Pain-Induced Distress and Its Alleviation Using Butorphanol After Ovariohysterectomy Of Bitches

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Appendices

A Cortisol / radioimmunoassay (RIA)

B Behaviour definitions

C Analgesia / butorphanol

D Publication: Fox, S.M., Mellor, D.J., Firth, E.C., Hodge, H. and Lawoko, C.R.O. (1994). Changes in plasma cortisol concentrations before, during and after analgesia, anaesthesia and anaesthesia plus ovariohysterectomy in bitches. *Research in Veterinary Science*, 57, 110-118.

E Process for determining distinct group differences from noninteractive hourly and interactive palpation behaviours (Chapter 4).

F Behavioural changes: emphasis on behaviour.

G Process for determining distinct group differences from noninteractive hourly and interactive palpation behaviours (Chapter 5).

H Combination graphs: descriptions.

			Summary of Events/Treatment																	
Treatment	**Sequence of events**																			
Control	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	"Induction" room sample	Approximately 53 minute sit on table							trolley back to ward (1 minute)	Placed into cage	"Extubation" sample	Sample	Sample	Sample	Sample	Sample	Sample
Anesthesia	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample	Approximately 47 minutes lateral recumbency			Off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample	Sample	Sample	Sample	Sample	Sample	Sample
Analgesia	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	"Induction" room sample	IV Butorphanol administration	Approximately 51 minute sit on table						trolley back to ward (1 minute)	Placed into cage	"Extubation" sample	Sample	Sample	Sample	Sample	Sample	Sample
Analgesia + Anesthesia	Premed sample in ward cage. IV Butorphanol administration	In cage for 30 minutes	trolley to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample	Approximately 47 minutes lateral recumbency			Off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample	Sample	Sample	Sample	Sample	Sample	Sample
Anesthesia + Immediate Analgesia	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample. IV Butorphanol administration	Approximately 47 minutes lateral recumbency			Off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample	Sample	Sample	Sample	Sample	Sample	Sample
Anesthesia + Analgesia	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample	Approximately 47 minutes lateral recumbency			Off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample. IV Butorphanol administration	Sample	Sample	Sample	Sample	Sample	Sample
Elapsed Time (minutes)	0	30	31	34	36	37	40	56	60	63	87	88	89	91	121	151	181	211	271	391

Cortisol blood samples were taken at the times indicated by cells with a heavy border.

Table 2.1 Summary of Events for Nonsurgical Treatments.

Excitatory Amino Acids	Acetylcholine	Noradrenaline	Dopamine
→ Arai et al., 1990	→ Bazil and Minneman, 1989a	↓ Akeson and Deamer, 1989	↑ Osbourne et al., 1990
↑ Hirose et al., 1992	→ Bazil and Minneman, 1989b	↓ Bazil and Minneman, 1989a	
	↓ Johnson and Hartzell, 1985	↓ Bazil and Minneman, 1989b	
	↓ Bosnjak et al., 1988	↓ Pocock and Richards, 1988	

Table 3.1 Effects of halothane on neurotransmitter release (Griffiths and Norman, 1993):

→ = no change in transmitter release

↑ = increase in transmitter release

↓ = decrease in transmitter release

Summary of Events/Treatment																				
Treatment	**Sequence of events**																			
Control	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	"Induction" room sample	Approximately 53 minute sit on table							trolley back to ward (1 minute)	Placed into cage	"Extubation" sample	Sample	Sample	Sample	Sample	Sample	Sample
Anesthesia + Surgery	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample	Clip/prep trolley to theatre	Incision sample	Ovary manipulation sample (3 minutes)	Closure: then off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample	Sample	Sample	Sample	Sample	Sample	Sample
Analgesia + Anesthesia + Surgery	Premed sample in ward cage. IV Butorphanol administration	In cage for 30 minutes	trolley to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample	Clip/prep trolley to theatre	Incision sample	Ovary manipulation sample (3 minutes)	Closure: then off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample	Sample	Sample	Sample	Sample	Sample	Sample
Anesthesia + Surgery + Analgesia	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample	Clip/prep trolley to theatre	Incision sample	Ovary manipulation sample (3 minutes)	Closure: then off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample. IV Butorphanol administration	Sample	Sample	Sample	Sample	Sample	Sample
Elapsed Time (minutes)	0	30	31	34	38	37	40	58	80	63	87	88	89	91	121	151	181	211	271	391

Cortisol blood samples were taken at the times indicated by cells with a heavy border.

Table 3.2. Summary of Events for Surgical Treatments.

			Summary of Events/Treatment																	
Treatment	**Sequence of events**																			
Control	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	"Induction" room sample	Approximately 53 minute sit on table							trolley back to ward (1 minute)	Placed into cage	"Extubation" sample	Sample	Sample	Sample	Sample	Sample	Sample
Anesthesia	Premed sample in ward cage	In cage for 30 minutes	trollay to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample	Approximately 47 minutes lateral recumbency			Off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample	Sample	Sample	Sample	Sample	Sample	Sample
Analgesia + Anesthesia	Premed sample in ward cage. IV Butorphanol administration	In cage for 30 minutes	trolley to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample	Approximately 47 minutes lateral recumbency			Off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample	Sample	Sample	Sample	Sample	Sample	Sample
Anesthesia + Analgesia	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample	Approximately 47 minutes lateral recumbency			Off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample. IV Butorphanol administration	Sample	Sample	Sample	Sample	Sample	Sample
Analgesia	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	"Induction" room sample	IV Butorphanol administration	Approximately 51 minute sit on table						trolley back to ward (1 minute)	Placed into cage	"Extubation" sample	Sample	Sample	Sample	Sample	Sample	Sample
Anesthesia + Immediate Analgesia	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample. IV Butorphanol administration	Approximately 47 minutes lateral recumbency			Off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample	Sample	Sample	Sample	Sample	Sample	Sample
Elapsed Time	0	30	31	34	36	37	40	56	60	63	87	88	89	91	121	151	181	211	271	391

Cortisol blood samples were taken at the times indicated by cells with a heavy border and palpations commenced at 121 minutes.

Table 4.1 Summary of Events for Nonsurgical Treatments.

SCC	Behaviour	CS
0.94	Draws legs up	0.17
0.93	Cage sniffing	0.29
-0.86	Normal speed cage circling	0.37
0.78	Normal speed position change	0.29
0.71	Lip licking	-0.15
-0.67	Stretch	0.25
0.67	Grooming	-0.21
0.62	Bark	0.21
-0.51	Thoracic limb weight shift	0.29
0.22	Slow motion position change	0.69
0.19	Ataxia	-0.15
0.08	Head lift	-0.14
0.04	Pant	0.74
0.02	Whine	-0.13
0.0	Hang stand	0.19

Table 4.2 Canonical 1 SCC and CS coefficients for noninteractive hourly behaviours in the nonsurgical groups. SCC= Pooled within-class standardised canonical coefficients, CS= pooled within canonical structure correlations.

SCC	Behaviour	*Order*	CS	Behaviour
0.94	Draws legs up	*1*	0.74	Pant
0.93	Cage sniffing	*2*	0.69	Slow motion position change
-0.86	Normal speed cage circling	*3*	0.37	Normal speed cage circling
0.78	Normal speed position change	*4*	0.29	Cage sniffing
0.71	Lip licking	*5*	0.29	Normal speed position change
-0.67	Stretch	*6*	0.29	Thoracic limb weight shift
0.67	Grooming	*7*	0.25	Stretch
0.62	Bark	*8*	0.21	Bark
-0.51	Thoracic limb weight shift	*9*	-0.21	Grooming
0.22	Slow motion position change	*10*	0.19	Hang stand
0.19	Ataxia	*11*	0.17	Draws legs up
0.08	Head lift	*12*	-0.15	Lip licking
0.04	Pant	*13*	-0.15	Ataxia
0.02	Whine	*14*	-0.14	Head lift
0.0	Hang stand	*15*	-0.13	Whine

Table 4.3 Ordering of noninteractive hourly behaviours in the nonsurgical groups by canonical 1 SCC and CS coefficients. This is the same data presented in Table 4.2. SCC= Pooled within-class standardised canonical coefficients, CS= pooled within canonical structure correlations.

Rank	Behaviour
1	Cage sniffing
1	Normal speed cage circle
2	Normal speed position change
3	Draws legs up
3	Slow motion position change
4	Stretching
5	Panting
6	Thoracic limb weight shift
7	Barking
7	Grooming
8	Lip licking
9	Ataxia
10	Hang stand
11	Head lift
12	Whine

Table 4.4 Resultant noninteractive hourly behaviour ranking based upon collated SCC and CS coefficients from canonical 1 analysis for use in determining major differences of nonsurgical groups.

SCC	Behaviour	CS
0.74	Panting	0.44
0.69	Slow motion position change	0.28
0.40	Thoracic limb weight shift	0.57
0.37	Normal speed cage circle	0.34
0.29	Cage sniffing	0.33
0.29	Normal speed position change	-0.06
0.25	Stretching	0.10
-0.21	Grooming	-0.29
0.21	Barking	0.19
0.19	Hang stand	0.10
0.17	Draws legs up	0.01
-0.15	Ataxia	0.14
-0.15	Lip licking	0.44
-0.14	Head lifts	0.26
-0.13	Whine	0.14

Table 4.5 Canonical 2 coefficient data for noninteractive hourly behaviours in the nonsurgical groups. SCC= Pooled within-class standardised canonical coefficients, CS= pooled within canonical structure correlations.

SCC	Behaviour	*Order*	CS	Behaviour
0.74	Panting	*1*	0.57	Thoracic limb weight shift
0.69	Slow motion position change	*2*	0.44	Panting
0.40	Thoracic limb weight shift	*3*	0.44	Lip licking
0.37	Normal speed cage circle	*4*	0.34	Normal speed cage circle
0.29	Cage sniffing	*5*	0.33	Cage sniffing
0.29	Normal speed position change	*6*	-0.29	Grooming
0.25	Stretching	*7*	0.28	Slow motion position change
-0.21	Grooming	*8*	0.26	Head lifts
0.21	Barking	*9*	0.19	Barking
0.19	Hang stand	*10*	0.14	Ataxia
0.17	Draws legs up	*11*	0.14	Whine
-0.15	Ataxia	*12*	0.10	Stretching
-0.15	Lip licking	*13*	0.01	Hang stand
-0.14	Head lifts	*14*	-0.06	Normal speed position change
-0.13	Whine	*15*	0.01	Draws legs up

Table 4.6 Canonical 2 ordering of both SCC and CS noninteractive hourly behaviours for development of Anaesthesia/Immediate Analgesia group differentiation. SCC= Pooled within-class standardised canonical coefficients, CS= pooled within canonical structure correlations.

Rank	Behaviour
1	Panting
2	Thoracic limb weight shift
3	Normal speed cage circling
4	Slow motion position change
5	Cage sniffing
6	Grooming
7	Lip licking
8	Barking
9	Stretching
10	Normal speed position change
11	Ataxia
12	Head lift
13	Hang stand
14	Draws legs up

Table 4.7 Resultant noninteractive hourly behaviour ranking for best differentiation of the Anaesthesia/Immediate Analgesia group from 1) Anaesthesia/Analgesia, Analgesia/Anaesthesia, and 2) Analgesia groups based upon collated SCC and CS coefficients from canonical 2 analysis.

Low (2-6)	Medium (7-10)	High (>10)
		Number of position changes
		Normal speed position change
		Position ataxia
		Lip licking
		Normal speed cage circling
		Head lifts
	Torso weight shifts	
Awake		
Asleep		
Lateral		
Sternal other		
Thrashing		
Head nodding		
Cage sniffing		
Stretching		
Grooming		
Pacing		

Table 4.8 Minute behaviour frequencies identified as Low, Medium or High (ie, >2 occurrences during the first hour after extubation) in all of the nonsurgical groups.

Treatment	Low (2-6)	Medium (7-10	High (>10)
Control	Awake	Normal speed position change	Number of position changes
	Sternal other		Head lifts
	Torso weight shift		
	Lip licking		
	Normal speed cage circling		
	Cage sniffing		
	Grooming		
Anaesthesia	Lateral	Torso weight shifts	Normal speed position changes
	Number of position changes	Head lifts	Normal speed cage circling
	Thrashing		Position ataxia
	Head nodding		Lip licking
	Stretching		
	Cage sniffing		
	Grooming		
	Pacing		
Analgesia	Awake	Head lifts	
	Sternal other		
	Torso weight shifts		
	Normal speed position changes		
	Position ataxia		
	Normal speed cage circling		
Analgesia / Anaesthesia	Normal speed position changes	Normal speed cage circling	Head lifts
	Asleep		
	Lateral		
	Position ataxia		
Anaesthesia / Immediate Analgesia	Asleep	Normal speed position changes	
	Lateral	Head lifts	
	Position ataxia		
	Stretching		
Anaesthesia / Analgesia	Asleep	Head lifts	
	Lateral		
	Normal speed position changes		
	Lip licking		
	Position ataxia		

Table 4.9 Summary of (summed) minute behaviours over the first hour after 'extubation' for each nonsurgical group.

	Low (2-6)	Medium (7-10)	High (>10)
Control	Torso weight shift		Normal speed position change
	Stretching		Head lifts
	Grooming		
Anaesthesia	Torso weight shift	Normal speed cage circling	Normal speed position change
	Lip licking		Head lifts
	Cage sniffing		
	Grooming		
	Stretching		
Analgesia	Torso weight shift	Normal speed position change	
		Head lifts	
Analgesia / Anaesthesia	Thoracic limb weight shift	Normal speed position change	
	Stretching	Normal speed cage circling	
	Whine	Head lifts	
Anaesthesia / Immediate Analgesia	Stretching	Normal speed position change	Normal speed cage circling
	Escape behaviours	Thoracic limb weight shift	
	Whine	Head lifts	
	Pant		
	Bark		
Anaesthesia / Analgesia	Thoracic limb weight shift	Head lifts	Normal speed cage circling
	Lip licking		
	Whine		

Table 4.10 Summary of (average) noninteractive hourly behaviours from the second through the fifth hour after 'extubation' (151-391 minutes) for the nonsurgical groups (Figure 4.4).

		Frequency Within Treatments			
Rank	**Behaviour**	**Control**	**Anaesthesia**	**Analgesia**	**Analgesia/ Anaesthesia; Anaesthesia/ Analgesia; Anaesthesia/I Analgesia**
1	Cage sniffing		Low		
1	Normal speed cage circle		Medium		
2	Normal speed position change	High	High	Medium	
3	Draws legs up				
3	Slow motion position change				
4	Stretching	Low			
5	Panting				
6	Thoracic limb weight shift				
7	Barking				
7	Grooming	Low	Low		
8	Lip licking		Low		
9	Ataxia				
10	Hang stand				
11	Head lift	High	High	Medium	
12	Whine				Low*

Table 4.11 Comparison of noninteractive hourly behaviours between treatments. Ranking was obtained by the canonical 1 analysis (Tables 4.2-4.4) and frequency from Table 4.10 (Figure 4.4). Behaviours that have no score for any treatment (e.g. draws legs up) would have appeared with a frequency of >2 for at least one of the hourly intervals between 151 and 391 minutes, but that behaviour would not have averaged a frequency of > 2 for the four hourly intervals between 151 and 391 minutes. Analgesia/Anaesthesia, Anaesthesia/ Immediate Analgesia, and Anaesthesia/Analgesia appear very similar within the canonical 1 analysis (Figure 4.5). *Of those behaviours ranked by canonical 1 analysis, only whining shared a common frequency in the Analgesia/Anaesthesia, Anaesthesia/Analgesia and Anaesthesia/Immediate Analgesia groups. Low = 2-6, Medium = 7-10, High = >10.

Rank	Behaviour	Ans/I Anl	Control	Ans	Anl
1	Panting	Low			
2	Thoracic limb weight shift	Medium			
3	Normal speed cage circling	High		Medium	
4	Slow motion position change				
5	Cage sniffing			Low	
6	Grooming		Low	Low	
7	Lip licking			Low	
8	Barking	Low			
9	Stretching	Low	Low		
10	Normal speed position change	Medium	High	High	Medium
11	Ataxia				
12	Head lift	Medium	High	High	Medium
13	Hang stand				
14	Draws legs up				

Table 4.12 Frequency of ranked behaviours for noting major differences of the Anaesthesia/ Immediate Analgesia group from other nonsurgical groups. Ranking was derived from the SCC and CS coefficients of the canonical 2 analysis (Tables 4.5-4.7) and frequency was sourced from Table 4.10 (Figure 4.4). Behaviours that have no score for any treatment (ie. slow motion position change) would have appeared with a frequency of >2 for at least one of the hourly intervals between 151 and 391 minutes, but that behaviour would not have averaged a frequency of > 2 for the four hourly intervals between 151 and 391 minutes.
Low = 2-6, Medium = 7-10, **High** = >10.

Behaviour	Decreasing Frequency	Increasing Frequency
Normal speed cage circling	Anaesthesia/Analgesia, Anaesthesia/Immediate Analgesia, Anaesthesia, Analgesia/Anaesthesia	
Normal speed position changes	Anaesthesia, Analgesia/Anaesthesia	
Thoracic limb weight shift	Anaesthesia, Analgesia/Anaesthesia	
Grooming	Control, Anaesthesia	
Escape behaviour	*This behaviour was seen only in Anaesthesia/ Immediate Analgesia*	
Head lifts	Anaesthesia/Analgesia	Control, Anaesthesia, Analgesia
Lip licking	All Treatments	

Table 4.13 Behavioural trends noted during the period from the second to the fifth hour after 'extubation' in the nonsurgical groups. Normal speed cage circling, normal speed position changes and thoracic limb weight shift may all be considered as expressions of restlessness.

Table 4.14			Time after extubation (hours)					
Behaviour	**Pre-op**	**0.5**	**1**	**1.5**	**2**	**3**	**5**	**24**
Tx: Control								
Start position:	stand	sit	sit	stand	sternal	stand	stand	sit
Position change:	no	yes	yes	no	yes	no	no	yes
End position:	stand	stand	stand	stand	stand	stand	stand	stand
Head position:	level	level	lowered	lowered	lowered	level	level	level
Ear position:	back	back	back	back	back	back	back	back
Eye position:	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead
Tail position:	low	low	on surface	low	on surface	low	low	low
Vocalisation:	none	none	none	none	none	none	none	none
Orientation:	tester	stare ahead	stare ahead	tester	stare ahead	stare ahead	stare ahead	stare ahead
Breathing:	normal	normal	normal	normal	normal	normal	normal	normal
Other:	arched back	arched back	arched back	arched back	arched back	arched back	arched back	arched back
Tx: Anaesthesia								
Start position:	stand	sit	sit	stand	sit	sit	sit	sit
Position change:	no	yes	yes	yes	yes	yes	yes	yes
End position:	stand	lateral	stand	sit	lateral	lateral	sternal	stand
Head position:	level	lowered	level	level	lowered	rest on surface	lowered	lowered
Ear position:	neutral	flat to sides	back	back	back	neutral	neutral	back
Eye position:	watch	glance/avert	watch	watch	watch	watch	stare ahead	watch
Tail position:	low	on surface	on surface	low	on surface	on surface	on surface	on surface
Vocalisation:	none	whine	none	none	none	none	none	none
Orientation:	slow belly	tester	tester	stare ahead	tester	tester	stare ahead	deliberate avert
Breathing:	normal	normal	normal	normal	normal	normal	normal	normal
Other:	lip licking	arched back	lip licking	lip licking	lip licking	arched back	lip licking	arched back
	draws legs up		arched back	restrained	rigid stance	restrained		
					draws legs up			
Tx: Analgesia								
Start position:	sit	sternal	sternal	sternal	sternal	sternal	stand	sit
Position change:	yes	no	no	no	yes	no	yes	no
End position:	sternal	sternal	sternal	sternal	lateral	sternal	sternal	sit
Head position:	high	level	lowered	lowered	lowered	level	level	lowered
Ear position:	forward alert	neutral	back	flat to sides	back	back	back	back
Eye position:	watch	watch	stare ahead	watch	stare ahead	stare ahead	watch	stare ahead
Tail position:	on surface	on surface	on surface	on surface	on surface	on surface	low	slow wag/curl
Vocalisation:	none	none	whine	whine	none	none	none	whine
Orientation:	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	tester	hide
Breathing:	normal	normal	normal	normal	normal	normal	normal	normal
Other:	lip licking	extended neck	arched back	lip licking	arched back		arched back	lip licking
	arched back			arched back	draws legs up			
	extended neck							
Tx: Analgesia/ Anaesthesia								
Start position:	stand	sternal	lateral	stand	sit	sternal	stand	stand
Position change:	yes	yes	no	yes	no	no	no	no
End position:	sternal	lateral	lateral	lateral	sit	sternal	stand	stand
Head position:	lowered	rest on surface	level	level	lowered	level	lowered	level
Ear position:	neutral	flat to sides	back	back	flat to sides	back	flat to sides	back
Eye position:	watch	stare ahead	stare ahead	stare ahead	sleepy/lidded	stare ahead	stare ahead	watch
Tail position:	low	on surface	on surface	low	on surface	on surface	low	low
Vocalisation:	whine	groan/moan	groan/moan	whine	whine	groan/moan	groan/moan	none
Orientation:	tester	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	tester
Breathing:	normal	normal	normal	normal	normal	normal	normal	normal
Other:	arched back	stretching	stretching		lip licking	lip licking	lip licking	lip licking
					arched back	arched back		arched back
						stretching		escape
Tx: Anaesthesia/ Immediate Analgesia								
Start position:	lateral	lateral	lateral	lateral	lateral	lateral	lateral	lateral
Position change:	no	yes	yes	yes	yes	no	no	yes
End position:	lateral	sternal	sternal	sternal	stand	lateral	lateral	stand
Head position:	level	rest on surface	rest on surface	rest on surface	level	level	level	level
Ear position:	back	neutral	back	back	neutral	forward alert	forward alert	forward alert
Eye position:	stare ahead	sleepy/lidded	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead
Tail position:	on surface	on surface	on surface	on surface	on surface	on surface	on surface	low
Vocalisation:	none	none	none	groan/moan	groan/moan	groan/moan	none	none
Orientation:	tester	stare ahead	stare ahead	stare ahead	tester	tester	tester	tester
Breathing:	normal	normal	normal	normal	pant	pant	normal	normal
Other:	lip licking	lip licking		draws legs up	stretchng	lip licking		lip licking
		rigid stance						
		escape						
		restrained						
		stretching						
Tx: Anaesthesia/ Analgesia								
Start position:	lateral	lateral	lateral	lateral	lateral	lateral	sit	stand
Position change:	yes	no	no	no	no	no	yes	no
End position:	stand	lateral	lateral	lateral	lateral	lateral	lateral	stand
Head position:	lowered	rest on surface	level	rest on surface	level	level	lowered	lowered
Ear position:	neutral	neutral	neutral	back	back	neutral	neutral	back
Eye position:	stare ahead	sleepy/lidded	closed	stare ahead	stare ahead	stare ahead	watch	stare ahead
Tail position:	on surface	on surface	on surface	on surface	on surface	on surface	on surface	low
Vocalisation:	none	none	none	none	none	groan/moan	groan/moan	none
Orientation:	tester	deliberate avert	tester	tester	tester	tester	tester	deliberate avert
Breathing:	normal	normal	normal	normal	normal	normal	normal	normal
Other:	arched back	draws legs up	stretching		stretching	lip licking	draws legs up	arched back
			draws legs up					

Rank	Behaviour	Con	Ans	Anl	Anl / Ans	Ans / I Anl	Ans / Anl
1	Start: lateral					Low	Low
2	Eyes: watch	Low	**High**	Low			
3	Head: rest on surface					Low	Low
4	End: lateral					Low	Low
5	Eyes: stare ahead	Low	Low	**High**	**High**	**High**	**High**
6	Ears: neutral		Low				Low
7	End: sternal			Low			
8	Start: sternal			Low	Low		
9	End: stand	**High**	Low	Low	Low		
10	Other: lip licking						
10	Position change: no	**High**		**High**	**High**	**High**	**High**
11	Orientation: stare ahead	Low	Low	**High**	**High**	**High**	**High**
11	Position change: yes						
12	Head: lowered	Low		Low			
13	Tail: low						
14	Start: stand	Low	Low	Low	Low		
15	Tail: on surface	Low	**High**	**High**	**High**	**High**	**High**
16	End: sit						
17	Other: arched back	Low					
18	Ears: back	**High**	Low	**High**	**High**	Low	Low
19	Eyes: sleepy						
20	Orientation: tester	Low	Low				
21	Head: level	Low	Low	Low	Low	Low	Low
22	Start: sit	Low					
23	Tail: slow wag						

Table 4.17 Frequency of occurrence for ranked interactive palpation behaviours, discriminating among nonsurgical treatments (canonical 1 analysis). Ranking is derived by collation of SCC and CS coefficients (Tables E3 and E4) and frequency is sourced from Figure 4.11. Behaviours that have no score for any treatment would have appeared with a frequency of >0.3 for at least one of the palpation events between 121 and 391 minutes (Figure F3), but that behaviour would not have averaged a frequency of >0.3 for all palpation events from 121 to 391 minutes. Low = 0.3-0.5, **High** = >0.5.

