Assessment of behavioural changes in domestic cats during short-term hospitalisation

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Abstract

We evaluated behavioural changes in domestic cats during a short-term hospitalisation using a novel cat demeanour scoring system. Thirty-five, healthy client-owned cats admitted for neutering were enrolled. Cats were housed in a standardised cat ward for a short-term hospitalisation period (3-5 days) and demeanour scores were recorded once daily. The scoring system classified cats into one of five behavioural groupings: friendly-and-confident, friendly-and-shy, withdrawn-and-protective, withdrawn-and-aggressive, and overtly-aggressive. Total demeanour score decreased over time (P<0.001) and the demeanour category improved (P<0.001). The intra-class correlation was 0.843 (P<0.001) and kappa was 0.606 (P<0.001) suggesting good repeatability and agreement among investigators. The demeanour scoring system was effective in detecting behaviour change in healthy cats undergoing a short-term hospitalisation period. The findings suggest that healthy cats require two days to acclimatise to hospitalisation.

Keywords

Behaviour, demeanour, domestic cats, feline behaviour, hospitalisation

Introduction

Behaviour scoring systems have been developed for domestic cats to determine responses when subjected to various stressors[1-7] or to assess their adaption to a long term caged environment.[8-10] However, none of these scoring systems appear to be applicable to a clinical hospitalisation situation.

Recent developments have been made in scoring pain in domestic cats.[11] However, the individual temperament or nature (friendly, confident, shy, protective, or feral) of the cat is not considered and subsequently any cat that is not friendly and confident may be incorrectly classified as experiencing pain.

Increased stress may worsen the perception of pain, delay healing and prolong hospitalisation.[12] Stress may elicit a change in behaviour even though not all stressors are painful. Thus an effective behaviour scoring system must consider the individual temperament of the cat and be able to monitor alterations in daily behaviour during hospitalisation. Pain scoring systems may be more sensitive in detecting pain after incorporation of the individual temperament and behaviour.

The objective of this study was to evaluate behavioural changes in domestic cats during short-term hospitalisation using a cat demeanour scoring system.

Materials and methods

Study animals

This was an owner consented observational clinical study, approved by the Animal Ethics

Committee of the University of (removed for blinding) prior to investigation (Protocol number).

Thirty five (n=35) healthy domestic cats were enrolled and some also participated in a separate

study that focused on three different general anaesthetic protocols used for routine gonadectomy.

Postoperative analgesia consisted of a single subcutaneous carprofen injection (4 mg/kg).[26] All

cats were determined to be healthy based on a comprehensive clinical examination, haematology

(complete blood count), serum biochemistry (total serum protein, creatinine) and a FIV/FeLV

snaptest (Anigen Rapid FIV Ab/FeLV Ag Test Kit; Bionote; Korea) prior to enrolment. Cats

were housed in a standardised enclosure equipped with a water bowl, food bowl, litter tray

(sand), igloo and blanketed floor within a dedicated cat ward. Variables outside the control of the

study included cat ward occupancy rates and human traffic through the ward during the day.

Environmental enrichment included a stuffed material mouse and feathered toys suspended from

the roof of the enclosure and dried chopped catnip (*Nepeta cataria*). A pheromone diffuser

(Feliway diffuser; Ceva Sante Animale, Libourne, France) was active during the study. All cats

underwent elective neutering (pan ovariohysterectomy or bilateral orchiectomy) on day 2, 3 or 4

of the study.

