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The human–animal relationship in dairy animals

Fabio Napolitano[1], Andrea Bragaglio[2], Emilio Sabia[3], Francesco Serrapica[4], Ada Braghieri[1] and Giuseppe De Rosa[4]

[1]Scuola di Scienze Agrarie, Forestali, Alimentari ed Ambientali, Università degli Studi della Basilicata, Via dell'Ateneo Lucano 10, 85100 Potenza, Italy; [2]Dipartimento di Medicina Veterinaria, Università degli Studi di Bari Aldo Moro, Strada provinciale per Casamassima km 3, 70010 Valenzano (BA), Italy; [3]Faculty of Science and Technology, Free University of Bolzano, Piazza Università 5, 39100 Bolzano, Italy and [4]Dipartimento di Agraria, Università degli Studi di Napoli Federico II, Via Università 133, 80055 Portici (NA), Italy

Research Reflection

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Author for correspondence:
Fabio Napolitano,
Email: fabio.napolitano@unibas.it

Abstract

The present study aims to identify margins for the improvement of dairy animal welfare and production based on the quality of the human–animal relationship (HAR). The main tool proposed to improve the quality of HAR in dairy animals is training of stock-people by targeting their attitude and behaviour. Given that a good quality HAR may benefit the welfare of dairy animals and productivity, new technologies, by monitoring the handling routine on farm, may be more effective in promoting good practices. In particular, the implementation of new technologies may allow identification of specific inappropriate behaviours to be targeted at stockperson level, thus increasing the efficacy of training. However, an issue related to the introduction of new technologies in the farms, particularly in those that follow traditional farming practices, is the resistance to innovation which may be encountered.

Introduction

Animal welfare is increasingly affecting consumer behaviour and, consequently, food enterprises have the chance to move from the current approach (based on compliance to new and emerging legislative norms) to an approach where the attention to animal welfare issues may create additional profit from increased production efficiency, product quality and fulfilment of consumer needs in terms of animal welfare standards. Products obtained from animals that are well treated on farm and throughout the production chain may get higher market shares, particularly in animal welfare conscious consumer segments (Carlucci *et al.*, 2009) The quality of the human-animal relationship plays a central role in defining the welfare of the animals (see Waiblinger, 2019 for a review) and, undoubtedly, in dairy animals the human-animal interactions are more frequent and more intensive than in the other farm species as some procedures are performed daily (handling, milking). This relationship can range from a predator/prey-like response (high flight distance and high fear of humans) to dominance-like interactions (medium to short flight distance and submissive approach to humans) and affiliative-like relationship (no flight distance and humans perceived as social partners) (see Rushen et al. 2001 for a review).

Australian researchers, headed by Paul Hemsworth, are renowned to be the pioneers of the study of human–animal interactions in farm animals and their effects on animal wefare. They defined stock-people's attitude towards animals as a psychological tendency to value an animal in a positive, neutral or negative way, albeit affected by various factors such as temperament, age, gender, level of education. This value assessment is considered to be the driving force in determining the quality of their interactions with animals (Hemsworth and Coleman, 2011). According to their model a negative/neutral/positive attitude of stock-people towards the animals they handle will be reflected in negative/neutral/positive interactions of stock-people with the animals, respectively (Hemsworth and Coleman, 2011). As a consequence, the animals will modulate their levels of fear towards their stock-people and the humans in general and, accordingly, the level of welfare will be affected. Fear may be defined as a psycho-physiological reaction to a danger situation (Jones, 1996) or, in other words, a response to a stimulus that the animal tries to end, avoid, or escape (Gray, 1987). Fear reactions may jeopardize both human and animal safety and increase handling difficulties and time. Fearful dairy animals show higher level of restlessness by increasing the frequency of stepping and kicking during milking, and milk ejection may be impaired (Hemsworth, 2003). Finally, this sequence of events will negatively impact milk production

