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Exploring heifers' perception of 'positive' treatment through their motivation to pursue a retreated human

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Abstract

This pilot study investigates dairy heifers' perception of 'positive treatment' by a human (stroking and brushing) through a test of appetitive motivation. The hypothesis was that positive treatment by a human results in heifers pursuing a human to seek further positive treatment. Thirty-seven dairy heifers were assigned to either minimal human contact or positive treatment during rearing for five minutes per week, for a total of four hours, between ages six to 24 months. Six months after treatment ceased, the heifers were tested in a suite of four sequential tests, conducted while free ranging in their home pen with a group of familiar conspecifics. The tests explored whether dairy heifers that received positive treatment had: 1) a lower flight distance than controls; 2) accepted initial positive treatment during the test; and (for those who voluntarily re-approached and interacted with the human after the human had retreated) whether this was due to 3) curiosity; or 4) motivation for further positive treatment. Positive treatment heifers had a lower flight distance in component 1 of the test and more of this group voluntarily approached the human compared to the control heifers. The positive treatment allowed more initial positive treatment (component 2) and sought further positive treatment in components 3 and 4. It is concluded that 'positive' treatment is rewarding for many heifers. It is suggested that positive treatment constitutes environmental enrichment of dairy cattle and can enhance cattle's quality of life and the human-animal relationship.

Keywords: *animal welfare, anthrozoology, heifers, human-animal relationship, positive treatment, re-approach test*

Introduction

Anthrozoology (the study of human-animal interactions) provides an insight into the impact that the quality of the human-animal relationship (HAR) has on various livestock species. Hemsworth's comprehensive review (2003) accepts that negative treatments are perceived as unpleasant by the animal, causing fear. This fear manifests as acute and chronic stress responses and exerts an effect on animal productivity and welfare (Hemsworth & Coleman 1998). Studies with cattle treated aversively compared to controls found lower milk yield and higher residual milk (Rushen *et al* 1999b), higher returns to service, ie lower pregnancy rates (Unshelm 1990), higher free cortisol when measured hours after rough handling (Breuer *et al* 2003) and possible evidence of immunosuppression resulting in poorer health and thus welfare (Hemsworth 2003). Studies imposing 'positive treatment' (PT: brushing, stroking), assumed to be perceived as 'pleasant' by dairy cows and veal calves, have shown benefits in terms of indicators of welfare (eg lowered cortisol responses: Boissy & Bouissou 1988; lowered heart rate: Rushen *et al* 2001 and lowered abomasal lesions: Lensink *et al* 2000b). In addition, effects on production (milk let down and flow rate: Bertenshaw & Rowlinson 2001a) have been demonstrated as well as behaviour in controlled tests (distance kept from an aversive and pleasant handler: Munksgaard *et al* [2001], withdrawal from an approaching person: Lensink *et al* [2000a], reduced time to first interaction with a human and increased duration of interaction, in a test of response to a stationary human in the test pen: Bertenshaw & Rowlinson [2001b]) and sham commercial situation tests (reduced heart rate during veterinary procedures, eg rectal palpation: Waiblinger *et al* [2004]; loading: Lensink *et al* [2000a]).

Those working with cattle have used their own expert judgement to suggest that "gentle treatment is rewarding to adult cattle" (Munksgaard *et al* 2001) as "humans... supply positive things like companionship" (Raussi 2003), "being stroked... seemed to be experienced as positive by the calf" (Lensink *et al* 2000b) and PT is 'comforting' to cattle (Rushen *et al* 2001).

Despite the above, there has been debate as to whether it can be proved that what humans term 'positive' is indeed positive from the animal's perspective and studies into states of animal pleasure have lagged behind other studies of negative affective states (Duncan 2006). There is a growing belief that positive mental states with the potential for enhancing life experience should be given equal importance

to negative states (McMillan 2005). Anthrozoologists have identified the need to examine the quality of the human stimuli in the dairy cow's environment and those factors influencing their approach to a human (Rushen *et al* 1999a; Breuer *et al* 2000; Munksgaard *et al* 2001; Hemsworth 2003; Raussi 2003; Waiblinger *et al* 2003; Petherick 2005; Schmied *et al* 2008) especially under farm conditions (Boivin *et al* 2003). In Waiblinger *et al*'s (2007) comprehensive review of 42 tests measuring response to humans, there were none investigating a cow's positive perception of a human and there remains a dearth of evidence to qualify the affective experience of cattle in relation to PT.

