupied with ruminating, to jump on their backs and play "king of the castle". Apparently this causes no irritation in the ewes in spite of the kids' sometimes energetic movements (Rudge, 1970).

2.4.2 Locomotor play

Many play behaviours have a locomotor aspect to them, but to be able to separate different types of play, locomotor play will here consist of "solitary" locomotor play behaviour; the type of play animals primarily engage in on their own such as jumping, gambolling and pivot, without any direct social contact. Though according to Berger (1980) gambolling is not regarded as a freestanding behaviour, but rather as a play signal in the form of a rotational pattern, along with neck twists and heel kicks, that communicates the intent to play. Rotational locomotor play with acrobatic components, such as gambolling, could be linked to the evolution of self-conception in non-primates, i.e. the concept of self, or simply the development of body awareness (Bekoff and Allen, 1998). Another hypothesis entails that these specific movements are related to responses displayed in evasion and escape of predators (Wilson and Kleiman, 1974), in other words locomotor play can be construed as the development of a general antipredator strategy (Berger, 1980).

Figure 10. Jumping: Gute lamb leaping high up in the air over a ditch.

Figure 11. Jumping: Gute lamb performing several consecutive jumps.

Beyond jumping and gambolling, Hass & Jenni (1993) labelled "stotting" as locomotor play, but did not keep any quantified data on its frequency. They saw lambs stotting through rocky, steep areas, which mimicked the locomotor motion adult sheep carry out when distressed. Many theories has been formed as to the actual function of stotting in adults, but the two most likely functions of stotting are firstly to inform the predator of its detection, which causes the predator to question if it is really productive to pursue the prey animals. Secondly, stotting may alert other conspecifics of the predator's presence (Caro, 1986).

Females generally invest more time in the performance of locomotor play compared to males (Dwyer, 2009; Sachs and Harris, 1978) and gambolling is considered as one of the most common locomotor play behaviours (Einon, 1983). This female inclination for locomotor play, especially gambolling, could perhaps be a result of the larger predatory pressure their ancestors were subjected to, particularly when they left the herd by themselves to bear their offspring (Sachs and Harris, 1978).

Some wide-ranging motivations for solitary locomotor play as well as for object play, besides the antipredatory-theory, are the development of muscles and bones, perfecting motor ability, exploring what limitations the body might have- all this will be of use in the future when the animals are grown. Additionally they get to obtain vital knowledge of the environment that they inhabit and its features (Kaufmann, 1974).

2.4.3 Object play

Novel objects and exploration plays a crucial part in play with objects, but a line has to be drawn between curiosity and play. This is done by observing if the animal just manipulates the object somewhat in order to gather information about its properties, or if it interacts and engages with the object repeatedly to simply "see what I can do with it" (Burghardt, 2005).

Object play includes for example manipulating, pushing, pulling and chewing of an object (e.g. Fagen, 1981) and Caroprese et al. (2006) describes object play in lambs as butting or rubbing water containers, straw and other objects. Pfeffer (1967) observed how a lamb was occupied with a broken branch for nearly 10 minutes; it engaged in tossing, retrieving the branch anew repeatedly. An extra aspect of object play in lambs is object climbing (Randle, 1993), which is sometimes referred to as pretending to be "king of the castle" or, in other words, "rule the roost" (swedish: *leka herre på täppan*) by climbing on top of a stone or a hill in the pasture. This specific type of play has been identified in for example lambs belonging to the breed *gute sheep* (Edberg, 2006).

Figure 12. Object play: Gute lamb playing "king of the castle".

Playing with object is especially common in young birds and primates (Burghardt, 2005), however in ruminants such as gazelles, it is rather infrequent in all ages and only represents a minor part of their entire amount of play (Gomendio, 1988). Though Caroprese et al. (2006) noticed that object play was significantly more common in lambs when they had been artificially reared. Possibly the difference could be deduced to the artificially reared lambs being more interested in investigative activities and in the exploration of the surrounding environment, as a consequence of the lack of a mother.

Pellis (1991) suggests that object play is connected to food procuring and feeding motivational systems, and this food-theory is shared by Watson (1992); he examined object play in laughing kookaburra (*Dacelo novaeguineae*) and noticed a bird grabbing a stone with its beak and striking it against a branch in a repeated manner. He found that this matched the behavioural pattern the kookaburra uses when it retrieves feed, or more precisely kills its prey.

Figure 13. Object play: Texel lamb chewing and tugging a wire.

Figure 14. Object play: Gute lamb chewing, dropping and butting a twig.

3. Aim

In view of the fact that many studies emphasizes the importance of implementing play behaviour as an indicator of animal welfare, it is fundamental to be endowed with sufficient knowledge. Hence a requisite to assess welfare based on the occurrence of play is to initially carry out extensive and detailed observations, to identify and describe the kinds of play that is specific for the particular animal species in question. Commonly studies concerning play is performed in a controlled experimental setting. Though as far as I know no previous research has been carried out regarding observations of play behaviour in lambs on pasture, where any human involvement such as induction or stimulation of play is absent.

The purpose of this study was to examine play behaviour in lambs in a semi-natural environment out on pasture, by observing the lambs during their first months of life from a qualitative and quantitative perspective.

The following questions were subjects for investigation:

1. What constitutes play in lambs, i.e. which types of play behaviour do lambs engage in?
2. Do the type and prevalence of play change with age in lambs?
3. Do lambs play more during certain times of the day, i.e. how does their diurnal cycle look like?
4. Do the type and prevalence of play differ between ram and ewe lambs, and between breeds?

My hypothesis was that the lambs would display play behaviour similar to other studies in the field, and that the occurrence of play would decrease with age starting from approximately week 9 or 10. Furthermore I hypothesized that most of the play would take place in the evening hours, that rams would engage in more male-like play such as mounting and butting, whereas ewes would engage in more locomotor play, and that Texel lambs would have the lowest prevalence of play.

4. Materials and methods

4.1 Animals and housing

The field-study was conducted on 8 pastures around Uppsala during 6 weeks, from 16th of June to 23th of July 2014. The objects of the study were three herds of different breeds of lambs. The farm *Grandin's lambs* provided the study with one group of 29 purebred Texel lambs as well as a group of 132 crossbred lambs, bred from Fine wool, Dorset and Suffolk. The third group came from the farm *Uppsala natural grazing*, and consisted of 26 Swedish Landrace lambs called Gute lambs. A total of 187 lambs were included in the study, with 98 female lambs and 89 male lambs. The Texel lambs were born between March 9th and April 1th, the crossbred lambs between March 12th and April 8th and the Gute lambs were the youngest, born as late as between April 24th and approximately May 20th.

In the beginning of the study, when the preparatory observations were made, the lambs were kept inside in stables on their respective farms. By the time the actual observation period began the lambs had been moved out on pasture. Throughout the study the crossbred lambs and the Gute lambs were moved regularly to different pastures, to keep the supply of grass on

a satisfactory level. However, the Texel lambs were kept in the same or adjacent pastures near the farm, for safety reasons.

The topography of the different pastures contrasted somewhat; the Gute lambs grazed on semi-natural pastures which were quite densely vegetated, with a high biodiversity of plant species such as Birdsfoot trefoil (*Lotus corniculatus L.*), Meadow fescue (*Festuca pratensis*), Lady's Bedstraw (*Galium verum*) and Quaking Grass (*Briza media*). Furthermore there were a lot of trees, some large stones and ditches, which provided a lot of hiding places, whereas the Texel lambs and the crossbred lambs were kept mostly on rather level, perspicuous areas, with a somewhat more homogenous vegetation consisting of grasses and clovers. All pastures were surrounded by fences, and no herding dogs were used to manage the sheep and their offspring.

4.1.2 Farm contact

The selection criteria for the farms were partly the accessibility to reach them from Uppsala, the cooperation of the farmers' and the breeds and ages of the lambs. Two farms were selected: Grandin's lambs and Uppsala natural grazing. The farmers were contacted by telephone in March and then gave their consent to participate in the study.

Regarding bio security, an agreement was made that during the time the animals stayed inside the stables, before they were let out on pasture, the observer would use protective clothing in the form of overalls and plastic protective shoe covers. Since two different farms participated in the study, two separate sets of protective clothing were used. In addition it was agreed that the farmers should be informed before each observation session of the lambs. When the animals were out on pasture it was sufficient to use different sets of ordinary clothing.

4.2 Observation procedure

4.2.1 Pilot study

Prior to the main study, a pilot study was conducted, partly for determining which times of the day that would be most productive to observe the animals. The specific times were selected by observing all the lambs continuously over two days for about 9.5 hours each, during which all occurrences of play behaviour in all animals were recorded. The gathered data from these two days were added to the experience from a number of other previous, not as systematic, preparatory observation sessions, and to the experience of the farmers. All this information indicated that the lambs displayed the most play behaviour in the early hours of the day and in the evening, and thus it was found that it wouldn't be very productive to observe the animals in the middle of the day.