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Different methods can be used to assess the quality of the human-animal relationship (HAR), each of them corresponding to one of the components of this model. Although stock-people's attitude cannot be assessed directly, the administration of attitude questionnaire has been used as a means to infer their underlying attitude (Hemsworth *et al.*, 2000; Waiblinger *et al.*, 2002; Ebinghaus *et al.*, 2018). However, stock-people may give false answers if they know or guess the aim of the questionnaire (Hemsworth and Coleman, 2011). Alternatively, the behaviour of the stock-people while they handle the animals can be observed and their interactions classified as positive (petting, talking quietly, gentle touching, etc.), neutral (talking dominantly, gentle handling, gentle stick usage, etc.) or negative (shouting, talking impatiently, forceful stick and hand use, etc.) (Waiblinger *et al.*, 2002; Napolitano *et al.*, 2019). Once again, stock-people may change their behaviour if they know or guess the aim of the observations (Waiblinger *et al.*, 2003). More reliably, the behaviour of the animals can be observed using different types of test (i.e. avoidance distance in the home pen, avoidance distance at the manger, approach test) or during the milking routine in dairy animals (e.g. number of steps, number of kicks). Even more reliably, the reaction of animals to human handling, could be monitored on farm by using precision livestock farming techniques, which would allow prompt interventions for the improvement of animal welfare.

Therefore, after a background description of the main findings concerning dairy species (cattle, buffaloes, sheep and goats) and the gaps to be filled to fully verify the applicability of the HAR model in those species (Table 1), the present study will identify margins for the improvement of dairy animal welfare and production through the combination of pieces of information on animal behaviour, human attitude and behaviour, and new technologies capable of impacting the quality of the interactions between stock-people and animals.

HAR in cattle

Humans

In dairy cattle the quantity and quality of HAR and their impact on behaviour, welfare and productivity have been widely investigated (see Waiblinger et al. 2006 for a review).

The sequential relationship between stock-people's attitude and their behaviour has been well documented in dairy cattle (see Hemsworth, 2003 for a review). For instance, in this species, a positive attitude was negatively associated with both the number and the percentage of forceful, negative, tactile interactions (Breuer *et al.*, 2000; Hemsworth *et al.*, 2000; Waiblinger *et al.*, 2002), and positively correlated with the number of quiet or soft vocalisations performed by the stock-people when moving the cows (Breuer *et al.*, 2000). In addition, the frequency of gentle contacts was positively associated with a positive attitude of the farmers towards veal calves (Lensink *et al.*, 2000). However, as suggested by Lensink *et al.* (2000), other factors, such as gender and work load may directly influence the behaviour of stock-people towards animals.

Training programmes and a more careful recruitment of stock-people have been proposed in order to improve the attitude and behaviour towards animals (Boivin *et al.*, 2003). For example, in dairy cattle (Hemsworth *et al.*, 2002) appropriate stock-people training, aimed at modifying their attitude and behaviour, had a beneficial effect on these aspects, as well as, on the fear response of animals to humans.

Animals

The behaviour expressed by humans towards the animals may elicit a fear response depending on the intensity of stimuli and its previous experiences (Price, 1999). In dairy cattle, this response may result in increased restlessness and heart rate when milked (Rushen *et al.*, 1999), or in reluctance to move, falling, baulking, etc. when handled (Grandin, 1997). For example, negative stock-people interactions were positively correlated with the number of kicks during milking and with farm milk cortisol concentrations, whereas positive interactions were negatively correlated with the number of kicks (Breuer *et al.*, 2000; Hemsworth *et al.*, 2000). In addition, the percentage of positive interactions during milking had a beneficial effect on udder health (Ivemeyer *et al.*, 2011).

Ultimately, an increased level of animals' fear of humans may be a major source of stress resulting in reduced productivity and welfare (Hemsworth, 2003). It has been observed that the use of negative interactions may have detrimental effects on milk ejection, with increased amounts of residual milk, on milk yield, with reduced milk production, and on milk quality in terms of reduced fat and protein contents (Rushen *et al.*, 1999; Breuer *et al.*, 2000; Hemsworth *et al.*, 2000; Waiblinger *et al.*, 2002). In contrast, positive interactions were associated with increased fertility and udder health of dairy cows (Hemsworth *et al.*, 2000; Ivemeyer *et al.*, 2011) and growth rate of dairy calves (Lürzel *et al.*, 2015). Further, gentle handling and less fearful dairy cattle may reduce the risk of injuries to humans during milking (Rousing *et al.*, 2004; Bertenshaw *et al.*, 2008), transport (Lensink *et al.*, 2000, 2001) and veterinary procedures (Waiblinger *et al.*, 2004).