Table 4.14 Interactive palpation behaviours representative for each palpation event for each group. Major behavioural classes are listed below the identification of each treatment. Specific behaviours cited in each cell of the table are those most frequently seen in each group for the palpation period noted.

Summary of Pre-operative and 24 Hour Behaviours For Each Group

TX / Behaviour	Start position	Position change	End position	Head position	Ear position	Eye position	Tail position	Vocalisation	Orientation	Breathing	Other
Control	stand	no	stand	level	back	stare ahead	low	none	tester	normal	arched back
Control	sit	yes	stand	level	back	stare ahead	low	none	stare ahead	normal	arched back
Anaesthesia	stand	no	stand	level	neutral	watch	low	none	slow belly	normal	lip licking
Anaesthesia	sit	yes	stand	lowered	back	watch	on surface	none	deliberate avert	normal	arched back
Analgesia	sit	yes	sternal	high	forward alert	watch	on surface	none	stare ahead	normal	arched back extended neck
Analgesia	sit	no	sit	lowered	back	stare ahead	slow wag/curl	whine	hide	normal	lip licking
Analgesia/ Anaesthesia	stand	yes	sternal	lowered	neutral	watch	on surface	whine	tester	normal	arched back
Analgesia/ Anaesthesia	stand	no	stand	level	back	watch	on surface	none	tester	normal	lip licking arched back escape
Anaesthesia/ Immediate Analgesia	lateral	no	lateral	level	back	stare ahead	on surface	none	tester	normal	lip licking
Anaesthesia/ Immediate Analgesia	lateral	yes	stand	level	forward alert	stare ahead	low	none	tester	normal	lip licking
Anaesthesia/ Analgesia	lateral	yes	stand	lowered	neutral	stare ahead	on surface	none	tester	normal	arched back
Anaesthesia/ Analgesia	stand	no	stand	lowered	back	stare ahead	low	none	deliberate avert	normal	arched back

Table 4.15 Summary of pre-operative and 24 hour behaviours per group. Specific behaviours are noted within each group under major behavioural headings. The pre-operative behaviours were made on the day the bitches were admitted to the hospital: the day before commencement of the treatment. The 24 hour behaviours (shaded cells) were made on the day the bitches were discharged from the hospital: approximately 24 hours after commencement of the treatment.

Summary of Representative Behaviours For Each Group

TX / Behaviour	Start position	Position change	End position	Head position	Ear position	Eye position	Tail position	Vocalisation	Orientation	Breathing	Other
Control	stand	no	stand	level	back	stare ahead	low	none	stare ahead	normal	arched back
Anaesthesia	sit	yes	lateral	lowered	back	watch	on surface	none	tester	normal	lip licking/ arched back
Analgesia	sternal	no	sternal	level/lowered	back	stare ahead	on surface	none/whine	stare ahead	normal	arched back
Analgesia/ Anaesthesia	sternal/sit lateral/stand	yes/no	lateral/sit sternal	level	flat to sides/ back	stare ahead	on surface	groan/moan whine	stare ahead	normal	stretching/ lip licking
Anaesthesia/ Immediate Analgesia	lateral	yes/no	sternal/stand lateral	rest on surface	back/ forward alert	stare ahead	on surface	none/ groan/ moan	stare ahead/ tester	normal	stretching/ lip licking
Anaesthesia/ Analgesia	lateral	no	lateral	rest on surface/ level	neutral	sleepy/lidded closed/stare ahead	on surface	none/ groan/ moan	tester	normal	stretching

Table 4.16 Summary of most frequent behaviours observed during all palpations within different groups. These representative behaviours are a summary of Table 4.14. The Control group is highlighted for distinction.

Rank	Behaviour	Control	Ans	Anl	Anl/ Ans	Ans/ I Anl	Ans/ Anl
1	End: lateral					Low	Low
1	Tail: on surface	Low	**High**	**High**	**High**	**High**	**High**
2	Tail: slow wag						
3	Eyes: stare ahead	Low	Low	**High**	**High**	**High**	**High**
4	Other: arched back	Low					
5	End: stand	**High**	Low	Low	Low		
6	Head: rest on surface					Low	Low
6	Position change: no	**High**		**High**	**High**	**High**	**High**
7	End: sternal						
8	Start: lateral			Low			
9	End: sit						
9	Eyes: watch	Low	**High**	Low			
10	Position change: yes						
11	Eyes: sleepy						
12	Start: stand	Low	Low	Low	Low		
13	Other: lip licking						
13	Tail: low	Low					
14	Start: sit	Low					
15	Head: lowered	Low		Low			
15	Orientation: stare ahead	Low					
16	Ears: back	**High**					
16	Orientation: tester	Low	Low	**High**	**High**	**High**	**High**
17	Start: sternal			Low	Low		
18	Ears: neutral		Low				Low
18	Head: level	Low	Low	Low	Low	Low	Low

Table 4.18 Frequency of occurrence for ranked nonsurgical interactive palpation behaviours among groups (canonical 2 analysis). Ranking was derived from the ordering of SCC and CS coeficients (Table E5) and frequency from Figure 4.11. Behaviours that have no score for any treatment would have appeared with a frequency of >0.3 for at least one of the palpation events between 121 and 391 minutes, but that behaviour would not have averaged a frequency of >0.3 for all palpation events from 121 and 391 minutes.
Low = 0.3-0.5, **High** = >0.5.

Behaviour	Decreasing Frequency	Increasing Frequency
Start, lateral	Anaesthesia/Immediate Analgesia, Analgesia/Anaesthesia	
Start, sit		Anaesthesia
Start, stand		Anaesthesia/Analgesia
Position change, yes		Anaesthesia
Position change, no	Anaesthesia/Analgesia	
End, lateral	Anaesthesia/Analgesia	
End, stand		Anaesthesia/Immediate Analgesia, Anaesthesia/Analgesia
Head, lowered		Anaesthesia/Analgesia, Analgesia/Anaesthesia, Anaesthesia
Head, rest on surface	Anaesthesia/Immediate Analgesia	
Ear, neutral	Anaesthesia/Analgesia, Analgesia	
Tail, on surface	Analgesia/Anaesthesia	Anaesthesia
Orient, stare ahead	Analgesia, Anaesthesia/Immediate Analgesia	
Lip licking	Anaesthesia	Anaesthesia/Immediate Analgesia
Stretching	Anaesthesia/Analgesia	

Table 4.19 Behavioural trends (palpation) in the nonsurgical groups over the period of palpations (121-391 minutes). The composite nature of several behaviours is illustrated in this table, e.g. in the Anaesthesia/Analgesia group 'end, stand' became more frequent over time which is reflected in the decreased frequency of 'end, lateral' and consequently, the associated behaviour 'tail, on surface'. Trends in palpation behaviours were of little value for making generalised conclusions.

			Summary of Events/Treatment																	
Treatment	**Sequence of events**																			
Control	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	"Induction" room sample	Approximately 53 minute sit on table							trolley back to ward (1 minute)	Placed into cage	"Extubation" sample	Sample	Sample	Sample	Sample	Sample	Sample
Anesthesia + Surgery	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample	Clip/prep trolley to theatra	Incision sample	Ovary menipulation sample (3 minutes)	Closure: then off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample	Sample	Sample	Sample	Sample	Sample	Sample
Analgesia + Anesthesia + Surgery	Premed sample in ward cage. IV Butorphanol administration	In cage for 30 minutes	trolley to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample	Clip/prep trolley to theatre	Incision sample	Ovary manipulation sample (3 minutes)	Closure: then off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample	Sample	Sample	Sample	Sample	Sample	Sample
Anesthesia + Surgery + Analgesia	Premed sample in ward cage	In cage for 30 minutes	trolley to induction room (1 minute)	IV catheter placement (3 minutes)	Induction (2 minutes)	Intubation	Induction sample	Clip/prep trolley to theatre	Incision sample	Ovary manipulation sample (3 minutes)	Closure: then off gases	trolley back to ward (1 minute)	Placed into cage	Extubation sample. IV Butorphanol administration	Sample	Sample	Sample	Sample	Sample	Sample
Elapsed Time	0	30	31	34	36	37	40	56	60	63	67	68	69	91	121	151	161	211	271	391
	Cortisol Sample Taken																			

Table 5.1. Summary of Events Over Time for Surgery Treatments.

Treatment	Low (2-6)	Medium (7-10)	High (>10)	Only In This Group*	Not In This Group†
Control	Torso weight shift		Normal speed position change		Hang stand
	Stretching		Head lifts		Groan/moan
	Grooming				
Anaesthesia	Torso weight shift	Normal speed cage circling	Normal speed position change	Manipulation	
	Lip licking				
	Cage sniffing				
	Grooming				
	Stretching				
Anaesthesia/ Surgery	Torso weight shift	Slow motion position change	Head lifts	Incision licking	
	Thoracic limb weight shift	Normal speed position change		Vomition	
	Stretching	Draws legs up			
	Normal speed cage circle				
	Lip licking				
	Whine				
	Grooming				
	Ataxia				
Analgesia/ Anaesthesia	Thoracic limb weight shift	Normal speed position change			
	Stretching	Normal speed cage circling			
	Whine	Head lifts			
Analgesia/ Anaesthesia/ Surgery	Slow motion position change	Normal speed position change	Head lifts		
	Torso weight shift				
	Draws legs up				
	Stretching				

	Normal speed cage circle				
	Lip licking				
	Whine				
	Panting				
	Groan/moan				
Anaesthesia/ Analgesia	Thoracic limb weight shift	Head lifts	Normal speed cage circling		
	Lip licking				
	Whine				
Anaesthesia/ Surgery/ Analgesia	Hang stand	Normal speed position change			
	Torso weight shift	Head lifts			
	Thoracic limb weight shift				
	Draws legs up				
	Stretching				
	Normal speed cage circle				
	Lip licking				
	Whine				

Table 5.2 Summary of (average) hourly behaviours from the second through the fifth hour after 'extubation' (151-391 minutes) compared across treatments (Figures 4.5 and 5.4). *Denotes behaviours unique to this group among all the groups in the table. †Denotes the behaviour was not seen in this group, but was seen in all the other groups included in the table.

Rank	Behaviour	Control	Anaesthesia	Ans/Sx
1	Slow motion position change			Medium
2	Draws legs up			Medium
2	Hang stand			
3	Normal speed position change	**High**	**High**	Medium
3	Cage sniffing		Low	
4	Ataxia			Low
5	Normal speed cage circling		Medium	Low
6	Thoracic limb weight shift			Low
6	Lip licking		Low	Low
6	Torso weight shift	Low	Low	Low
6	Head lifts	**High**	**High**	**High**
6	Stretching	Low	Low	Low
7	Grooming	Low	Low	Low
7	Whine			Low
8	Panting			
9	Bark			

Table 5.3 Frequency of occurrence for ranked hourly behaviours discriminating between Anaesthesia, Anaesthesia/Surgery and Control groups by canonical 1 analysis. Ranking was sourced from Table G1 and frequency from Figures 4.5 and 5.4. Behaviours that have no score for any treatment would have appeared with a frequency of >2 for at least one of the hourly intervals between 151 and 391 minutes, but that behaviour would not have averaged a frequency of >2 for the four hourly intervals between 151 and 391 minutes.
Low = 2-6, Medium = 7-10, **High** = >10

Rank	Behaviour	Control	Anl/Ans	Anl/Ans/Sx
1	Draws legs up			Low
2	Slow motion position change			Low
2	Stretching	Low		Low
3	Grooming	Low		
3	Cage sniffing			
3	Panting			Low
3	Normal speed position change	**High**	Medium	Medium
4	Head lifts	**High**	Medium	**High**
5	Whine		Low	Low
6	Normal speed cage circle		Medium	Low
7	Lip licking			Low
8	Hang stand			
9	Bark			
9	Torso weight shift	Low		Low
10	Thoracic limb weight shift		Low	
11	Ataxia			

Table 5.4 Frequency of occurrence for ranked hourly behaviours discriminating between Analgesia/Anaesthesia, Analgesia/Anaesthesia/Surgery and Control groups by canonical 1 analysis. Ranking was sourced from Table G2 and frequency was sourced from Figures 4.5 and 5.4. Behaviours that have no score for any treatment would have appeared with a frequency of >2 for at least one of the hourly intervals between 151 and 391 minutes, but that behaviour would not have averaged a frequency of >2 for the four hourly intervals between 151 and 391 minutes.
Low = 2-6, Medium = 7-10, **High** = >10

Rank	Behaviour	Control	Ans/Anl	Ans/Sx/Anl
1	Normal speed cage circle		**High**	Low
2	Draws legs up			Low
3	Lip licking		Low	Low
4	Stretching	Low		Low
5	Normal speed position change	**High**	Medium	Medium
6	Panting			
7	Torso weight shift	Low		Low
7	Ataxia			
8	Head lifts	**High**	Medium	Medium
9	Slow motion position change			
9	Thoracic limb weight shift		Low	Low
9	Hang stand			Low
10	Grooming	Low		
11	Cage sniffing			
11	Whine		Low	Low
12	Bark			

Table 5.5 Frequency of occurrence for ranked hourly behaviours discriminating between Anaesthesia/Analgesia, Anaesthesia/Surgery/Analgesia and Control groups by canonical 1 analysis. Ranking was sourced from Table G3 and frequency from Figures 4.5 and 5.4. Behaviours that have no score for any treatment would have appeared with a frequency of >2 for at least one of the hourly intervals between 151 and 391 minutes, but that behaviour would not have averaged a frequency of >2 for the four hourly intervals between 151 and 391 minutes.
Low = 2-6, Medium = 7-10, **High** = >10

Rank	Behaviour	Con	Ans	Ans/Sx	Anl/Ans	Anl/Ans /Sx	Ans/Anl	Ans/Sx/ Anl
1	Draws legs up			Medium		Low		Low
2	Normal speed position change	High	High	Medium	Medium	Medium	Medium	Medium
3	Normal speed cage circle		Medium	Low	Medium	Low	High	Low
3	Stretching	Low	Low	Low		Low		Low
3	Slow motion position change			Medium		Low		
4	Lip licking		Low	Low		Low	Low	Low
5	Panting					Low		
5	Cage sniffing		Low					
6	Head lifts	High	High	High	Medium	High	Medium	Medium
7	Hang stand							Low
8	Grooming	Low	Low	Low				
9	Torso weight shift	Low	Low	Low		Low		Low
9	Ataxia			Low				
10	Thoracic limb weight shift			Low	Low		Low	Low
10	Whine			Low	Low	Low	Low	Low
11	Bark							

Table 5.6 Collated (Tables 5.3-5) summary of hourly behaviours for differentiating the treatment effects of surgery. The order of ranking was derived from the same process used to collate SCC and SC coefficient orders for ranking, ie. each behaviour was given a number of points equal to its rank for each of the three comparative analyses: the behaviours were then ranked by total points. Low, medium or high frequency classification was sourced from Figue 5.4. Undeniably, behaviours seen from bitches subjected to Anaesthesia, Analgesia/Anaesthesia or Anaesthesia/Analgesia alone are virtually never seen outside the research environment. In this table discriminating behaviours for each group undergoing surgery were contrasted to those from a comparative 'base' group (adjacent column within the vertical double lines) as well as the Control group by discriminate canonical analysis. Those behaviours in the shaded cells occurred in such patterns as to provide the most apparent contrasts for across-treatment comparisons.
Low = 2-6, Medium = 7-10, High = >10

Summary of Representative Behaviours For Each Surgery and Base Group

TX / Behaviour	Start position	Position change	End position	Head position	Ear position	Eye position	Tail position	Vocalisation	Orientation	Breathing	Other
Control	*stand*	*no*	*stand*	*level*	*back*	*stare ahead*	*low*	*none*	*stare ahead*	*normal*	*arched back*
Anaesthesia	sit	yes	lateral	lowered	back	watch	on surface	none	tester	normal	lip licking/ arched back
Anaesthesia/Surgery	sternal	no	sternal	level	neutral	stare ahead	on surface	none	tester	normal	lip licking/ arched back/ rigid stance/ extended neck
Analgesia/ Anaesthesia	sternal/sit lateral/ stand	yes/no	lateral/sit sternal	level	flat to sides/ back	stare ahead	on surface	groan/moan whine	stare ahead	normal	stretching/ lip licking
Analgesia/Anaesthesia/ Surgery	stand	no	stand	level	neutral	stare ahead	low	whine	stare ahead	normal	arched back/ retreat/ escape
Anaesthesia/ Analgesia	lateral	no	lateral	rest on surface/ level	neutral	sleepy/lidded closed/stare ahead	on surface	none/ groan/ moan	tester	normal	stretching
Anaesthesia/Surgery/ Analgesia	lateral	no	lateral	high	back	stare ahead	on surface	whine	stare ahead	normal	lip licking/ arched back/ retreat/ draws legs up

Table 5.7 Summary of the most frequent behaviours observed during all palpations within the surgery and base groups. The Control group is cited for reference and the surgery groups are in shaded cells.

Summary of Representative Behaviours For Each Surgery Group

Tx / Behaviour	Start position	Position change	End position	Head position	Ear position	Eye position	Tail position	Vocalisation	Orientation	Breathing	Other
Control	stand	no	stand	level	back	stare ahead	low	none	stare ahead	normal	arched back
Anaesthesia/Surgery	sternal	no	sternal	level	neutral	stare ahead	on surface	none	tester	normal	lip licking/ arched back/ rigid stance/ extended neck
Analgesia/Anaesthesia/ Surgery	stand	no	stand	level	neutral	stare ahead	low	whine	stare ahead	normal	arched back/ retreat/ escape
Anaesthesia/Surgery/ Analgesia	lateral	no	lateral	high	back	stare ahead	on surface	whine	stare ahead	normal	lip licking/ arched back/ retreat/ draws legs up

Table 5.8 Summary of the most frequent behaviours observed during all palpations within the surgery groups. These are the same data presented in Table 5.7, but without the additional observations from the base groups.

Rank	Behaviour	Control	Anaesthesia	Ans/Sx
1	Eye position: watch	Low	**High**	Low
2	End: lateral			
3	Tail: low	Low	Low	
4	End: sternal			Low
5	Vocal: whine			
5	Eyes: stare ahead	Low	Low	Low
5	End: stand	**High**	Low	
6	Tail: slow wag			
6	Orient: stare ahead	Low	Low	**High**
7	Head: high			
8	Start: sternal			Low
8	Start: stand	Low	Low	
9	Position change: no	**High**	**High**	**High**
10	Head: level	Low	Low	
10	Head: lowered	Low		
11	Other: arched back	Low		
11	End: sit			
12	Ears: neutral		Low	Low
13	Other: lip licking			
14	Position change: yes			
15	Orient: tester	Low	Low	
16	Start: sit	Low		
17	Ears: back	**High**	Low	Low
18	Eyes: sleepy/lidded			
19	Head: rest on surface			
20	Start: lateral			
21	Tail: on surface	Low	**High**	**High**

Table 5.9 Frequency of occurrence for ranked palpation behaviours discriminating between Anaesthesia, Anaesthesia/Surgery and Control groups by canonical 2 analysis. Ranking was sourced from Table G4 and frequency was sourced from Figures 4.11 and 5.9. Behaviours that have no score for any treatment would have appeared with a frequency of >0.3 for at least one of the palpation events between 121 and 391 minutes, but that behaviour would not have averaged a frequency of >0.3 for each of the palpation events between 121 and 391 minutes.
Low = 0.3-0.5, High = >0.5

Rank	Behaviour	Control	Ans/Anl	Ans/Sx/Anl
1	End: lateral		Low	
2	Start: lateral		Low	
3	Eyes: stare ahead	Low	**High**	Low
4	Vocal: whine			Low
5	End: sternal			
6	Orient: stare ahead	Low	**High**	Low
7	Tail: low	Low		
7	Position change: no	**High**	**High**	**High**
8	Head: rest on surface		Low	
8	Orient: tester	Low		
9	Position change: yes			
10	Other: lip licking			
10	Start: stand	Low		
11	Head: high			
11	Ears: neutral		Low	
11	Head: level	Low	Low	
11	Tail: on surface	Low	**High**	**High**
12	Start: sit	Low		
13	Eye position: watch	Low		
14	Head: lowered	Low		
15	Start: sternal			Low
16	Tail: slow wag			
17	End: stand	**High**		
18	Ears: back	**High**	Low	Low
19	End: sit			
20	Other: arched back	Low		
21	Eye: sleepy/lidded			

Table 5.10 Frequency of occurrence for ranked palpation behaviours discriminating between Anaesthesia/Analgesia, Anaesthesia/Surgery/Analgesia and Control groups by canonical 1 analysis. Ranking was sourced from Table G5 and frequency from Figures 4.11 and 5.9. Behaviours that have no score for any treatment would have appeared with a frequency of >0.3 for at least one of the palpation events between 121 and 391 minutes, but that behaviour would not have averaged a frequency of >0.3 for each of the palpation events between 121 and 391 minutes.
Low = 0.3-0.5, **High** = >0.5

Rank	Behaviour	Control	Anl/Ans	Anl/Ans/Sx
1	Position change: no	**High**	**High**	**High**
2	Vocal: whine			
3	Tail: low	Low		Low
3	Start: sit	Low		
4	Eye position: watch	Low		
5	End: lateral			
6	Ears: back	**High**	**High**	Low
7	Tail: slow wag			
7	End: sit			
7	End: sternal			
8	Head: rest on surface			
9	Head: high			
10	Position change: yes			
10	End: stand	**High**	Low	**High**
11	Start: lateral			
12	Eyes: stare ahead	Low	**High**	**High**
13	Head: level	Low	Low	Low
13	Start: sternal		Low	Low
14	Other: lip licking			
15	Start: stand	Low	Low	Low
16	Eyes: sleepy/lidded			
17	Other: arched back	Low		
18	Ears: neutral			Low
19	Orient: stare ahead	Low	**High**	**High**
20	Tail: on surface	Low	**High**	Low
21	Orientation: tester	Low		
22	Head: lowered	Low		

Table 5.11 Frequency of occurrence for ranked palpation behaviours discriminating between Analgesia/Anaesthesia, Analgesia/Anaesthesia/Surgery and Control groups by canonical 1 analysis. Ranking was sourced from Table G6 and frequency from Figures 4.11 and 5.9. Behaviours that have no score for any treatment would have appeared with a frequency of >0.3 for at least one of the palpation events between 121 and 391 minutes, but that behaviour would not have averaged a frequency of >0.3 for each of the palpation events between 121 and 391 minutes.
Low = 0.3-0.5, **High** = >0.5

Rank	Behaviour	Con	Ans	Ans/Sx	Anl/ Ans	Anl/ Ans/ Sx	Ans/ Anl	Ans/ Sx/Anl
1	End: lateral						Low	
2	Vocal: whine							Low
3	Tail: low	Low	Low			Low		
4	End: sternal			Low				
5	Position change: no	High	High	High	High	High	High	High
6	Ears: back	High	Low	Low	High	Low	Low	Low
7	Eyes: stare ahead	Low	Low	Low	High	High	High	Low
8	Head: high							
9	Tail: slow wag							
10	Start: sit	Low						
10	Orient: stare ahead	Low	Low	High	High	High	High	Low
11	End: stand	High	Low		Low	High		
12	Position change: yes							
12	Start: lateral						Low	
12	Start: stand	Low	Low		Low	Low		
13	Head: level	Low	Low		Low	Low	Low	
14	Head: rest on surface						Low	
15	Start: sternal			Low	Low	Low		Low
16	End: sit							
16	Other: lip licking							
17	Ears: back		Low	Low	High	Low	Low	Low
18	Ears: neutral		Low	Low		Low	Low	
19	Orientation: tester	Low	Low					
20	Head: lowered	Low						
21	Other: arched back	Low					Low	
22	Tail: on surface	Low	High	High	High	Low	High	High
23	Eyes: sleepy/lidded							

Table 5.12 Collated (Tables 5.9-11) summary of interactive palpation behaviours for differentiating the treatment effects from surgery. The order of ranking was derived from the same process used to collate SCC and SC coefficient orders for ranking, ie. each behaviour was given a number of points equal to its rank for each of the three comparative analyses: the behaviours were then ranked by total points. Low or high frequency classification was sourced from Figue 5.9. Discriminating behaviours for each group undergoing surgery were contrasted to those from a comparative 'base' group (adjacent column within the vertical double lines) as well as the Control group by discriminate canonical analysis. Low = 0.3-0.5, High = >0.5

2-6 (Low)	7-10 (Medium)	>10 (High)
		Head lifts
		Whine
		Groan/moan
		Number of position changes
		Lip licking
		Normal speed position changes
		Draws legs up
		Stretching
	Torso weight shifts	
	Ataxia	
	Normal speed cage circling	
	Paddling	
Awake		
Lateral position		
Sternal other		
Head nodding		
Increased thoracic limb weight bearing		
Slow speed position changes		
Cage sniffing		
Grooming		
Thrashing		
Look back		
Pant		
Walking		

Table 5.13 Notable minute behavioural frequencies (total >2 from 91-151 minutes) in all the surgery groups.