Another purpose of the pilot study was to get acquainted with the animals and their behavioural repertoire, to record their play behaviours correctly and to know the appropriate distance to keep from the animals without causing any disturbance. Since some difficulty transpired concerning the possibility to locate and distinguish the animals, the check sheets were modified to some extent during the pilot study.

In addition the practical points of the study were tried out, involving equipment such as binoculars, the computer with check sheets and the digital camera.

4.2.2 Main study

One single observer carried out all the observations, and the observations were divided into two different sessions; the first session was conducted approximately between 08.00 and 10.00 am, and the second session between 06.00 and 08.00 pm.

Observations of the lambs were made while primarily sitting on a chair on a comfortable distance from the herd. Since the herd moved continuously, it was necessary to follow along inconspicuously without inducing stress in the animals and hence disrupt potential play

behaviour. The observations were recorded on check sheets, either on the computer or on paper, depending on the weather conditions.

Throughout the observation period the lambs were occasionally filmed and photographed, to document the performance of the different play behaviours. This was not done systematically, but rather when a moment of play behaviour presented itself.

The different recorded play behaviours were identified during the pilot study, and they were complemented and confirmed by other studies made in the same field. For definitions of recorded play behaviours see the ethogram (Table 1).

Table 1. *Ethogram: Definitions of recorded play behaviours (modified after Sachs & Harris 1978, McDonnell & Poulin 2002)*

Recorded play behaviours	
Behaviours	**Definitions**
Race	Running in a group, commonly back and forth in the same area repeatedly. It involves at least 3 participants, and occasionally ewes join in.
Chase	One animal is pursued by another in an effort to reach or pass it, usually by running at medium speed.
Being chased	The animal is subjected to the behaviour described above.
Gambole	The animal jumps, commonly with speed, and twists its body and head at the same time.
Mount	The animal raises its forelegs and chest against the rear of another animal. It rests the forelegs on the back of the animal and pushes the chest against the back. This is similar to mating in adults, though here it is very brief since the other lamb removes itself quickly. Commonly no thrusting occurs, instead the behaviour is performed by a single jumping motion.
Being mounted	The animal is subjected to the behaviour described above.
Reciprocal butt	Lunge with the forehead against the forehead of another animal. It is a mutual action, where both lambs participates. The behaviour was often first preceded by head lowering and

	pawing the ground with forelegs a couple of times.
One-way butt, frontal contact	The animal lunges with the forehead against another animal, but here it is not mutual; the other animal does not actively participate. The animal lunges against the front of the other animal. Here as well the behaviour was often preceded by head lowering and pawing.
One-way butt, side/rear	Same as above, except from that the lunges are instead directed to the side or rear of the other animal.
Being butted	The animal is subjected to lunges with the forehead either from the front, side ore rear from another animal.
Jump (no twists)	The animal elevates the body from the ground several times in a row, through a springing motion by the legs. The body is rather stiff, and no twists are included. The behaviour is commonly preceded by a some running.
Push	The lamb presses its shoulder or body against the other lamb. This seems to be an perceptible attempt to displace the other animal.
Being pushed	The animal is subjected to the behaviour described above.
Balance on ewe	Standing on the back of an adult ewe, presumably their mother.
Manipulate object	The animal manoeuvres an item in some way by chewing, butting, shaking (with their mouth) or picking it up and dropping it repeatedly (with their mouth). The item can be for example a stick, stone, small bush, high grass, fence, rope or plastic cord.
Pivot	A quick, stiff, rotation horizontally through a little jump on the same spot. This makes the animal face another direction.

4.2.3 Distinguish individuals

The Gute lambs were selected to be distinguished on an individual basis, regarding the lambs which were included in the focal group (consisting of 8 lambs). The Texel lambs and the crossbred lambs were differentiated only on the basis of their sex. The motivation for not using the same method to distinguish all the lambs included in the focal groups, were that the

Gute lambs had such a unique appearance regarding the patterns and colours of their coats. Hence it was easy to tell the Gute lambs apart from each other. On the other hand the Texel lambs and the crossbred lambs were very similar in appearance, and consequently they were not possible to tell apart within the options of this study.

To correctly identify the individuals in the Gute group a list were made with photographs of the lambs and the collective information about their respective date of birth, sex, mother and identification number on the ear tag. During the observations both the list as well as binoculars were used to secure the right identity of the lambs. The binoculars made it possible to read the identification numbers on the yellow, or a combination of yellow and orange, ear tags that all the lambs were provided with.

4.2.4 Behavioural observations

4.2.4.1 Focal observations

A total of eight Gute lambs, four females and four males, were chosen for focal observations. Each of these lambs was systematically and continuously observed for 10 minutes at a time, and after that a 5 minute break followed to make sure the protocol was complete and to identify the new focal lamb. Thus it took 2 hours to observe all eight lambs, and a check sheet was used to document the frequency of each element of play behaviour.

The Texel lambs and the crossbred lambs were observed systematically from left to right, since they could not be identified individually, due to practical constraints and large group sizes. Hence they were only distinguished on the type of sex; four males and four females were observed. Regarding the Gute lambs however eight specific lambs had been chosen, as mentioned previously, to be included in the focal observations. They were not observed in any particular order, given that the lambs moved constantly and therefore the possibility to find the animals in time in accordance to the set observations schedule would be impaired. Instead they were observed in the meantime they happened to appear.

The focal observations were carried out continuously to ensure that no play was missed, considering play behaviours in lambs being very transient.

4.2.4.2 Scan sampling

After each focal observation session, the scan sampling on group level was performed for 2 minutes. It entailed that all the lambs in the entire group were observed instantaneously, to note which type of behaviour they engaged in for the moment, and then the number of lambs involved in each behaviour was documented in a check sheet. Play behaviour as well as five other behaviours were recorded: resting, eating/drinking, suckling, standing/walking and grooming. For definitions of recorded behaviours during scan sampling see table 2 .

It should be noted that because of the vast number of lambs, especially in the crossbred group with approximately 132 lambs, it was not possible to determine the behaviours of all the lambs. Hence recordings were made of the lambs that could be located over the duration of 2 minutes.

Table 2. *Definitions of recorded behaviours during scan sampling*

Recorded behaviours during scan sampling	
Behaviours	**Definitions**
Play	The animal is engaged in any of the play behaviours in table 1.
Lie/sit	The rear, belly or side of the body are placed on the ground or in contact with the ground. No other behaviour is preformed.
Eat/drink	Putting roughage or water in the mouth or chewing with the mouth.
Suckle	The animal draws milk with its mouth from the ewe's nipple.
Stand/walk	The body is raised up and all the feet are in contact with the ground.
Groom	The animal moves its hind feet repeatedly against the body or licks/bites the fur. In addition it can rub the body against a fence, rock or vegetation.

4.3 Data analysis

All data assembled from the observations of play frequency were put into Excel. The data was organised according to week, in order to avoid any potential bias for a certain lamb group. A total of five categories were chosen according to the research questions: play frequency as an effect of gender, age, time (morning or evening), temperature and breed.

Both male and female lambs were observed in all three groups during the first three weeks of observations. Afterwards, the ram lambs in the Texel group were moved to a separate pasture for weaning, and thenceforth only the ewe lambs in the Texel group were observed. During the last week of observations (i.e. the sixth week) all lambs of the crossbreed group as well as the Texel group were moved from their mothers, to separate pastures. Regarding the Gute group, both males and females stayed with their mothers over the whole observation period. These changes are illustrated in the figures in the results section below.

The age category was equipped with a three table (Table 3A, B and C) which specified play frequency recordings made of the Gute lamb group; the only lamb group which was differentiated on an individual basis. Since the days between the observation session varied each week, the age intervals in the table were arranged purely according to age. Hence, each interval does not represent the exact age span of the lambs during each session. For example there is 11 days between the first observation of the Gute lambs until the second. Regarding the second and third observations there are instead 5 days between. Subsequently some recordings, made at separate occasions, take place during the same week-span. This is demonstrated in the table with the help of dotted lines.

A descriptive approach was used to process and present the data, hence no statistical tests were performed.

5. Results

Each category, except for gender, is represented by two graphs; one which displays data from the focal sampling observations and one which shows data from the scan sampling.

5.1 Play as an effect of gender

The ram lambs performed the majority of play; during the first three weeks of observation (before any ram lambs had been separated from their groups) they stood for 59 % (44 recordings) of all play whereas the ewe lambs represented 41 % (31 recordings).