Demeanour scoring system

The behaviour of the cats was scored once daily during the afternoon cleaning session from day

1 (admission) until the day of discharge (3 to 5 days later) using a purposely designed demeanour

scoring system (DSS). The DSS (Annex 1) was designed to be used during routine enclosure

cleaning sessions to monitor behaviour and determine mannerisms of the cat during hospitalisation. During this period the cat was exposed to human interaction from a far distance (inspection of the enclosure), from a close distance where activity was not directed towards the cat (opening of the enclosure door, maintaining litter tray and bowls), and from a close distance where activity was directed towards the cat (approaching the cat to pick it up and perform a clinical examination and palpate the urinary bladder). The DSS consisted of 8 multiple choice questions (5 hands-off and 3 hands-on questions) to describe the action of the cat during each interaction. Each question was assigned a score ranging from 0 to 4 based on the selected option and the total DSS score was the simple sum of responses from all questions. The range of total scores (0 to 25) was classified into 5 different demeanour categories (Table 1). A single investigator (XX) performed the DSS for all cats. Additionally, two other investigators (XX, XX) also scored a subset of cats (n=13) on either the second or third day of the study to evaluate inter-user variability.

Appetite and litter tray usage

Appetite was assessed daily and scored using a simple descriptive scale based on the amount of food left in the bowl between scheduled feeding times. The following scores were allocated: 1 – did not eat; 2 – ate a small amount; 3 – ate normal daily amount for individual cat. Litter tray usage was based on scoring the urine and stool production independently. Urine production was scored as follows: 1 – none produced, empty bladder; 2 – urinated; 3 – none produced, enlarged bladder. Stools were scored as follows: 1 – none produced; 2 – present with normal consistency; 3 – present but loose or diarrhoea.

Table 1: The total range of total scores obtainable (0 to 25) divided into the five different demeanour categories.

Total Score	Category	Definition of category and note on possible link with pain scoring systems
0	Friendly and confident	Cat is "loveable" with attention seeking. Will approach handler for human-cat interaction. The pain score may be considered true as these cats are assumed to be able to reflect their true demeanour.
1-8	Friendly and shy	Cat is friendly and "loveable" when handled but will not seek interaction with human. These cats may mask pain and thus the score obtained in the pain score may be lower than the true pain experienced.
9-18	Withdrawn and protective	Cat remains ridged and appears "uneasy" when handled. Handler does not feel in danger of being attacked by cat during handling. These cats may mask pain very well. The pain score may be lower than the true pain experienced.
19-24	Withdrawn and aggressive	Cat is ridged or frozen and may demonstrate pawing, biting, or clawing when handled. May or may not be associated with growling. Handler feels in danger of being hurt when handling this cat. These cats may mask their pain very well. The pain score may be lower than the true pain experienced.
25	Overtly aggressive	Handler at risk of being injured when handling this cat. Cat makes aggressive gestures including hissing, growling, pawing, clawing and rapid aggressive movement towards handling attempts. These cats are a challenge to handle and evaluate correctly. This makes pain scoring a challenge or perhaps even impossible.

Statistical analysis

Categorical data were described as frequencies and proportions with their corresponding 95% confidence intervals. Quantitative data were described using medians and inter-quartile ranges (IQR). Spearman's rank correlation coefficient was used to estimate the association between day of hospitalisation and the total demeanour score. Wilcoxon signed rank test was used to evaluate the change of demeanour category over time. The agreement between observers in assigning the total demeanour score was evaluated by estimating the intra-class correlation and the kappa statistic was used for the demeanour category. Data were analysed using commercially available

software (IBM SPSS Statistics Version 21, International Business Machines Corp., Armonk, NY) and results interpreted at the 5% level of significance.