Treatment	2-6 (Low)	7-10 (Medium)	>10 (High)
Control	Awake	Normal speed position change	Number of position changes
	Sternal other		Head lift
	Torso weight shift		
	Lip licking		
	Normal speed cage circling		
	Cage sniffing		
	Grooming		
Anaesthesia/ Surgery	Lateral		
	Torso weight shift		Number of position changes
	Slow speed position change		Lip licking
	Positional ataxia		Head lift
	Head nodding		Draws legs up
	Normal speed cage circle		Whine
	Stretching		
	Grooming		
	Look back		
	Groan/moan		
Analgesia/ Anaesthesia/ Surgery	Lateral	Torso weight shift	Number of position changes
	Normal speed position change	Normal speed cage circling	Head lifts
	Lip licking	Positional ataxia	Draws legs up
	Thrashing		Whine
	Stretching		Groan/moan
	Panting		
Anaesthesia/ Surgery/ Analgesia	Normal speed cage circling	Number of position changes	Normal speed position changes
	Lateral	Positional ataxia	Head lifts
	Walking	Paddling	Draws legs up
	Thrashing		Stretching
	Panting		Whine
			Groan/moan

Table 5.14 Relevant minute behaviours (summed from 91-151 minutes) presented as low, medium or high for each group.

2-6 (Low)	7-10 (Medium)	>10 (High)
		Head lifts
		Normal speed position change
	Slow motion position change	
	Slow motion position change	
	Drawing legs up	
Grooming		
Panting		
Hang stand		
Ataxia		
Whine		
Groan/moan		
Stretching		
Normal speed cage circling		
Lip licking		
Torso weight shifts		
Thoracic limb weight shift		

Table 5.15 Low, medium or high frequencies of noninteractive hourly behaviours without regard to association with a given (surgical) treatment.

Treatment	Low (2-6)	Medium (7-10)	High (>10)	Only In This Group	Not In This Group
Control	Torso weight shift		Normal speed position change	Bandage chew	Hang stand
	Stretching		Head lifts		Groan/moan
	Grooming				
Anaesthesia/ Surgery	Torso weight shift	Slow motion position change	Head lifts	Incision licking	
	Thoracic limb weight shift	Normal speed position change		Vomition	
	Stretching	Draws legs up			
	Normal speed cage circle				
	Lip licking				
	Whine				
	Grooming				
	Ataxia				
Analgesia/ Anaesthesia/ Surgery	Slow motion position change	Normal speed position change	Head lifts		Thrashing
	Torso weight shift				Grooming
	Draws legs up				
	Stretching				
	Normal speed cage circle				
	Lip licking				
	Whine				
	Panting				
	Groan/moan				
Anaesthesia/ Surgery/ Analgesia	Hang stand	Normal speed position change		Door Pawing	Groan/moan
	Torso weight shift	Head lifts			Bark
	Thoracic limb weight shift				Pant
	Draws legs up				Yawn
	Stretching				
	Normal speed cage circle				
	Lip licking				
	Whine				

Table 5.16 Summary of relevant hourly behaviours compared across treatments and characterised as low, medium or high. The frequency of each behaviour per group represents an average of the four hourly intervals from 151 to 391 minutes.

Behaviour	Decreasing Frequency	Increasing Frequency	Other
Slow motion position change	Ans/Sx, Anl/Ans/Sx		
Normal speed position change	Ans/Sx		
Thoracic limb weight shift		Ans/Sx	
Draws legs up	Ans/Sx/Anl, Anl/Ans/Sx		Ans/Sx: maintained at medium frequency
Stretching	Ans/Sx/Anl, Ans/Sx		
Normal speed cage circling	Anl/Ans/Sx		Ans/Sx: maintained at high end of low frequency
Head lifts	Ans/Sx, Ans/Sx/Anl		
Lip licking	Ans/Sx, Ans/Sx/Anl		
Whine	Ans/Sx, Ans/Sx/Anl		
Grooming	Ans/Sx		
Door pawing		Ans/Sx/Anl	
Bark	Anl/Ans/Sx		
Groan/moan		Anl/Ans/Sx	
Hang stand			Ans/Sx/Anl: maintained at low frequency

Table 5.17 Trends observed in the noninteractive hourly behaviours for the surgical groups (Figure F5).

Rank	Behaviour	Control	Ans/Sx	Anl/Ans/Sx	Ans/Sx/Anl
1	Slow motion position change		Medium	Low	
2	Draws legs up		Medium	Low	Low
3	Ataxia		Low		
4	Normal speed position change	**High**	Medium	Medium	Medium
4	Torso weight shifts	Low	Low	Low	Low
5	Lip licking		Low	Low	Low
5	Stretching	Low	Low	Low	Low
6	Normal speed cage circle		Low	Low	Low
7	Head lifts	**High**	**High**	**High**	Medium
7	Panting			Low	
8	Thoracic limb weight shift		Low		Low
9	Bark				
10	Whine		Low	Low	Low
11	Grooming	Low	Low		
12	Cage sniffing				
12	Hang Stand				Low

Table 5.18 Characteristic noninteractive hourly behaviours for the surgery groups and Controls. Distinction of the Anaesthesia/Surgery group from the presurgical and postsurgical groups was best achieved by the canonical 1 analysis; however, the Analgesia/Anaesthesia/Surgery and Anaesthesia/Surgery/Analgesia treatments were poorly differentiated by canonical 1 analysis (Figure 5.18). Ranking was obtained by the canonical 1 analysis of SCC and CS coefficients (Table G7) and frequency from Figure 5.4. Behaviours that have no score for any treatment (e.g. bark) would have appeared with a frequency of >2 for at least one of the hourly intervals between 151 and 391 minutes, but that behaviour would not have averaged a frequency of >2 for the four hourly intervals between 151 and 391 minutes.
Low = 2-6, Medium = 7-10, **High** = >10.

Rank	Behaviour	Control	Ans/Sx	Anl/Ans/Sx	Ans/ Sx/Anl
1	Grooming	Low	Low		
1	Normal speed position change	**High**	Medium	Medium	Medium
2	Stretching	Low	Low	Low	Low
3	Normal speed cage circling		Low	Low	Low
4	Whine		Low	Low	Low
5	Thoracic limb weight shift		Low		Low
6	Hang stand				Low
6	Head lifts	**High**	**High**	**High**	Medium
7	Cage sniffing				
8	Lip licking		Low	Low	Low
8	Torso weight shift	Low	Low	Low	Low
9	Draws legs up		Medium	Low	Low
10	Ataxia		Low		
10	Bark				
10	Slow motion position change		Medium	Low	
11	Panting			Low	

Table 5.19 Characteristic noninteractive hourly behaviours as elucidated by canonical 2 analysis. Differentiating behaviours for the Control group were best identified by this canonical 2 analysis. Ranking was obtained by SCC and CS coefficients (Table G8) and frequency was sourced from Figure 5.4. Behaviours that have no score for any treatment (ie. cage sniffing) would have appeared with a frequency of >2 for at least one of the hourly intervals between 151 and 391 minutes, but that behaviour would not have averaged a frequency of >2 for the four hourly intervals between 151 and 391 minutes.
Low = 2-6, Medium = 7-10, **High** = >10.

Low (0.3-0.5)	High (>0.5)
	Starting Position Lateral
	Position Changes No
	End Position Stand
	Ear Position Back
	Eye Position Stare ahead
	Tail Position On surface
	Orientation Stare ahead
	Breathing Normal
Starting Position Sternal	
Starting Position Sit	
Starting Position Stand	
End Position Sternal	
Head Position Level	
Head Position Lowered	
Ear Position Neutral	
Eye Position Watch	
Tail Position Low	
Vocalisation Whine	
Orientation Tester	
Other Arched back	

Table 5.20 Interactive palpation behaviours with frequencies ≥0.3 observed from 121-391 minutes, which were retained for analysis from the surgery groups.

			Time after extubation (hours)					
Behaviour	**Pre-op**	**0.5**	**1**	**1.5**	**2**	**3**	**5**	**24**
Tx: Control								
Start position:	stand	sit	sit	stand	sternal	stand	stand	sit
Position change:	no	yes	yes	no	yes	no	no	yes
End position:	stand	stand	stand	stand	stand	stand	stand	stand
Head position:	level	level	lowered	lowered	lowered	level	level	level
Ear position:	back	back	back	back	back	back	back	back
Eye position:	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead
Tail position:	low	low	on surface	low	on surface	low	low	low
Vocalisation:	none	none	none	none	none	none	none	none
Orientation:	tester	stare ahead	stare ahead	tester	stare ahead	stare ahead	stare ahead	stare ahead
Breathing:	normal	normal	normal	normal	normal	normal	normal	normal
Other:	arched back	arched back	arched back	arched back	arched back	arched back	arched back	arched back
Tx: Anaesthesia/ Surgery								
Start position:	sternal	sternal	sternal	sternal	stand	sit	sternal	stand
Position change:	yes	no	no	no	yes	no	no	yes
End position:	stand	sternal	sternal	sternal	sit	sit	sternal	sternal
Head position:	level	level	level	level	tilt	level	lowered	lowered
Ear position:	back	neutral	neutral	neutral	neutral	back	back	back
Eye position:	stare ahead	stare ahead	watch	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead
Tail position:	low	on surface	on surface	on surface	on surface	on surface	on surface	on surface
Vocalisation:	none	whine	none	none	none	none	none	whine
Orientation:	stare ahead	tester	tester	tester	stare ahead	tester	stare ahead	stare ahead
Breathing:	normal	normal	normal	normal	normal	normal	normal	normal
Other:	lip licking	lip licking	arched back	lip licking	lip licking	lip licking	arched back	lip licking
	arched back	rigid stance	rigid stance	arched back	arched back	arched back	neck	arched back
		escape		rigid stance	extended neck	rigid stance		extended neck
		restrained		neck		neck		
				restrained				
Tx: Analgesia/ Anaesthesia/ Surgery								
Start position:	stand	sternal	stand	sternal	lateral	stand	stand	sit
Position change:	no	yes	no	no	yes	no	no	no
End position:	stand	stand	stand	sternal	stand	stand	stand	sit
Head position:	lowered	level	lowered	level	level	level	lowered	hang
Ear position:	flat to sides	neutral	neutral	neutral	flat to side	back	flat to side	back
Eye position:	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	stare ahead	watch
Tail position:	on surface	on surface	low	on surface	low	low	low	on surface
Vocalisation:	none	whine	whine	groan/moan	whine	whine	whine	whine
Orientation:	stare ahead	stare ahead	tester	stare ahead	stare ahead	stare ahead	stare ahead	tester
Breathing:	normal	normal	normal	normal	normal	normal	normal	normal
Other:	lip licking	lip licking	arched back	retreat	arched back	lip licking	arched back	arched back
	arched back	arched back	retreat		escape	arched back	escape	retreat
		rigid stance				retreat		
		escape				escape		
Tx: Anaesthesia/ Surgery/ Analgesia								
Start position:	stand	lateral	lateral	sternal	lateral	sternal	stand	stand
Position change:	no	no	no	no	no	no	no	no
End position:	stand	lateral	lateral	sternal	lateral	sternal	stand	stand
Head position:	level	high	high	level	high	high	level	lowered
Ear position:	alert	back	back	back	back	back	back	back
Eye position:	watch	stare ahead	stare ahead	stare ahead	watch	stare ahead	stare ahead	atare ahead
Tail position:	low	on surface	on surface	on surface	on surface	on surface	on surface	fast wag/curl
Vocalisation:	none	whine	whine	whine	whine	whine	whine	none
Orientation:	tester	tester	stare ahead	stare ahead	stare ahead	tester	stare ahead	deliberate avert
Breathing:	normal	normal	normal	normal	normal	normal	normal	normal
Other:		lip licking	arched back	arched back	lip licking	lip licking	lip licking	arched back
		arched back	rigid stance	escape	arched back	arched back	arched back	
		escape	neck	draws legs up	draws legs up	retreat	retreat	
		restrained		bite/snap		stretching		
		draws legs up						

Table 5.21 Interactive palpation behaviours representative for each palpation event for each group undergoing surgery. Major behavioural classes are listed below the identification of each treatment. Specific behaviours cited in each cell of the table are those most frequently seen in each group for the palpation period noted.

Summary of Pre-operative and 24 Hour Behaviours For Each Surgical Group											
Tx / Behaviour	Start position	Position change	End position	Head position	Ear position	Eye position	Tail position	Vocalisation	Orientation	Breathing	Other
Control	stand	no	stand	level	back	stare ahead	low	none	tester	normal	arched back
Control	sit	yes	stand	level	back	stare ahead	low	none	stare ahead	normal	arched back
Anaesthesia/Surgery	sternal	yes	stand	level	back	stare ahead	low	none	stare ahead	normal	lip licking/ arched back
Anaesthesia/Surgery	stand	yes	sternal	lowered	back	stare ahead	on surface	whine	stare ahead	normal	lip licking/ arched back/ extended neck
Analgesia/Anaesthesia/ Surgery	stand	no	stand	lowered	flat to sides	stare ahead	on surface	none	stare ahead	normal	lip licking/ arched back
Analgesia/Anaesthesia/ Surgery	sit	no	sit	hang	back	watch	on surface	whine	tester	normal	arched back/ retreat
Anaesthesia/Surgery/ Analgesia	stand	no	stand	level	forward alert	watch	low	none	tester	normal	
Anaesthesia/Surgery/ Analgesia	stand	no	stand	lowered	back	stare ahead	fast wag/curl	none	deliberate avert	normal	arched back

Table 5.22 Summary of pre-operative and 24 hour behaviours per group. Specific behaviours are noted within each group under major behavioural headings. The pre-operative behaviours were made on the day the bitches were admitted to the hospital: the day before commencement of the treatment. The 24 hour behaviours (shaded cells) were made on the day the bitches were discharged from the hospital: approximately 24 hours after commencement of the treatment.

Behaviour	Decreasing Frequency	Increasing Frequency	Other
Start, lateral	Ans/Sx/Anl		
Start, sternal	Ans/Sx		
Start, stand		Ans/Sx/Anl	
End, lateral	Ans/Sx/Anl		
End, sternal	Ans/Sx, Ans/Sx/Anl		
End, stand		Ans/Sx/Anl, Anl/Ans/Sx	
Head, level	Anl/Ans/Sx		
Ears, back	Con	Anl/Ans/Sx, Ans/Sx/Anl	
Eyes, stare ahead		Ans/Sx	
Tail, on surface	Ans/Sx/Anl		*Ans/Sx: maintained at high frequency*
Lip licking		Ans/Sx/Anl	

Table 5.23 Trends noted in interactive palpation behaviours for the surgical groups (Figure F6). Several of these trends reflect the composite nature of some behaviours, eg. the increasing frequency of 'start, stand' in the Anaesthesia/Surgery/Analgesia group corresponds to the decreasing frequency of 'start, lateral' in the same group, and as this group showed an increase in frequency of 'start, stand' they showed a correlated decrease in 'tail, on surface'.

Rank	Behaviour	Con	Ans/Sx	Anl/Ans/Sx	Ans/Sx/Anl
1	Start: sit	Low			
2	End: stand	**High**			
3	Vocal: whine				Low
4	Head: lowered	Low			
4	Position change: yes				
5	Start: lateral				
6	Orientation: stare ahead	Low	**High**	**High**	Low
7	Position change: no	**High**	**High**	**High**	**High**
8	Other: arched back	Low			
9	End: lateral				
9	Head: rest on surface				
10	End: sternal		Low		
10	Eye position: watch	Low	Low		
10	Head: high				
10	Tail: slow wag				
11	Ears: back	**High**	Low	Low	Low
11	Start: stand	Low			
12	End: sit				
13	Head: level	Low		Low	
13	Orientation: tester	Low			
13	Start: sternal		Low	Low	Low
14	Ears: neutral		Low	Low	
15	Other: lip licking				
15	Tail: on surface	Low	**High**	Low	**High**
16	Eyes: stare ahead	Low	Low	**High**	
17	Tail: low	Low		Low	

Table 5.24 Characteristic interactive palpation behaviours ranked for each surgical group which allowed group distinction by treatment effect. This table was best used for differentiation of the **Anaesthesia/Surgery/Analgesia** group. Ranking was obtained from canonical 1 analysis of SCC and CS coefficients (Figure G9) and frequency was soured from Figure 5.9. Behaviours that have no score for any treatment would have appeared with a frequency of >0.3 for at least one of the palpation events between 121 and 391 minutes, but that behaviour would not have averaged a frequency of >0.3 for all palpation events from 121 to 391 minutes. The Anaesthesia/Surgery and the Analgesia/Anaesthesia/Surgery groups were poorly differentiated by canonical 1 analysis (Figure 5.16). Low = 0.3-0.5, **High** = >0.5.

Rank	Behaviour	Con	Ans/Sx	Anl/ Ans/Sx	Ans/Sx/ Anl
1	End: stand	**High**			
2	Start: stand	Low			
3	End: sit				
4	Head: high				
5	Eyes: stare ahead	Low	Low	**High**	
6	Eye position: watch	Low	Low		
7	Tail: on surface	Low	**High**	Low	**High**
8	Start: sit	Low			
9	End: sternal		Low		
10	Tail: slow wag				
11	Tail: low	Low		Low	
12	Head: rest on surface				
13	Ears: back	**High**	Low	Low	Low
13	End: lateral				
13	Start: lateral				
13	Start: sternal		Low	Low	Low
14	Head: lowered	Low			
15	Ears: neutral		Low	Low	
16	Head: level	Low		Low	
17	Other: lip licking				
18	Vocal: whine				Low
19	Orientation: stare ahead	Low	**High**	**High**	Low
19	Other: arched back	Low			
20	Orientation: tester	Low			
20	Position change: no	**High**	**High**	**High**	**High**
21	Position change: yes				

Table 5.25 Characteristic interactive palpation behaviours ranked for each surgical group which allowed group distinction by treatment effect. This table was best used for the differentiation of the **Analgesia/Anaesthesia/Surgery** group. Ranking was obtained from canonical 2 analysis of SCC and CS coefficients (Figure G10) and frequency was soured from Figure 5.9. Behaviours that have no score for any treatment would have appeared with a frequency of >0.3 for at least one of the palpation events between 121 and 391 minutes, but that behaviour would not have averaged a frequency of >0.3 for all palpation events from 121 to 391 minutes. The Anaesthesia/Surgery and the Analgesia/Anaesthesia/Surgery groups were poorly differentiated by canonical 1 analysis (Figure 5.16).
Low = 0.3-0.5, **High** = >0.5.

Decreasing Cortisol Concentration/ Increasing Behaviour Frequency	**Decreasing Cortisol Concentration/ Decreasing Behaviour Frequency**	**Low Cortisol Concentration/ High Behaviour Frequency**	**Unchanging Cortisol Concentration/ Unchanging Behaviour Frequency**
Door Pawing: *Ans/Sx/Anl*	Normal speed position change: *Ans/Sx*	Normal speed position change: *Con*	Torso weight shift: *Con* **Low C/Low B†**
	Torso weight shift: *Ans/Sx/Anl*		Thoracic limb weight shift: *Con* **Low C/High B**
	Draws legs up: *Anl/Ans/Sx, Ans/Sx/Anl*		Draws legs up: *Con* **Low C/Low B**
	Normal speed cage circling: *Anl/Ans/Sx*		Normal speed cage circle: *Con* **Low C/Low B**
	Head lifts: *Ans/Sx/Anl*		Head lifts: *Con* **Low C/Low B**
	Lip licking: *Ans/Sx*		Lip licking: *Con* **Low C/Low B**
	Whine: Ans/Sx, *Anl/Ans/Sx*		Cage sniffing: *Con* **Low C/Low B**
	Grooming: *Ans/Sx*		Yawning: *on* **Low C/Low B**
	Barking: *Anl/Ans/Sx*		
	Ataxia: *Ans/Sx, Anl/Ans/Sx, Ans/Sx/Anl*		

Table 6.1 Associations between cortisol concentrations and noninteractive hourly behaviours for Controls and the surgical treatments. (Associations were not statistically significant.)

Con = Control

Ans/Sx = Anaesthesia/Surgery

Anl/Ans/Sx = Analgesia/Anaesthesia/Surgery

Ans/Sx/Anl = Anaesthesia/Surgery/Analgesia

† : **C** = cortisol concentration, **B** = behavioural frequency

Corresponding Cortisol Concentration and Behaviour Frequency	**Inverse Relationship Between Change in Cortisol Concentration and Frequency of Behaviour**
Normal speed position change: *Con, Ans* **Low C/Low B†**	Normal speed position change: *Ans, I Anl*
Normal speed cage circle: *Con* **Low C/Low B**	Head lifts: *Ans, Ans*
Head lifts: *Con* **Low C/High B**	Whine: *Ans, I Anl*
Whine: *Ans/Anl, Ans/I Anl* **Change in cortisol concentration followed change in frequency of behaviour**	Cage sniffing: *Ans, I Ans*
Cage sniffing: *Con* **Change in cortisol concentration followed change in frequency of behaviour**	
Yawning: *Con, Ans* **Low C/Low B**	

Table 6.2 Associations between cortisol concentrations and noninteractive hourly behaviours for nonsurgical treatments. (Associations were not statistically significant.)