The few studies to date have had limited success in confirming that PT is pleasant to animals. Pajor *et al* (2003) compared the relative reward of bucket feeding, hand feeding, talking, PT and a control, via a Y-maze test, with cows and heifers and found no evidence that PT is rewarding to cattle although speaking gently was preferable to shouting. Boivin *et al* (1998) assessed whether a human proactively brushing beef calves was a rewarding experience for the animals but their inconclusive results were attributed to habituation. They propose confounding factors of insufficient treatment to reinforce brushing as a positive experience (50 min over two weeks), and a novel environment that lowered motivation to approach the human as social isolation is more aversive than human contact is rewarding. They suggest that the 'positive' nature of interactions requires further investigation.

Ambiguous interpretations of the emotional responses of animals to situations make it difficult to indicate the valence (pleasant or unpleasant) of the response (eg cortisol: Paul *et al* [2005]) and approach/avoidance: Waiblinger *et al* [2003]). Waiblinger *et al* (2007) suggest more detailed ethograms may provide considerable information about an animal's emotional state and its perception of humans, and identify this as a research priority. Rousing and Wemelsfelder (2006) believe an animal's expressive body language can communicate its perspective and reflects what an animal would like in a given situation. A pilot study by Schmeid *et al* (2008) explores postural response to PT of regions of the cow but draws no conclusions on relative emotional responses, ie which is more pleasurable.

The 'motivation to re-approach a retreated human test' detailed in the following paper is a pilot design that seeks to assess dairy heifers' perception of 'positive' treatment. When measuring positive aspects of the HAR, the focus shifts from avoidance to attraction (Waiblinger *et al* 2007). Positive motivations are known as appetitive and Kirken and Pajor (2006) explain that motivation is "the tendency to perform a behaviour but is understood to reflect the animal's desire". This pilot appetitive test involves analyses of qualitative details of approach behaviour and posture to gain information on the motivation of these cattle to interact with the human, and avoids the confounding factors of social isolation and novelty of test location.

Cognitive ethologists favour experimental conditions akin to the usual environment of the animal (Bekoff 1994). Rousing and Waiblinger (2004) produced high test/re-test reliability when measuring collective avoidance distance and, to a lesser extent, approach behaviour of small herds of European dairy cows tested loose-housed and free-ranging in their home pens surrounded by their usual herd mates. Kirkden and Pajor (2006) explain that motivation tests generally test animals in isolation, due to practical difficulties of distinguishing responses made by different subjects and ensuring the correct subject is rewarded, and cite only two exceptions in mice. Dairy cows in the UK are managed in free-ranging groups (rather than tie stalls as in the studies of Munksgaard *et al* [2001] and Waiblinger *et al* [2004]). Cattle's responses within a group warrant investigation (Raussi 2003), and Winckler *et al* (2003) advocate "on-farm welfare assessment… (which)... should be based on feasible indicators which reflect the animal's state in the context of the housing and management system… (including)… measures of the HAR". Bertenshaw *et al* (2002) successfully conducted tests of flight distance in the dairy heifers' home pen which depicted manipulation of fear of humans based on PT of heifers compared to a control group. *In situ* tests, such as these, may result in easy-to-implement on-farm assessment procedures for commercial or research purposes, to assess the quality of the HAR (Petherick 2005).

This paper details a pilot technique designed to investigate whether PT was rewarding to heifers and is assessed in the home pen in typical UK management conditions. The hypothesis is that PT by a human is sufficiently rewarding to heifers that they are motivated to seek further PT by pursuing (re-approaching) a retreated human, and that this response is more than a product of curiosity, indicating that some element of the interaction with the human was pleasant.

Materials and methods

Thirty-seven Holstein/Friesian heifer calves were taken from the autumn-born dairy replacements at Cockle Park Farm, University of Newcastle-upon-Tyne, UK. The heifers were identically managed according to typical UK commercial practice to six months of age; individually penned and bucket-fed milk replacer to six weeks, then large-group housed on straw, with only minimal routine human contact thereafter (see Bertenshaw *et al* 2007).

Initial assessment of fear

Prior to dividing the heifers into treatment groups at six months old, two concurrent assessments of their relative fear of humans were made in order to balance the groups. The first, a five-minute human-approach test, was assessed individually in a novel arena (4 × 5 m; length × breadth). The extent of approach behaviour to a stationary experimenter is inversely proportional to the level of fear of humans (Hemsworth & Barnett 1987). Behaviours measured included the time taken to move to within one metre of the experimenter and the amount of time spent in contact with the experimenter. This equates to Waiblinger *et al*'s (2007) classification of tests as "reaction to a stationary human in the test arena" or 'RSH-T'. Where possible, the nomenclature of Waiblinger *et al* (2007) has been adopted, to allow for standardisation and transparency in this field of anthrozoology.