Results

The median (IQR) age of the cats was 1.0 (1-2) years. Five female and 30 male cats were included in the study. A total of nine cats were hospitalised for 3 days, and 13 cats each for 4 and 5 days. None of the cats tested positive for FIV or FeLV and no clinical abnormalities were recorded in any cat during the study period. The total demeanour score significantly decreased
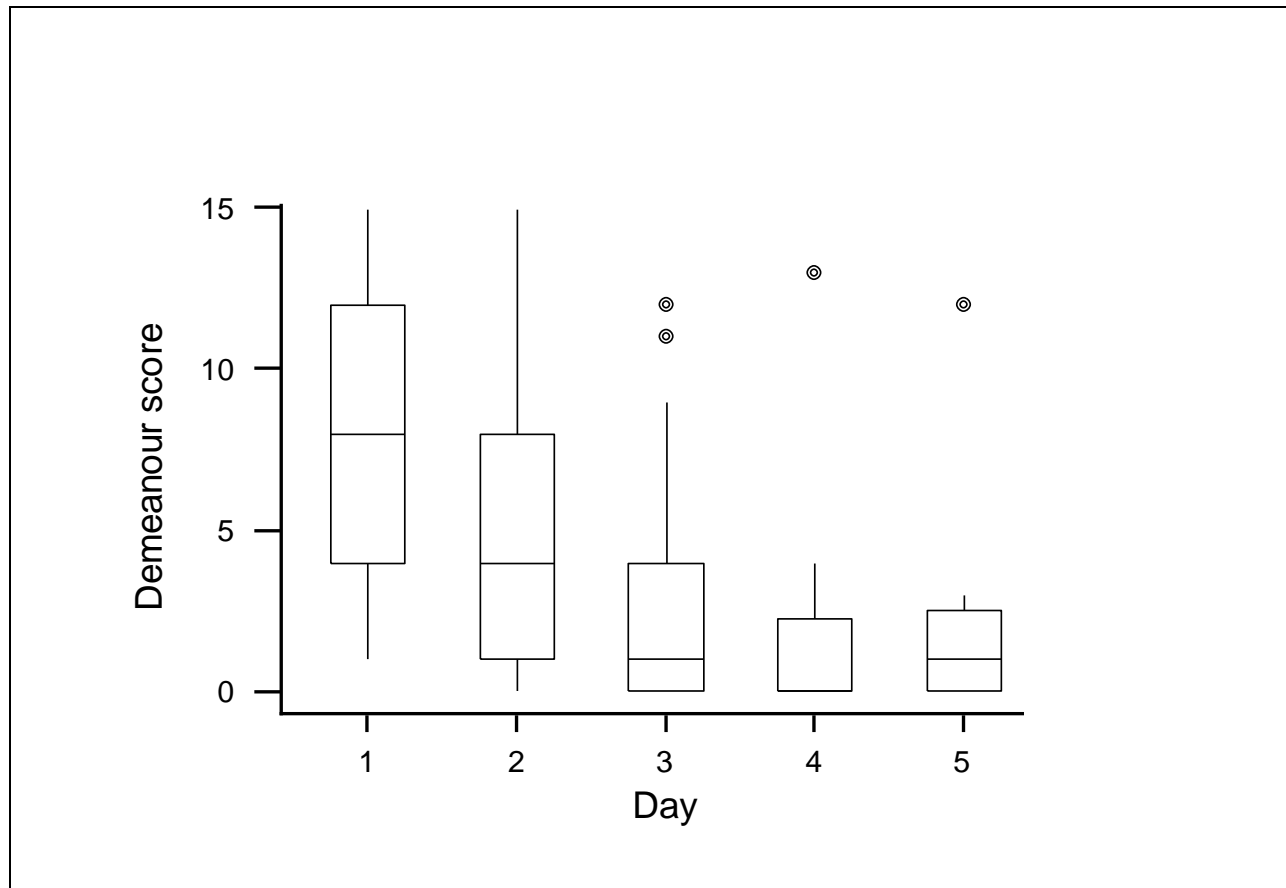

Figure 1: Total demeanour score over the five day hospitalization period, reported as median (interquartile range) as boxes and maximum and minimum values as the whiskers. The circles represent outliers. The decrease in total demeanour score over time was significant (P<0.001).