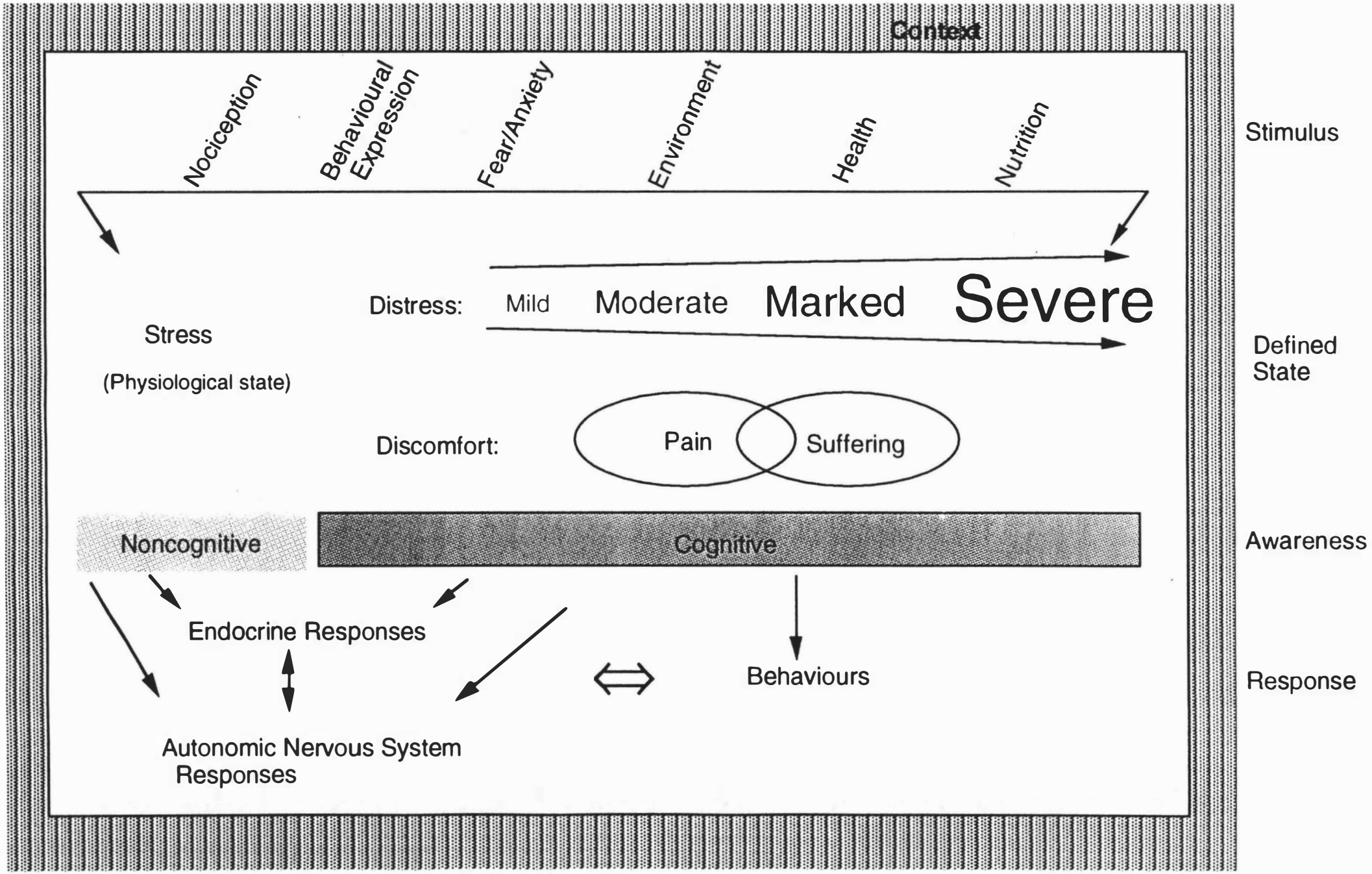
Con = Control

Ans = Anaesthesia

Ans/Anl = Anaesthesia/Analgesia

Ans/I Anl = Anaesthesia/Immediate Analgesia

† : **C** = cortisol concentration, **B** = behavioural frequency


Context
Nociception
Behavioural Expression
Fear/Anxiety
Environment
Health
Nutrition
Stimulus
Distress:
Mild
Moderate
Marked
Severe
Stress
(Physiological state)
Defined State
Discomfort:
Pain
Suffering
Noncognitive
Cognitive
Awareness
Endocrine Responses
Behaviours
Response
Autonomic Nervous System Responses

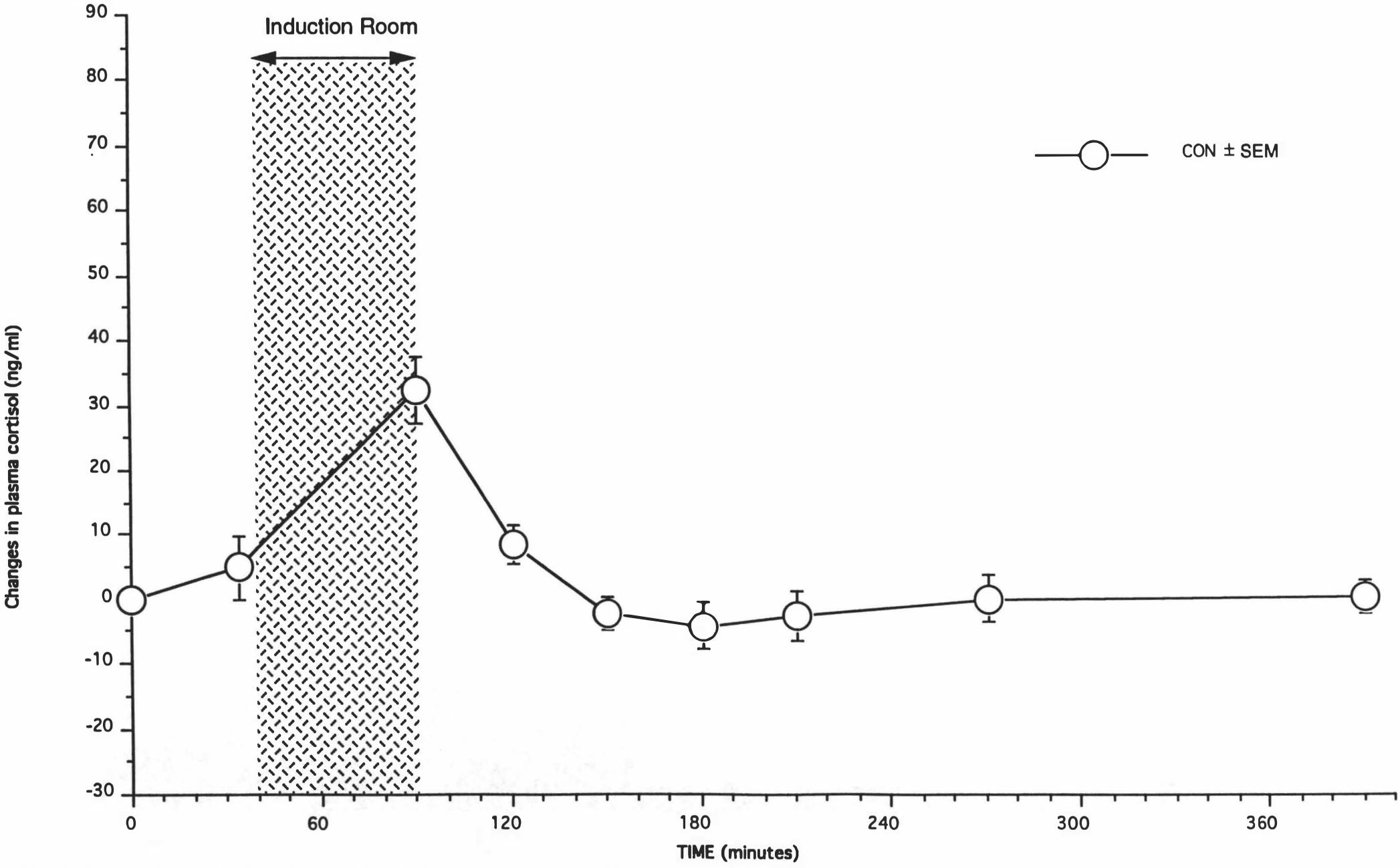


Figure 2.1 Plasma Cortisol Concentration: change from pretreatment value

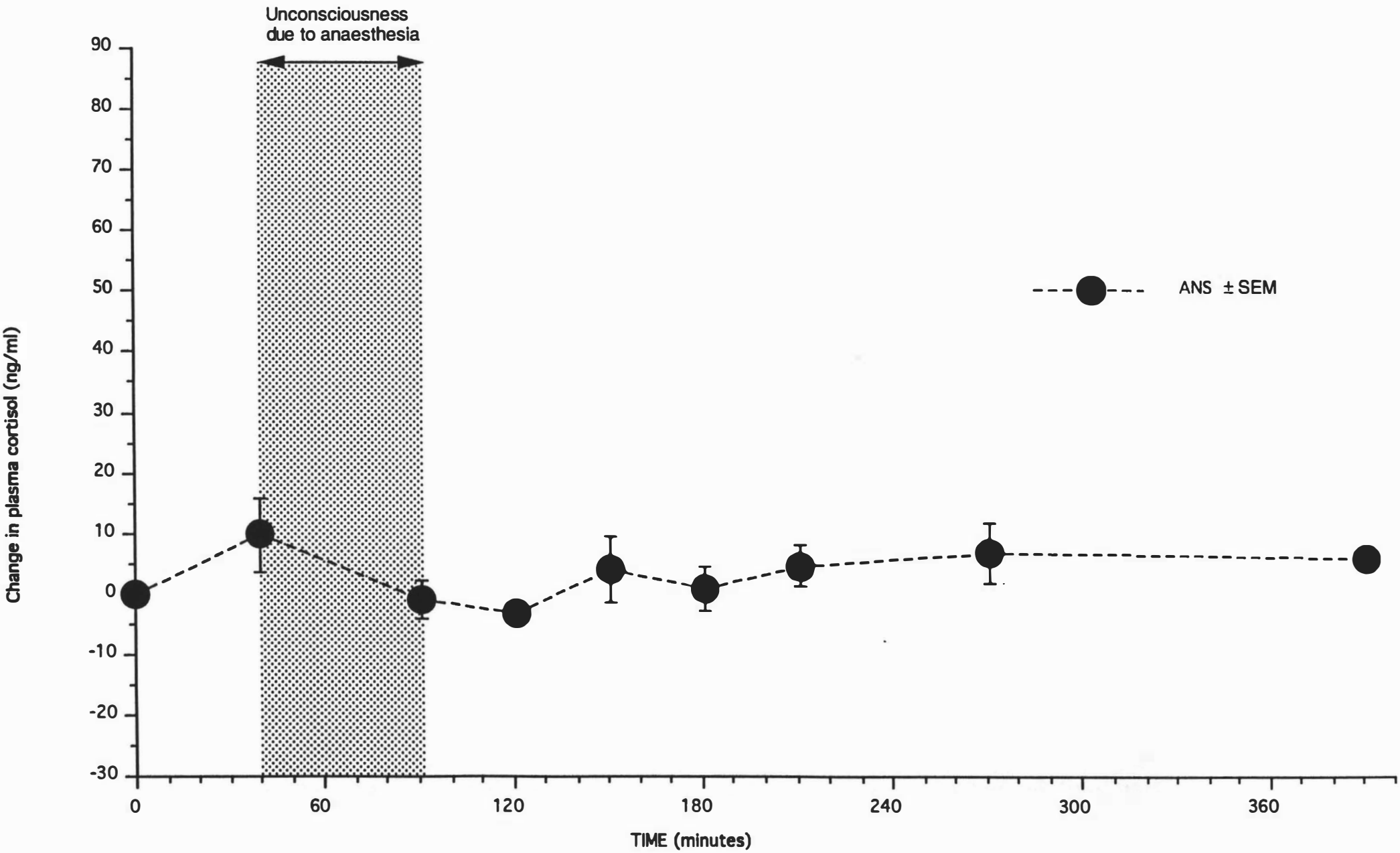


Figure 2. 2 Plasma Cortisol Concentration: change from pretreatment value

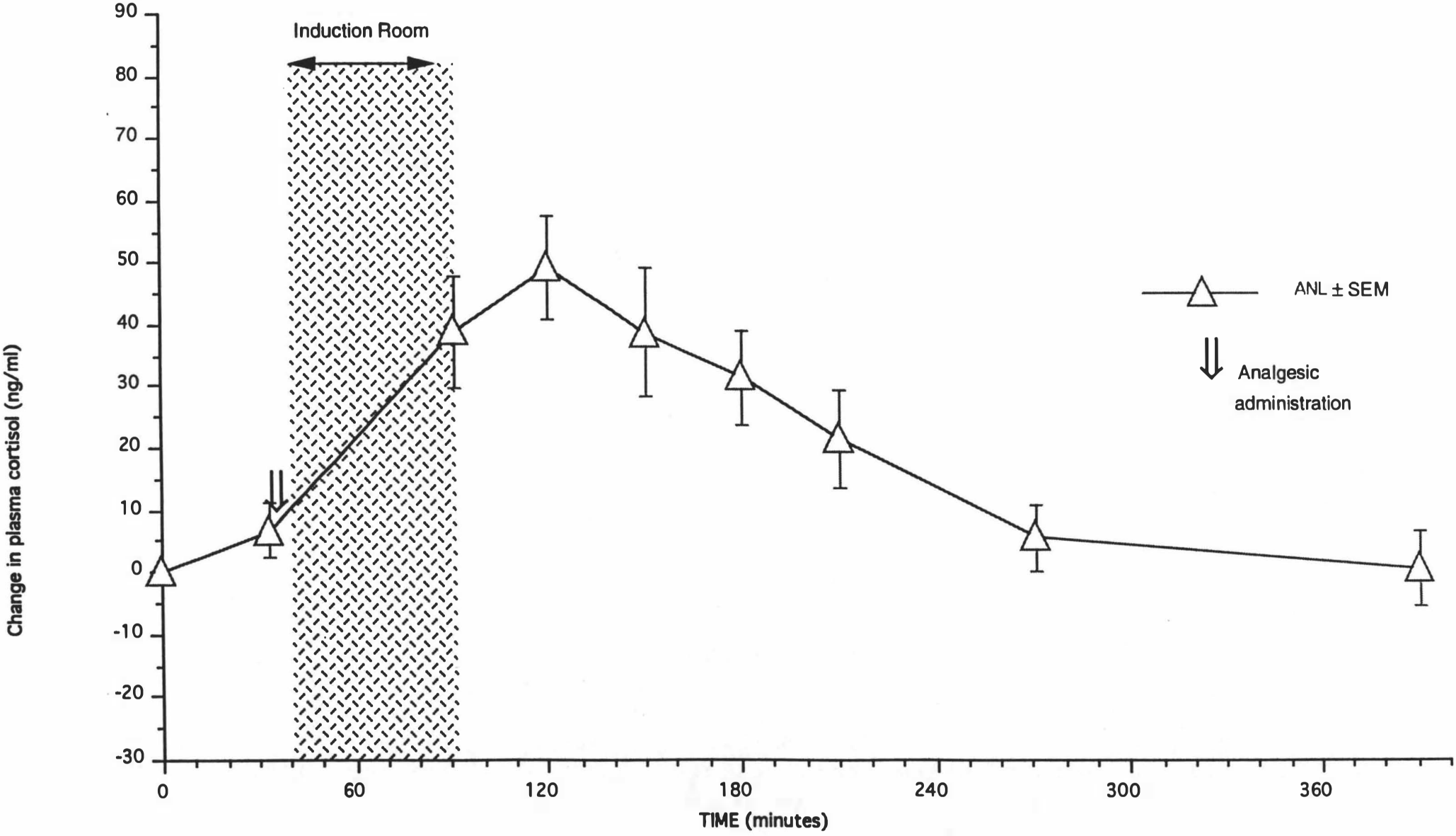


Figure 2.3 Plasma Cortisol Concentration: change from pretreatment value

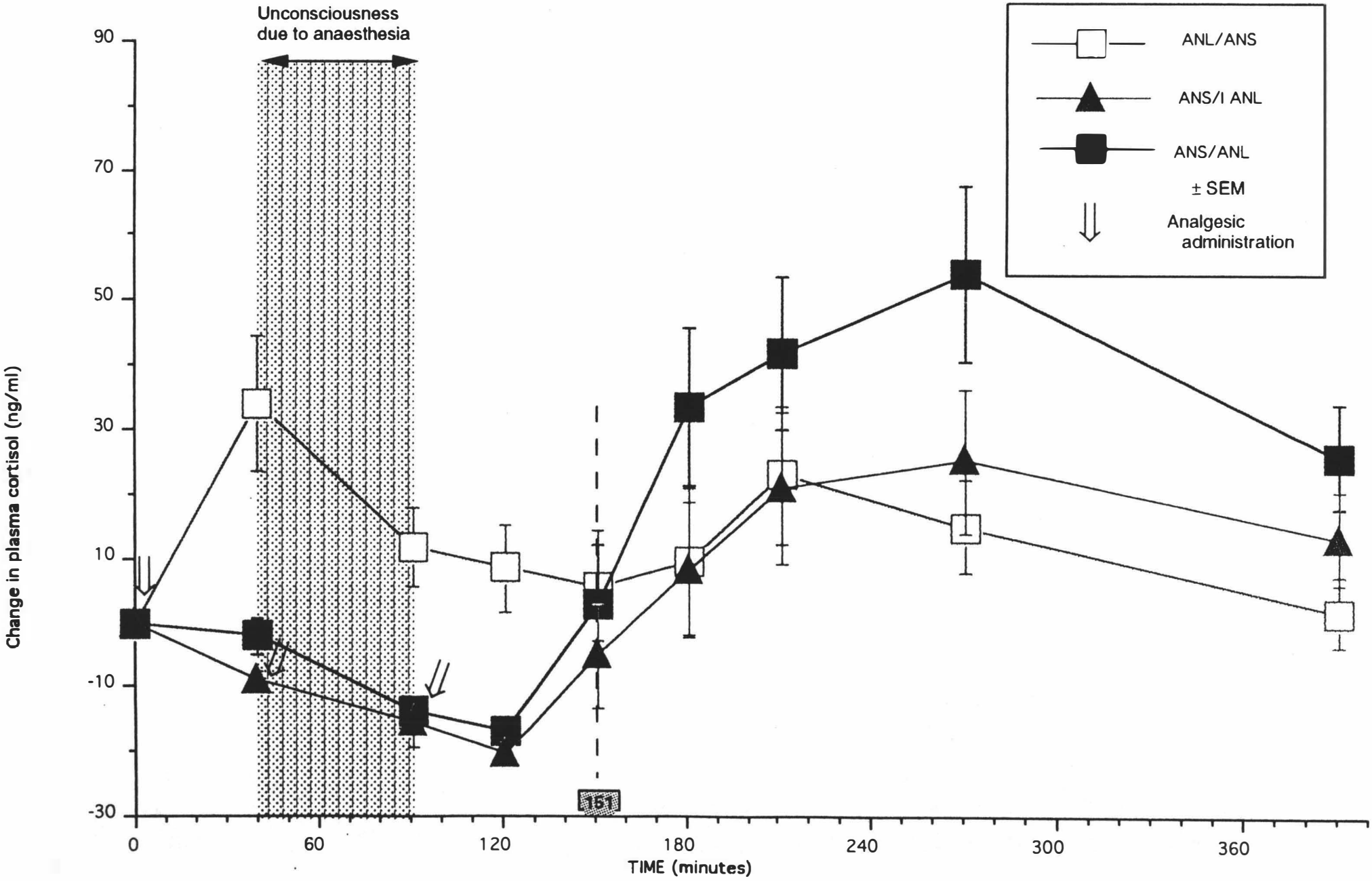


Figure 2.4. Plasma Cortisol Concentration: change from pretreatment value

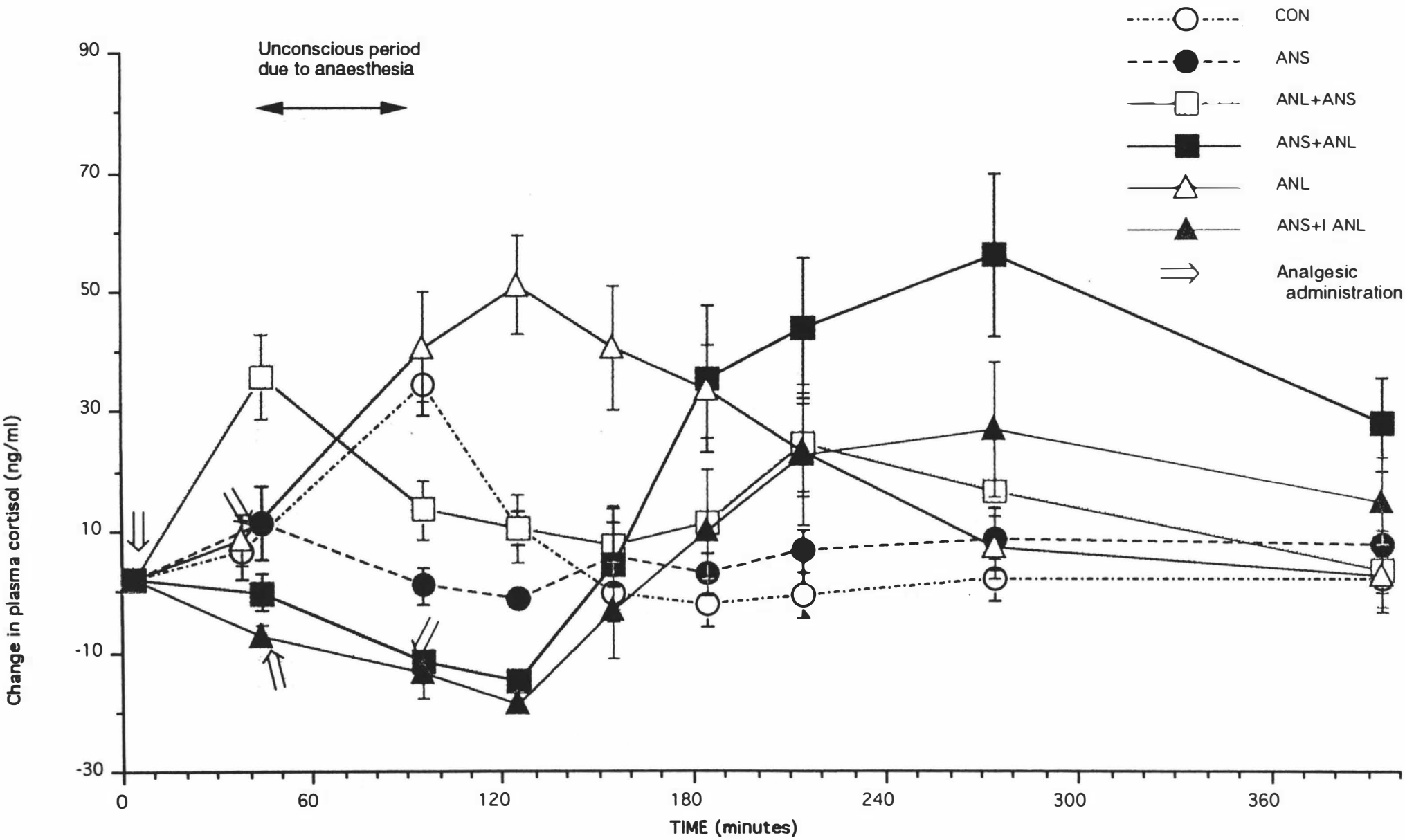


Figure 2.5 Changes in plasma cortisol concentrations from pretreatment values (mean±SEM): 17±3.4, 17±2.2, 23±4.4, 26±4.7, 25±3.6, and 29±5.1 ng/ml for Control (n=11), Anaesthesia (11), Analgesia (11), Analgesia plus Anaesthesia (10), Anaesthesia plus Analgesia (10) and Anaesthesia plus Immediate Analgesia (10)

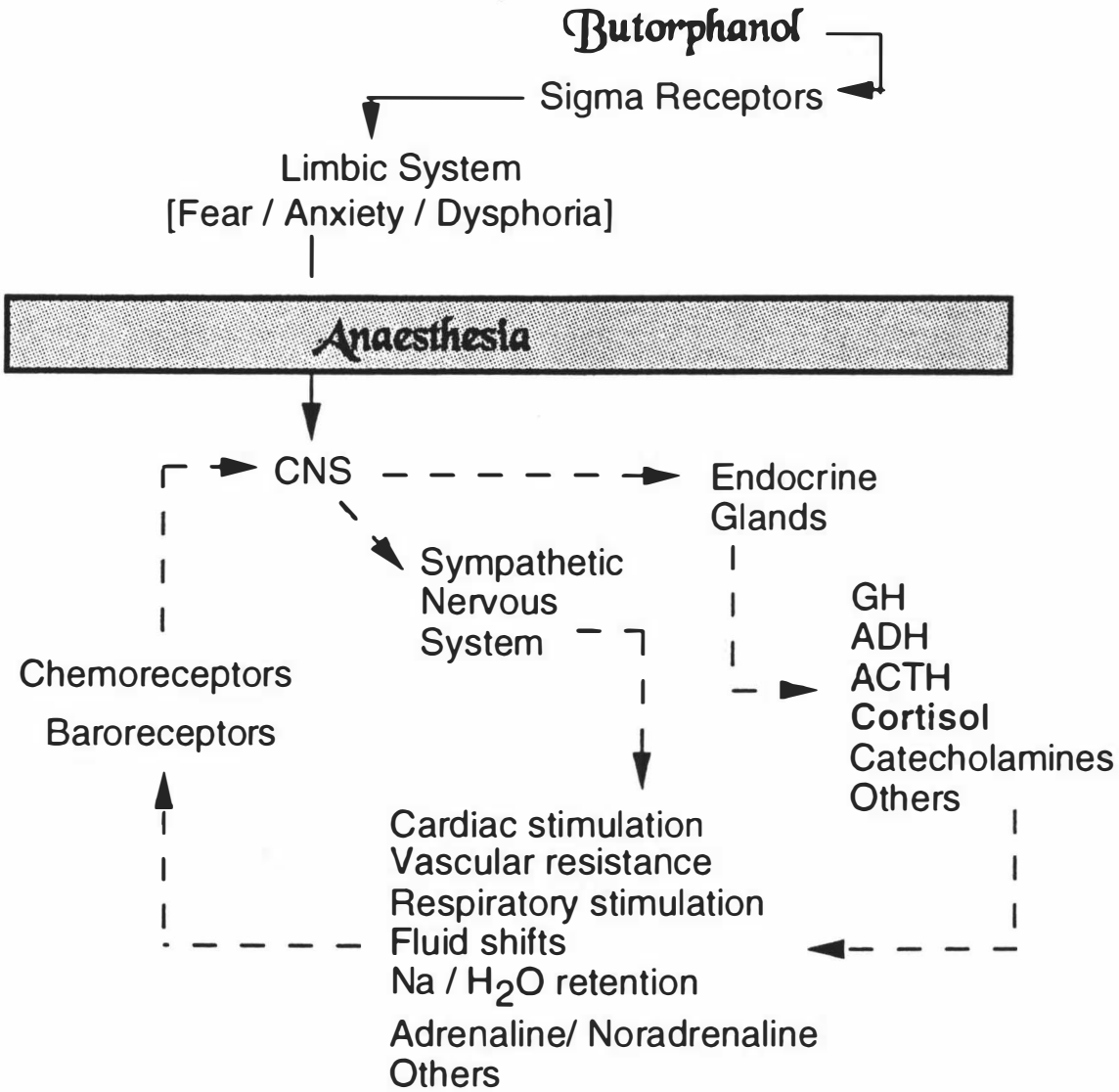


Figure 2.6 Blocking effect of halothane anaesthesia on the cortisol response to butorphanol administration. Several feedback loops (dashed lines) influence the response of cortisol to a cascade of events occurring within the central nervous system. A functional block to the response from butorphanol administration appears to occur in the presence of halothane anaesthesia at the limbic level of the central nervous system.