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The second test was 'the forced approach test' or 'reaction to a moving human in the test arena' (RMH-T; Waiblinger *et al* 2007) and this is a direct measure of the animal's avoidance of the human stimuli, ie 'flight distance'. The experimenter approached from a distance of three metres, at one pace per second, hand outstretched. At the point at which the heifer turned away, the distance between the experimenter's hand and the nearest point of the animal's head was estimated (Johansson *et al* 1999). It was conducted immediately after the RSH-T test above. Each heifer was tested alone and remained in the same arena.

These initial tests were novel to all heifers and conducted by a non-familiar female experimenter.

Treatment allocation

Heifers were ranked on flight distance and time to enter within one metre of the experimenter (which were significantly correlated, $r = 0.37$, $P < 0.001$) and then divided into two groups using the following method: the first ranked heifer was assigned to group 1; the second and third ranked heifers to group 2; the fourth and fifth to group 1, etc.

Treatment

One group (n = 18) was randomly assigned the treatment (T), the other (n = 19) the control (C: minimal human interaction; only that associated with routine husbandry). The treatment group (T) received additional positive treatment 'PT' where the known female experimenter brushed the heifer on the head, neck and shoulders with a bristled, equine-grooming brush. Significantly, the heifer was free ranging in her home pen and unrestrained, unlike any published study to date. Treatment was given only when the heifers did not withdraw from the experimenter's advances. Each heifer was targeted for five min once a week by the same experimenter. If the heifer withdrew from advances, the experimenter would stay at the edge of her flight zone for that heifer's allocated five min, attempting to approach every 20 s. If the heifer made appreciable movements away she was not pursued immediately but further attempts would be made for the remainder of her five min. The heifers were managed in their treatment group (T or C) and, in contrast to other studies, the treatment took place in the current home environment; a field (summer months) or loose straw pen (winter months), with the animal unrestrained. Treatment was intermittent over some months due to management constraints and totalled 245 min between the approximate mean ages of the group from six to 24 months. Treatment ceased when group calving began as groups diminished to an unsustainable size for commercial management. Calving began at 24 months but extended to 28 months for individuals.

Motivation to pursue the retreated human test

The motivation to pursue the retreated human test, described below, was conducted on heifers after calving when they were established in the milking herd; on average two to four months post calving, at a median of five to six months since treatment ceased.

The test comprised a suite of four sequential components, assessing the animals' response to an experimenter delivering PT, detailed below. The suite of tests was conducted with conspecifics present and in the home pen: a free-range, cubicle shed which measured 80 × 50 m (length × breadth) (including the parlour) and housed 120 head of cattle. Tests were conducted after morning milking once the main feeding period had subsided and all were tested on the same day. The experimenter represented the only extraordinary stimulus, minimising disruption to the herd.

Component 1, the flight distance, was the first of the sequentially-tested behaviours. For this, the experimenter moved to within three metres of the target heifer and waited for acknowledgement of her presence by the direction of the target heifer's gaze. The experimenter approached the target heifer and recorded the flight distance (as detailed previously) and the heifer's behaviour was recorded as one of three categories: 'voluntary approach' (the heifer moved towards the experimenter); 'standing stationary'; or 'avoidance' (moved away).

For component 2 (acceptance of initial positive treatment [IPT]) the experimenter (having approached the heifer) then attempted to brush the heifer for ten seconds (termed 'initial positive treatment' [IPT]). If she withdrew from the experimenter's IPT she was not groomed and was recorded as not tolerating IPT (as were those with a flight distance of greater than zero).

Component 3 (pursuit of the retreated experimenter) consisted of the experimenter, after IPT, retreating to a distance of three metres to determine if the heifer would pursue the individual who had imposed IPT.

Finally, component 4, acceptance of a second bout of positive treatment (SBPT), consisted of the experimenter attempting to deliver a second ten second bout of positive treatment (SBPT) to qualify the heifer's motivation to pursue. The posture and behaviour of those heifers that pursued the experimenter were recorded as follows: a) lowering the head with forehead approximately 70° to the floor (offering the poll); b) head lowered, lower mandible closer to parallel to the floor; c) lifting the head (offering the chin); d) stretching out the neck and resting the chin or muzzle on the experimenter's shoulder; e) normal posture (head up) and f) head up (shaking).

