

# Pathological Temperament Changes in Bovine Animals

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## Abstract

Temperament change occurs in most cases of bovine spongiform encephalopathy (BSE). Initially, changes may be subtle but usually progress to overt signs of fear. This study examined temperament changes in cows clinically suspected of having BSE, in which the disease was either confirmed or unconfirmed in subsequent histopathological examination, and compared them with the temperament of healthy cows. Signs indicative of fear were displayed with much greater intensity by cows with confirmed BSE than in other cows. Their performance in an improvised open-field test also differed from other cows. Some unconfirmed BSE suspects also displayed changed temperament. Their behaviour in open-field testing and in other assessments showed them to be a heterogeneous group. Some unconfirmed suspects showed behaviour indicative of anxiety such as hyperkinesis, escape and panic.

**Keywords:** Temperament, Bovine, Bovine spongiform encephalopathy

## Introduction

The temperament of healthy cattle has received attention in research because of its importance for the performance of animals in particular systems of husbandry and because of implications for the welfare of individual animals in matching their temperament to environmental circumstances (Kilgour, 1975; Lawstuen, Hansen and Steuernagel, 1988; Purcess, Arave and Waters, 1988; O'Connell, Giller and Meaney, 1989).

Temperament change is one of the characteristic clinical changes in bovine spongiform encephalopathy (BSE). Data from a standard questionnaire, used to record the presence of specific clinical signs of 17,154 cases of the disease, showed that 78 per cent of affected animals had a changed temperament (Wilesmith, Hoinville, Ryan and Sayers, 1992). No definition of temperament change was employed in the study and several other recorded signs, including apprehension, nervousness, head shyness and frenzy, may also be indica-

tive of altered temperament.

In the application of measures taken to control BSE, a proportion of animals which are slaughtered as suspects subsequently do not have the diagnostic brain changes on which disease is confirmed by histopathological examination. This proportion is variable but is in the region of 16 per cent of animals slaughtered (Wilesmith, personal communication). Histopathological findings in these unconfirmed suspects have been reported (Jeffery, 1992; McGill and Wells, 1993; Jeffery, Simmons and Wells, 1994; Simmons, Harris, Jeffery, Meek, Blamire and Wells, 1996). Although these suspects represent a miscellany of conditions, temperament change is a frequently recorded clinical sign (Wells, Sayers and Wilesmith, 1995).

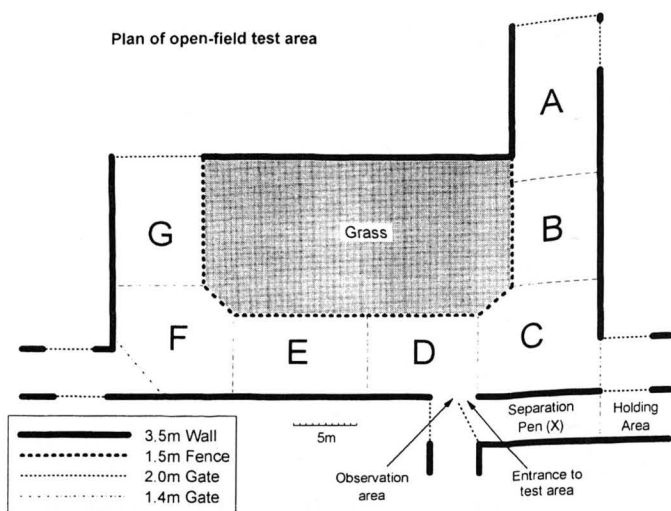
The recognition of temperament changes associated with both BSE and other pathological conditions requires the characterization of these changes in order to assist with their clinical discrimination. This report presents observations made in a research laboratory on the temperament of cows clinically suspected of having BSE.

## Materials and Methods

Thirty-three cows which had been reported under the BSE Orders (1988) as suspected of having BSE were transferred from commercial farms to the Central Veterinary Laboratory for detailed neurological assessment. Six healthy cows culled from dairy herds because of reproductive failure were employed as normal control animals. In 24 of the BSE suspects the disease was confirmed and in 9 suspects it was not confirmed by subsequent histopathological examination. Two of the unconfirmed suspects were found to have cerebellar degenerations, one had focal spongiosis of the white matter in the substantia nigra and the other 6 had no significant histopathological lesions (Jeffery *et al.*, 1994; McGill & Wells, 1993; Simmons *et al.*, 1996).