over time (P<0.001; Figure 1). The demeanour category classification of the cat improved from day 1 to day 3 (P<0.001). Demeanour score was significantly lower on the day of surgery compared to the previous day (P<0.001) but not different than the day following surgery (P=0.342). A marked upward trend in appetite and litter tray usage occurred over the first 3 days (Figure 2). Multiple observers collected data from 13 of the study cats. The intra-class correlation was estimated as 0.843 (95% CI, 0.640-0.950; P<0.001) for the assigned total demeanour scores from the three investigators. Kappa was estimated as 0.606 (95% CI, 0.292-0.920; P<0.001) for agreement among assigned demeanour score categories.
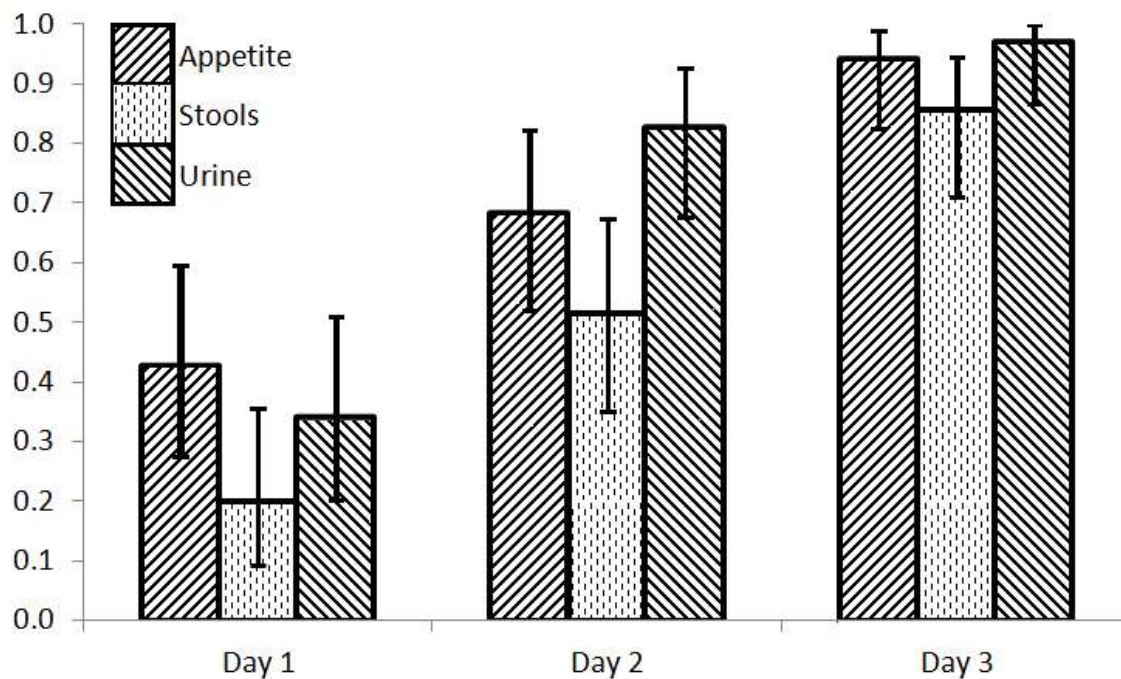

Figure 2: Trend of appetite and litter tray usage (stools and urine) over time a 3-day hospitalization period reported as the proportion of cats (n=35) demonstrating the monitored behaviour. Error bars are set to 95% confidence interval (CI).

Discussion

Behaviour scoring systems have been developed for use as instruments to assess painful conditions;[1,3,5,13,14] to identify feral cats;[15] to evaluate response to stressors;[4,6,7,9,16] to evaluate response to clinical behaviour therapy;[2] and to evaluate the response to locomotor environment enrichment.[17] Caged cats have been studied during long-term periods with particular emphasis on their temperament and welfare within these living conditions.[18] Guidelines[19] and practical strategies[20] have been published to improve the welfare of caged domestic cats. However, none of these developed systems are useful for monitoring behavioural responses during short-term hospitalisation.