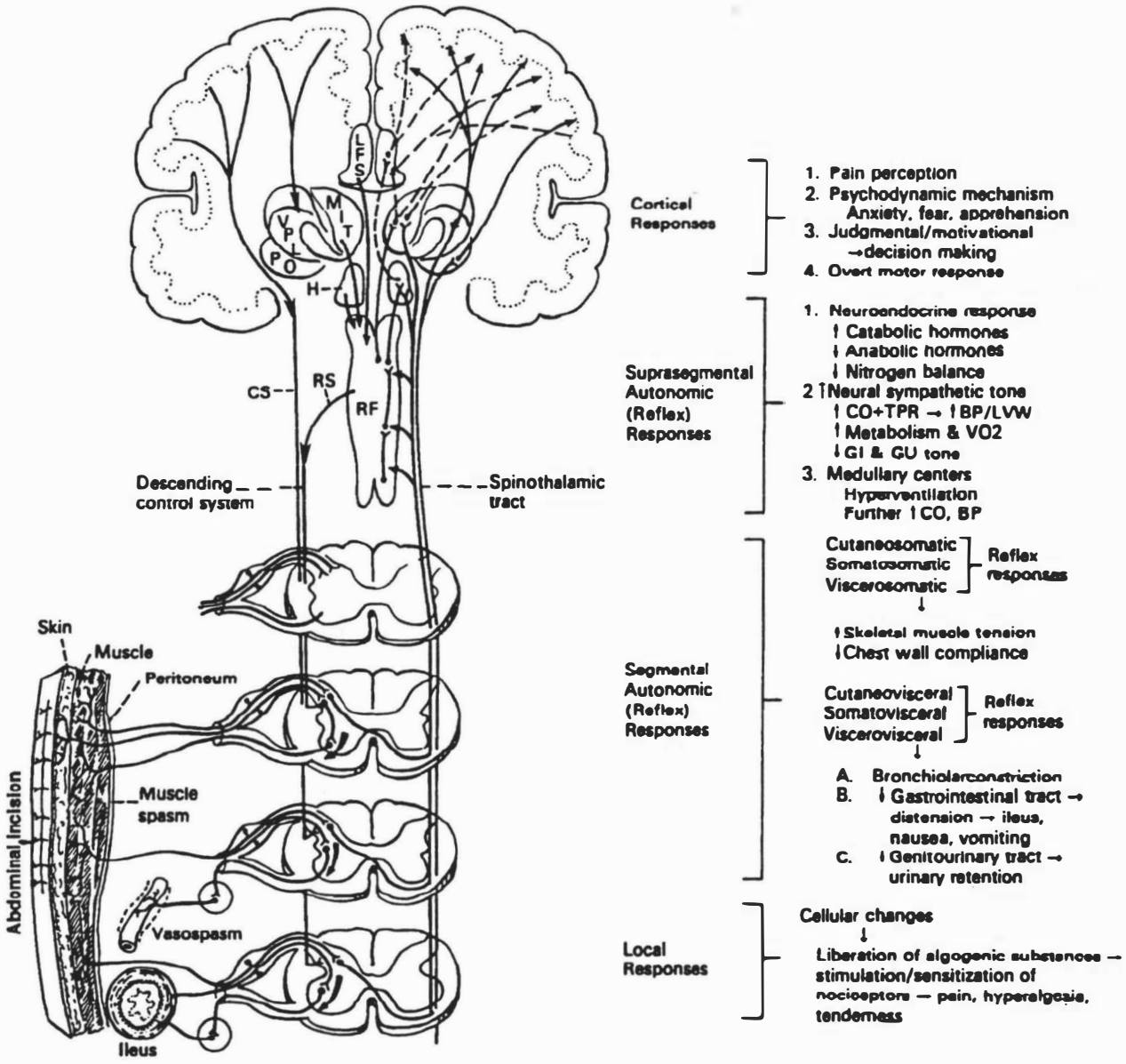


Figure 3.1. Schematic depiction of the responses to noxious stimuli (in humans) induced by trauma during intra-abdominal surgery (LFS, limbic forebrain structure; MIT, medial and intralaminar thalamic nuclei; VPL, ventroposterolateral nucleus; PO, posterior group of thalamic nuclei; H, hypothalamus; CS, central gray substance; RS, rubrospinal tract; and RF, reticular formation). CO, cardiac output; TPR, total peripheral resistance; BP, blood pressure; LVW, left ventricular work; VO2, oxygen consumption; GI, gastrointestinal; GU, genitourinary. (Bonica, 1990: with permission)

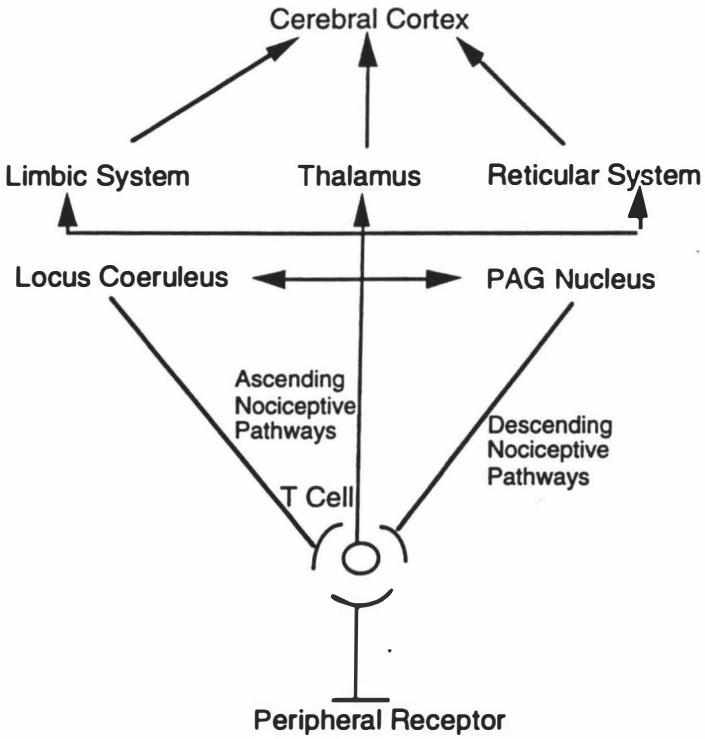


Figure 3.2 Simplified illustration of anatomic structures associated with pain-induced distress.

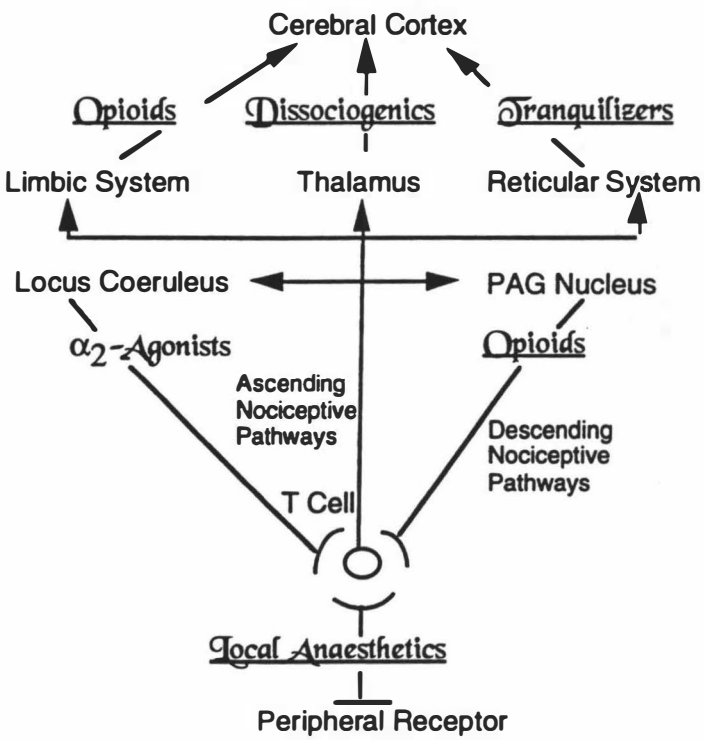


Figure 3.3 Simplified illustration of locations for pharmacological blockade to nociception. PAG = periaqueductal gray. (Many areas have both α2 and opioid receptors.)(Benson and Tranquilli, 1994)

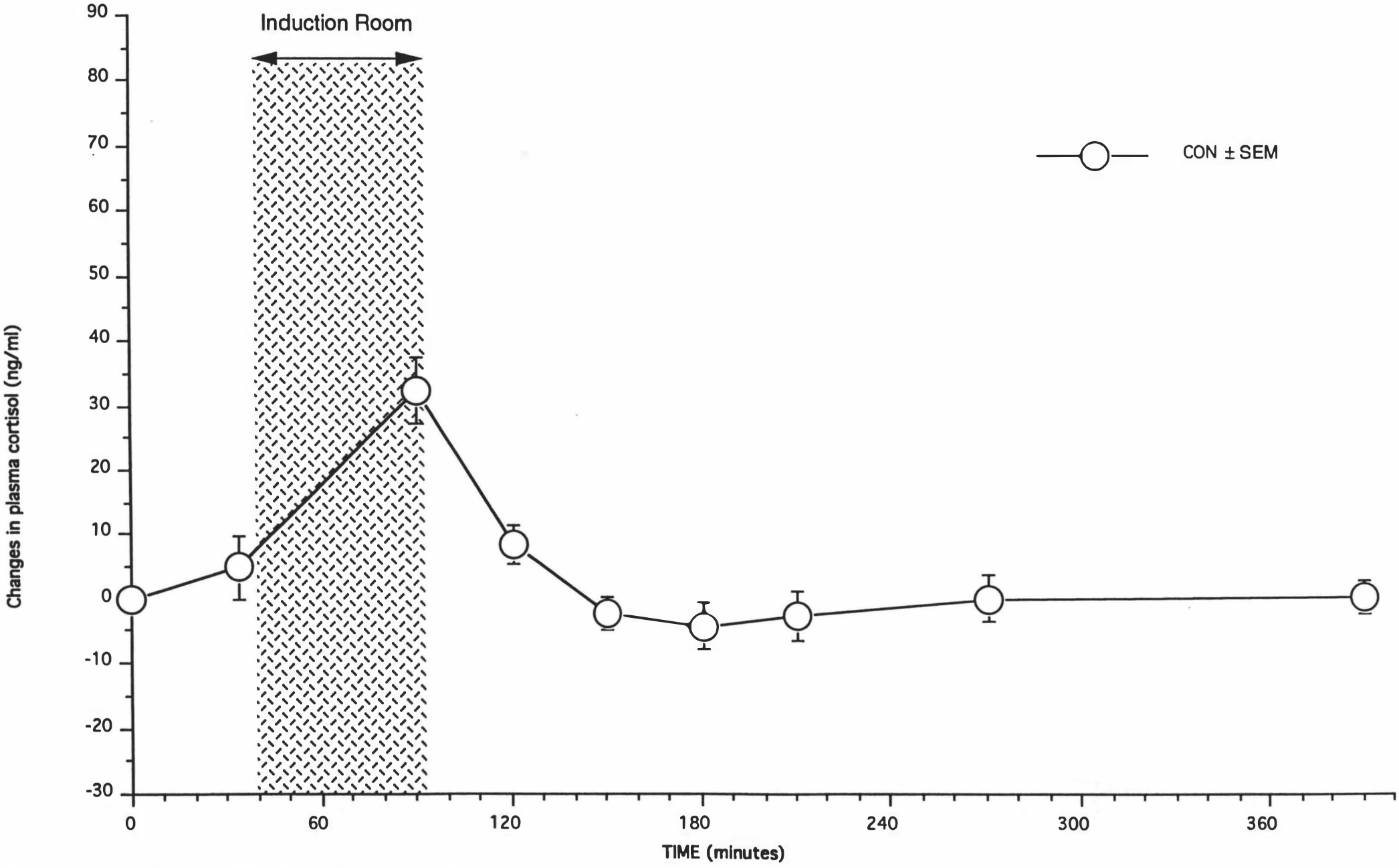


Figure 3.4 Plasma Cortisol Concentration: change from pretreatment value

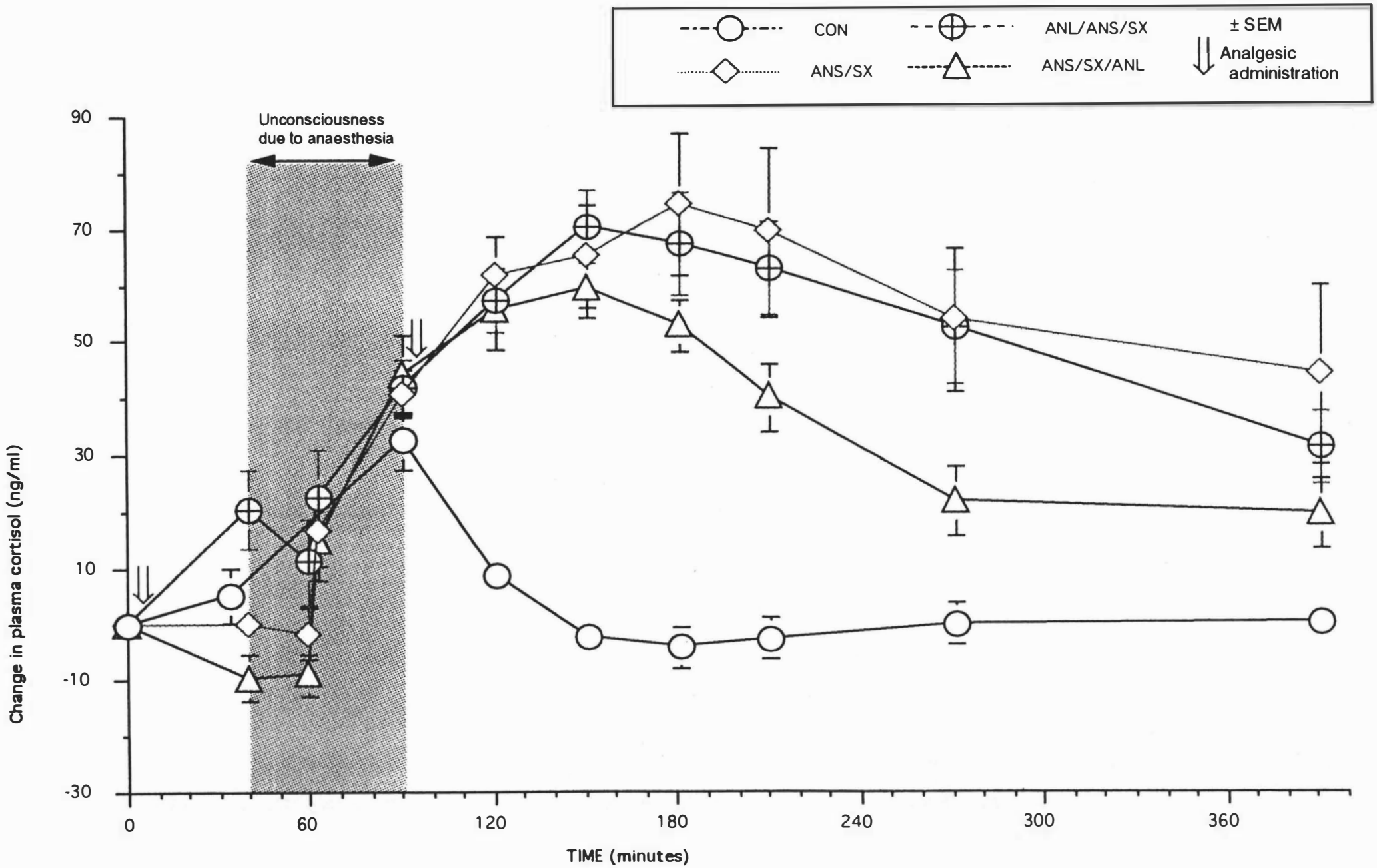


Figure 3.5 . Changes in plasma cortisol concentrations from pretreatment values (Mean±SEM): 17±3.4, 26±3.6, 31±6.5, and 34±5.1 ng/ml for Control (n=11), Anaesthesia plus Surgery (12), Analgesia plus Anaesthesia plus Surgery (10), and Anaesthesia plus Surgery plus Analgesia (10).

Animal_____Date_____Treatment_____

NONINTERACTIVE BEHAVIOUR (MINUTE)

EXTUBATION_____	0-2 min present	3-10 min present	11-30 min frequency	31-60 min frequency
1. Awareness				
1.1 awake	❑	❑	❑	❑
1.2 asleep	❑	❑	❑	❑
2. Stationary positions				
2.1 lateral	❑	❑	❑	❑
2.2 sternal curl	❑	❑	❑	❑
2.3 sternal other	❑	❑	❑	❑
2.4 normal sit	❑	❑	❑	❑
2.5 hang sit	❑	❑	❑	❑
2.6 normal stand	❑	❑	❑	❑
2.7 hang stand	❑	❑	❑	❑
3. Position changes				
3.1 number of changes	❑	❑	❑	❑
3.2 torso weight shifts	❑	❑	❑	❑
Modifiers				
3.3 normal speed	❑	❑	❑	❑
3.4 slow speed	❑	❑	❑	❑
3.5 increased thoracic limb weight bearing	❑	❑	❑	❑
3.6 ataxia	❑	❑	❑	❑
4. Motion				
4.1 (walking: 30 sec)	❑	❑	❑	❑
Modifiers				
4.2 normal speed	❑	❑	❑	❑
4.3 slow speed	❑	❑	❑	❑
4.4 increased thoracic limb weight bearing	❑	❑	❑	❑
4.5 ataxia	❑	❑	❑	❑
4.6 first stand	❑	❑	❑	❑

Animal_____Date_____Treatment_____

EXTUBATION_____		0-2 min present	3-10 min present	11-30 min frequency	31-60 min frequency
5. Activities					
5.1	lip licking	❑	❑	❑	❑
5.2	thrashing	❑	❑	❑	❑
5.3	head nodding	❑	❑	❑	❑
5.4	slo motion cage circling	❑	❑	❑	❑
5.5	normal speed cage circling	❑	❑	❑	❑
5.6	head lifts	❑	❑	❑	❑
5.7	quiet alert (5 min)	❑	❑	❑	❑
5.8	drawing legs up	❑	❑	❑	❑
5.9	stretching	❑	❑	❑	❑
5.10	cage digging	❑	❑	❑	❑
5.11	cage licking	❑	❑	❑	❑
5.12	door pawing	❑	❑	❑	❑
5.13	cage sniffing	❑	❑	❑	❑
5.14	grooming	❑	❑	❑	❑
5.15	incision licking	❑	❑	❑	❑
5.16	yawning	❑	❑	❑	❑
5.17	pacing	❑	❑	❑	❑
5.18	trembling	❑	❑	❑	❑
5.19	manipulations	❑	❑	❑	❑
5.20	urination	❑	❑	❑	❑
5.21	defecation	❑	❑	❑	❑
5.22	vomition	❑	❑	❑	❑
5.23	salivation	❑	❑	❑	❑
5.24	paddling	❑	❑	❑	❑

Animal_____Date_____Treatment_____

EXTUBATION_____		0-2 min present	3-10 min present	11-30 min frequency	31-60 min frequency
5.25	Look back	❑	❑	❑	❑
5.26	bandage chew	❑	❑	❑	❑
5.27	IV licking	❑	❑	❑	❑
6.	Breathing				
6.1	pant	❑	❑	❑	❑
6.2	normal	❑	❑	❑	❑
7.	Vocalization				
7.1	whine	❑	❑	❑	❑
7.2	bark	❑	❑	❑	❑
7.3	groan/moan	❑	❑	❑	❑
7.4	howl	❑	❑	❑	❑

Animal_____Date_____Treatment_____

NONINTERACTIVE BEHAVIOUR (1-5 HOURS)

EXTUBATION_____	Pre Sx	1-2	2-3	3-4	4-5
1. Stationary major behaviours					
1.1 lateral rest or sleep	❑	❑	❑	❑	❑
1.2 sternal curl (head on front or rear leg)	❑	❑	❑	❑	❑
1.3 sternal rest or sleep	❑	❑	❑	❑	❑
1.4 lateral awake	❑	❑	❑	❑	❑
1.5 sternal awake	❑	❑	❑	❑	❑
1.6 sit alert	❑	❑	❑	❑	❑
1.6.5 sit other (lazy)	❑	❑	❑	❑	❑
1.6.6 hang sit	❑	❑	❑	❑	❑
1.7 hang stand (15 sec)	❑	❑	❑	❑	❑
1.8 normal stand	❑	❑	❑	❑	❑
2. Position Changes					
2.1 Slow motion posit changes	❑	❑	❑	❑	❑
2.2 norm speed posit changes	❑	❑	❑	❑	❑
2.3 torso weight shifts (not standing)	❑	❑	❑	❑	❑
2.4 thoracic limb weight shifts (standing or sitting)	❑	❑	❑	❑	❑
2.5 drawing legs up	❑	❑	❑	❑	❑
2.6 stretching	❑	❑	❑	❑	❑
3. Movement behaviours					
3.1 attention seeking (5 min) (whining or pawing)	❑	❑	❑	❑	❑
3.2 normal speed cage circling (360 in 15 sec)	❑	❑	❑	❑	❑
3.3 slow speed cage circling (360 in > 1 min)	❑	❑	❑	❑	❑
3.4 escape behaviour (> 5 min)	❑	❑	❑	❑	❑