Tests were conducted on the first heifer located by the experimenter in the home pen from either treatment, followed by subsequent heifers until all were tested, to minimise disturbance to the herd. An approach would not be made if a herd mate was between the experimenter and target heifer, in these circumstances she would be approached from a different direction, or later in the testing session. Heifers were not tested if they were lying in the cubicles, feeding at the trough or in a location whereby it was impossible to evade the experimenter. The heifers remained in the commercial milking herd after this study.

Data were tested for normality of distribution using Levene's test. Statistical analysis was then conducted using independent *t*-tests for parametric data and Mann Whitney *U* tests for non-parametric data. Cross-tabulation with Pearson chi-squared tests were also used for categorical data.

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Table 1 Categories of flight distance of T and C heifers (expected versus actual).

		Positive	Control
Flight distance 0 m; voluntary approach	Actual	10	1
	Expected	5.4	5.6
	% within those who approached	90.9%	9.1%
	% within treatment group	55.6%	5.3%
Flight distance 0 m; stationary	Actual	4	11
	Expected	7.3	7.7
	% within those who approached	26.7%	73.3%
	% within treatment group	22.2%	57.9%
Flight distance > 0 m; avoidance	Actual	4	7
	Expected	5.4	5.6
	% within those who approached	36.4%	63.6%
	% within treatment group	22.2%	36.8%

Table 2 Acceptance of initial positive treatment (expected versus actual).

		Positive	Control
Accepted initial positive treatment	Actual	11	3
	Expected	6.8	7.2
	% within those initially groomed	78.6%	21.4%
	% within treatment group	61.4%	15.8%
Did not accept initial positive treatment	Actual	7	16
	Expected	11.2	11.8
	% within those not initially groomed	30.4%	69.6%
	% within treatment group	38.9%	84.2%

Table 3 Pursuit of retreated experimenter (expected versus actual.

		Positive	Control
Heifers re-approached	Actual	12	5
	Expected	8.3	8.7
	% within those who re-approached	70.6%	29.4%
	% within treatment group	66.7%	26.3%
Heifers did not re-approach	Actual	6	14
	Expected	9.7	10.3
	% within those who did not re-approach	30.0%	70%
	% within treatment group	33.3%	73.7%

Results

Within four weeks of treatment commencing, all but three T heifers had a flight distance of 0 m in the home environment, engaged in positive interaction and did so throughout the treatment sessions.

For component 1 — the flight distance test — the T group had a smaller flight distance than C (mean 5.8 vs 20.5 cm, mean rank: 14.67 vs 23.11, $U = 93.0$, $P < 0.017$, Table 1). T heifers showed a substantial and significant reduction in flight distance since initial testing, prior to grouping, to testing in component 1 (T: 1.29 [± 0.76] to 0.17 [± 0.09] m, $P = 0.004$) whereas C did not (1.1 [± 0.66] to 0.61 [± 0.18] m, $P = 0.053$). Eighty percent of T had a flight distance of 0 m and 56% of T voluntarily approached the experimenter (only 5% of C voluntarily approached: $\chi^2 = 11.43$, $P < 0.01$). T heifers constituted 91% of the total heifers (from treatment and control) that approached the experimenter during the flight distance test.

For components 2 and 4, ie acceptance of initial positive treatment, pursuit of the retreated experimenter and acceptance of SBPT, the positive group T accepted more IPT ($\chi^2 = 8.072$, $P < 0.01$, Table 2), pursued the experimenter significantly more ($\chi^2 = 6.060$, $P = 0.014$, Table 3) and accepted an SBPT ($\chi^2 = 16.414$, $P < 0.001$, Table 4) more than the control group.

T heifers constituted 79% of total heifers accepting IPT (Table 2) equating to 61% of the positive treatment heifers, 84% of the control group did not accept IPT. This was significantly different from the T hiefers ($P < 0.01$).

Table 3 shows that the majority of heifers that pursued the experimenter after her retreat were from the positive treatment group (71%), with 70% of C not pursuing the experimenter ($P < 0.05$).

Again, Table 4 shows that significantly more (61%) T heifers than expected, participated in an SBPT (11 actual vs 6 expected, $P < 0.001$). Only 10.5% of C heifers participated in SBPT.

Analysis of data using chi-square (Table 5) shows 66% of T did not flinch during SBPT, while two control heifers that received SBPT either stood still or shook their head.