Some types of play behaviour were more gender specific than the rest. These were mounting, butting, pushing and jumping. The rams displayed 22 acts of mounting, compared to 3 acts by ewe lambs. There were also a predominance of the ram lambs concerning butting; a total of 34 butts were performed by the rams, and 19 by the ewes. Pushing was solely observed when practised by ram lambs (6 recordings). Jumping was on the other hand a behaviour dominated by ewe lambs, with 12 recordings in relation to 2 by rams (Fig.15).

Regarding the distribution of the play categories there were some rather clear contrasts between the genders. Ram lambs counted for 64 recordings of social play with contact, as to 26 by ewes. Conversely, the ewes performed the majority of locomotor play; 23 recordings compared to 8 (Fig. 15).

A complete data set for both ewe and ram lambs was collected in the Gute group, since both genders could be observed during all the weeks of the study. Also here it was evident that rams engaged most frequently in social play (rams = 37 recordings, ewes = 27). Concerning locomotor play a slight predominance by the ewe lambs was found (Table 3 A and B).

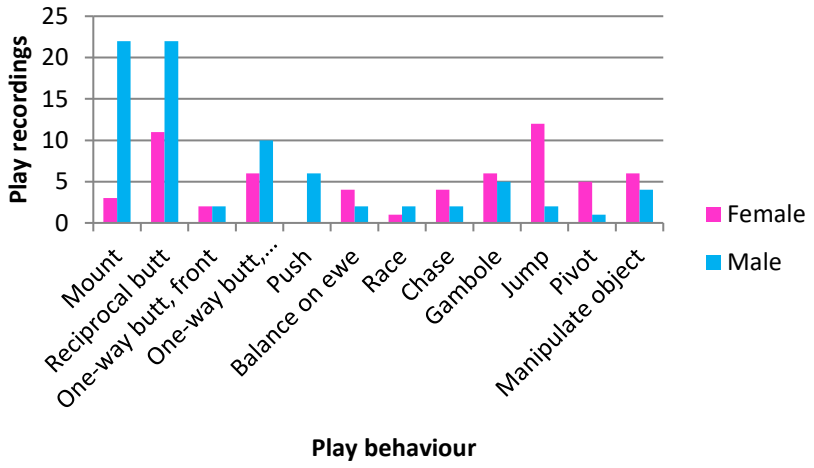


Figure 15. Focal observations: *The total number of recorded occurrences of play behaviour arranged according to gender.*

5.2 Play as an effect of breed and week

Week

The play frequency fluctuated over the course of the weeks regarding all four play categories. This was particularly evident in social play with contact, which was also clearly the most common play category over all observation weeks, and this category showed two peaks at week 25 and week 28 in both observation methods (Fig. 16A and B). For the other play behaviours, there was a reduction in frequency over time, according to focal observations (Fig. 16A). A trough of activity was observed at week 26, when play decreased from 21 recordings week 25 down to 15 recordings. The display of social play (contact) plateaued over the final two weeks of observation; play went down from 21 recordings during week 28 to 16 recordings week 29 and then remained at that number at week 30 as well (Fig. 16A).

Object play was only witnessed on a few occasions (2-5 times) during the first weeks in both methods, and then ceased to appear from week 28 and onwards in focal sampling (Fig. 16A and B). However, the behaviour continued for another week according to scan sampling (Fig. 16B).

Thus scan sampling mainly displayed the same development as focal sampling, with the exception of social play- without contact (Fig. 16A and B). The play category was generally recorded more frequently compared to the focal method, especially during week 26 and 29, and additionally it was recorded over all the weeks, apart from week 28. However it was only identified focally during the first two weeks (Fig. 16A). The great difference between the observation methods can be accredited to racing; this specific behaviour is consistently recorded a lot more in scan sampling (Fig. 16B).

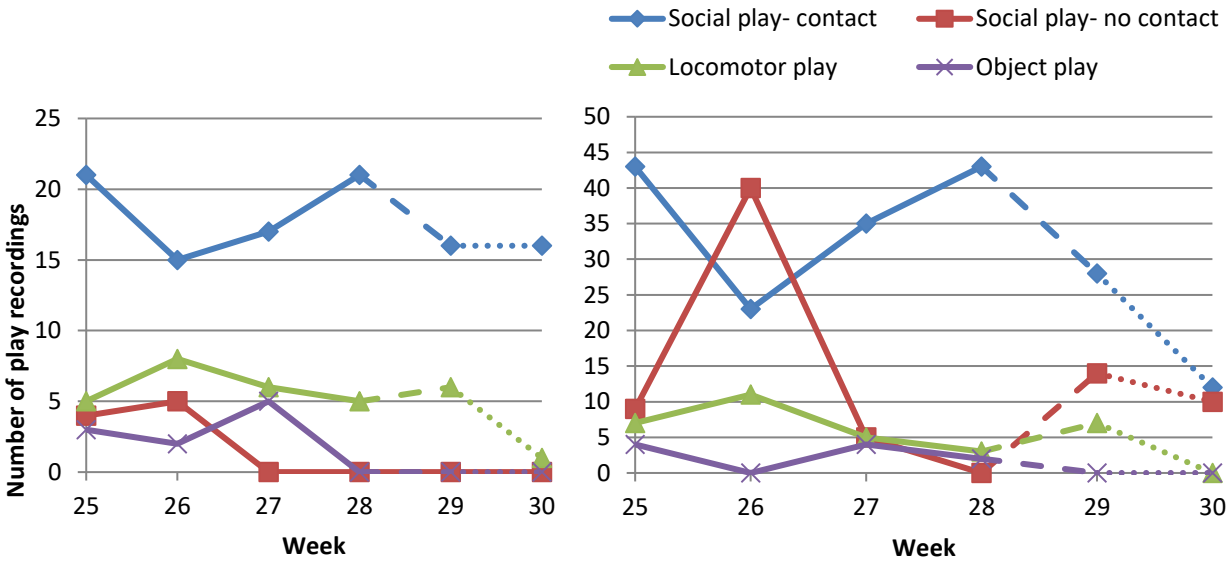


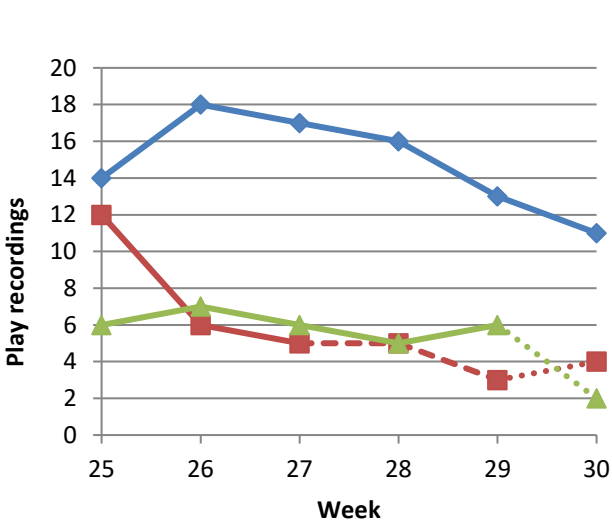
Figure 16A. Focal sampling ***Figure 16B. Scan sampling***

Illustrates the number of play acts performed during the six weeks of observation arranged into four different play categories; social play- contact, social play- no contact, locomotor play and object play. The dotted lines of the larger size represent the times when only the ram lambs were observed (with their mothers), and the smaller sized dotted lines represent the weeks when the lambs were observed parted from their mothers.

Breeds on a weekly basis

Fluctuations in the performance of play were seen in all three lamb groups, and they all had in common that their lowest play recordings were made during the last and 6st week of observations (Fig. 17A and B). Markedly both methods convey that the Gute lambs played substantially more than the other lambs groups throughout the whole study (Fig. 17A and B). Though notably, the first week deviates somewhat from this pattern, as the focal method merely displays a difference consisting of two recordings between the Gute and Texel lambs (Fig. 17A). However during week two there is a steep increment in play among the Gute lambs, while the Texel lambs experience a rather great reduction in play occurrence; from 12 down to 6 recordings focally (Fig. 17A) and from 21 to 5 recordings in scan sampling (Fig. 17B). From then and three weeks onward, the play displayed by the Gute group was kept on a high level until it began to decline in week 29 (Fig. 17A and B).

The two observation methods differentiated somewhat when it came to the development of play in the two older lamb groups. In focal sampling both groups followed a pretty similar pattern where play varied between 7 and 6 recordings (2nd week) to 2 and 4 recordings (6st week), devoid of any peaks except for the 1st week as mentioned above concerning the Texels (Fig. 17A). The same parallel pattern was not seen in scan sampling to the same extent; the crossbreeds displayed two distinct peaks in week 26 and 29, while the Texels had a peak in week 25 (1st week of observations) and then dropped to a consistently low play level with recordings ranging from 5 to 2 per week (Fig. 17B).