Acute stress responses of cats subjected to short-term novel environments is not as well understood as chronic stress responses to long-term cage environments.[4] Hospitalised cats admitted for elective procedures are not considered to be under stresses related to injury or disease; thus, this population was selected to determine the usefulness of the DSS in detecting a change in behaviour and coping with stress related to a short-term novel caged environment within a hospital or clinic context.

The demeanour scoring system was able to detect a change in behaviour over a 3-5 day period. The decrease in the total demeanour score over time, improvement in the demeanour category and the upward trend in appetite and litter tray usage (stool and urine production) imply a fast adaption period. Possible explanations for rapid adaption may be due to: the novelty of the environment where once the cat realised that the environment was safe they could express normal feeding and elimination behaviours;[10,19-21] routine interaction and adaption to a fixed daily

routine;[10,21] young cat population, where they may adapt more easily to a change in environment and routine; provision of environmental enrichment; and clinical effects of the pheromone diffuser. Although feline facial pheromone fraction F3 (Feliway) help calm cats it does not appear to have any sedative effects.[22] The return to a state where appropriate feeding and elimination behaviour is expressed does not mean that the cat is devoid of stress, it may rather indicate that the cat is coping with the stress. The behaviour patterns expressed during the short-term hospitilisation could be due to the innate temperament of the cat, or due to its individual flight-fight response when placed in a stressful or unusual situation. The DSS allows further research avenues to better define if it is measuring a true fight-flight response or if the true temperament of the cat is being evaluated by this scoring system.

In the present study, cats were challenged with various stressors throughout the hospitalisation period which included physical stressors (jugular venopuncture for blood tests and undergoing a surgical procedure), social stressors (solitary confinement to a cage with sporadic human interaction that may have been associated with painful procedures), dietary stress (change in normal daily diet, starving for 8 hours before surgical procedure), all of which may be anticipated in any cat undergoing hospitalisation within a clinical context. Further research is required to evaluate the DSS for domestic cats presenting to hospitals or clinics with medical or surgical related processes that may undergo a hospitalisation period. After evaluation of the DSS usefulness in clinical cases then further research is warranted to better define the link between behaviour and pain. The authors believe that the DSS will allow better interpretation of pain scoring systems used in domestic cats. Validation of this scoring system could be done by demonstrating a good agreement between multiple users from different practices or hospitals in a

multicenter study. This will also allow further addition of relevant cat behaviours to the current suggested weighted options for the 8 questions.

The DSS made use of a graduated approach towards the cat to determine the flight or fight threshold of the cat towards human interaction. This is a useful approach to define the inherent temperament or nature (demeanour category) of the cat and how the cat responds to regular interaction. For example, a cat that can be picked up without trying to escape may be classified as a friendly and confident cat; if this behaviour alters after 2 days of hospitalisation where the cat opts to hide or escape while the observer is trying to evaluate the cat then there has been a significant alteration in the behaviour of the cat. This alteration could be due to the cat anticipating that removal from the cage will lead to a painful or uncomfortable procedure and therefore attempts to avoid interaction. If this information is monitored daily then the veterinarian or caregiver may alter their interaction with the cat or adjust possible medication (i.e. analgesia) to improve welfare.

The DSS has the potential to be adjusted to suit the experience and clinical observations of the clinician making use of the DSS. The options for the 8 question may be expanded to incorporate cats that demonstrate a behaviour not currently described. When clinicians include more options they would need to assign an appropriate weighted score to satisfy the total score. If a clinician had to add an additional option for question 1, for example, then they would include the option to the list. Such as: During the last 24 hours the cat was: "pacing around the enclosure continuously with or without vocalisation." Behaviour of this nature may indicate that the cat is not coping well and that this type of option should reflect a larger score relative to a relaxed cat. Thus a clinician may award a weighted score of 3 for this option. Clinicians wishing to add additional

options should assign weighted scores within the current range of scores for the question. Doing so will not alter the overall outcome of the current DSS.