Thirty-three per cent of T heifers offered their head or necks for PT, a further 33% (T) adopted a relaxed posture with head lowered. These differences in posture are significant ($P < 0.01$).

Discussion

This study found that PT of heifers, while free-ranging with no restraint, was possible, despite concerns that approaching cattle in group-housed situations may provoke fear (Hemsworth 2003) and cause the animal to evade the human (Raussi 2003). This alone provides evidence that the treatment was not unpleasant. Significant differences in flight distance confirm that PT can reduce fear in heifers. The significant differences between the T and C groups in their motivation to pursue the retreated experimenter and accept an SBPT through the heifers' own volition suggests PT is rewarding to the heifers and a 'positive' experience.

Although the mean flight distance for T was 5.8 cm, 80% had a flight distance of 0 m. Many heifers with a flight

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distance of 0 m had voluntarily approached the experimenter, further support for the impact of PT and the heifers' perception of humans. This additional qualitative information demonstrates that a zero flight distance was not simply a product of habituation.

The data on posture during SBPT (Table 5) show distinctly different behaviour in T heifers which proactively offered their chin or poll for PT, compared to C heifers. It is proposed that the control heifers' interaction represents a tentative response as they kept flinching, head shaking or stoically accepted PT. The postures of T represent more than habituation, passive acceptance of interaction or curiosity as their behaviour in pursuit of and during SBPT differ greatly from Hafez and Bouissou's (1975) description of curiosity. A similar number of T heifers which pursued, then went on to accept SBPT. This dropped appreciably for C, adding weight to the proposal that the motivation of the T group was to solicit more PT. The heifer had learned, through a process of classical and operant conditioning, that the human stimulus provided a rewarding experience (a reinforcer) which could be accessed by being in close proximity and, in some instances, offering a body part (poll/chin), as "the animal's own 'spontaneously generated' behaviour is instrumental in its gaining a reward" (Manning & Dawkins 2005). Had the heifer continued to investigate (sniff/lick), retreat or engage in another activity around the human it would be interpreted that they had pursued the experimenter for some other reason and not the inherent positive affective state 'pleasure' they found in PT. Fraser and Duncan (1998) also explain the decision to continue an action may be influenced by positive motivational affective state, ie if an animal experiences pleasure it will continue to pursue the action, this suggests to the authors that PT was a pleasant experience and pursuit is a decision, anticipating the experience to follow. Waiblinger *et al* (2007) ask "can animals anticipate the consequence of a future interaction with humans?" The authors would suggest that this test shows evidence that in this instance they do. Duncan (2006) asks "can an animal remember a rewarding experience?" In the face of Boivin *et al*'s (1998) postulation that their calves did not remember positive interaction, the heifers in the current study had ceased PT several months prior to this test at ages ranging between 21 and 25 months, suggesting at least four to seven months duration of recollection for PT. Mendl *et al* (2000) explain that situations inducing positive emotional arousal are more memorable than neutral experiences.

The control group's reaction may reflect the fact that this brief interaction was insufficiently rewarding. The authors propose a combination of reduced fear, habituation and increased exposure to PT is required to reinforce PT as a pleasant experience, and only cows with low fear of humans will experience a positive affective state ('enjoy') PT. Therefore, PT may have a limited role for improving welfare in very timid cattle or those already fearful of humans, based on previous aversive experiences. However, where fear of humans is likely to develop, for instance through unpleasant commercial routines (eg restraint for disbudding, weighing or freezebranding), there may be opportunities to establish a positive HAR prior to these procedures as research by Waiblinger *et al* (2004) has demonstrated. Hemsworth and Gonyou (1997) identify that it is the ratio of positive to negative experiences that form an animal's perception of humans. A survey of commercial dairy farm practices in the UK (Bertenshaw 2002; Bertenshaw & Rowlinson 2008) highlights the prevalence of negative interactions during commercial rearing practices (only 2% of respondents stated their heifers experience positive interactions, 86% naming four or more aversive procedures). This suggests there is a need to redress the balance in favour of positive experiences to reduce dairy heifers' experientially-determined fear of humans. This pilot study suggests positive interaction is a pleasant experience for many heifers and may be one way of achieving this balance.

The effects of PT during rearing in the current study were a reduction in flight distance which infers reduced fear and, thus, an increase in welfare. In a continuation of this study, heifers which had received PT were also found to have improved their parlour behaviour (Bertenshaw *et al* 2007) which is desirable for both cow and worker welfare. Efforts to reduce fear of humans should be a standard consideration of management on commercial farms as, to ignore this,

Table 4 Acceptance of a second bout of positive treatment (expected versus actual).