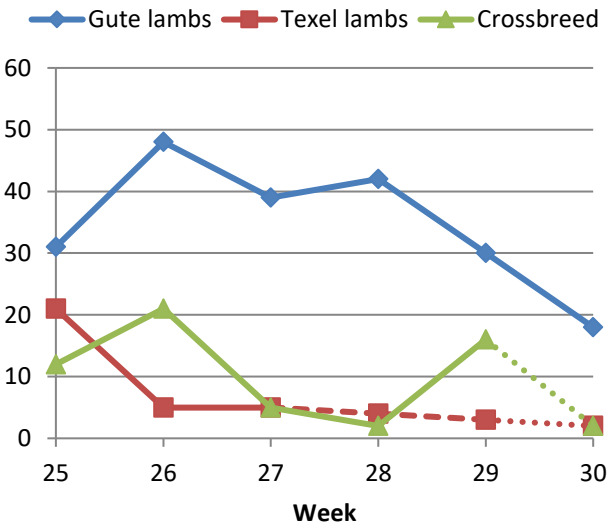


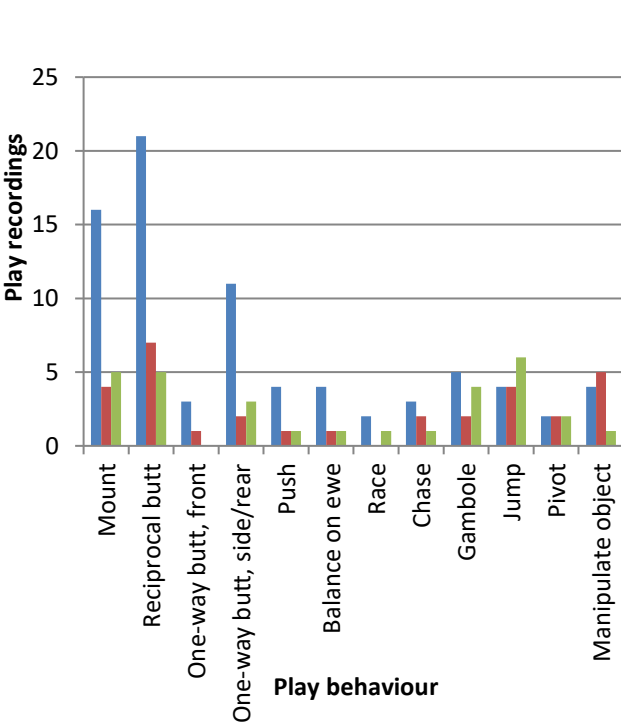
Figure 17A. Focal sampling ***Figure 17B. Scan sampling***

Amount of play acts performed during the six weeks of observation arranged according to breed. As mentioned above in Fig. 16 A and B the dotted lines of the larger size indicate the times when just the ram lambs were observed (with their mothers), and the smaller sized dotted lines represent the weeks when the lambs were observed separate from their mothers.

Total play according to breed

It was shown that the Gute lambs dominated almost all the different types of play behaviour in both scan and focal sampling (Fig. 18A and B). Three behaviours, which slightly deviated from this dominance concerning the focal observations, were jump, pivot and manipulation of object (Fig. 18A). The most recordings for jumping were attributed to the crossbreeds, with a marginal of 2 acts, whereas the Texels had one more recording of manipulation of object compared to the Gute group. Pivot was performed twice by all three groups (Fig. 18A).

According to scan sampling the Texels clearly were the least active play practitioners seen to the total number of play recordings, with 40 compared to 58 recordings of the crossbreeds. This difference stems from the contrasting data as regards to racing; the Texels were not observed to perform any racing at all in scan sampling whereas 27 recordings were made of the crossbreeds (Fig. 18B). This diversity between the two lamb groups was not witnessed in the focal method, where the total number of recordings were rather analogous; the Texels displayed 31 acts and the crossbreeds 30 acts (Fig. 18A).



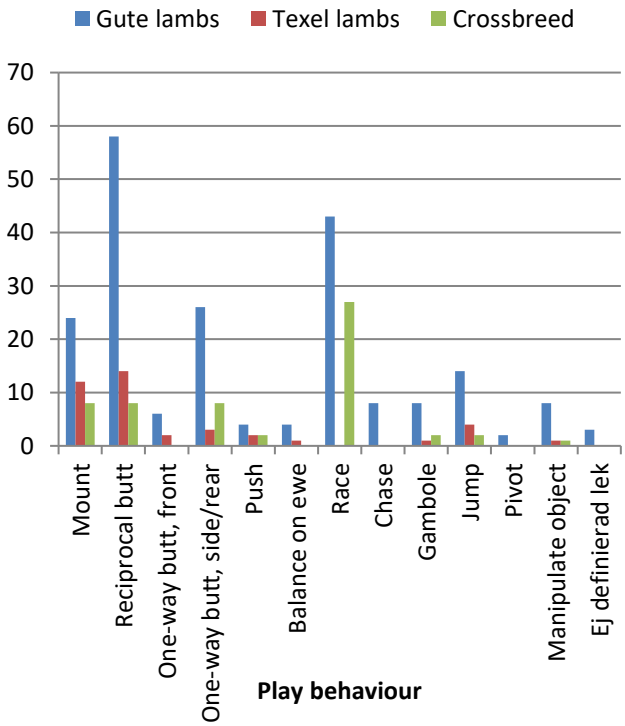


Figure 18A. Focal sampling ***Figure 18B. Scan sampling***

Number of recordings of each play behaviour arranged according to breed.

Individual distribution of play among the Gute lambs

The age when the Gute lambs displayed the most social play acts was between 56 to 69 days of age, with 19 and 13 recordings respectively (Table 3A). The lowest amount of social play was seen between the ages of 84 to 90 days (not including the recordings made at 35-41 days of age, as just one lamb was observed at that specific age interval). Regarding the performance of both locomotor and object play they were only observed on very few occasions, hence no particular peaks could be distinguished (Table 3A and B).

The individuals who engaged the most in social play were the following lambs: ram nr. 15 with 14 recordings; ram nr. 20 with 11 recordings; ram nr. 9 and ewe nr. 7 with 10 recordings each (Table 3A).

Table 3A. Social play (focal): *Number of recorded occurrences are arranged according age intervals for each focal Gute lamb (M: male, F: female, X: The lamb was not observed during the particular age interval, -: No play was observed, Dotted line: recordings were made at separate sessions.)*

Individual Tag number/DOB/Gender			**Age intervals**							
			35-41	**42-48**	**49-55**	**56-62**	**63-69**	**70-76**	**77-83**	**84-90**
20	05/08	M	1	X	2	- 5	X	3	X	X
18	05/05	F	X	2	1	2	-	-	2	X
15	05/05	M	X	2	-	3	4	2	3	X
9	04/30	M	X	2	X	4	1 2	X	1 -	X
5	04/29	F	X	X	-	1	-	-	3	1
7	04/27	F	X	X	2	4	3	-	-	1
6	04/27	F	X	X	-	-	2	3	-	-
2	04/24	M	X	X	3	X	1	1 1	X	1 -
	Tot. play		**1**	**6**	**8**	**19**	**13**	**10**	**9**	**3**

Table 3B. Locomotor play (focal): *Number of recorded occurrences are arranged according age intervals for each focal Gute lamb.*

Individual Tag number/DOB/Gender			**Age intervals**							
			35-41	**42-48**	**49-55**	**56-62**	**63-69**	**70-76**	**77-83**	**84-90**
20	05/08	M	-	X	-	- -	X	-	X	X
18	05/05	F	X	-	1	-	-	2	1	X
15	05/05	M	X	1	-	-	1	-	-	X
9	04/30	M	X	-	X	-	- -	X	1 -	X
5	04/29	F	X	X	-	1	-	-	-	-
7	04/27	F	X	X	-	1	1	-	-	-

6	04/27	F	X	X	1	-	-	-	-	-
2	04/24	M	X	X	-	X	1	1	X	-
	Tot. play		**0**	**1**	**2**	**2**	**3**	**3**	**2**	**0**

Table 3C. Object play (focal): *Number of recorded occurrences are arranged according age intervals for each focal Gute lamb.*

Individual Tag number/DOB/Gender			**Age intervals**							
			35-41	**42-48**	**49-55**	**56-62**	**63-69**	**70-76**	**77-83**	**84-90**
20	05/08	M	-	X	-	-	X	-	X	X
18	05/05	F	X	-	-	2	-	-	-	X
15	05/05	M	X	-	1	-	-	-	-	X
9	04/30	M	X	-	X	-	-	X	-	X
5	04/29	F	X	X	-	-	-	-	-	-
7	04/27	F	X	X	-	-	-	-	-	-
6	04/27	F	X	X	-	-	-	-	-	-
2	24/24	M	X	X	-	X	-	1	X	-
	Tot. play		**0**	**0**	**1**	**2**	**0**	**1**	**0**	**0**

5.3 Play as an effect of diurnal rhythm

There were some play behaviours whose diurnal rhythm were more obvious compared to the other behaviours (Fig. 19A and B). Starting with the focal observations, three behaviours stood out; reciprocal butting, which was predominantly performed in the morning (morning = 19, evening = 14), mounting, which was mainly seen in the evening (morning = 10, evening = 15) and pivot, which appeared solely in the morning (morning = 6, evening = 0) (Fig. 19A).