Patients that are stressed are more likely to have increased pain sensation and deteriorate physiologically due to a lack in appetite,[12,23] abnormal elimination behaviour and increased susceptibility to infections.[14,24] These factors may decrease patient welfare and potentially increase morbidity.

A recently published pain scoring system for cats related the importance of monitoring normal behaviour patterns in cats where the appetite and elimination behaviour are assessed during the scoring.[11] A cat that becomes quieter or is more reluctant to move is classified as being in more pain by this scoring system. Pain is one possible explanation for a cat becoming more withdrawn; however, it does not consider social stress, different temperaments of cats, or alterations in behaviour unrelated to pain.[25] It is the authors' opinion that the behavioural and pain scoring should be done using separate scoring tools. Pain scoring systems should be designed to detect and quantify objective painful cues such as flinching when palpating a wound margin and behavioural scoring systems should try to characterise the cat to help interpret the pain score.

Limitations of the present study include: inter-user variability was only assed in 13 cats and the cat population was uniform and consisting mostly of young, healthy male cats. The DSS was scored once a day, which may indicate that there is a lack of sensitivity in determining a change in behaviour as the cat may have demonstrated a different behaviour in the morning and evening.

However, more frequent scoring of cats may adversely affect results due to the cat learning to adapt to the frequent examinations by either avoidance or increased aggression.

In conclusion, the evaluated demeanour scoring system was able to detect a change in the behaviour of healthy cats hospitalised for an elective surgical procedure. Further data collection and research are indicated to determine if the DSS tool is capable of detecting changes in behaviour in cats that are diseased, injured or in pain. The proposed link between monitoring behaviour changes and pain scoring warrants further investigation.

Conflict of interest

The authors declare that there is no conflict of interest.

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Annex 1

Domestic Cat Demeanour Scoring System

Hands-off Evaluation

1. During the **last 24 hours** the cat was:
   a) Hiding in the igloo all the time and there is no evidence that it has come out (check sandbox, food and water bowls).
   b) Sitting crouched in the sandbox for the last 12 to 24 hours, peering over the edge and watching.
   c) Lies hidden behind the igloo or sandbox without much movement.
   d) Moves around the enclosure and seems quite content.
2. What does the cat do when you approach the enclosure to **open the door**:
   a) It is still hiding in the igloo and does not try to move out.
   b) Move from its current resting position outside the igloo to inside the igloo in a hasty fashion.
   c) Lies completely still in its current position and crouches its head and pulls its ears down.
   d) Lies completely still in its current position and watches you with its ears pointed forward.
   e) Tries to rush out of the cage while ignoring you.
   f) Walks at a normal friendly manner towards you in the hope of getting attention.
   g) Hisses and growls at you, it may try to move to the back of the cage or hide behind or inside the igloo. It may even try to escape while putting up a fight.
   h) Peeps out of the igloo to see what is going on without any hissing or growling.
3. When you examine the **food bowl** you notice:
   a) That the cat has eaten most or all of its food.
   b) Has not even touched any of it.
   c) Has maybe eaten a small amount of food.
4. When you examine **the sandbox** you notice:
   a) Urine.
   b) Urine and stools of normal size and consistency.
   c) Nothing.
   d) Diarrhoea or loose stools with or without urine.
5. When you begin to **remove the bowls and sandbox from the cage**, the cat:
   a) Still sits in the igloo.
   b) Sits in the igloo while hissing and growling.
   c) Tries to escape the whole time, may even put up a fight.
   d) Moves calmly out of the way so you can complete the task.
   e) Hastily moves to the back of the enclosure or into the igloo to hide.
   f) Tries to attack you by making aggressive advances towards your arms.
   g) Tries to get attention by rubbing up to your hands and arms.
   h) Does nothing, it just watches you.
   i) Rigidly and slowly slinks out of your way, may even arch its back while moving out of your way.