		Positive	Control
Accepted FPT	Actual	11	2
	Expected	6.3	6.7
	% within those who accepted FPT	84.6%	15.4%
	% within treatment group	61.1%	10.5%
Did not accept FPT	Actual	7	17
	Expected	11.7	12.3
	% within those who did not accept FP	29.2%	70.8%
	% within treatment group	38.9%	89.5%

Table 5 The difference in posture during a second bout of positive treatment (cross-tabulation).

Posture while groomed		Treatment group		Total
		Positive	Control	
Stood quietly head down (a) and (b)	% within group	33%	5.3%	18.9%
Offered chin etc for PT (c) and (d)	% within group	33%		16.2%
Stood quietly head up (e)	% within group		5.3%	2.7%
Head shaking (f)	% within group		10.5%	5.4%
Did not elicit FPT	% within group	33%	78.9%	56.8%

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contravenes one of the five freedoms (freedom from fear and distress), devised by the UK Farm Animal Welfare Council and used as a framework for many livestock codes of practice and the RSPCA's Freedom Food Scheme. Spinka (2006) discusses behaviour patterns in farm animals which he terms 'luxuries' (eg use of a rotating grooming brush in cattle) which are linked with positive affective states, and believes allowing animals to perform these patterns, associated with positive emotions, undoubtedly improves their welfare. Morgan and Tromberg (2007) state that positive interactions with humans can result in improved well-being. In response to Schetini de Azevedo *et al* (2007), citing agriculture as having the lowest studies into environmental enrichment of animal enterprises, it is the authors' suggestion that PT constitutes both social and sensory enrichment and this important contribution of stockmanship is often overlooked on farms.

The methods described in this pilot study have the advantage of only requiring minimal technical assistance or facilities and can be conducted on large numbers of animals, making it equally suitable for use on commercial farms as in controlled experiments. Further investigation into test-retest reliability and with different human stimuli will increase the external validity of the tests. Due to its convenience, it could be used at standard times after calving, thus removing another variable and possible bias, namely time lapse to testing.

It is suggested that the previously described postures (a)-(d) ie (a) lowering the head with forehead approximately 70° to the floor (offering the poll); b) head lowered, lower mandible closer to parallel to the floor; c) lifting the head (offering the chin) and d) stretching out the neck and resting the chin or muzzle on the experimenter's shoulder, all reflect pleasure. Posture (e) (head up) may be habituation and (f) (head up: shaking) is proposed to be a tentative approach. We suggest that further study of heart rate, frustration behaviours when PT is denied, price elasticities (consumer demand) and choice tests, eg between an automated brush and a human performing brushing, would add validity to the interpretations made in this pilot study.

This test on commercially-housed cattle indicates a significant effect of PT however, the social effects of conducting both PT and tests on group-housed cattle warrants further investigation.

Animal welfare implications

If PT is rewarding for heifers and reduces fear of humans (the predominant state of the HAR across our nation's farms: Fraser & Broom 1997), then providing heifers the opportunity to engage in them could improve their welfare in one of three ways: 1) reducing fear when humans are present; 2) using the positive affective state to offset the unpleasantness of a negative handling procedure or 3) purely hedonistically increasing pleasure rather than just minimising fear.

It is suggested that positive interaction should be encouraged in commercial situations to improve the welfare of dairy heifers. Singer (1979) believes that as long as a sentient being is conscious, it has an interest in "experiencing as much pleasure… as possible", while Fraser (2003) has outlined the ways in which welfare should be measured and judged and one of these includes the promotion of contentment. In addition, Webster (2003) defines good welfare for a sentient animal as "fit and feeling good" and Boissy *et al* (2007) believe the presence of positive emotions should be used in assessment of welfare and quality of life.

Such a simple test could be used to give an indication of the positive welfare state of cattle around humans on commercial farms and, thus, an indicator of HAR or 'stockpersonship'.

Conclusions

This paper provides evidence to support the hypothesis that PT reduced fear in T heifers and was perceived as positive in nature by the majority of the treatment group when tested several months after treatment had subsided. These significant differences in behaviour were achieved in commercial cattle tested in their home pen.