The lambs displayed almost the exact same total amount of play in the morning and evening, with a mere difference of 1 recording in focal sampling (morning = 66, evening = 67) (Fig. 19A). This similarity was topped by the play category social play with contact, where the number of acts in the morning mirrored the amount in the evening (45 acts). Furthermore, there were a predominance in the evening for locomotor play (morning = 11, evening = 13) and social play without contact (morning = 3, evening = 6). On the other hand object play was seen most frequently in the morning (morning = 7, evening = 3) (Fig. 19A).

In scan sampling there were a couple of play behaviours that stood out as well; racing and mounting (Fig. 19B). Racing appeared in fact to be the utmost diurnal navigated behaviour, considering that 53 recordings were made in the evening and 17 during the morning hours. There was also a substantial diurnal variety regarding mounting with a total of 32 recordings in the evening and 12 in the morning (Fig. 19B).

As opposed to the similarity in the distribution of total play in the focal method, a rather big difference was identified in scan sampling; 192 recordings were made in the evening and 114 in the morning. In addition all four categories of play were displayed most frequently in the evening hours (Fig. 19B).

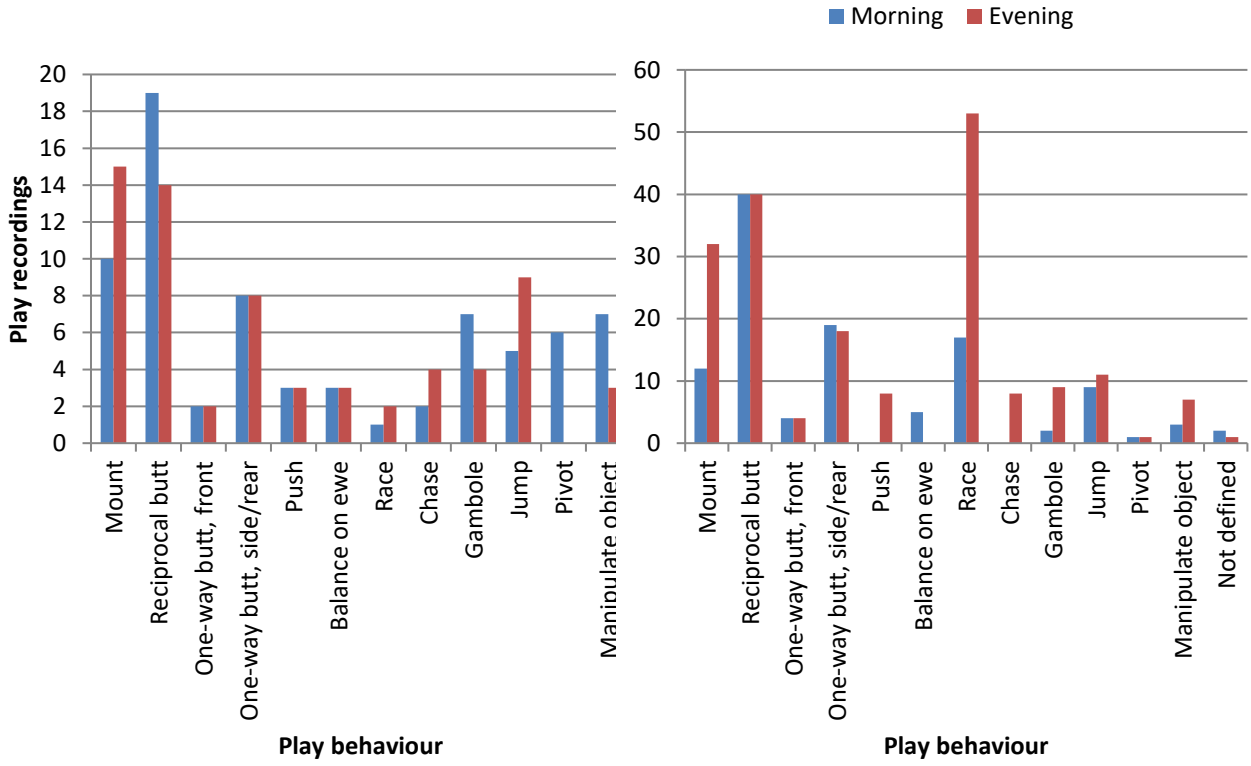
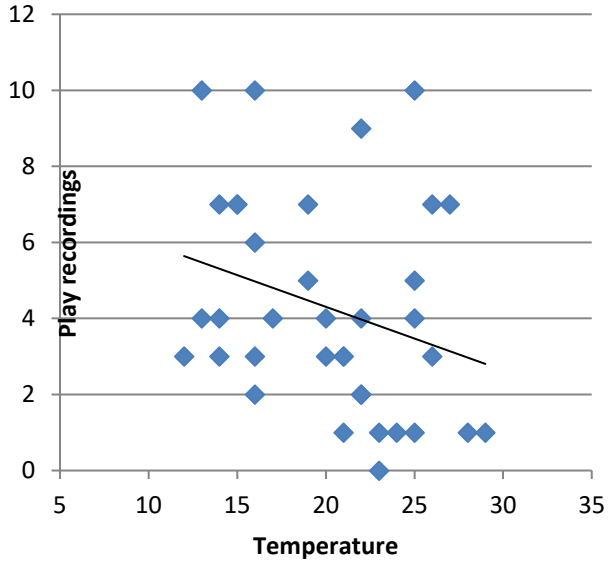


Figure 19A. Focal sampling ***Figure 19B. Scan sampling***
The recordings of each play behaviour arranged according to their diurnal performance pattern.

5.4 Play as an effect of temperature

The lambs tended to decrease their play performance along with an increasing temperature (Fig. 20A and B). Both focal and scan sampling demonstrated this inclination (Fig. 20A and B), and it was particularly evident in the focal method with an extra steep trend line (Fig. 20A).

In focal sampling a total of 89 play recordings were made when the temperature was between 12-20 degrees, compared to 65 recordings when the temperature measured 21-29 degrees (even though two more sessions were carried out in the higher temperature range) (Fig. 20A). Corresponding numbers were seen in scan sampling; 188 recordings were made in the lower temperature range (12-20 degrees) and 118 recordings in the higher range (21-29 degrees) Fig. 20B). However notably a larger amount of play was observed at 25-27 degrees with 85, as opposed to 78 recordings at 13-15 degrees (Fig. 20B). This phenomena was not found in focal sampling (Fig. 20A).



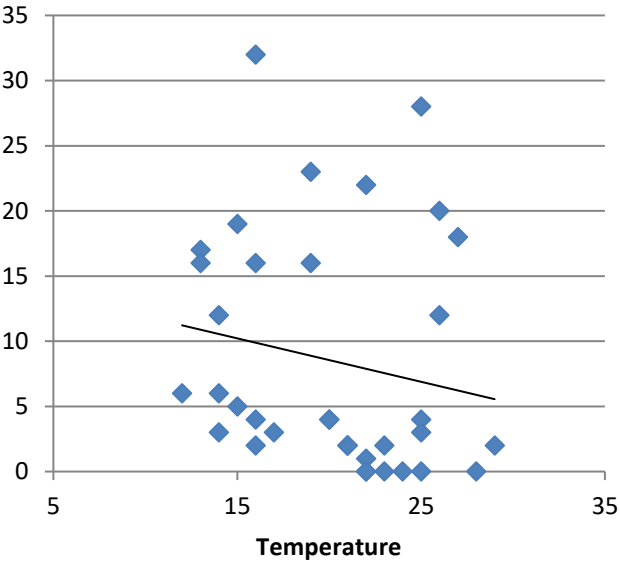


Figure 20A. Focal sampling ***Figure 20B. Scan sampling***

The tendency to play in relation to the prevailing temperatures at the respective observation sessions.