Animal_____Date_____Treatment_____

EXTUBATION_____	Pre Sx	1-2	2-3	3-4	4-5
4. Short behaviours					
4.1 head lifts	❑	❑	❑	❑	❑
4.2 lip licking	❑	❑	❑	❑	❑
4.3 whine	❑	❑	❑	❑	❑
4.4 cage sniffing	❑	❑	❑	❑	❑
4.5 thrashing	❑	❑	❑	❑	❑
4.6 grooming	❑	❑	❑	❑	❑
4.7 yawning (no vocalization)	❑	❑	❑	❑	❑
4.8 cage licking	❑	❑	❑	❑	❑
4.8.5 door biting	❑	❑	❑	❑	❑
4.9 breathing, pant	❑	❑	❑	❑	❑
4.10 breathing, normal	❑	❑	❑	❑	❑
4.11 urination	❑	❑	❑	❑	❑
4.12 defecation	❑	❑	❑	❑	❑
4.13 cage digging	❑	❑	❑	❑	❑
4.14 door pawing	❑	❑	❑	❑	❑
4.15 head nodding	❑	❑	❑	❑	❑
4.16 incision licking	❑	❑	❑	❑	❑
4.18 bark	❑	❑	❑	❑	❑
4.19 groan/moan	❑	❑	❑	❑	❑
4.20 howl	❑	❑	❑	❑	❑
4.21 pacing (15 sec)	❑	❑	❑	❑	❑
4.22 ataxia	❑	❑	❑	❑	❑
4.23 trembling	❑	❑	❑	❑	❑
4.24 manipulation behaviours	❑	❑	❑	❑	❑
4.25 vomition	❑	❑	❑	❑	❑
4.26 salivation	❑	❑	❑	❑	❑
4.27 look back	❑	❑	❑	❑	❑

Animal_____Date_____Treatment_____

EXTUBATION_____	Pre Sx	1-2	2-3	3-4	4-5
4.28 IV licking	❑	❑	❑	❑	❑
4.29 stand	❑	❑	❑	❑	❑
4.30 bandage chew	❑	❑	❑	❑	❑
4.31 door biting	❑	❑	❑	❑	❑

Animal_____Date_____Treatment_____

PALPATION BEHAVIOUR

EXTUBATION_____	Pre-Sx	0.5	1.0	1.5	2.0	3.0	5.0	24hr
1. Starting positions								
1.1 lateral	❑	❑	❑	❑	❑	❑	❑	❑
1.2 sternal	❑	❑	❑	❑	❑	❑	❑	❑
1.3 sit	❑	❑	❑	❑	❑	❑	❑	❑
1.4 stand	❑	❑	❑	❑	❑	❑	❑	❑
2. Postion changes								
2.1 yes	❑	❑	❑	❑	❑	❑	❑	❑
2.2 no	❑	❑	❑	❑	❑	❑	❑	❑
3. End position								
3.1 lateral	❑	❑	❑	❑	❑	❑	❑	❑
3.2 sternal	❑	❑	❑	❑	❑	❑	❑	❑
3.3 sit	❑	❑	❑	❑	❑	❑	❑	❑
3.4 stand	❑	❑	❑	❑	❑	❑	❑	❑
4. Head position								
4.1 high	❑	❑	❑	❑	❑	❑	❑	❑
4.2 level	❑	❑	❑	❑	❑	❑	❑	❑
4.3 lowered	❑	❑	❑	❑	❑	❑	❑	❑
4.4 hang	❑	❑	❑	❑	❑	❑	❑	❑
4.5 rest on surface	❑	❑	❑	❑	❑	❑	❑	❑
4.6 high alert (ears forward)	❑	❑	❑	❑	❑	❑	❑	❑
4.7 scooping	❑	❑	❑	❑	❑	❑	❑	❑
4.8 tilt	❑	❑	❑	❑	❑	❑	❑	❑
4.9 sway	❑	❑	❑	❑	❑	❑	❑	❑
4.10 sudden head lift	❑	❑	❑	❑	❑	❑	❑	❑
5. Ear position								
5.1 forward alert	❑	❑	❑	❑	❑	❑	❑	❑
5.2 neutral	❑	❑	❑	❑	❑	❑	❑	❑
5.3 back	❑	❑	❑	❑	❑	❑	❑	❑
5.4 alternating	❑	❑	❑	❑	❑	❑	❑	❑
5.5 flat to sides	❑	❑	❑	❑	❑	❑	❑	❑

Animal_____Date_____Treatment_____

EXTUBATION_____	Pre-Sx	0.5	1.0	1.5	2.0	3.0	5.0	24hr
6. Eye position								
6.1 glance/avert	❑	❑	❑	❑	❑	❑	❑	❑
6.2 stare ahead (vacant)	❑	❑	❑	❑	❑	❑	❑	❑
6.3 watch	❑	❑	❑	❑	❑	❑	❑	❑
6.4 wary (head away/eyes toward)	❑	❑	❑	❑	❑	❑	❑	❑
6.5 eyebrow lift	❑	❑	❑	❑	❑	❑	❑	❑
6.6 wide-eyed	❑	❑	❑	❑	❑	❑	❑	❑
6.7 sleppy or lidded	❑	❑	❑	❑	❑	❑	❑	❑
6.8 closed	❑	❑	❑	❑	❑	❑	❑	❑
6.9 frantic searching	❑	❑	❑	❑	❑	❑	❑	❑
7. Tail position								
7.1 on surface	❑	❑	❑	❑	❑	❑	❑	❑
7.2 low	❑	❑	❑	❑	❑	❑	❑	❑
7.3 level	❑	❑	❑	❑	❑	❑	❑	❑
7.4 high	❑	❑	❑	❑	❑	❑	❑	❑
7.5 tuck	❑	❑	❑	❑	❑	❑	❑	❑
7.6 high arch	❑	❑	❑	❑	❑	❑	❑	❑
7.7 no wag/curl	❑	❑	❑	❑	❑	❑	❑	❑
7.8 slow wag/curl	❑	❑	❑	❑	❑	❑	❑	❑
7.9 fast wag/curl	❑	❑	❑	❑	❑	❑	❑	❑
8. Vocalizations								
8.1 whine	❑	❑	❑	❑	❑	❑	❑	❑
8.2 bark	❑	❑	❑	❑	❑	❑	❑	❑
8.3 groan/moan	❑	❑	❑	❑	❑	❑	❑	❑
8.4 yelp/scream	❑	❑	❑	❑	❑	❑	❑	❑

Animal_____Date_____Treatment_____

EXTUBATION_____	Pre-Sx	0.5	1.0	1.5	2.0	3.0	5.0	24hr
9. Orientation								
9.1 stare ahead	❑	❑	❑	❑	❑	❑	❑	❑
9.2 sharp belly	❑	❑	❑	❑	❑	❑	❑	❑
9.3 slow belly	❑	❑	❑	❑	❑	❑	❑	❑
9.4 tester (head/neck toward tester)	❑	❑	❑	❑	❑	❑	❑	❑
9.5 deliberate avert (head away from tester)	❑	❑	❑	❑	❑	❑	❑	❑
9.6 hide	❑	❑	❑	❑	❑	❑	❑	❑
10. Breathing								
10.1 normal	❑	❑	❑	❑	❑	❑	❑	❑
10.2 pant	❑	❑	❑	❑	❑	❑	❑	❑
10.3 catch breath	❑	❑	❑	❑	❑	❑	❑	❑
11. Other behaviours								
11.1 lip licking	❑	❑	❑	❑	❑	❑	❑	❑
11.2 arched back	❑	❑	❑	❑	❑	❑	❑	❑
11.3 rigid stance	❑	❑	❑	❑	❑	❑	❑	❑
11.4 extended neck	❑	❑	❑	❑	❑	❑	❑	❑
11.5 retreat	❑	❑	❑	❑	❑	❑	❑	❑
11.6 escape	❑	❑	❑	❑	❑	❑	❑	❑
11.7 restrained	❑	❑	❑	❑	❑	❑	❑	❑
11.8 stretching	❑	❑	❑	❑	❑	❑	❑	❑
11.9 drawing legs up	❑	❑	❑	❑	❑	❑	❑	❑
11.10 lip lift	❑	❑	❑	❑	❑	❑	❑	❑
11.11 bite/snap	❑	❑	❑	❑	❑	❑	❑	❑

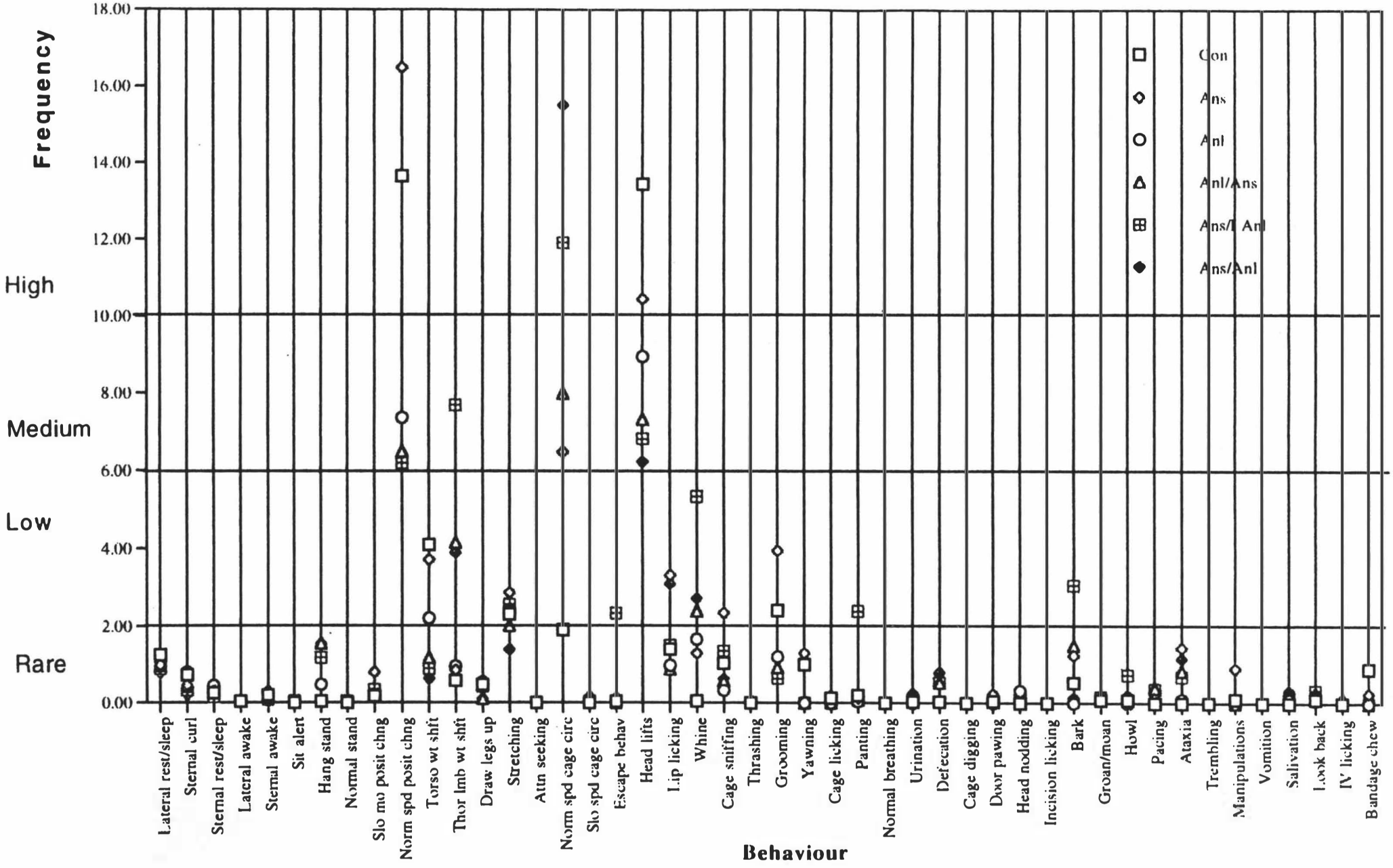


Figure 4.4 Averaged occurrence for each noninteractive hourly behaviour in each nonsurgical treatment. Values plotted represent the average of each behaviour over hours 2-5, inclusive.

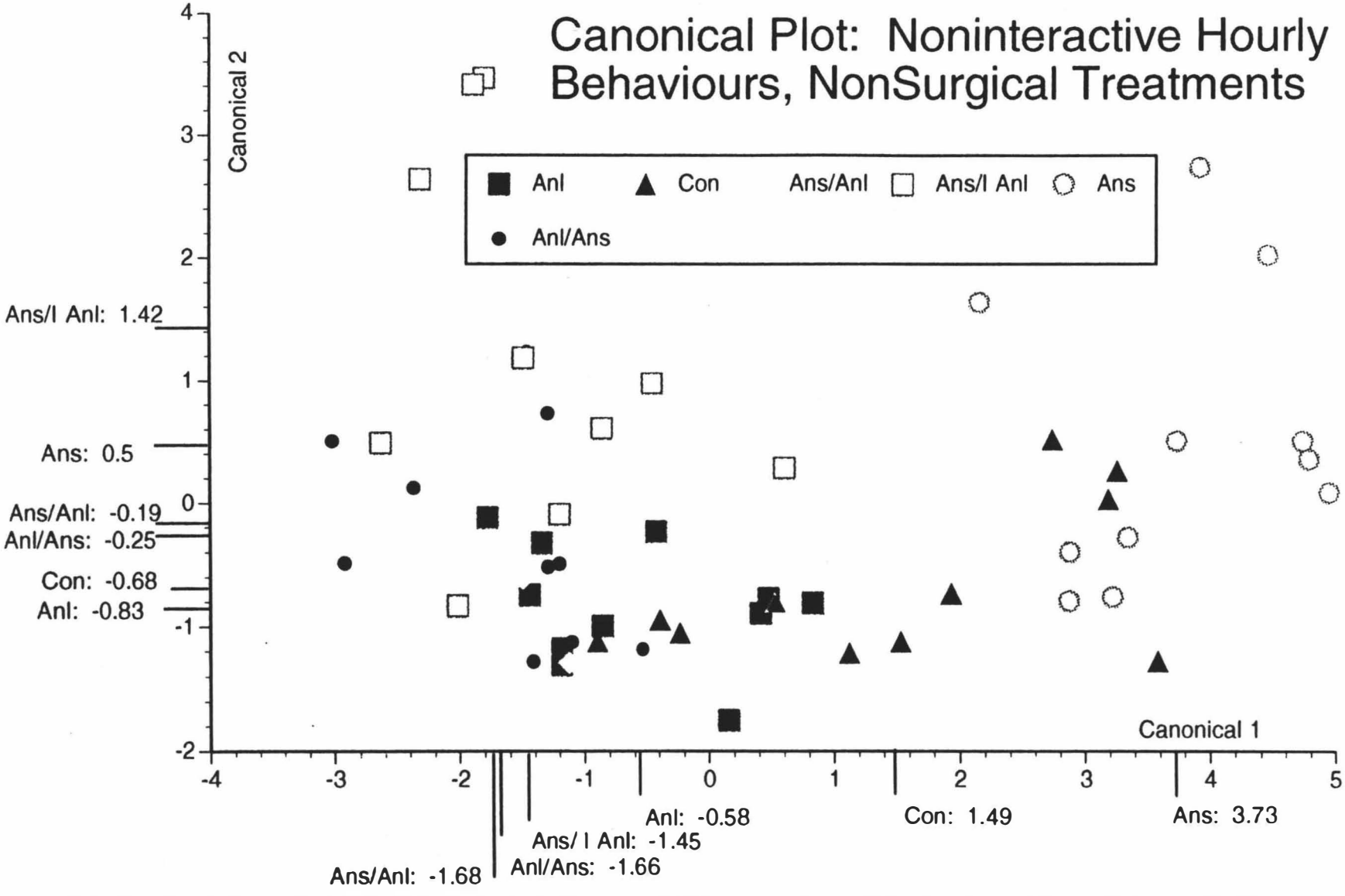


Figure 4.5a Canonical plot of noninteractive hourly behaviours for the nonsurgical treatments. Values plotted for each bitch in each treatment are canonical discriminant functions (Z), which consists of contributing behaviours (V) with weighting coefficients (c); ie., $Z_1 = c_1V_1 + c_2V_2$ + .etc.. Lines off the axis are group means.

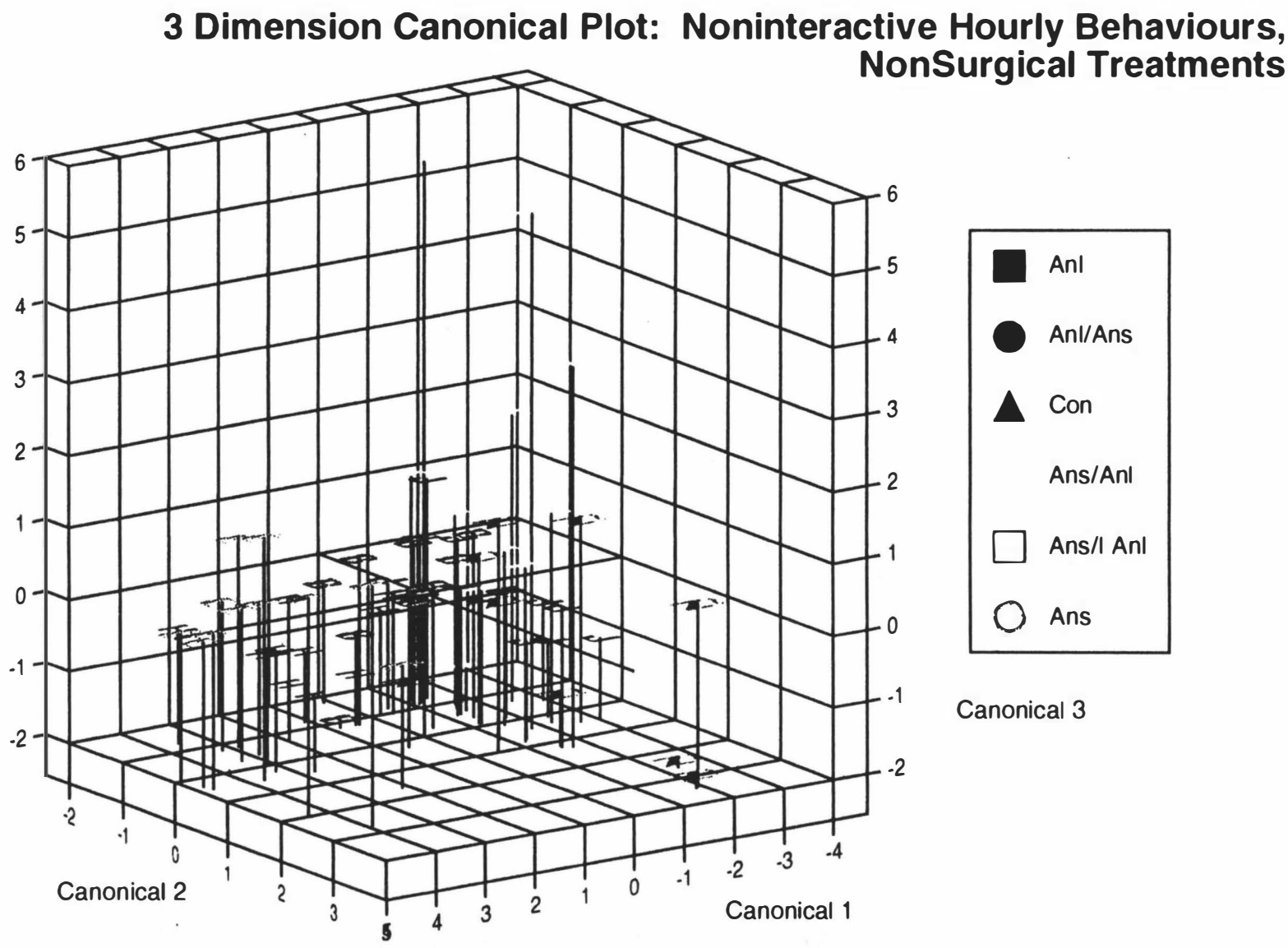


Figure 4.5b 3 dimension plot of noninteractive hourly behaviours for the nonsurgical treatments. Data plotted is the same as in Figure 4.4a, but with inclusion of the third canonical discriminant function which represents approximately 7% of the between-group differences for this data set.

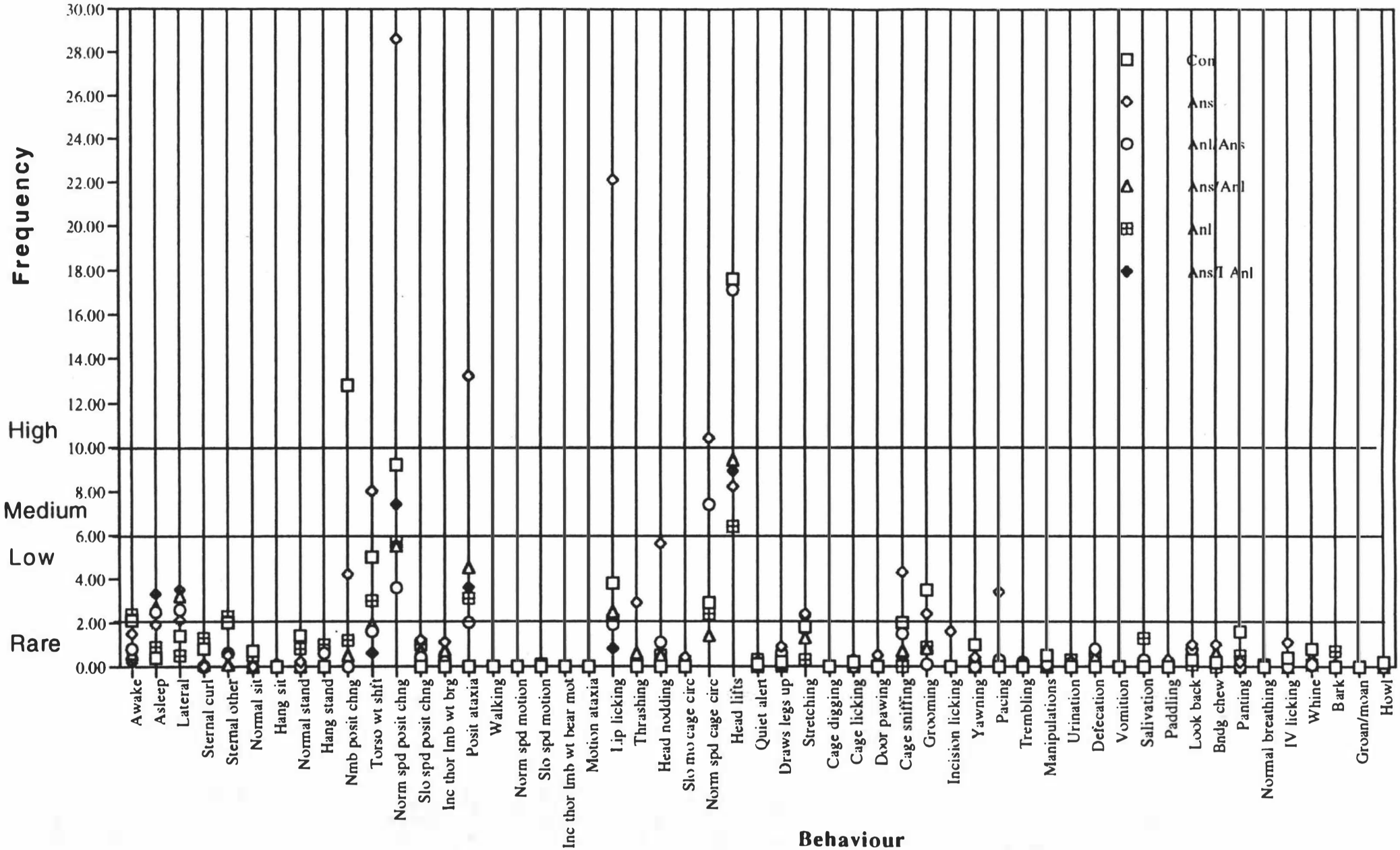


Figure 4.6 Totaled occurrence for each noninteractive minute behaviour in each nonsurgical group. Values plotted represent the total of each behaviour for each group from 91-151 minutes.