The temperament of the cows was assessed subjectively as normal or abnormal during the course of clinical examinations and handling procedures. This assessment focused particularly on signs indicative of fear (Austin, Hawkins, Kelly and Simmons, 1994).

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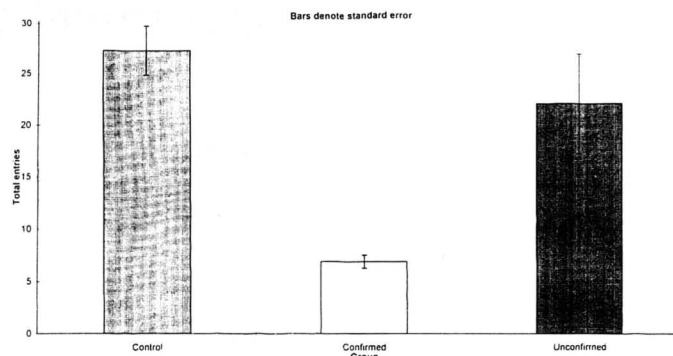
**Figure 1.** Plan of open-field test area.

An improvised open-field test was applied in order to obtain some objective measurement of behaviours which are influenced by temperament (Kilgour, 1975). The plan of the test area is shown in Fig. 1. Animals were first penned in x for approximately 30 seconds, after which the door providing entry to the test area was open to provide a 91 cm wide access. Time for emergence through the door was measured and movements between the test blocks, designated A to G, were recorded for a period of 5 minutes. Open-field tests have been used to examine changes in behaviour of mice inoculated with scrapie agents (Savage and Field, 1965; Heitzman and Corp, 1968; McFarland, Baker and Hotchin, 1980).

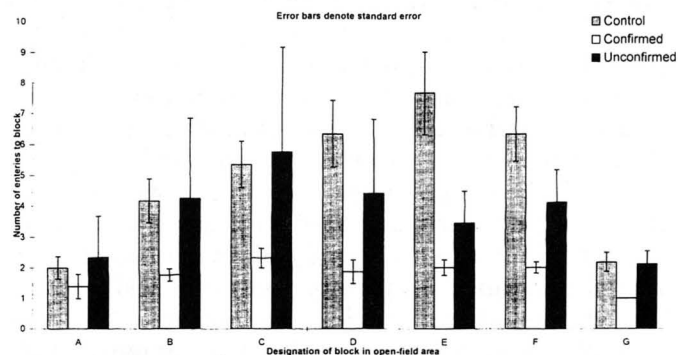
### Results

The temperament of the six control cows was judged to be within the normal limits for healthy dairy cows, although differences between individuals were evident. Resistance to entry and to restraint in a crush was either absent or modest, requiring only minimal persuasion. Initially, there was mild resistance and avoidance to handling of the head and fitting of a halter. Five of the cows habituated to head handling to show little resistance but one cow persistently resisted. This cow also displayed intolerance of other clinical procedures, such as testing the panniculus reflex, and was inclined to kick at the perpetrator.

In the open-field test the control cows showed no signs of fear. Indeed, intermittent bucking and vigorous locomotion indicated that they enjoyed access to the environment. Emergence to the test area was immediate with no hesitation. The means of total movements between blocks A to G and the mean number of entries to specific blocks are shown in Figs. 2 and 3 respectively.



**Figure 2.** Means of total entries to all blocks in open-field test area by healthy cows and confirmed and unconfirmed BSE suspects during 5 minute periods.



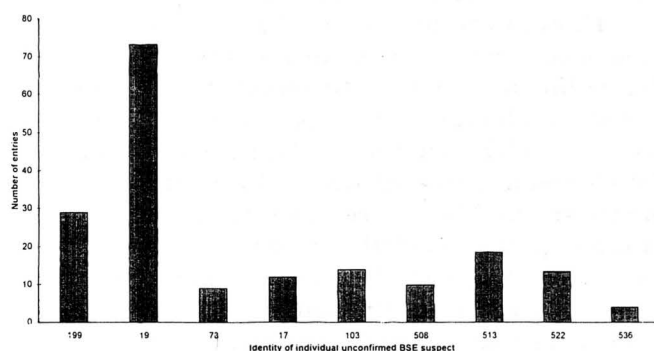
**Figure 3.** Mean number of entries to each block in an open-field test area by healthy cows and confirmed and unconfirmed BSE suspects during 5 minute periods.

