THE DURATION OF THE BEHAVIOURAL EFFECTS OF VELVET ANTLER REMOVAL

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ABSTRACT
The duration of the behavioural effects of velvet antler removal was investigated using two groups of 8 one-year-old stags housed indoors. Within each group, the antlers of four of the deer were removed according to a standard velveting procedure (Treatment V), while the remaining four deer were handled but not velveted (Treatment C). Activities of the deer were recorded over 0-2 hrs, and at 13, 24, 48 and 72 hrs post-treatment. Significant differences in activities, and in the rates of change of activities, were observed between Treatments V and C over 0-2 hours post-treatment. No significant differences in treatment means were observed at subsequent observation periods, but a significant interaction between changes over time and treatment was found for jumping (play) behaviour ($P<0.05$), which was absent in V stags at 24 hours but increased steeply over 48 and 72 hrs. It was concluded that if stags experienced any strongly negative effects of the velveting treatment, these effects were of short duration.

INTRODUCTION
In December 1991, the effects of post-velveting analgesia on the behaviour of two-year old red deer stags were investigated (Pollard *et al.*, 1992). Velveted stags were given either saline or analgesic (acetyl salicylate), injected intravenously immediately following antler removal. Analgesic was associated with lower levels of many of the behavioural changes otherwise seen following velveting. This effect was seen over the full observation period, from 0-4 hours following antler removal. There was no evidence that the analgesic affected the behaviour of stags which were not velveted. It was concluded that velveted stags suffered from post-operative pain, which was reduced by analgesic. The aim of the present study was to determine the duration of the behavioural effects of velveting, to assist the development of a protocol for providing analgesia

METHODS
Animals
Sixteen yearling red deer stags with growing velvet antlers were housed indoors in two 4x6 m light-proof pens each containing eight deer. The deer had been housed in these conditions for 7 months prior to the trial, and were accustomed to handling for weekly weight recordings. During the trial the deer were fed deer nuts *ad libitum*, and maintained under their usual lighting regime of 16 hrs light, 8 hrs dark, and fed/checked daily. To facilitate recording, two days prior to the trial the onset of the light period was moved from 0700 hrs to 0900 hrs. On the day prior to the trial, the deer were fitted with coloured collars to allow identification of individuals. Within groups, stags were assigned to four treatment pairs.

Treatments
Starting at 0900 hrs (onset of the light period) on Day 0, each group in turn was shifted to a handling area and one member of each treatment pair received a standard velveting treatment (V) as follows. Five-ten ml lignocaine hydrochloride (sufficient to infiltrate the entire area) was injected as a nerve ring block around the base of the antler pedicles, then a rubber tourniquet was applied pedicles. Four minutes later the antlers were removed using a surgical saw, 2 cm above the antler-pedicle junction, then the stag was released from the crush into a post-treatment pen. The tourniquet was removed in this pen, 20 minutes after velvet removal. The opposite members of the treatment pairs remained untreated, in the handling area, as a control (Treatment C), and were returned to their home pens with the velveted stags once all four stags in the group had been treated.

Measurements
Behaviour of individuals in each group was recorded using a video camera for the first three hours, and at 13 hours, following antler cutting (or the equivalent time periods for the opposite members of the treatment pairs). Further recordings were made for one hour starting at 0900 hrs on Days 1, 2 and 3. The videotapes were used to measure the duration and frequency of all measurable activities (Appendix 1) of each individual at each observation period

Analysis
A preliminary analysis suggested that all activities fell into a consistent time pattern within each of three time phases: (a) 0, 1 and 2 hours (b) 13 hours, and (c) 24, 48 and 72 hours. Count data were (1+log) transformed and time data were expressed as a percentage of total time They were then analysed by analysis of variance, with groups, and animals within groups defining the block structure, and velveting treatment (C or V), a linear time contrast for phases (a) and (c), and their interaction defining the treatment structure. This assumes independence of animals within groups.

RESULTS
Mean frequency profiles for key activities (moving (stepping + pacing), flicking ears, grooming, and jumping) are shown in Figure 1.

Phase (a)
Treatment means and slope estimates for Phase (a) (0-2 hrs) are given in Table 1. Most activities declined significantly in frequency for both treatments over this phase. In the case of moving (stepping + pacing; Figure 1a), nosing and the percentage of time spent with the head up and at shoulder level, significant differences in the slopes for Treatments C and V were found. Mean levels for C stags declined from values comparable to V stags at 0 hrs, to values comparable to evening/night (13 hrs) resting levels by 2 hrs; while levels for V stags declined at a much smaller rate or remained stable.

A different pattern was seen for earflicking (Figure 1b), licking and shaking the head or body. These activities showed significant differences between treatments and a sharp decline in rate, irrespective of treatment, throughout Phase (a). The pattern for grooming (Figure 1c), time spent sitting, and eating was similar, except that these activities increased rapidly, rather than decreasing. In addition, 2 and 5 velveted stags received aggression during hours 0 and 1, respectively, compared to 0 velveted stags in both cases.