Undoubtedly, in dairy cattle the most used measure of the quality of human-animal relationship is represented by the avoidance distance of animals to humans (AD). AD may be defined as the distance at which an animal allows a moving unfamiliar person to approach (Waiblinger *et al.*, 2002). AD has been measured either at the feeding place or in the barn (Waiblinger *et al.*, 2003; Windschnurer *et al.*, 2008; Ivemeyer *et al.*, 2011). AD in the barn was negatively correlated with positive interactions during milking and positively correlated with negative interactions (Waiblinger *et al.*, 2002). In addition, it has been reported that the number of negative stock-people interactions during milking was negatively associated with the percentage of cows approaching a motionless observer within 1 m in a standard approach arena test (Hemsworth *et al.*, 2000). However, it has been documented that AD at the feeding place and AD in the barn were highly correlated (Waiblinger *et al.*, 2003; Windschnurer *et al.*, 2008). Indeed, AD measured at the feeding place is more feasible than that measured in the barn. Therefore, AD measured at the feeding place was included in the Welfare Quality® assessment protocol for cattle to assess the quality of the human–animal relationship at farm level (Welfare Quality®, 2009).

HAR in buffaloes

Humans

In Italy dairy buffalo intensification occurred in the last five decades. Obviously, this intensification has led to an increase in the number of events where stock-people and animals interact. Thus, the role of stock-people, as in other intensive production systems, has become more and more important (Napolitano *et al.*, 2019).

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Table 1. Summary of the studies on the sequential relationship between human attitude/behaviour and animal behaviour/welfare/production

Animal species	Human attitude – human behaviour	Human behaviour – animal behaviour	Animal behaviour – animal welfare	Animal behaviour – milk production
Cattle	Breuer et al. (2000), Hemsworth et al. (2000), Waiblinger et al. (2002)	Breuer et al. (2000), Hemsworth et al. (2000), Waiblinger et al. (2002)	Breuer et al. (2000), Hemsworth et al. (2000), Rushen et al. (1999)	Hemsworth et al. (2000), Ivemeyer et al. (2011), Rushen et al. (1999)
Buffaloes	Not studied	Saltalamacchia et al. (2007), Napolitano et al. (2019)	Not studied	Napolitano *et al.* (2019)
Sheep	Napolitano et al. (2011)	Coulon et al. (2015), Serrapica et al. (2017)	Not studied	Not studied
Goats	Not studied	Battini et al. (2016), Boivin and Braastad (1996), Jackson and Hackett (2007)	Baxter *et al.* (2016)	Not studied

However, to our knowledge, the study of the attitude of stock-people towards dairy buffaloes has never received scientific attention.

Animals

The relatively recent introduction of machine milking, together with early calf-separation practice, configure buffaloes as sensitive animals to the milking environment and routine changes, as even small modifications can elicit restlessness and other discomfort emotional states (Napolitano *et al.*, 2013; Polikarpus *et al.*, 2014). Stepping and kicking, frequency of urination and defecation, pulling the teat cup off the teats, and a delay in milk ejection can be considered the most frequent behaviours expressing discomfort in dairy buffaloes during milking (De Rosa *et al.*, 2005; Saltalamacchia *et al.*, 2007). In dairy buffaloes, negative stock-person interactions during milking were positively correlated with the number of kicks and the percentage of buffaloes injected with oxytocin to facilitate milk ejection (Saltalamacchia *et al.*, 2007; Napolitano *et al.*, 2019). In addition, Napolitano *et al.* (2019) found a correlation between the number of positive interactions and milk production.

In buffaloes, milking parlour design may affect stock-people behaviour towards animals, with a higher number of negative stock-people interactions in tandem parlours as compared with herring-bone parlours (Napolitano *et al.*, 2019). This may be due to the fact that the chance to perform negative interactions is higher in tandem than in herring-bone, as in the former the animals are individually handled, whereas in the latter the animals are group-managed.

Cavallina *et al.* (2008) observed more kicking and frequency of urination during milking in primiparous than multiparous buffalo cows. As expected, they also observed a reduction of these behavioural expressions in primiparous animals as the lactation proceeded as a result of the process of habituation to this novel procedure. These findings were confirmed by the work of Polikarpus *et al.* (2014) where a pre-partum habituation programme to the milking routine (including the presence of two milkers) was effective in reducing buffalo heifers' level of restlessness, expressed in terms of kicking and stepping, when they subsequently entered the lactating group and were regularly milked.