References

Bekoff M 1994 Cognitive ethology and the treatment of non-human animals: how matters of mind inform matters of welfare. *Animal Welfare 3*: 75-96

Bertenshaw CE and Rowlinson PR 2001a The influence of positive human-animal interaction during rearing on the welfare and subsequent production of the dairy heifer. In: *Proceedings of the British Society of Animal Science Conference*. 9-11 April 2001, York, UK

Bertenshaw CE and Rowlinson PR 2001b The influence of positive human-animal interaction during rearing on the approach behaviour of the dairy heifer. In: *Proceedings of the International Society of Applied Ethology*. 9-11 April 2001, York, UK

Bertenshaw CE 2002 *The influence of positive human-animal interaction during rearing on the welfare and subsequent production of the dairy heifer*. PhD Thesis, University of Newcastle-upon-Tyne, UK

Bertenshaw CE, Rowlinson PR, Edge HL, Douglas SB and Shiel R 2007 The effect of different degrees of 'positive' human-animal interaction during rearing on the welfare and subsequent production of commercial dairy heifers. *Applied Animal Behaviour Science*. doi:10.1016/j.applanim.2007.12.002

Bertenshaw CE and Rowlinson PR 2008 Exploring stock managers' perceptions of the human-animal relationship on dairy farms and an association with milk production. *Anthrozoos*, in press

Boissy A and Bouissou MF 1988 Effects of early handling on heifers' subsequent reactivity to unfamiliar situations. *Applied Animal Behaviour Science 20*: 259-273

Boissy A, Manteuffel G, Jensen MB, Moe RO, Spruijt B, Keeling L, Winckler C, Forkman B, Dimitrov I, Langbein L, Bakken M, Veissier I and Aubert A 2007 Assessment of positive emotions in animals to improve their welfare. *Physiology and Behaviour 92(3)*: 375-397

Boivin XJP, Garel JP, Durier C and Le Neindre P 1998 Is positive treatment rewarding for beef calves? *Applied Animal Behaviour Science 61*: 1-12

Boivin XJP, Lensink J, Tallet C and Veissier I 2003 Stockmanships and farm animal welfare. *Animal Welfare 12*: 479-492

Breuer K, Hemsworth PH, Barnett JL, Matthews LR and Coleman GJ 2000 Behavioural response to humans and the productivity of commercial dairy cows. *Applied Animal Behaviour Science 66*: 273-288

Breuer K, Hemsworth PH and Coleman JG 2003 The effect of positive or negative handling on the behavioural and physiological responses of non-lactating heifers. *Applied Animal Behaviour Science 84*: 3-22

https://doi.org/10.1017/S0962728600032231 Published online by Cambridge University Press

Duncan I 2006 The changing concept of animal science. *Applied Animal Behaviour Science 100*: 11-19

Fraser AF and Broom DM 1997 *Farm Animal Behaviour and Welfare*. CABI: Wallingford, UK

Fraser D and Duncan IJH 1998 'Pleasure', 'pains' and animal welfare: toward a natural history of affect. *Animal Welfare 7*: 383-396

Fraser D 2003 The interplay of science and values. *Animal Welfare 12*: 433-443

Hafez ESE and Bouissou MF 1975 The Behaviour of Cattle. In: Hafez ESE (ed) *The Behaviour of Domestic Animals*, *3rd Edition* pp 203-245. Bailliere-Tindall: London, UK

Hemsworth PH and Barnett JL 1987 *Human-animal Interactions*. WB Saunders: Philadelphia, USA

Hemsworth PH and Gonyou HW 1997 Human Contact. In: Appleby MC and Hughes BO (eds) *Animal Welfare* pp 205-305. CABI: Wallingford, UK

Hemsworth PH and Coleman GJ 1998 *Human-livestock Interactions*. Oxford University Press: Oxford, UK

Hemsworth PH 2003 Human-animal interactions in livestock production. *Applied Animal Behaviour Science 81(3)*: 185-198

Johansson B, Redbo I and Svennersten-Sjaunja K 1999 Effect of feeding before, during and after milking on behaviour and the hormone cortisol. *Animal Science 68*: 597-604

Kirkden RD and Pajor EA 2006 Using preference, motivation and aversion tests to ask scientific questions about animals' feeling. *Applied Animal Behaviour Science 100*: 29-47

Lensink BJ, Raussi S, Boivin XJP, Pyykkönen M and Veissier I 2000a Reactions of calves to handling depend on housing condition and previous experience with humans. *Applied Animal Behaviour Science 70*: 187-199

Lensink BJ, Fernandez X, Boivin XJP, Pradel P, Le Neindre P and Veissier I 2000b The impact of gentle contacts on ease of handling, welfare, and growth of calves, and quality of veal meat. *Journal of Animal Science 78*: 1219-1226