The 24 cows confirmed as having BSE all displayed temperaments which were indicative of increased fearfulness (Austin *et al.*, 1994), but with considerable differences in degree between individuals. Resistance to entry and to restraint in a handling crush varied from modest to extreme. No cow with BSE showed docility in this respect. In extreme cases restraint resulted in terror and frenzied behaviour so that the animal had to be released. Commonly, after resisting entry to the crush and yoking of the head, cows stood relatively calmly until the head was approached or handled, or the feet were touched, when defensive and avoidance behaviour of varying degrees was again provoked. Interference with the head typically caused avoidance or butting towards the threat, sometimes accompanied by vigorous vocalization of a nature indicative of fear. One Hereford-cross suckler cow made charges at humans when approached with its head held low and butting towards the perceived threat. This was characteristic of defensive aggression observed in other BSE cows elsewhere (Austin, personal observation) when they have been confronted in circumstances where escape has not been an option. Deliberate challenge of cows in this way routinely was avoided

due to consideration for operator safety. Touching the lower hind limbs elicited powerful, ballistic kicks in many cases. This was interpreted as another manifestation of defensive aggression. In restraint one cow, after a short period of active resistance, sank into sternal recumbency necessitating the release of its head, and lay immobile while handling and clinical procedures were conducted. This appeared to be the equivalent of freezing or tonic immobility (Gray, 1987).

Emergence of cows with BSE into the open-field test was without hesitation except in the cases of two cows which took between 20 and 30 seconds to emerge. In other respects their performance in the test was distinct from that of control cows. The number of moves between blocks was markedly less (Fig. 2). The mean entries to block C, D and E were also greatly reduced (Fig. 3) due to the habit of BSE cows in moving to either the left or right parts of the test area and not transferring frequently from one to the other, which would have increased the score in blocks C, D and E. The lesser mobility of the BSE cows was not due to any overt physical inability for none of them at the time of the tests displayed an ataxia which apparently disabled movement.

The nine cows which were unconfirmed BSE suspects were a heterogeneous group which was reflected in differing temperaments and performances in the open-field test (Fig. 4). In general they did not demonstrate marked increase in fear in the manner characteristic of most cows suffering from BSE. Changes in temperament which appear to have been pathological, however, were observed and need to be considered on an individual basis.



**Figure 4.** Total entries to all blocks in an open-field test area by individual unconfirmed BSE suspects during 5 minute periods.

#### Case 199

This Friesian/Holstein (FH) cow, aged 5, had displayed changed behaviour on its farm of origin, described as altered temperament and sudden bouts of rapid locomotion especially when separated from other cows.

At the laboratory it was very wary of the entry of attendants to the housing. Vigorous pawing of bedding was a regular response and its gaze was fixed on observers in a state of constant vigilance. Entry to the pen intensified the pawing and caused agitation and movements directed at escape. Despite the agitation no aggression was directed at attendants, although determined attempts to escape during approach rendered the animal dangerous. Escape motivation was sufficient to effect escape from 1.5 metre high handling races by jumping. Once outside the handling facility the animal stood passively and allowed itself to be driven back into its pen. Two circumstances appeared to upset this cow greatly: separation from a companion cow or cows and the preliminaries associated with handling, such as human approach or driving towards a crush. In the open-field test area kinesis (Fig. 4) was similar to that of normal cows but greater than that of BSE cows (Fig. 2). Its condition did not worsen over a year's observation but when transported at the end of this period it showed panic and frenzy of a profound degree and had to be immobilized by dart.

#### Case 73

This FH cow, aged 7, had been described as a very nervous cow but within a week at the laboratory it was judged to have a normal temperament and over ensuing weeks became docile. Seemingly some acute disturbance had affected her which resolved on transfer to laboratory conditions, which included termination of lactation.

#### Case 19

The response of this FH cow, aged 4, to an observer entering its pen was to turn away, presenting its rear, and to place its head through horizontal bars of the pen thus distancing its head from the observer. Sudden, proximal noises caused repetitive and vigorous head shaking with the mouth held wide open. This reaction appeared to be involuntary and occurred in response to repeated stimuli, but usually habituation began after four or so stimuli. This reaction appeared to be an abnormal auditory startle response. In the open-field test there was marked hyperkinesis (Fig. 4) with an appearance of anxiety. During a year's observation no progression of the condition was observed. Response to auditory stimuli lessened but hyperkinesis and anxiety remained.