As reported for dairy cattle, also for dairy buffaloes, avoidance distance measured at the feeding place was included in Welfare Quality® assessment protocol to assess the quality of the human–animal relationship at farm level (De Rosa *et al.*, 2005, 2015).

HAR in sheep

Humans

In a recent cross-cultural study, the quality of HAR was not mentioned by a number of stakeholders when asked to list the most important aspects to be considered to sustain sheep welfare (Dalla Costa *et al.*, 2019) and, although incorporated in the AWIN scheme under the form of a familiar human approach test (AWIN, 2015), it was not included in a list of relevant parameters for the assessment of the welfare of sheep kept for meat production (Munoz *et al.*, 2017). Accordingly, Phillips and Phillips (2010) noted that farmers consider long-lasting factors such as malnutrition, poor management and parasite infestations, as the main welfare issues in sheep kept for meat production in Australia, whereas animal welfare activists paid more attention to acute pain induced by mutilations such as castration. However, farmer attitudes are affected by education level, job satisfaction, gender and size of the farm. For instance, in Turkey the welfare of sheep kept for meat production is given more consideration by farmers with increasing education level and job satisfaction, while they are deemed less relevant by farmers with increasing farm size and by male farmers, as these characteristics (farm size and male gender) were possibly more associated with an interest towards profits rather than with the conditions of individual animals (Kılıç and Bozkurt, 2013). This latter aspect highlights the lack of knowledge concerning the relationship between animal welfare and productivity and signals an oppoortunity for animal welfare improvement by targeting sheep farmers' attitude. In particular, Munoz *et al.* (2019) observed a close relationship between farmer attitude and management decisions, which in turn were able to markedly affect the welfare of sheep kept for meat production. The attitude of farmers, even when they are not directly involved in farm activities and animal handling, has an impact on stock-people attitude and behaviour in terms of training provided and priorities identified in flock management. A study conducted in Italy (Napolitano *et al.*, 2011) showed that stock-people generally had a positive attitude towards dairy sheep (they considered them to be sensitive animals), about working with them (they considered them manageable when handled) and about how to interact with them (positive interactions were considered the most effective to handle the animals), and were satisfied about their job.

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As to human behaviour, numerous studies showed that gentle interactions increased the affinity of lambs from dairy breeds towards humans (Caroprese *et al.*, 2006; Napolitano *et al.*, 2006), while subsequent studies indicate that the consequent close relationship may function as social support in lambs kept for meat production prematurely separated from their mothers (Coulon *et al.*, 2015; Serrapica *et al.*, 2017).

Animals

It has been demonstrated that sheep can be easily habituated to the human presence (González-Pech *et al.*, 2018) and, more importantly, to the milking routine (Dimitrov *et al.*, 2012). Although no studies are available on the behaviour of stock-people in the milking parlour and its effect on animal behaviour, it has been observed that positive attitudes of stock-people about working with dairy sheep and about how to interact with sheep were correlated with a reduced flight distance at the feeding place (Napolitano *et al.*, 2011). Habituation to human handling and the development of a positive human-animal relationship may, therefore, make the ewes calmer and less reactive to the milking routine with increased welfare, more effective milk ejection and higher production (Dimitrov and Djorbineva, 2003). Taken together these results suggest that a positive human behaviour at milking may potentially impact animal behaviour and welfare and consequently increase the productivity of dairy sheep enterprises.

HAR in goats

Humans

As also observed for sheep, different stakeholders did not mention the quality of HAR as a relevant issue for dairy goat welfare (Dalla Costa *et al.*, 2019). After a number of preliminary studies where it was repeatedly tested and validated (Mattiello *et al.*, 2010; Battini *et al.*, 2016; Can *et al.*, 2016) HAR was integrated in the AWIN scheme under the form of latency to the first contact test (AWIN, 2015) and, although it was not listed among a number of animal based parameters suggested for dairy goat welfare assessment by Anzuino *et al.* (2010), these authors stated that a measure of goat fearfulness had to be developed to make the assessment more comprehensive.