Manning A and Stamp Dawkins M 2005 *An Introduction to Animal Behaviour*. Cambridge University Press: Cambridge, UK

McMillan F 2005 The Concept of Quality of Life in Animals. In: McMillan FD (ed) *Mental Health and Well-being in Animals* pp 183-200. Blackwell Publishing: Oxford, UK

Mendl M, Burman O, Laughlin K and Paul E 2000 Animal memory and animal welfare. In: *UFAW Symposium on Consciousness Cognition and Animal Welfare*. 11-12 May 2000, Zoological Society of London, UK

Morgan KN and Tromberg CT 2007 Sources of stress in captivity. *Applied Animal Behaviour Science 102*: 262-302

Munksgaard L, de Passillé AM, Rushen J, Herskin MS and Kristensen AM 2001 Dairy cows' fear of people: social learning, milk yield and behaviour at milking. *Applied Animal Behaviour Science 73*: 15-26

Pajor EA, Rushen J and de Passillé AM 2003 Dairy cattle's choice of handling treatments in a Y-maze. *Applied Animal Behaviour Science 80*: 93-107

Paul ES, Harding EJ and Mendl M 2005 Measuring emotional processes in animals: the utility of a cognitive approach. *Neuroscience Biobehaviour Review 29*: 469-491

Petherick CJ 2005 Animal welfare issues associated with extensive livestock production: The northern Australian beef cattle industry. *Applied Animal Behaviour Science 92(3)*: 211-234

Raussi S 2003 Human-cattle interactions in group housing. *Applied Animal Behaviour Science 80*: 245-262

Rousing T and Waiblinger S 2004 Evaluation of on-farm methods for testing the human-animal relationship in dairy herds with cubicle loose housing systems — test–retest and inter-observer reliability and consistency to familiarity of test person. *Applied Animal Behaviour Science 85*: 215–231

Rousing T and Wemelsfelder F 2006 Qualitative assessment of social behaviour of dairy cows housed in loose housing systems. *Applied Animal Behaviour Science 101(1-2)*: 40-53

Rushen J, Taylor AA and de Passille AM 1999a Domestic animals' fear of humans and its affect on their welfare. *Applied Animal Behaviour Science 65*: 285-303

Rushen J, de Passille AM and Munksgaard L 1999b Fear of people by cows and the effects on milk yield. *Journal of Dairy Science 82*: 720-727

Rushen J, de Passille AMB, Munksgaard L and Tanida H 2001 People as social factors in the world of farm animals. In: Keeling LJ and Gonyou HW (eds) *Social Behaviour in Farm Animals* pp 353-372. CAB International: Oxon, UK

Schetini de Azevedo C, Cipreste CF and Young R 2007 Environmental enrichment: A GAP analysis. *Applied Animal Behaviour Science 102*: 329-343

Schmeid C, Waiblinger S, Scharl T, Leisch F and Boivin XJP 2008 Stroking of different body regions by a human: effects on behaviour and heart rate of dairy cows. *Applied Animal Behaviour Science 109(1)*: 25-38

Singer P 1979 Killing humans and killing animals. *Inquiry 22*: 145-156

Spinka M 2006 How important is natural behaviour in animal farming systems? *Applied Animal Behaviour Science 100*: 117-128

Unshelm J 1990 Introductory comments. In: Seabrook MF (ed) *The Role of the Stockman in Livestock Productivity and Management*. Report EUR 10982 EN

Waiblinger S, Menke C and Fölsch DW 2003 Influences on the avoidance and approach behaviour of dairy cows towards humans on 35 farms. *Applied Animal Behaviour Science 84(1)*: 123-139

Waiblinger S, Menke C, Korff J and Bucher A 2004 Previous handling and gentle interactions affect behaviour and heart rate of dairy cows during a veterinary procedure. *Applied Animal Behaviour Science 85*: 31-42

Waiblinger S, Boivin XJP, Pederson V, Tosi M-V, Janczak AM, Visser KE and Jones R 2007 Assessing the human-animal relationship in farmed species: a critical review. *Applied Animal Behaviour Science 101*: 185-242

Webster AJF 2003 Introduction and overview. *Animal Welfare: Assessment of Animal Welfare at Farm and Group Level 12*: 429-431

Winckler C, Capdeville J, Gebresenbet G, Hörning B, Roiha U, Tosi M and Waiblinger S 2003 Selection of parameters for on-farm welfare-assessment protocols in cattle and buffalo. *Animal Welfare 12*: 619-624

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