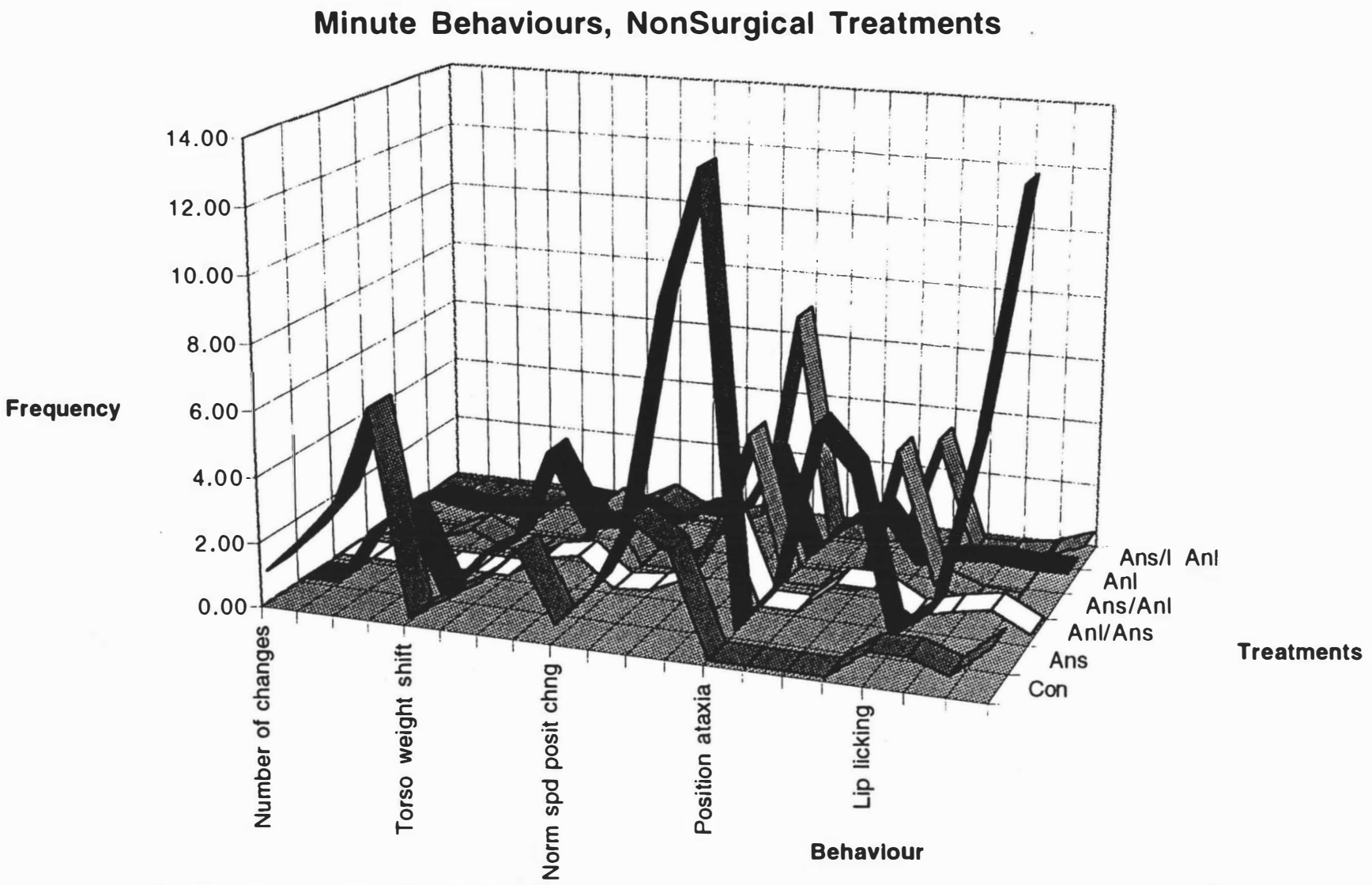


Figure 4.7a 3 dimension graph of minute behaviours for the nonsurgical treatments. Each sequence of 4 points from a stated behaviour is continuous; however, the break between different behaviours is not shown.

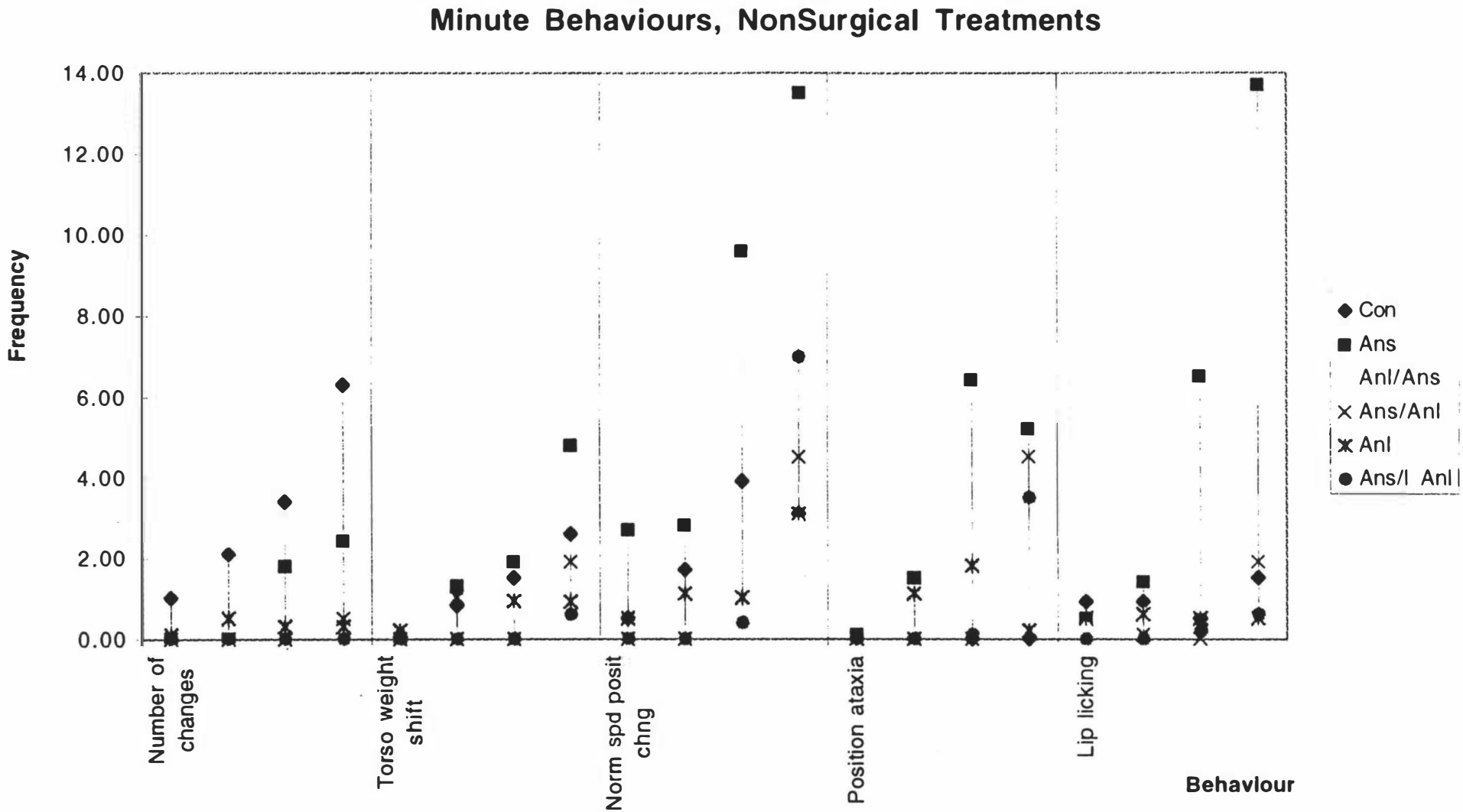


Figure 4.7b 2 dimension graph of minute behaviours for the nonsurgical tretments. This is the same data as appears in Figure 4.7a. The four intervals following a stated behaviour are: 0-2 min., 3-10 min., 11-30 min. and 31-60 min.

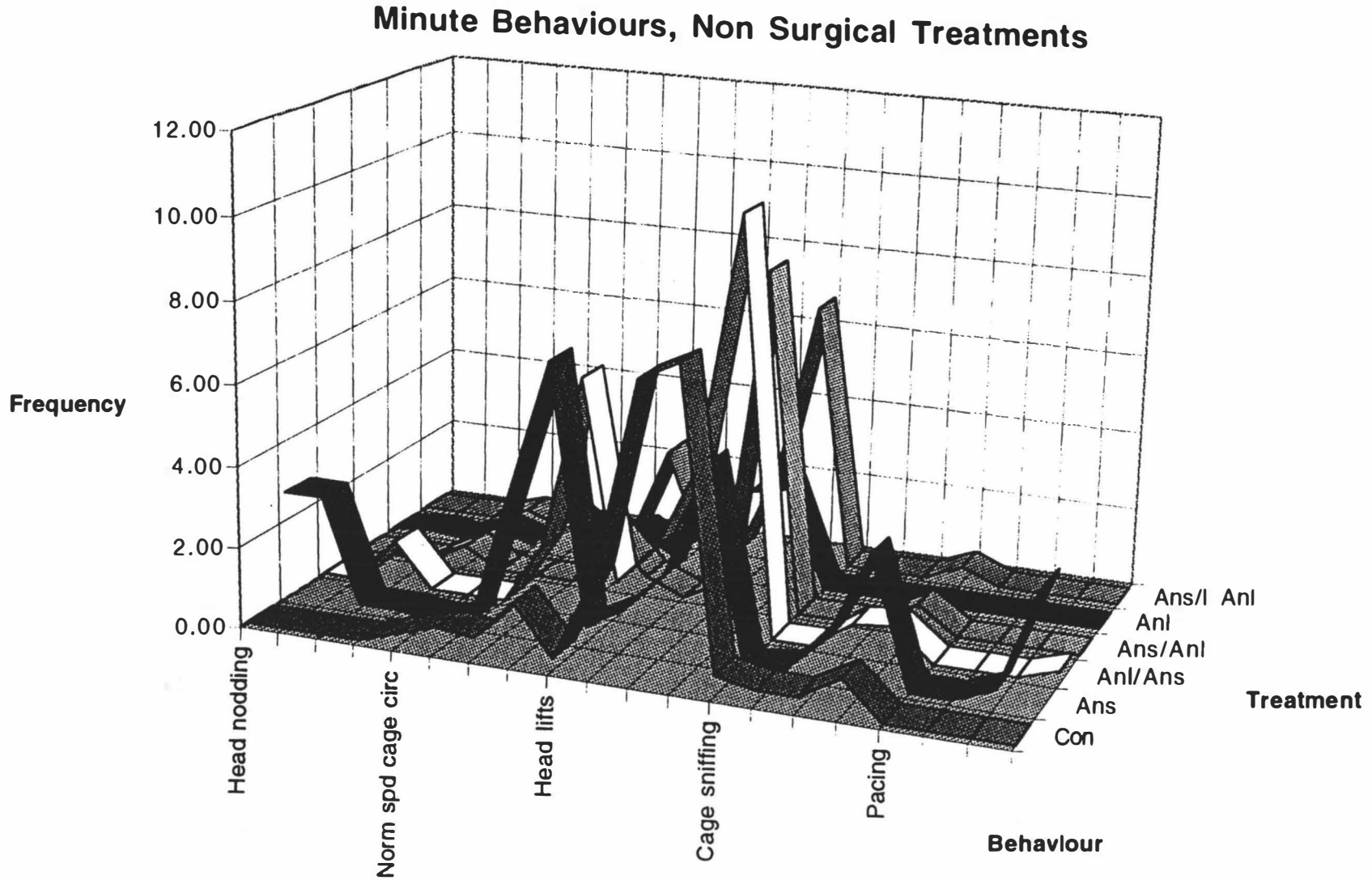


Figure 4.8a 3 dimension graph of minute behaviours for the nonsurgical treatments. Each sequence of 4 points from a stated behaviour is continuous; however, the break between different behaviours is not shown.

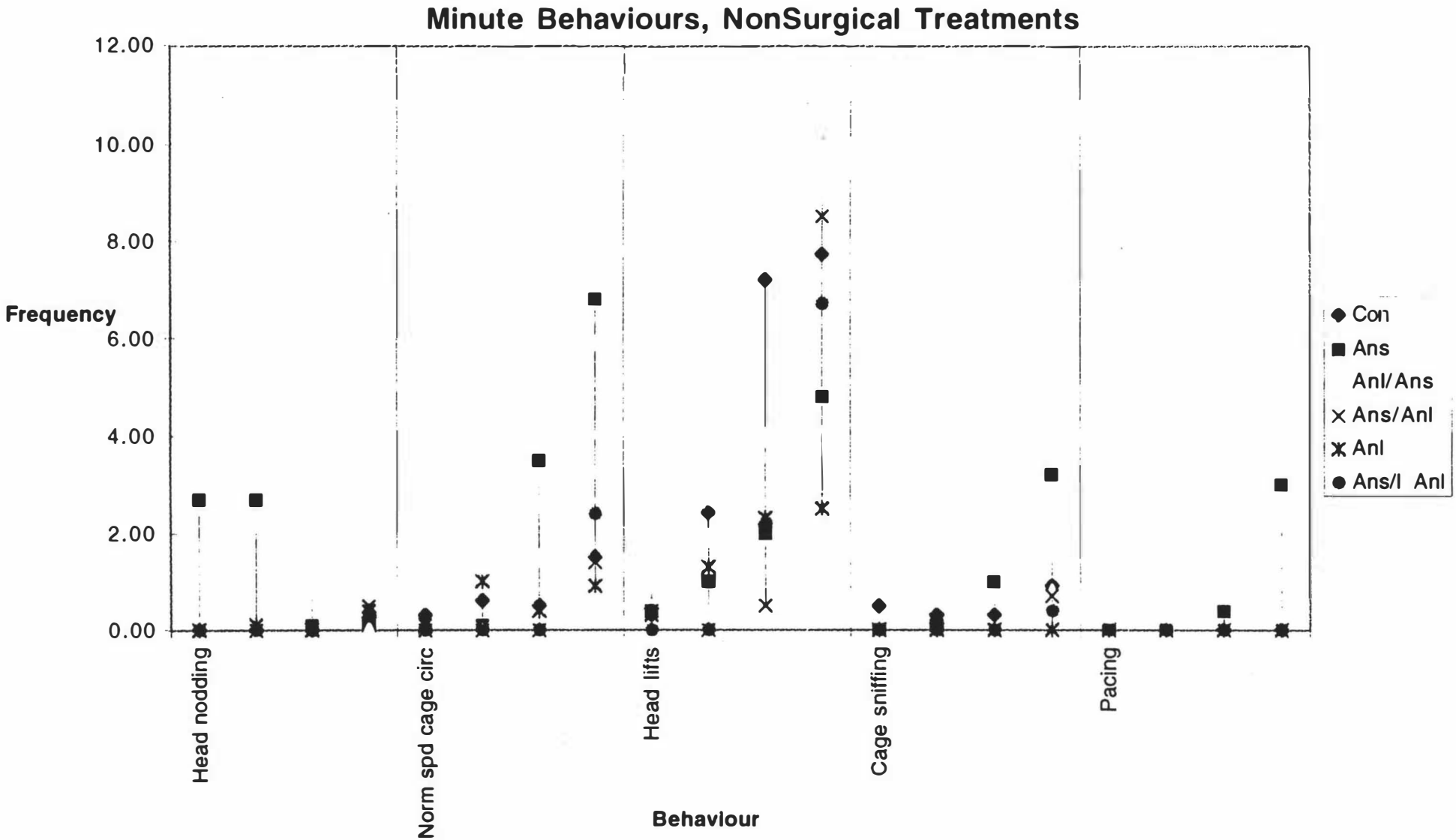


Figure 4.8b 2 dimension graph of minute behaviours for the nonsurgical treatments. This is the same data as appears in Figure 4.8a. The four intervals following a stated behaviour are: 0-2 min., 3-10 min., 11-30 min. and 31-60 min.

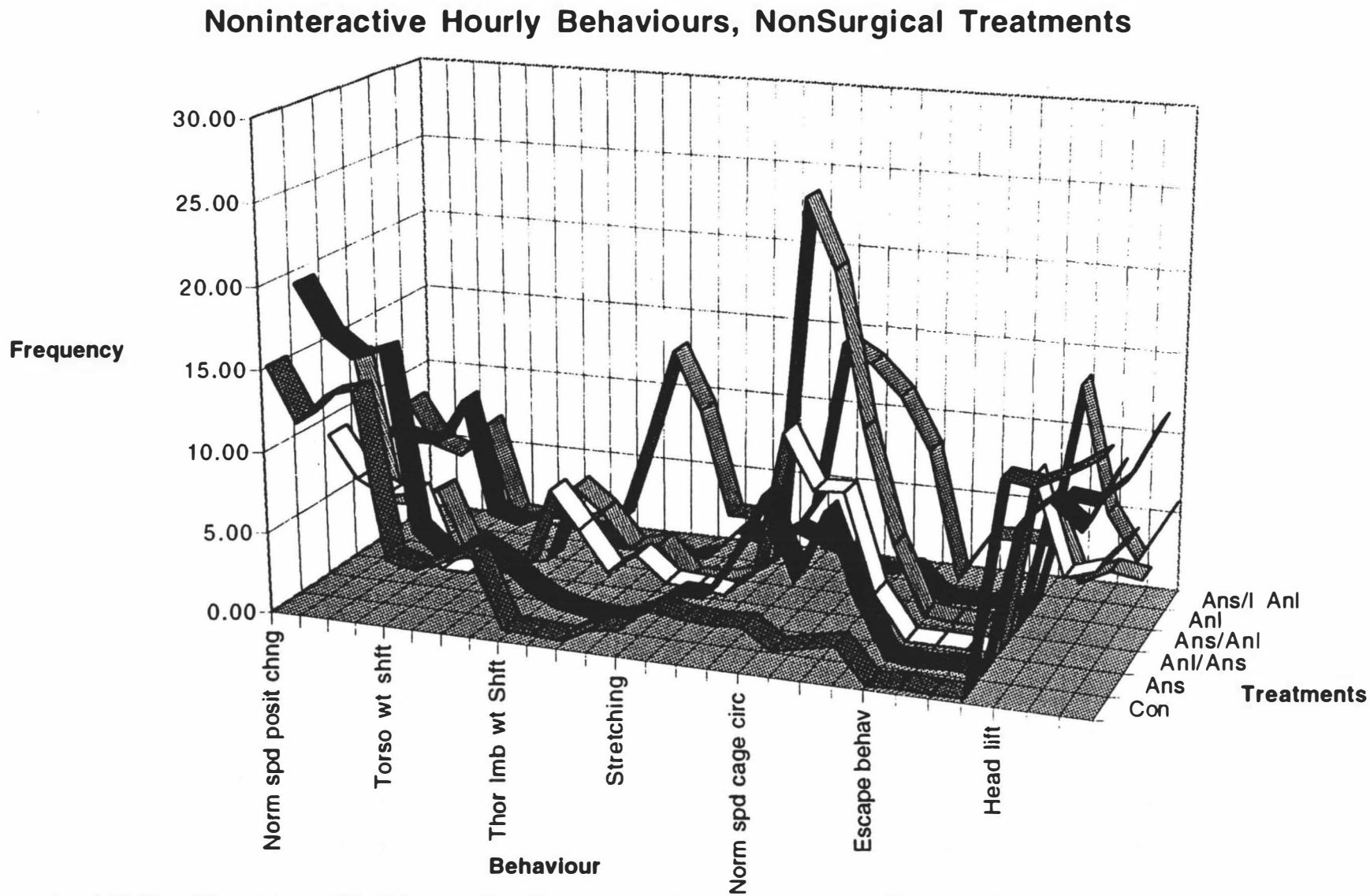


Figure 4.9a 3 dimension graph of noninteractive hourly behaviours for the nonsurgical treatments. Each sequence of 4 points from a stated behaviour is continuous; however, the break between different behaviours is not shown.

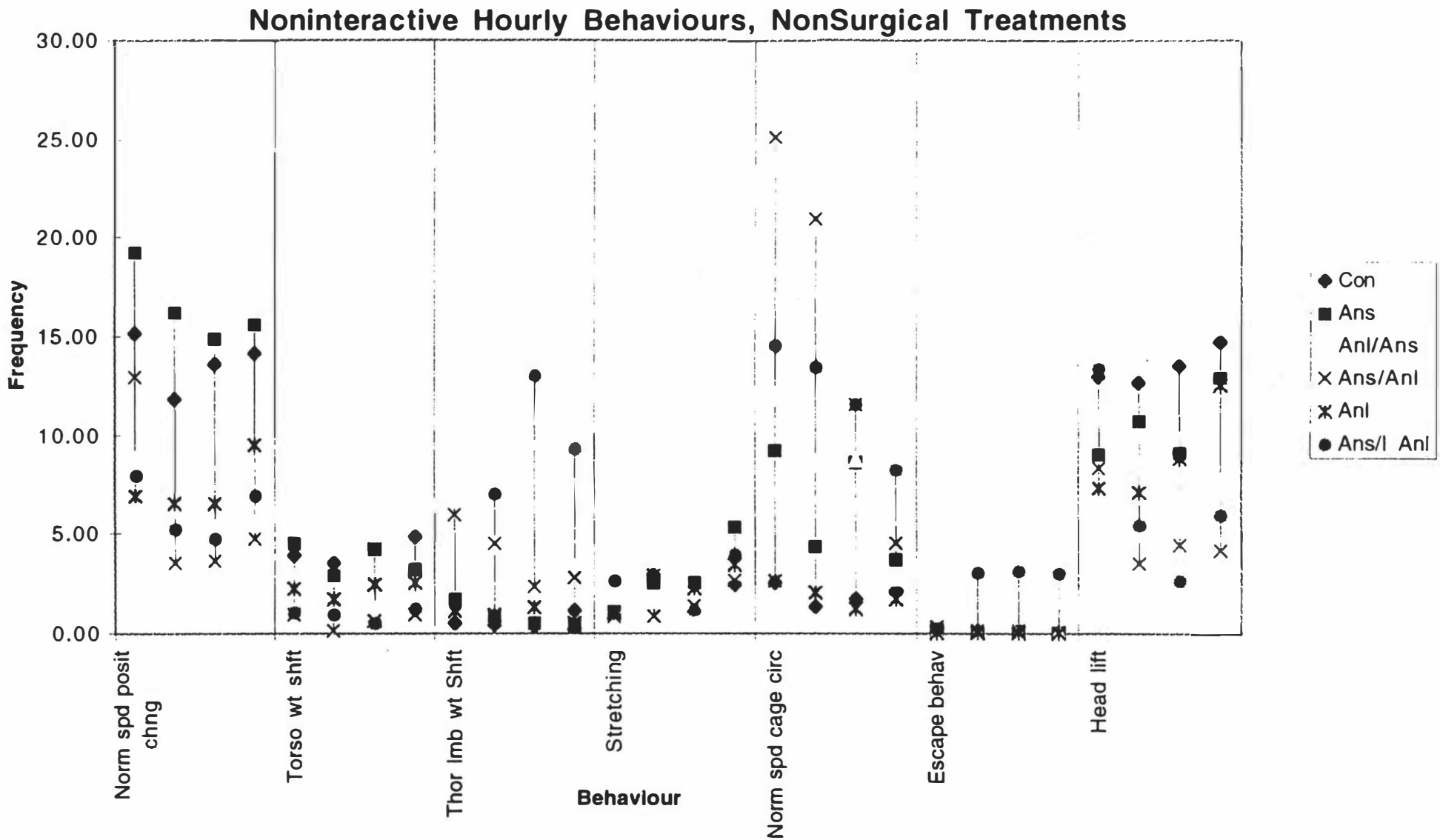


Figure 4.9b 2 dimension graph of noninteractive hourly behaviours for the nonsurgical treatments. This is the same data as appears in Figure 4.9a. The four intervals following a stated behaviour are: 2nd, 3rd, 4th and 5th hour after extubation.