#### Case 17

On arrival at the laboratory this cow was very nervous and kicked readily in response to handling. An acute onset of nervousness in early lactation with ataxia and falling had caused suspicion of BSE on farm. Locomotor problems were not observed at the laboratory and

the temperament resolved to that of a normal though mildly nervous cow.

#### Case 522

The temperament of this three year Limousin heifer changed dramatically within two days of calving. Offensive aggression towards humans was regularly and vigorously displayed. Charges were made even when the animal was not approached closer than five metres and when turning away from the observer was an option. Charging was the immediate response to attendants entering its pen. Paradoxically, once the animal was restrained in a crush it was not unduly reactive, showing only mild avoidance to interference with its head and little reaction to other procedures, such as testing the panniculus reflex. Aggressive responses lessened over a period of two months and a temperament within the normal range for this type of animal became established.

#### Case 508

Temperament change was not a clinical feature of this case. The cow was a Hereford cross suckler, aged 8, and could be handled as a normal cow of this type.

#### Case 103

The only sign indicative of temperament change in this Hereford-cross cow, aged 7, was frequent pawing of bedding. On farm it had displayed signs such as pseudophagia and ataxia, which might have been indicative of nervous ketosis during late pregnancy. Twin calves were born at the laboratory.

#### Cases 513 and 536

At necropsy these two FH cows aged 3½ and 4, were found to have marked cerebellar hypoplasia. Temperament change was not a prominent sign and in this respect they were different from BSE cases.

### Discussion

The principal temperament change in suspects confirmed as BSE was interpreted as increased fear and is consistent with previous findings (Austin, *et al*, 1994). The mediation of flight or fight responses to unconditioned aversive stimuli, characteristic of fearful behavior, is functionally focused on to the periaqueductal grey matter of the mid brain (Gray, 1987). This region is a target of the vacuolar pathology of BSE (Wells, Wilesmith & McGill, 1991), indicating a possible functional association of pathology and temperament change in the disease. The hypokinesia of BSE cases in the open-field test may be a true reflection of their behaviour in farm circumstances in which most cases move away from perceived threats such as human approach, but having removed themselves to a distance do not continue kine-

sis in a purposeless manner.

Cases 17, 73 and 103 were unconfirmed suspects which showed changes in temperament. Their clinical histories indicate that the changes were of acute onset and they proved to be transient, unlike the chronicity of BSE cases.

Three of the unconfirmed suspects, Cases 199, 19 and 522, displayed profound temperament changes with features which were confusable with those shown by cows with BSE. Case 199 appeared to suffer from a pathological state of anxiety. Over a long period of examination and observation, its condition proved to be chronic but with no signs of progression.

Case 19 displayed marked hyperkinesia in the open-field test, in great contrast to BSE cases. The hyperkinesia may have been a sign of unusual anxiety to isolation in the test area. One author (ARA) has encountered other unconfirmed BSE suspects on commercial farms which have displayed persistent, unprovoked kinesis in yards. Accordingly, Case 19 may represent a distinct neurological condition needing further study.

Although anecdotal reports indicate that some BSE cows are offensively aggressive, most cases show signs of only defensive aggression towards humans or escape behaviours which in confined circumstances can be mistaken for offence (Cranwell, Hancock, Hindson, Hall, Daniel, Hopkins, Wonnacott, Vivian and Hunt 1988). The behaviour displayed by Case 522 was offensive in that it would charge humans even when it was not threatened imminently. The abrupt onset within two days of calving suggests an association with the partum period. These features and similar cases encountered elsewhere by one author (ARA), suggest that such cases represent another distinct condition.

**Histopathological studies on these unconfirmed suspects are continuing but, as yet, no evidence has been found to indicate that the temperament changes were associated with progressive neurodegenerations. Current knowledge of developmental changes, nutrition, metabolism or environmental insults relevant to the bovine brain is inadequate to attribute causes to these problems. However, the observations made here may assist in focusing attention on aspects of behaviour which could contribute to the clinical discrimination of BSE from other disorders and towards the characterization of other bovine temperament disorders.**

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