Once you have completed these questions the enclosure is free of bowls and the sandbox. This will allow enough room to evaluate the cat with a hands-on approach.

Hands-on Evaluation

6. When you approach the cat to pick it up it:
    a) Crouches down and slowly tries to move away.
    b) Bunts up against your hand in a friendly manner, it may or may not be purring.
    c) Looks frantically at your approaching hand and then towards the back of the cage calculating an escape or hiding spot.
    d) Folds its ears down and growls in a low drone fashion, as your hand gets closer it may even begin to escalate the aggression by hissing, biting and clawing.
    e) Sits very still, almost frozen.
    f) Sits still but as your hand gets closer it will watch it and move its head to allow you to scratch the back, ears do not fold down.
7. When you touch the cat and try to pick it up, it:
    a) Allows you to without putting up any resistance.
    b) Claws the side of the igloo or cage or blanket to hold on tight, making removal uneasy.
    c) Dodges your hand and attempts to escape the whole time, when you touch it, it calms down and allows handling.
    d) Dodges your hand and attempts to escape the whole time, when you touch it, it becomes very aggressive and puts up a big fight with scratching and/or biting.
8. When the cat is in your hands and you examine it, it:
    a) Is calm and receptive to the handling, trying to get attention the whole time.
    b) Is not aggressive but clearly not enjoying the handling by not focusing on getting attention but slowly trying to escape your hands the whole time.
    c) Is very rigid and/or slow moving.
    d) Freezes in a crouched and/or tucked up position making examination a challenge.
    e) Is aggressive, fighting your hands and/or trying to escape in a hasty manner.
    f) Handling this cat is impossible and a danger to the examiner.

Once you have evaluated the cat completely you must tally your scores on the score sheet for the cat.

Answer Score Sheet

Question	Answer Score (Answer followed with Score in square brackets e.g. a)-[**3**])
1	a)-[**2**] b)-[**1**] c)-[**3**] d)-[**0**]
2	a)-[**2**] b)-[**2**] c)-[**3**] d)-[**1**] e)-[**3**] f)-[**0**] g)-[**4**] h)-[**1**]
3	a)-[**0**] b)-[**2**] c)-[**1**]
4	a)-[**1**] b)-[**0**] c)-[**2**] d)-[**2**]
5	a)-[**1**] b)-[**3**] c)-[**3**] d)-[**1**] e)-[**2**] f)-[**4**] g)-[**0**] h)-[**1**] i)-[**3**]
6	a)-[**2**] b)-[**0**] c)-[**2**] d)-[**3**] e)-[**2**] f)-[**1**]
7	a)-[**0**] b)-[**2**] c)-[**2**] d)-[**3**]
8	a)-[**0**] b)-[**2**] c)-[**2**] d)-[**3**] e)-[**3**] f)-[**4**]

Domestic Cat Demeanour Score Sheet

Information:

Date of Evaluation: _____:_____:20____

Person Capturing Data: _____

Signature: _____

Answers to the Questions

Question	Answer	Score	
1			The cat fits into the following category:
2			
3			☐ Friendly and confident
4			
5			☐ Friendly and shy
6			☐ Withdrawn and protective
7			
8			☐ Withdrawn and aggressive
Total Score			☐ Overtly aggressive

Total Score	Category	Note on possible link with pain scoring systems
0	Friendly and confident	The pain score may be considered true as these cats are assumed to be able to reflect their true demeanour.
1-8	Friendly and shy	These cats may mask pain and thus the score obtained in the pain score may be lower than the true pain experienced.
9-18	Withdrawn and protective	These cats may mask pain very well. The pain score may be lower than the true pain experienced.
19-24	Withdrawn and aggressive	These cats may mask their pain very well. The pain score may be lower than the true pain experienced.
25	Overtly aggressive	These cats are a challenge to handle and evaluate correctly. This makes pain scoring a challenge or perhaps even impossible.