In Norwegian dairy farms a generally positive farmer attitude towards goats (they were considered to be capable of distinguishing different humans), about how to interact with them (positive interactions were considered more effective to handle the animals) and job satisfaction was recorded (Muri *et al.*, 2013) while in Italy Battini *et al.* (2016) observed that a positive attitude of the handler tended to be associated with the farms qualitatively classified as 'good' in terms of HAR (based on the judgment provided by the technical advisor regularly visiting the farms), whereas a negative attitude tended to be associated with 'poor' farms.

Human behaviour has an impact on the reaction expressed by goats. Boivin and Braastad (1996) recorded a higher affinity of gentled kids to a familiar human as compared with untreated animals. They also noted that gentling was more effective if performed at 1 week than at 6 weeks of age. In adult goats Jackson and Hackett (2007) observed that gentled animals were quicker in approaching an unknown person as compared with non-gentled goats, whereas Battini *et al.* (2016) noted that the majority of the variables recorded during the approach and the avoidance tests were able to discriminate the farms classified as 'good' and 'poor' in terms of HAR quality. Then, we can suppose that the model proposed by Hemsworth and Coleman (2011) is applicable to dairy goats, as also reported for other animal species, and assume that stock-people attitude is reflected in stock-people behaviour.

Animals

Unfortunately, no specific studies on the effect of human behaviour at milking on goats are available leaving room for further research to have this gap filled. Nevertheless, a recent study demonstrated that positive and negative handling of pregnant goats had significantly different outputs in terms of reproduction efficiency and maternal behaviour, with lower pregnancy maintenance rates in animals receiving aversive treatments, and improved maternal care in mothers receiving gentle treatments (Baxter *et al.*, 2016). Accordingly, lactating goats had a significant increment of heart girth (a proxy of body weight) if previously gentled but did not show any changes if left untreated, possibly because the former were able to adsorb and use more efficiently the nutrients contained in their ration (Jackson and Hackett, 2007), thus potentially compensating the negative energetic balance experienced by lactating animals soon after parturition. In addition, goats receiving aversive handling showed increased salivary cortisol levels during the treatment as compared with control and gentled animals (Baxter *et al.*, 2016). These results indicate that human behaviour can have a marked effect on goat behaviour, welfare, reproduction and feed conversion efficiency, while further studies are needed to verify whether the quality of HAR can affect milk production.

New technologies

Several devices and sensors have been developed to assess the welfare of the animals (such as thermography and accelerometers), although no new technologies specifically designed to monitor the quality of HAR on farm are available. Therefore, existing technologies could be further developed to this aim. For instance, a system combining video management and machine learning may allow collection, recording and analysis of the videos and the corresponding sounds, thus enabling a real time feed-back with a potentially prompt improvement of the welfare of the animals through tailored interventions on handlers (such as training on specific aspects of animal handling) or facilities (elimination of abrupt changes in flooring, for example). However, in a recent study conducted in the UK, sheep farmers, albeit acknowledging the advantages deriving from the application of precision livestock farming techniques, showed a resistance to their adoption due to the belief that they would, at least partly, lose the control of the farm (Kaler and Ruston, 2019). Further aspects potentially hindering the implementation of new technologies are economic and cultural constraints and lack of information and competence (Pierpaoli *et al.*, 2013).

Concluding remarks

The present review highlighted the need for further research to definitively verify the applicability of the HAR model proposed for other species to dairy sheep and goats. In particular, in both species, studies linking human behaviour at milking to animal behaviour, animal welfare and milk production are lacking. In

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dairy cattle the model has been fully verified, whereas in dairy buffaloes, studies on the relationship between stock-people attitude and behaviour are lacking. However, in both dairy cattle and buffaloes the effects of human behaviour on animal welfare and milk production have been confirmed. The main tool proposed to improve the quality of HAR is training of stock-people by targeting their attitude and behaviour. Given that a good quality HAR may benefit the welfare of dairy animals and productivity, new technologies for monitoring the handling routine on the farm may be more effective in promoting good practices. In particular, the implementation of new technologies may allow the precise identification of specific inappropriate behaviours to be targeted at stockperson level, thus increasing the efficacy and efficiency of training. However, an issue related to the introduction of new technologies in the farms, particularly in those that follow traditional farming practices, is the resistance to innovations which may be encountered.

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