Activities which occurred at a low frequency, without significant variation with treatment or time, included jumping (Figure 1d), bobbing the head, instigating or receiving aggression, mounting, and climbing.

Phase (b)
At 13 hrs an overall average of 48.5 (S.E. 2.0)% of time was spent sitting. Other activities included standing (35.6%) and eating (2.9%). No significant difference between treatments was found for any activity, and mean levels were generally lower than at any other time

Phase (c)
Mean activity levels and slope parameters for Phase (c) (24-72 hrs) are given in Table 2. No evidence was found that overall means for any activity varied between treatments Most activities increased in frequency over this phase (Figure 1), and only the percentage of time spent sitting declined significantly. Some activities which occurred at low levels during Phases (a) and (b) began to increase significantly during Phase (c), including jumping (Figure 1d), which increased more rapidly for V stags than C stags ($P<0.05$).

FIGURE 1. Mean frequencies (no./hr) of moving (stepping + pacing), flicking ears, grooming, and jumping, for Treatments C and V, at 0, 1, 2, 13, 24, 48 and 72 hours post-treatment Vertical bars represent the standard error of differences between means (SED).

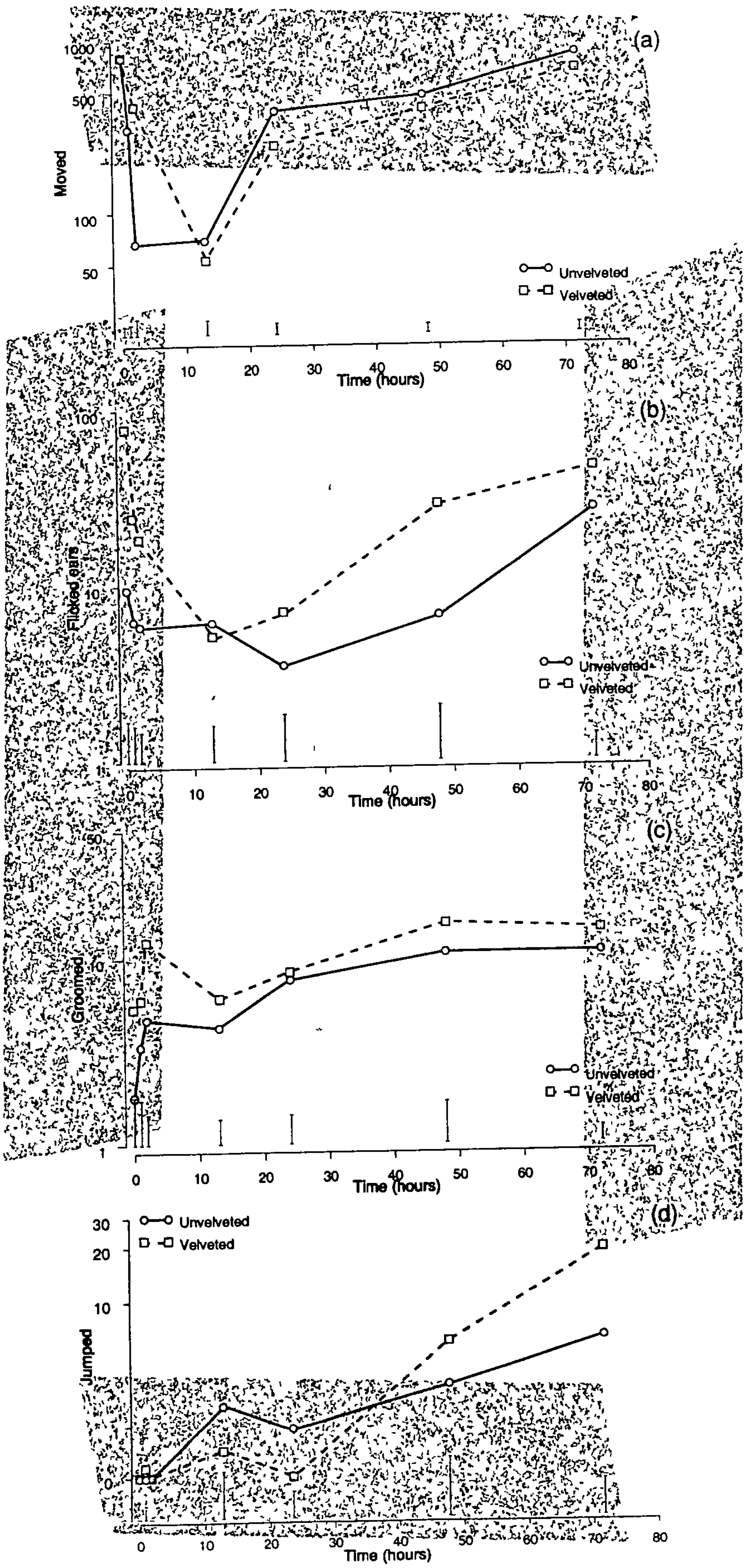

Table 1. Treatment means (+ SEDs) and slope estimates for activities during Phase (a) (0-2 hrs post-treatment). Significance levels are indicated as follows. (i) difference between treatment means, (ii) slope, (iii) slope x treatment means (ns not significant; *P<0.05; **P<0.01; ***P<0.001).