6. Discussion

This present study investigated how play "played out" in three groups of domestic lambs during their first months of life when reared out on pasture. Several different aspects of play were investigated during nearly two months of field-observations, without including the observations carried out during the pilot study; the ontogeny of play, the frequency of which play behaviours were displayed according to gender and breed, the diurnal cycle of play occurrence and, plainly, which different play behaviours domestic lambs display. One of the primary findings of the study was that there was a great difference in play occurrence between

the breeds; the Gute lambs performed the most play over the course of the whole study, whereas the Texels and crossbreeds displayed a lot less play. The play peaked from observation week 2 to 4 among the Gute lambs, which corresponds to the ages of 51-65 days until 61-75 days of age. Some other key findings include that social play was identified as the most common play category, particularly when contact was involved, and the most of the play was undertaken by ram lambs. Among all the different behaviours *reciprocal butting* was observed to be the most prevalent. Furthermore it was seen that the lambs distributed their play rather evenly between the morning and evening hours, however *mounting* and *racing* (according to scan sampling) were largely overrepresented in the evening. These and other results will be discussed below in relation to other studies in the area and possible explanations will be proposed.

Identified play behaviours

A total of 10 separate behavioural patterns, which could be interpreted as play oriented according to the five criteria set by Burghardt (2005), were identified over the course of the study (not counting the different versions of butting). The majority of these were seen as early as during the pilot study and hence included in the ethogram (table 1). However there were some juvenile behaviours observed that could presumably be recognized as play, but were not included in the ethogram, and hence not included in the results of the study. This can be explained by the fact that the behaviours in question were not identified until after a few weeks into the main study. Consequently these behaviours were not recorded systematically, however they were observed often enough to be acknowledged. One of these behaviours was *object climbing*, which has also been reported by Randle (1993). Though Randle (1993) did not record specifically object climbing on its own; it was recorded in the category *object play* together with other object related play behaviours. Edberg (2006) mentions the behaviour as well and says that Gute lambs engage in the pretend-activity, called "king of the castle", on top of a rock or hill. In this current study the behaviour was seen in all three lamb groups, although it was definitely more frequent in the group with Gute lambs. The more I observed the behaviour the more it became evident that it should be labelled as play; the lambs alternated between staying on the rock for just a short while (under 1 minute), or staying on the rock for a longer time (from 1 minute to approximately 5 minutes), before jumping off or climbing down. During the time each lamb spent on the rock it seemed to defend its position,

on its own or next to one other lamb, by butting of pushing the lambs trying to climb on top of the same rock. It seemed to be some kind of hierarchy-game, which is further confirmed by the fact that the sight of a lamb on top of a rock or hill seemed to act as a trigger in the lambs on the ground, to approach the lamb and challenge it. The challenge used to manifest itself either in butting, or in a behaviour that lacked any actual physical contact where the ground-lamb ran towards the lamb on the elevated spot and then simply stopped abruptly, standing face to face with the other lamb without ever touching one another.

With all this said, playing "king of the castle" apparently involves more than only object play, but all three categories of play behaviour; social, locomotor and object play. It should be pointed out that the behaviour did not seem to be associated with a genuine hierarchy among the lambs, considering that the lambs took turns to "reign" on the rock, and all the actions involved relayed a playful impression.

A behaviour that likewise was not recorded in this study, for the same reasons discussed above, is a behaviour that entails the lambs walking up to another lamb and placing its chin on the other lamb's back or neck. As far as I can tell this particular behaviour has not been reviewed in any other literature, with the exception of Sachs & Harris (1978) who reported to have witnessed it only a few times. Although they did not know whether to interpret it as play or not, and they did not observe it resulting in any subsequent play behaviours. On the other hand I actually noticed that the behaviour, on several occasions, was followed up with butting and /or pushing. For this reason I propose that the behaviour should be considered as play, considering it is included in a play bout, or alternatively a signal which conveys the initiation of play.

A behaviour that was recorded and where parallels can be drawn to "king of the castle" regarding the aspect of object climbing, is the play behaviour *balancing on ewe*. The theories concerning this behaviour are conflicting, where Ewbank (1967) ascribes the behaviour as an effort to make the ewe stand up in order to enable suckling. Whereas Rudge (1970) sees the behaviour as play. He has observed it in goat kids, and describes it as playing "king of the castle". Both theories seem viable, though it is important to weigh in that they examine different species; Ewbank (1967) speaks about lambs and Rudge (1970) about goat kids, and thus certain behavioural differences exist despite them being closely related (Sjödin et al., 2007) and described as more or less analogous in behaviour (Dane, 1977). Though based on

my own observations the lambs appeared to jump on top of the ewes and then balance in a manner as if they considered the ewes to be rocks. It can possibly be interpreted as a playful way to develop their sense of balance, in the light of that their ancestors lived in mountains and areas with rocky terrain (Sjödin et al., 2007). Additionally the lambs seemed to overlook their surroundings, as they would from a large rock or hill. Something else that speaks against Ewbank (1967) is that I was unable to notice a connection between the lambs standing on ewes' backs and later standing up and therefore enabling suckling. But of course it is possible that the behaviour indeed did result in rising the ewes eventually, but that the attempts were not successful during my observations. Furthermore it should be mentioned as well that playing "king of the castle" when standing on a ewe, appeared to differ somewhat from when it involves a rock; when standing on a rock, the lamb seemingly attracted other lambs and defended its place, whereas standing on a ewe this did not occur. In other words, the same element of hierarchy seemed to be absent.

Among the least recorded play behaviours in this study was *pivot*. The infrequent occurrence of this behaviour might serve as an explanation for the lack of mentioning in other studies, regarding play in lambs. Conversely, it is a common play element in piglets (Donaldson et al., 2002), and the sightings of pivot in my observations more or less corresponded to the movement seen in piglets.

Focal observations versus scan sampling

According to literature both focal and scan sampling have their advantages and disadvantages. Therefore it can be beneficial to combine the two methods, as it provides a more comprehensive assessment of the behaviours observed (Martin and Bateson, 2007; Damerose and Hopkins, 2002). Focal sampling provides a detailed picture of the individual animal, since only one or a couple of animals are observed during a determined amount of time. Yet complications can arise if a focal animal moves out of sight, and potential behaviours performed during that absence may be missed (Martin and Bateson, 2007). Fortunately the lambs in the current study were lost to view very infrequently; though during the 3rd observation week the crossbreeds had recently been moved to a new pasture with rather high grass, which rendered it difficult to see them clearly. However this affected both focal sampling and scan sampling equally.

Since focal sampling operates on a closer, more individual level, it is easier to distinguish more subtle and transient play behaviours such as *object play* and *pivot*. On the other hand, scan sampling provides a broader coverage of the group observed through a frequent, rapid scan of all the animals (i.e. all the animals in sight) (Martin and Bateson, 2007). So there could perhaps be a bigger likelihood that more conspicuous play behaviours "catches the observer's eye". This can explain why the recordings of *racing* is much higher in scan sampling (70 recordings) compared to focal sampling (3 recordings), seeing as racing incorporates several lambs and it occurs quite seldom. So the behaviour would presumably go more unnoticed in focal sampling, where only one animal is in focus for a couple of minutes while all other surrounding animals are ignored (Bernstein, 1991).

Effect of gender

It was concluded that the ram lambs represented the larger part of the total play performance, and it was predominantly displayed in the form of social play, where an equal number of each gender was observed, which corresponds to the findings of many other studies (e.g. Hass and Jenni, 1993; Vázquez et al., 2014; Dwyer, 2009). Likewise, the findings concerning locomotor play complemented prior research (e.g. Dwyer, 2009; Sachs Harris, 1978); the ewe lambs engaged in considerably more locomotor play than the rams. The specific play behaviours that contributed most to these differences were mounting, butting, pushing, which were dominated by the rams, and pivot and jumping, which was almost exclusively seen in the ewes. When the mentioned gender contrasts are set in perspective to the kind of behaviours that adult sheep are occupied with, a clear logic arises. Since male and female adult sheep have a quite distinct division in their behavioural repertoire. Adult males engage in rivalries with other males, which can be associated with butting and pushing, and mating behaviour, which can be compared to mounting. Adult ewes, on the other hand, are responsible for the wellbeing of their young, and this entailed that their ancestors had to keep them safe from predators, especially in the vulnerable state of parturition. This is mirrored in the higher prevalence of jumping and pivoting in ewe lambs. However, contrary to the findings of Sachs and Harris (1978), ewe lambs did not show a strong preference for gambolling in comparison to the rams, and had substantially fewer recordings than jumping. Though it should be acknowledged that jumping bears a great resemblance to gambolling, with the exception of body and head twists.