Activities	Treatment		SED	(i)	Slope	SE	(ii)	(iii)
	Control	Velveted						
No./hr								
Moved (stepped & paced)	248	560	142	*	-0.79	0.21	***	*
Nosed (wall or ground)	37.9	57.6	15.1	ns	-0.40	0.14	**	*
Licked head	3.0	9.1	1.6	**	-0.58	0.17	**	ns
Licked body	10.0	18.0	3.4	*	-0.94	0.17	***	ns
Head Licked	4.5	8.8	1.6	*	-0.38	0.14	*	ns
Body licked	7.4	14.5	3.0	*	-0.73	0.12	***	ns
Scratched head	1.3	3.6	1.5	ns	0.12	0.13	ns	ns
Flicked ears	6.0	31.3	5.1	**	-0.49	0.18	**	ns
Shook head	7.3	24.2	4.5	*	-0.56	0.12	***	ns
Shook body	1.6	3.1	0.6	**	-0.40	0.08	***	ns
Groomed	2.0	6.3	1.9	*	0.46	0.14	**	ns
Attempted to groom	0.1	0.8	0.24	*	0.03	0.10	ns	ns
Bobbed head	0.6	0.9	0.49	**	-0.05	0.12	ns	ns
Jumped	0.0	0.1	0.05	ns	0.00	0.03	ns	ns
Instigated aggression	0.4	0.3	0.4	ns	0.01	0.01	ns	ns
Received agression	0.1	0.5	0.2	*	-0.02	0.10	ns	ns
Mounted other deer	0.4	0.3	0.4	ns	-0.26	0.13	ns	ns
Mounted by other deer	0.1	0.4	0.3	ns	-0.23	0.13	ns	ns
Climbed	0.2	0.1	0.2	ns	-0.13	0.07	ns	ns
% of time								
Standing								
- head up	30.3	34.1	4.2	ns	-17.2	2.4	***	*
- head at shoulder level	3.2	4.8	1.2	ns	-0.6	0.6	ns	*
- head down	6.1	12.1	3.2	ns	0.2	1.4	ns	ns
Sitting	35.4	14.0	6.3	**	24.3	3.8	***	*
Eating	3.3	4.5	1.2	ns	2.1	0.6	**	ns

Table 2. Mean values (pooled data for both treatments) + SE, and slope estimates for activities during Phase (c) (24-72 hrs post-treatment). Significance levels are indicated as follows: (i) slope, (ii) slope x treatment (ns not significant; *P<0.05; **P<0.01; ***P<0.001).

Activities	Mean	SE	Slope	SE	(i)	(ii)
No./hr						
Moved (stepped & paced)	457	72	0 018	0 003	***	ns
Nosed (wall or ground)	78 2	5 8	0 005	0 002	*	ns
Licked head	8 8	1 0	0 014	0 004	**	ns
Licked body	25 5	2 4	0 020	0 004	***	ns
Head Licked	8 8	1 0	0 014	0 004	***	ns
Body licked	17 8	1 9	0 022	0 003	***	ns
Scratched head	4 4	0 9	0 000	0 004	ns	ns
Flicked ears	12 3	3 2	0 041	0 006	***	ns
Shook head	23 1	2 5	0 019	0 004	***	ns
Shook body	1 1	0 14	-0 001	0 002	ns	ns
Groomed	9 8	1 1	0 009	0 003	*	ns
Attempted to groom	0 15	0 04	-0 004	0 003	ns	ns
Bobbed head	0 52	0 18	0 015	0 004	***	ns
Jumped	3 1	0 7	0 043	0 008	***	*
Instigated aggression	0 74	0 24	0 008	0 004	ns	ns
Received agression	1 10	0 21	0 006	0 005	ns	ns
Mounted other deer	0 94	0 16	0 020	0 005	***	ns
Mounted by other deer	0 93	0 17	0 023	0 004	***	ns
Climbed	0 28	0 19	0 005	0 003	ns	ns
% of time						
Standing						
- head up	35 0	2 3	0 11	0 08	ns	ns
- head at shoulder level	2 9	0 3	0 01	0 01	ns	ns
- head down	14 4	1 5	-0 06	0 05	ns	ns
Sitting	9 3	2 6	-0 45	0 12	***	ns
Eating	5 2	0 7	-0 04	0 03	ns	ns

Relationships between activities
Activities which showed similar patterns across time also tended to be highly correlated within times. In particular, the average correlation coefficient between moving and nosing was 0.66, while shaking the head showed average correlation coefficients of 0.61, 0.53, 0.51 and 0.48 with shaking the body, earflicking, having the body licked, and grooming, respectively.