Effect of age

The tendency to engage in play appeared to likely be affected by age, seeing as there were weekly fluctuations in all play categories and the lowest level of play took place during the 6th and final observation week. In order to accurately relate to other research regarding the effect of age on play, it is advisable to focus on the Gute lambs, separate the other two groups. For the reason that the Texel and crossbred lambs were approximately 1 month older than the Gute lambs, and also because there is individual data on the Gute group. The Gute lambs reached their play height between week 26-28 (2-4th observation week) which corresponds to 51-75 days of age. This agrees somewhat with the results of Sachs & Harris (1978) who identified a peak at 37 to 54 days of age, apart from that the lambs in the present study extended their peak. Thereafter it declines in both scan and focal sampling. This was expected, since the literature states that play is greatly reduced from 9-12 weeks of age (Hass and Jenni, 1993; Sachs and Harris, 1978; Guilhem et al., 2006), and at the time of the final week of observations the Gute lambs had reached an age of about 10-12 week. At this last week of observations almost all the lambs among the Texels and crossbreeds had surpassed or come close to turning 4 months old. This marks a rather notable time, seeing as it has been found that play starts to become rare after reaching that particular age (Lynch et al., 1992). And accurately enough, the two lamb groups displayed barely any play behaviours at the time period in question. Interestingly the Texels and the crossbreeds, especially the crossbreeds, played noticeably more the preceding week (week 29). So it seems that this 4 months age mark is an important "timestamp" in the closing stages of play.

The high level of performance of social play with contact persisted even towards the end of the study, in the focal method. Whereas the other play categories dropped. This phenomena has also been reported by Hass & Jenni (1993), who saw that the lambs continued to engage in social play longer than other play, until about 12 weeks of age. And as mentioned, the lambs in our study had reached an age of 10-12 weeks in the final week. One could speculate that social behaviours is of a more complex nature that needs to be more "finely-tuned" in order to be successfully exercised, compared to locomotor and object field. Hence it takes more training to develop and this is shown through further play which extends into an older age range. Although this pattern is not seen in the scan sampling. Instead there is a fairly steep drop in social play over the last two observation weeks.

Object play kept a rather consistently low level over all the weeks. Nevertheless is appeared more often in the initial 2-3 weeks of observation, with a peak in both methods in the 3rd week, and after that it became exceedingly scarce. I suggest that this can be explained by an urgent need to obtain basic but crucial information about the animals' surrounding environment, in order to learn what is appropriate to eat and how different objects should be handled. Interestingly, object play was almost only recorded among the Gute lambs and hardly at all in the Texels and crossbreeds. Perhaps it is plainly a matter of age, bearing in mind that the Texel and crossbred lambs were considerably older than the Gute lambs. So they could very well had displayed their object play before the observations started. Another approach to explain this difference between the lamb groups is to investigate if some breeds have a greater predisposition to play than others. This is discussed under section *effect of breed*.

The play behaviour, balance on ewe, ceased more or less completely in the last weeks. There is several plausible causes for this. Firstly, it could be a consequence of an increased body weight among the lambs as they grew older, which could be too overbearing for their mothers. Or perhaps the lambs had become more independent and adventurous and preferred "real" stones or hills over their mothers' backs to play "king of the castle". Alternatively, a reduced milk requirement may play a part, if you apply the theory which entails that the lambs' stand on their mothers in order to make them stand up and provide the lambs with milk (Ewbank, 1967). In other words, the lambs do not need as much milk as before, and thus their motivation to climb on top of their mothers is lowered.

Effect of breed

Both focal and scan sampling conveyed that the Gute lambs played substantially more than the Texels and crossbreeds. The crossbreed group comes in second place, according to scan sampling (58 recordings), and the Texel group in last place (40 recordings). Though notably, focal sampling fails to differentiate between the two groups.

The contrasts between the three lamb groups, and the obvious preponderance of the Gute lambs, regarding total play frequency open up for reflections involving the potential significance of breed. Perhaps breeding for specific desirable traits, such as milk, meat, skins and wool, have indirectly led to various behavioural modifications. The Gute sheep has not

been exposed to breeding for a particular trait after 1940 (Näsholm, 2007), but any selection processes before that date unknown. The Texels and crossbreeds (Dorset, Suffolk and Swedish Fine Wool) on the other hand have been quite intensely bred, especially for meat and wool (Källander and Ögren, 2005; Näsholm, 2007; Svensk Texelförening, 2014). Moreover the Gute sheep is described as having a good vitality, highly mobile, and prefers to spread out on pasture, parting somewhat from the herd, unlike other sheep breeds (Skansen, 2015). Whereas the Texels are said to be undemanding and calm (Näsholm, 2007). Unfortunately, any literature concerning the temperament of the crossbreeds could not be found. Also it might be valuable to compare the contrasts in weight; the Gute sheep are the smallest, then the crossbreeds and the Texels are unquestionably the largest and heaviest (Edberg, 2006; Näsholm, 2007). So it seems that the Gute sheep has kept more of the attributes of their ancestors intact, who likely inhabited challenging mountains areas in the Middle East (Sachs and Harris, 1978), which apparently includes the motivation to play. On the opposite side of the spectrum, the Texels appear to have lost some of the original behavioural characteristics in the breeding process, where the primary goal has been to achieve a superior meat carcass. This, combined with their vaster and perhaps more restrictive body size, might in turn, inadvertently, have lead to a lower play performance.

This reasoning about the plausible consequences of breeding can be linked to the *resource allocation theory*. Simply put it means that there is trade-offs as a consequence of a targeted selection for a higher production in farm animals. For example when animals are bred in favour for a specific trait/traits, such as a rapid body growth in the Texels, it can be done at the expense of other traits, such as the inclination to play. So perhaps a disproportionately large part of the Texel lambs' resources is reserved for feed intake and feed conversion, and not as much is left for exploration of their environment and interaction with their peers in a playful manner (Rauw, 2009).

Another contributing factor to the different occurrences of play in the three lamb groups might be the contrasting environments the lambs were reared in. As mentioned, the Gute lambs grazed on semi-natural pastures comprised of many trees, large stones and ditches. On the other hand, The Texel and crossbred lambs grazed on fairly level and perspicuous areas. Subsequently, the pastures of the Gute lambs could perhaps be depicted as providing a more varied environment more compatible with their natural environments, which could have a stimulating effect on the animals and therefore result in more play (eg. Chaloupková et al.,

2007; Ahola et al., 2011; Vinke et al., 2005). This theory is supported by the findings of Berger (1979), who concluded that Bighorn sheep living in mountain areas played more frequently compared to Bighorn sheep in the desert areas. Though not only the barren conditions in the desert can be deemed to have a part in the infrequent display of play; there were physical hazards in the desert which could further have contributed to a reduction in play such as cacti, as well as a probable shortage of nutritious feed. Additional support can be retrieved in the findings of Byers (1977) that observed how juvenile Siberian ibex (*Capra ibex sibirica*) preferred play on sloped terrain instead of flat areas, despite the increased risks. This is likewise accredited to the similarity of the sloped terrain with the animals' natural environment, which consists of mountainous regions (Byers, 1977). Fagen (1981) takes the same line by expressing that the occurrence of play may vary as a consequence of environmental properties.

Diurnal play cycle

The results of the pilot study convey that the highest frequency of play takes place during the morning hours (8-10 am) and in the evening (6-8 pm). These two peaks of play corresponds to the results reported by Broekman (2014), who found three peaks: 7-8 am, 9-10 am and 7-8 pm. However, notably the play peaks established in this present study were based on a non systematic data collection from two days, where all occurrences of play during 9,5 hours per day were recorded. Additionally they were weighted together with the information provided by the sheep farmers. Nevertheless it is remarkable that the peaks possessed such a high degree of similarity in the two studies.

Broekman (2014) hypothesized that the time peaks could be explained, to a certain extent, by the management pattern of the caretakers that fed the animals, especially concerning the play behaviours undertaken during the morning hours. Alternatively, it is mentioned that the results possibly could be applicable to the general diurnal play rhythm. Since the findings from my study, which stem from semi-natural conditions, complement the results from Broekman (2014), I hold the view that the peaks actually represent the natural daily play cycle for lambs. Because in the semi-natural environment out on pasture, there was no influence from humans that through their presence could have a stimulating effect on the lambs (with the exception of the observer and shorter visits from the farmers).

If it is assumed that the play peaks in question are in fact an in-built hereditary rhythm, then one could speculate about their origin. Conceivably the answer can be found in their evolutionary background; as mentioned previously it has been suggested that the ancestors of today's domestic sheep was mountain living sheep, though this is not completely verified (Sjödin et al., 2007). More specifically the European Mouflon (*Ovis aries orientalis*) is considered as a potential ancestor, whose background can be traced from mountain areas in Asia, Sardinia, Cyprus and Corsica (Hiendleder et al., 1998; Lynch et al., 1992). And if you then look at the activity patterns of the predators specialized on hunting Muoflons, a contributing factor for the activity patterns of domestic sheep may be provided. Though the mountain terrain protects the Mouflons from the majority of predators, there is some predatory pressure for young lambs from the golden eagle (*Aquila crhysäetos*) (Love and Watson, 1990, cited by Ciuti et al., 2008), foxes and canines (e.g. wolves) (Cransac and Hewison, 1997). The golden eagle is active during the day hours (Palmer, 1988), whereas foxes and wolves are mainly crepuscular (most active at dusk and dawn) (Cypher, 2003; Merrill and Mech, 2003). The Mouflons are crepuscular to nocturnal animals (Santiago-Monero et al., 2000; Peichl, 2005), so it is possible that they have adapted their activity pattern after the pattern of some of their predators, by being active during the same hours and thereby alert and ready for emerging predators. Though it would seem dangerous to also synchronize the play behaviour among the lambs in the same manner, since that would make the young more vulnerable to potential attacks. This reasoning would in turn fit well with the diurnal pattern of the eagle; if the labs reserve their play for the hours when there is a lower risk for predatory attacks from eagles (i.e. morning and evening) the lambs would be less exposed. All the same, these are just speculations, given that the origins of the domestic sheep, Mouflons and their likely predators are rather unknown (Lynch, 1992).

Or alternatively, it can be a matter of the change in climate and temperature over the course of the day. Taken into account that this present study was conducted during summertime (16th of June- 23th of July 2014), the temperature often reached high temperatures at midday and in the early afternoon. And when the weather is strenuous the animals have a tendency not to engage in play. Additionally according to research, play in animals is usually concentrated in the morning and in the evening, and the temperature appears to be a largely contributing factor in this. This is understandable since play at cooler temperatures involves energy conservation and less thermal stress (Fagen, 1981). On the other hand, other factors may be involved besides temperature and climate, considering that the temperature only measured 12-22

degrees during the first three observation weeks, though presumably it was a couple of degrees warmer at midday.

Something that is worthy of discussion is that the majority of play takes place during the evening, according to scan sampling (192 recordings compared to 114 in the morning), and this was especially the case for racing (53 to 17 recordings) and mounting (32 to 12 recordings). Unfortunately I was unable to find any literature which examines this phenomena. Perhaps it has something to do with that these two play behaviours are more energy consuming than the others. But it is uncertain how this is related to the preference of the evening over the morning, considering that the temperature was consistently cooler in the morning hours during the study. Another theory is that the evening darkness triggers the play; however this needs to subjected to further investigation.

Effect of temperature

As argued above, the play frequency tended to decrease alongside an increased temperature. This was demonstrated in both observation methods. Though, it is important not to make any conclusions based plainly on this result, bearing in mind that the age of the lambs also advanced simultaneously. Thus it is cumbersome to separate the effects of temperature and age respectively, on the predisposition to play.

Effect of weaning

Both the Texel lambs and the crossbred lambs were weaned through separation from their mothers, and moved to separate pastures during the last week/weeks of the observations. It appeared to be a traumatic event for both lamb groups, however it visibly only affected the play frequency in the crossbred lambs. They played somewhat less compared to the prior observation session the week before, when they were held with the ewes. It is feasible that the small difference in age could be of importance, where the younger crossbred lambs had closer bonds with their mothers and hence they would be more negatively affected by the weaning. This would then result in a impaired tendency to play. But the difference is very marginal with a age-span of approximately 1 week (the Texel lambs were born March 9 th - April 1th, the crossbred lambs, March 12 th - April 8 th). Using the age-difference as an explanation is even more questionable when it is taken into consideration how "old" the lambs in the two

groups really were; the Texel lambs were about 16-20 weeks old (this refers to the females, since the males had been weaned two weeks before and were then on not subjected to any more observations), and the crossbred lambs were 15-20 weeks old. This means that they reached and surpassed the recommended age for weaning for spring lambs, which is around 100-115 days (Eggertsen 2007), and should therefore have been able to cope with the weaning quite well and recover rapidly from a behavioural perspective. Also, research has shown that play is rare after 4 months or age (Broom and Fraser, 2007), and so the lambs were generally not inclined to play at the time of the weaning. In other words the weaning process did not cause a meaningful disturbance in the play frequency, even though Krachun et al. (2010) concludes that weaning is a stressful event that can lead to a reduction of play. However, Krachun et al. (2010) conducted their study on calves, and weaned the animals at 7 and 13 weeks, whose natural weaning time can range from 7 to 14 months (Reinhardt and Reinhardt, 1981). In comparison, lambs are weaned much earlier in the wild, at 6 months of age (Dwyer, 2009). Hence, the lambs were a lot closer to their natural weaning age than the calves, and subsequently the effect of the weaning was not as substantial.

Limitations of the study and future research

Regarding the focal observations there were some aspects that call for discussion. The first aspect involves the manner of which the lambs were distinguished. Since the Texel and crossbred lambs were differentiated only on the basis of their sex, it was not possible to examine the development of play according to their age as accurately as in the Gute lambs, which were distinguished on an individual basis. So to retain better, more specific, data it would be advisory to conduct a future study where all the focal lambs are marked with different colours and patterns according to a specific system for identification. This was also originally planned in this present study, however because of certain complications of a practical nature the marking system was not implemented.

Another suggestion for future research would be to observe lambs closer in age than the lambs in my study, considering that the age range between the oldest and youngest lambs in the study was about 1,5 months. That would make it easier to compare results between genders and breeds. Additionally it would be recommended to start the observations from birth, so no behaviours go unnoticed. For example it is probable that the lambs are more inclined to perform object play at a very young age, seeing as the behaviour was almost nonexistent

during the second half of the study. Though this would likely mean that a part of the study would have to be carried out inside the stable, instead of outside on pasture, and hence it would go against the purpose of my study.

All the observations were carried out by one single observer, which could be considered as limiting; there may be an increased risk for observer errors such as observer's drift or biases. So it would perhaps be helpful to measure the recordings against those made simultaneously by another observer. Furthermore, an extra observer would likely be accommodating in bestowing a more complete set of recordings, in the view of that the lambs, on some rare occasions, disappeared out of sight especially when the grass was very high. So if the observers were deployed at somewhat different angles, it would minimize the "blank" recordings. Optimally, the direct recordings of the observers could be complemented with cameras placed at several different locations in the pasture. Though this would obviously increase the cost of the study, it would contribute to an increased access to the animals during both day and night. However it might be unpractical to use cameras for such a large space as a pasture, and instead more appropriate for indoor studies.

Welfare implications

The results of this study could hopefully provide material for the assessment of the level of play in lambs, and thereby be helpful in the usage of play occurrence as a measure of the wellbeing of animals. Though it could perhaps be deemed too time-consuming to record the play frequency during inspections by animal welfare inspectors, depending on the age of the animals. In that regard it is important for the inspectors to possess the knowledge that play is performed more at certain ages, and hence if the lambs only engage in little or no play at a otherwise very "play-dense" period it could be a warning sign of unsatisfactory animal welfare. Play incidence could also be a useful welfare indicator for the farmers; a scarcity of play may give aid in identifying potential shortcomings in factors such as management, environment or nutrition. This, in turn, would likely lead to an improved productivity, higher profit and of course an enhanced animal welfare.
Practically, it could mean that the animal welfare authorities and farmers are provided with sheets were the different types of play behaviours are described and illustrated. Additionally, information about when the various play behaviours should be expected, according to prevailing lamb age, could be included as well. In that way the identification and assessment

of play is facilitated. In other words, it is important to know what you are looking for considering that play in lambs, and in animals in general, is usually very transient and typically only observed in a few animals at a time.

7. Conclusions

The most important conclusions of this study are the following:

- It was discovered that lambs perform several different play behaviours. Most of them had been recorded in other research, and was: race, chase, gambole, butt, jump (no twists) and manipulate object. However some had not been previously statistically recorded or only briefly commented: balance on ewe, push and pivot.

- The type and prevalence of play changed over time, and became increasingly infrequent as the lambs grew older. More specifically, play was visibly reduced by the 12th week of age, and then became rare at the age of 4 months. Object play was almost only seen during the first 3 observation weeks, whereas the display of social play continued throughout the study. A play peak was observed between 2nd to 4th week of observation, which corresponds to 51-75 days among the Gute lambs.

- The lambs played substantially more during the morning hours (before 10 am) and in the evening hours (6-8 pm), and the evening was somewhat preferred over the morning.

- Obvious contrasts were identified between the rams and ewe lambs, both regarding the type and prevalence of play. The ram lambs stood for the larger part of play, particularly when it came to social play. On the other hand, ewe lambs engaged more in locomotor play. Mounting, pushing and butting were dominated by the rams, and jumping and pivot were nearly solely observed among the ewes. Substantial differences were also observed between the breeds, where the Gute lambs undoubtedly showed the highest occurrence of play, followed by the crossbreeds and lastly the Texels. These breed differences can presumably be a consequence of both age and breeding for specific traits.

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