DISCUSSION
For both treatments there was a large effect of handling on activities, evident in the period of rapid change over the first three hours following treatment. The deer appeared to be mainly resting at 13 hrs. Many activities sharply increased from 24-72 hours with no indication of stabilisation by 72 hrs. Considering that the deer were accustomed to weekly handling for weighing, this sustained increase may have been related to adjustment to the shift in photoperiod, carried out three days before the 24 hour sample, rather than a sustained effect of handling on activity levels.

Velveted stags were generally more active than control stags during 0-2 hrs post-treatment. There was evidence that recovery from treatment was slower in these stags compared with C stags, as levels of several activities declined at a slower rate. The more pronounced and durable effects of the velveting treatment could be attributed to the longer and more complex nature of the velveting treatment. However, in a previous study of one-year-old deer, behavioural effects of velveting were apparent even though the control treatment involved the same amount of handling, and restraint in the crush for an equivalent period of time as for the velveted stags (Pollard *et al.*, 1991). Thus it is likely that some additional effect(s) of the velveting procedure were responsible for the treatment effects seen over 0-2 hours in the present study. It is likely that these additional effects were at least partly due to pain, as almost all of the behavioural effects of velveting (the exception was shaking the head) seen over a four-hour observation period were reduced when additional analgesic was provided to two-year-old stags (Pollard *et al.*, 1992).

Activity levels were very low at 13 hours post-treatment Therefore this sample period was of little use in determining whether differences between treatments were still present. Over 24-72 hours no significant differences in treatment means were found, nevertheless the figures for earflicking and grooming (Figure 1b and 1c) were suggestive of residual effects. The only significant difference which occurred over this time period was the increase in the frequency of jumping, which was greater for velveted stags, having been absent at 24 hours, then reaching a mean frequency of 19/hr and observed in all individuals at 72 hours. Stags carrying out jumping appeared to be playing. Play behaviour is considered an indicator of good welfare (Fagen, 1981), thus it would be difficult to argue that the welfare of the velveted stags was seriously compromised 72 hours after treatment

Results were similar, but not identical, to findings from previous studies carried out over shorter time periods. Grooming, head-shaking, and earflicking were increased in velveted one-year-old stags during three hrs of observation post-treatment (Pollard *et al.*, 1991). Findings from the study of two-year-old stags, made over four hrs post-treatment, showed a similar trend as in the present experiment for generally higher levels of activity in velveted stags not given additional analgesia (Pollard *et al.*, 1992) In that study velveted, non-analgesic stags showed particularly high values for the time spent eating, frequencies of nosing the ground and attempting to groom, and spent more time with their heads held down or at shoulder level than control stags (Pollard *et al.*, 1992), results which are consistent with the present findings.

Findings from previous studies which contrasted with the present experiment were an initial depression in eating in velveted stags and a tendency for velveted stags to sit down as time passed (Pollard *et al*, 1991), and increased aggression in velveted stags (Pollard *et al*, 1992) Differences in the extent of habituation to the indoor environment (some habituation was involved in 1991, none was used in 1992, while the stags in the present experiment had been living indoors for several months), and age (two-year-old stags were used in 1992) are possible reasons for these discrepancies.

In conclusion, the behaviour of velveted stags differed from that of control stags with intact antlers over 0-2 hours post-treatment. At 13, 24, 48 and 72 hours post-treatment, little difference in behaviour was observed, except for a tendency for velveted stags to show a marked increase in playing over 24-72 hours. Thus any strongly negative effects of velveting were likely to be of short duration.

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APPENDIX 1. Activities measured

Frequency data

Stepped
Paced (stepped parallel to, within 0.5m of, enclosure perimeters)
Nosed wall
Nosed ground
Licked head of another deer (licked head)
Licked body of another deer (licked body)
Head licked by another deer (head licked)
Body licked by another deer (body licked)
Scratched head
Flicked ears
Shook head
Shook body
Groomed self (groomed)
Attempted to groom self, without making contact (attempted to groom)
Bobbed head (moved head down vertically)
Jumped (either both forelegs or both hind legs off ground simultaneously)
Climbed (placed one or both forelegs on wall or trough)
Instigated aggression
Received aggression
Mounted another deer
Mounted by another deer

Duration data

Standing, head above shoulder level (head up)
Standing, head at shoulder level
Standing, head below shoulder level (head down)
Ventral recumbency (sitting)
Eating