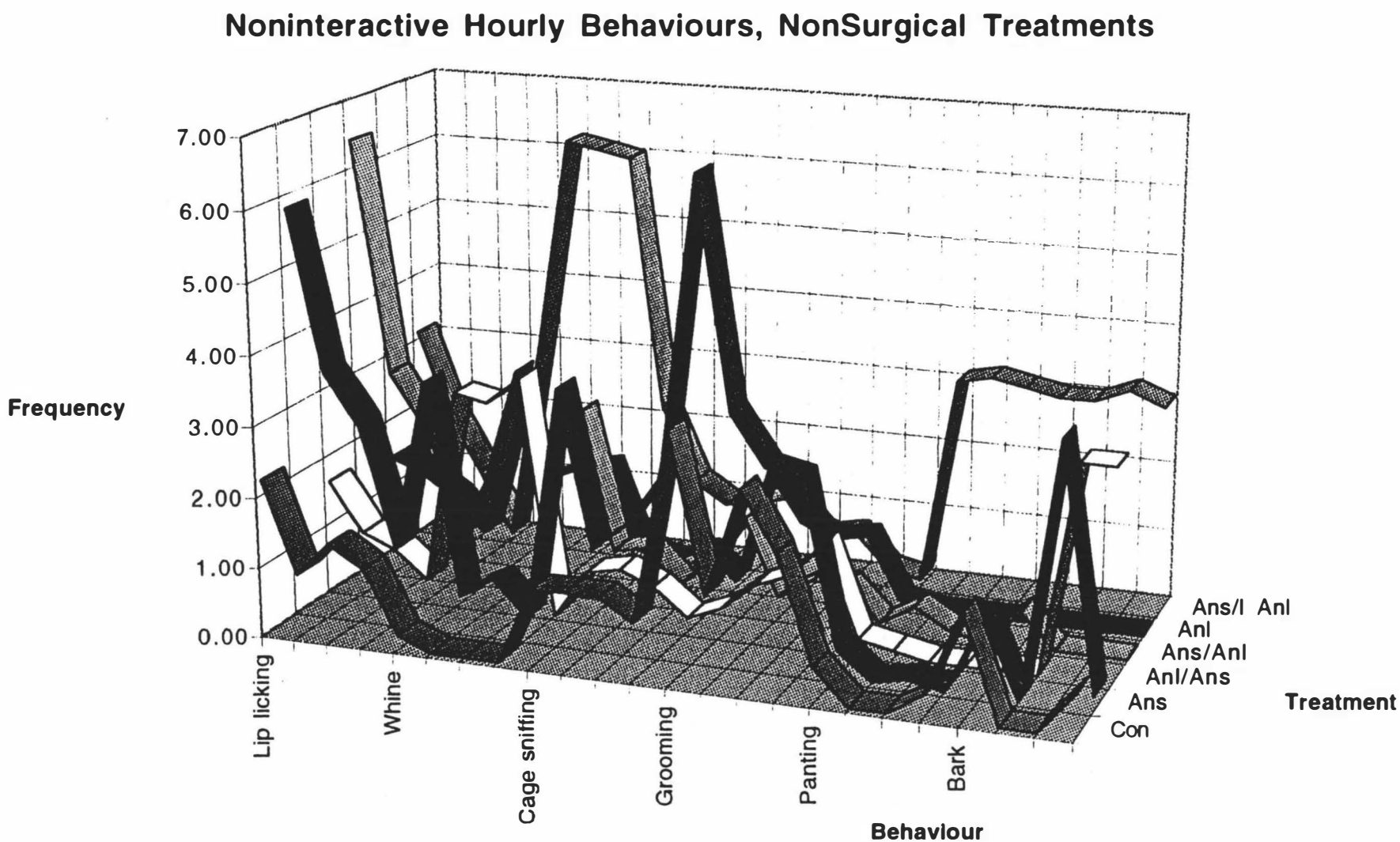


Figure 4.10a 3 dimension graph of noninteractive hourly behaviours for the nonsurgical treatments. Each sequence of 4 points from a stated behaviour is continuous; however, the break between different behaviours is not shown.

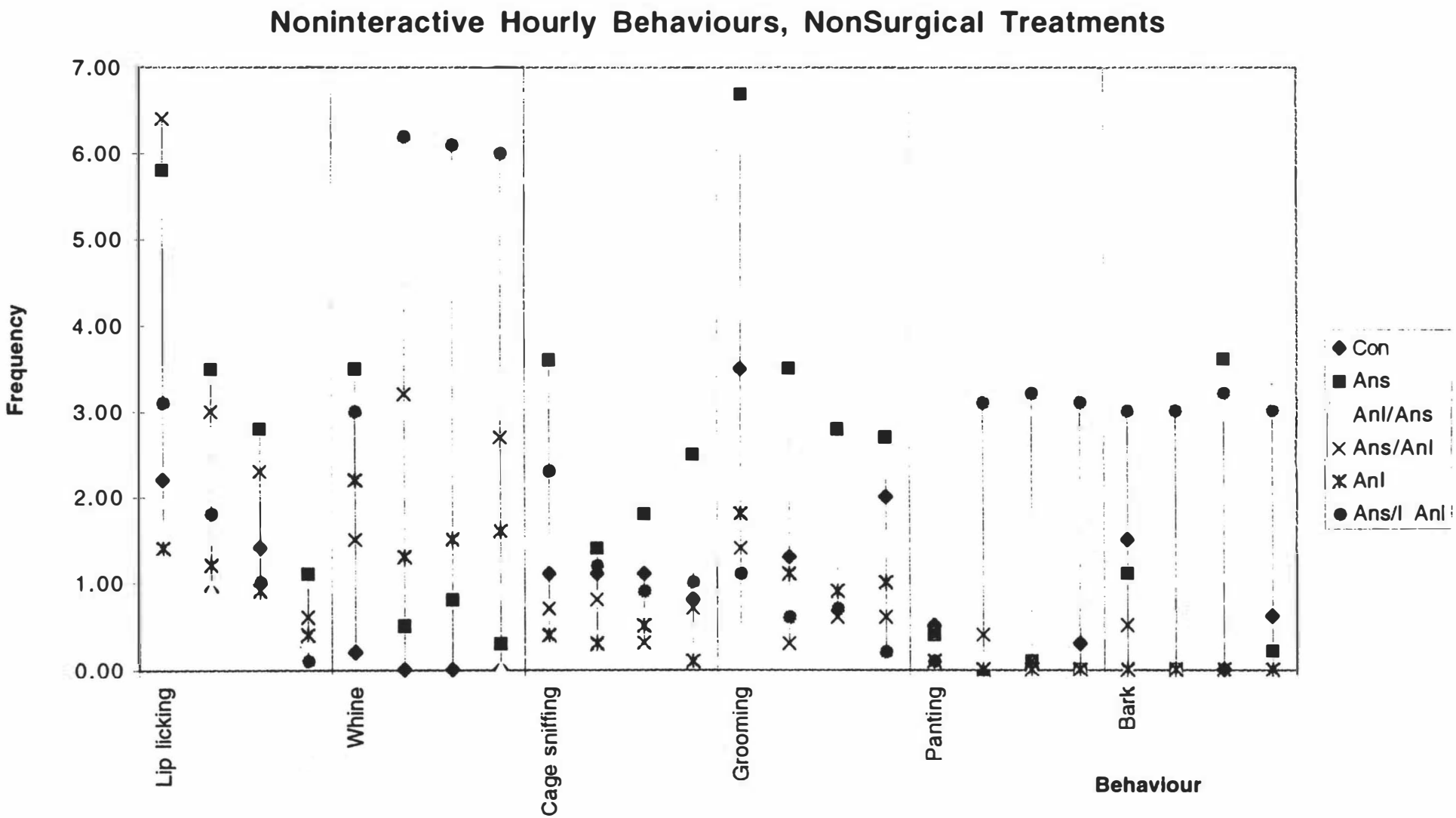


Figure 4.10b 2 dimension graph of noninteractive hourly behaviours for the nonsurgical treatments. This is the same data as appears in Figure 4.10a. The four intervals following a stated behaviour are: 2nd, 3rd, 4th and 5th hour after extubation.

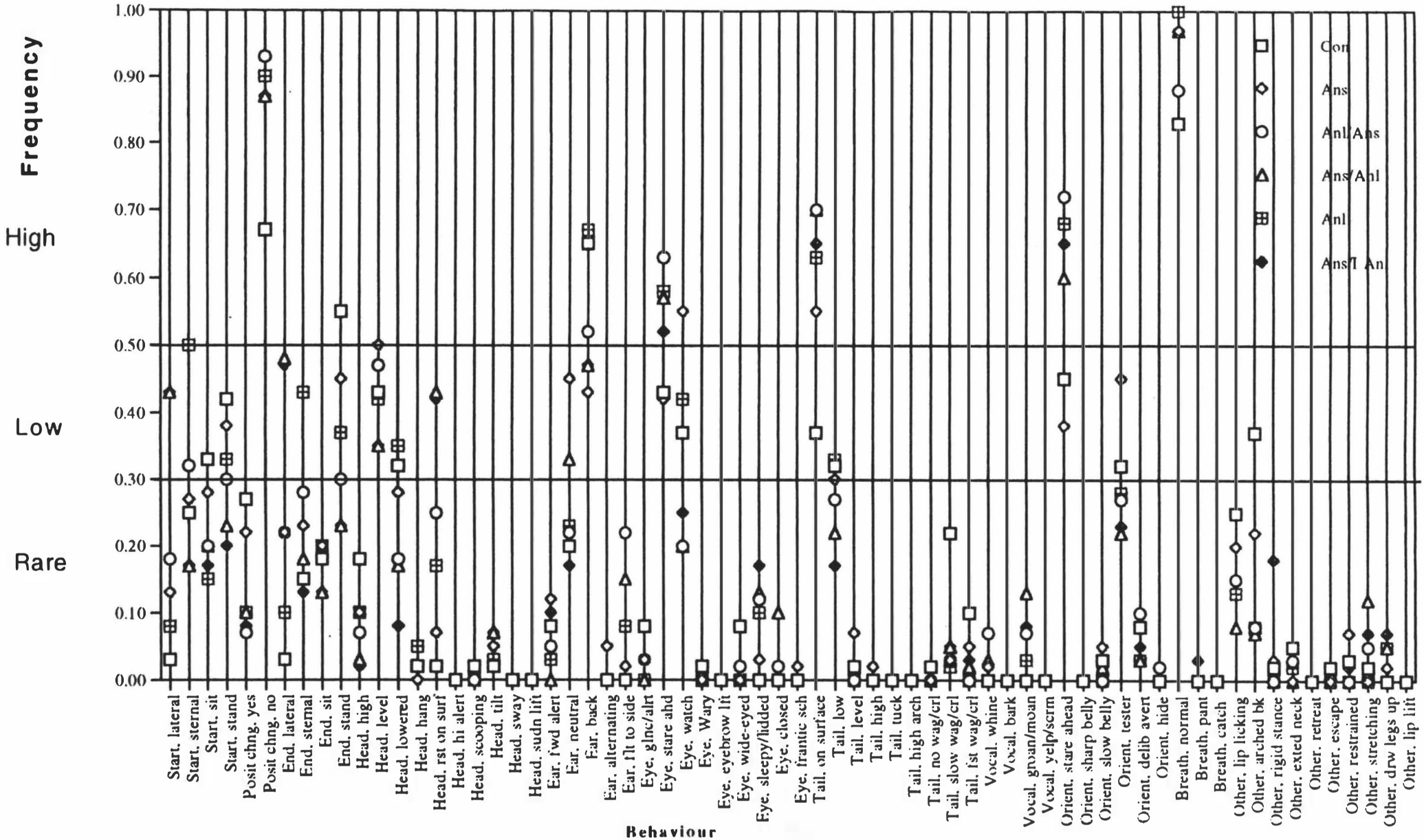


Figure 4.11 Averaged occurrence for each interactive palpation behaviour in each nonsurgical treatment. Values plotted represent the average of each behaviour during the palpations from 121-391 minutes.

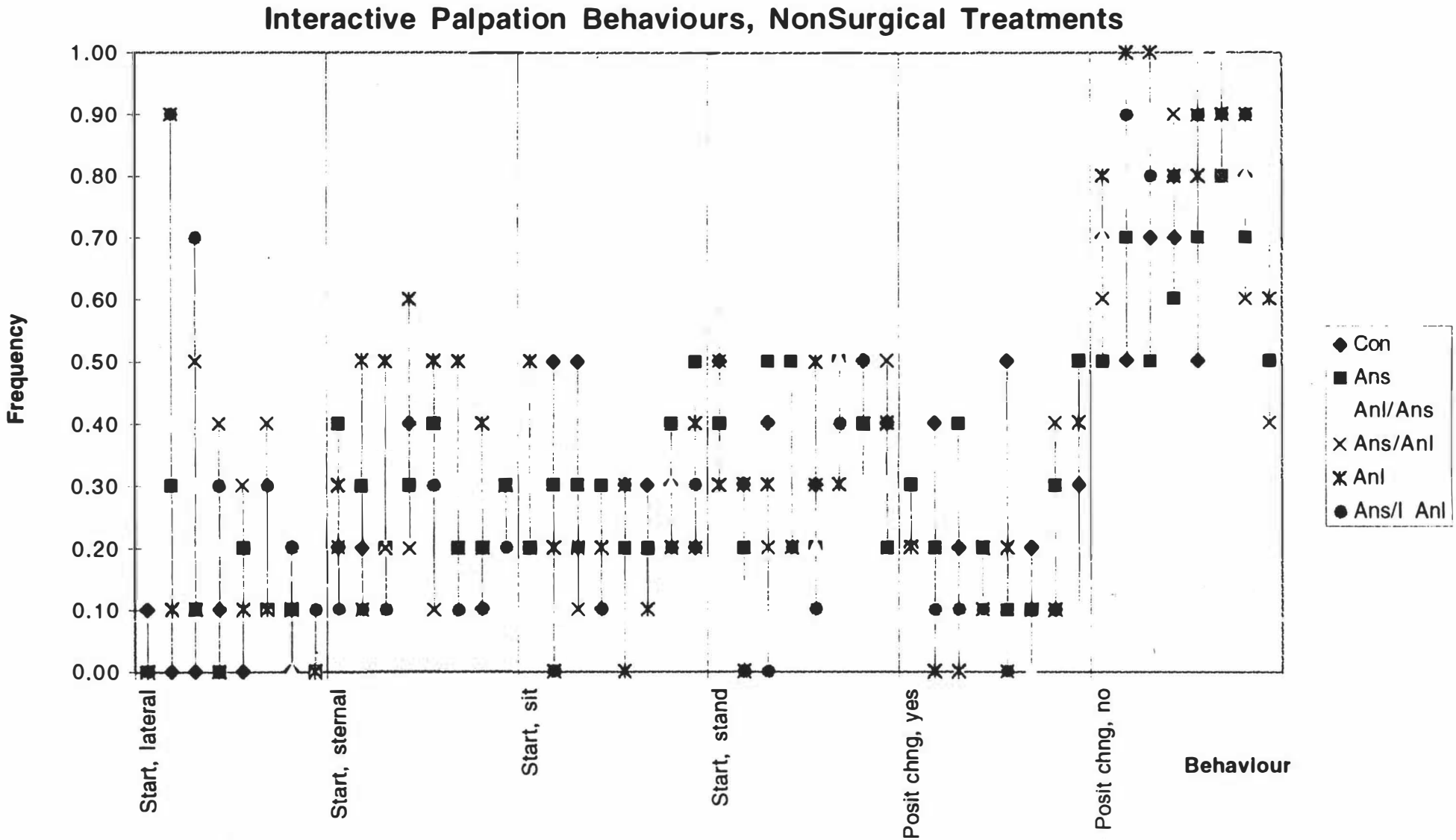


Figure 4.12 Interactive behaviours for the nonsurgical treatments. The sequence of 8 points from a stated behaviour represent the following times:

day before commencement of a treatment, and; 0.5 hr., 1.0 hr., 1.5 hr., 2.0 hr., 3.0 hr., 5.0 hr. and 24 hr. after the treatment.

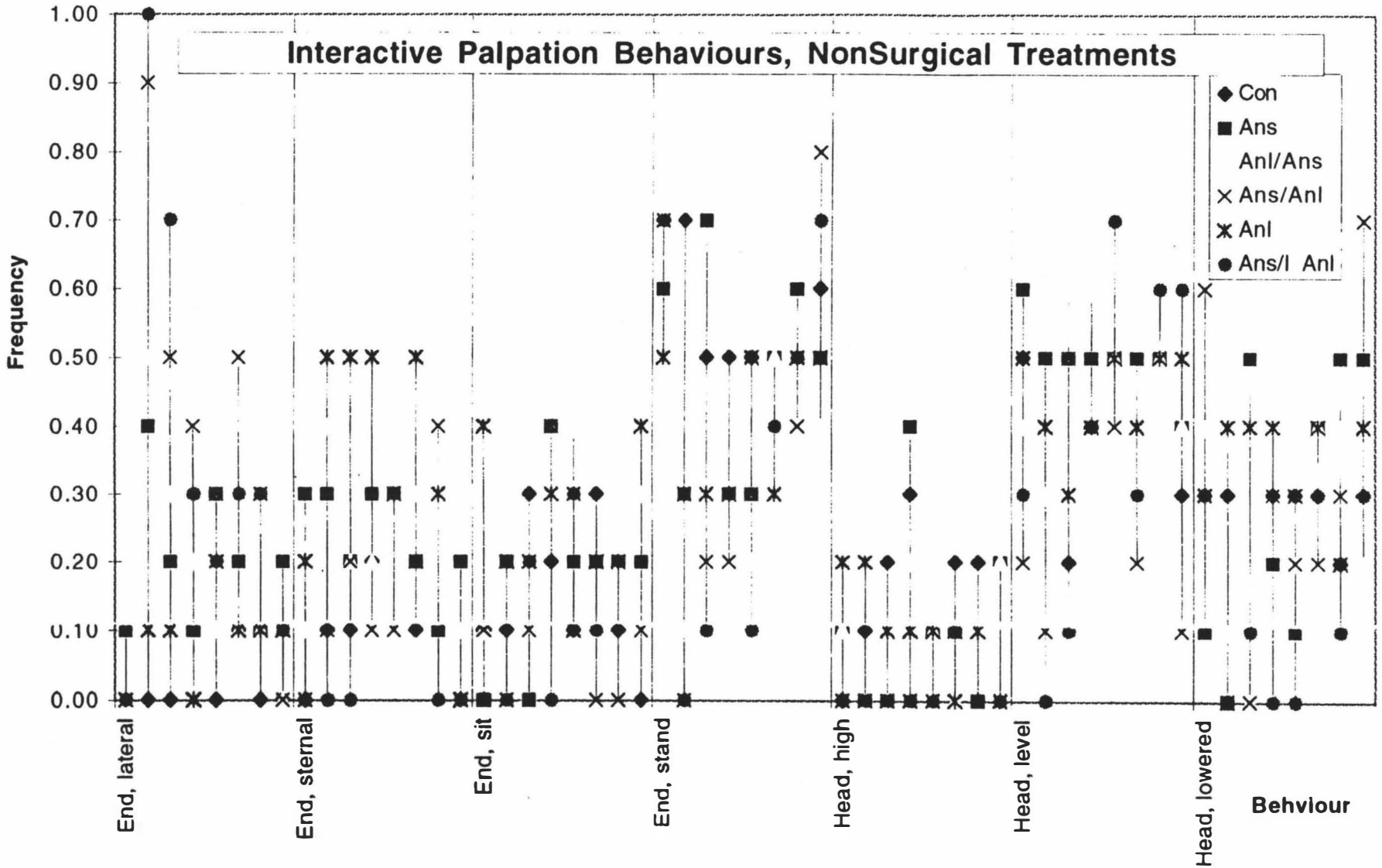


Figure 4.13 Interactive behaviours for the nonsurgical treatments. The sequence of 8 points from a stated behaviour represent the following times:

day before commencement of a treatment, and; 0.5 hr., 1.0 hr., 1.5 hr., 2.0 hr., 3.0 hr., 5.0 hr. and 24 hr. after the treatment.

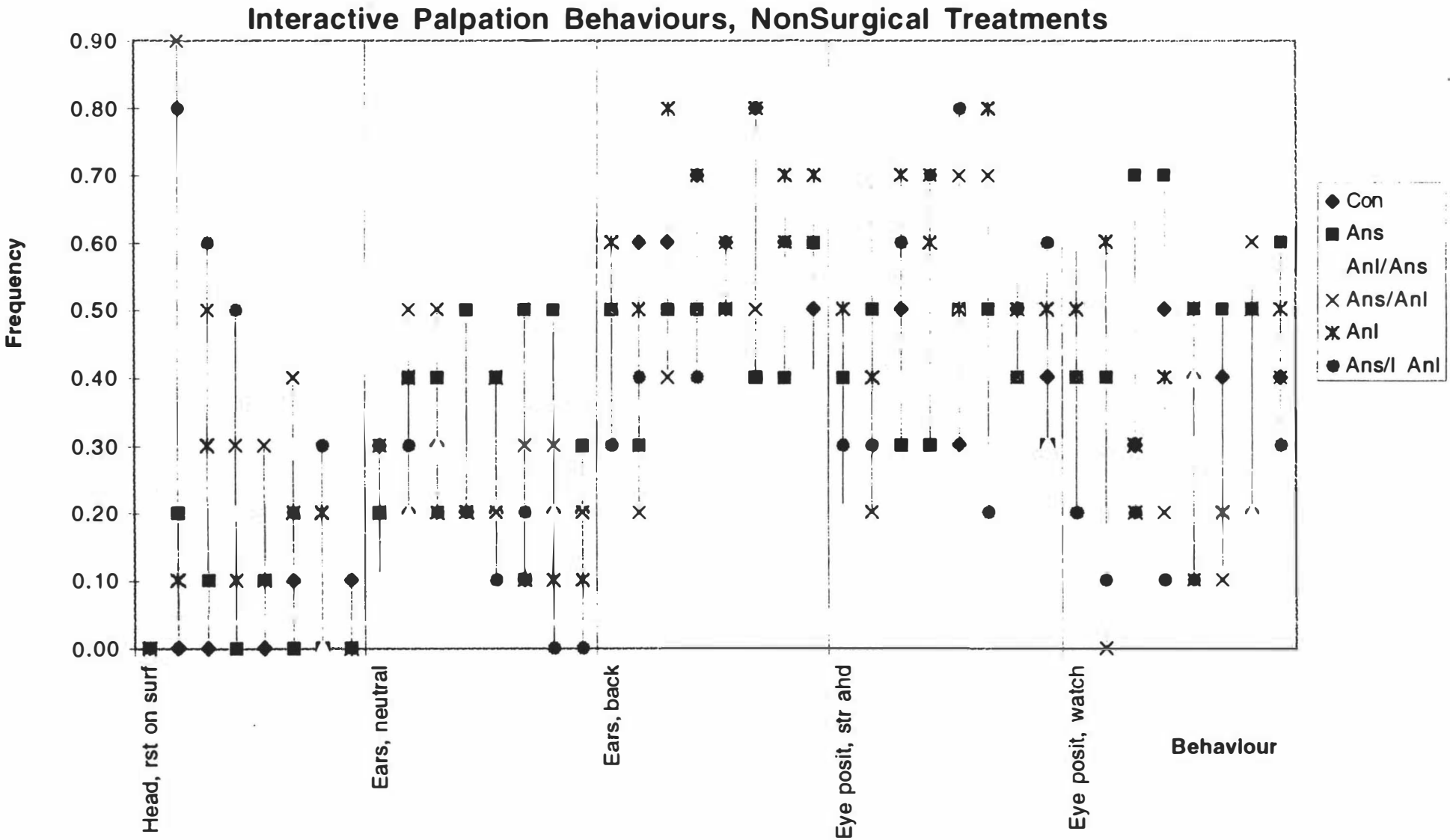


Figure 4.14 Interactive behaviours for the nonsurgical treatments. The sequence of 8 points from a stated behaviour represent the following times:

day before commencement of a treatment, and; 0.5 hr., 1.0 hr., 1.5 hr., 2.0 hr., 3.0 hr., 5.0 hr. and 24 hr. after the treatment.

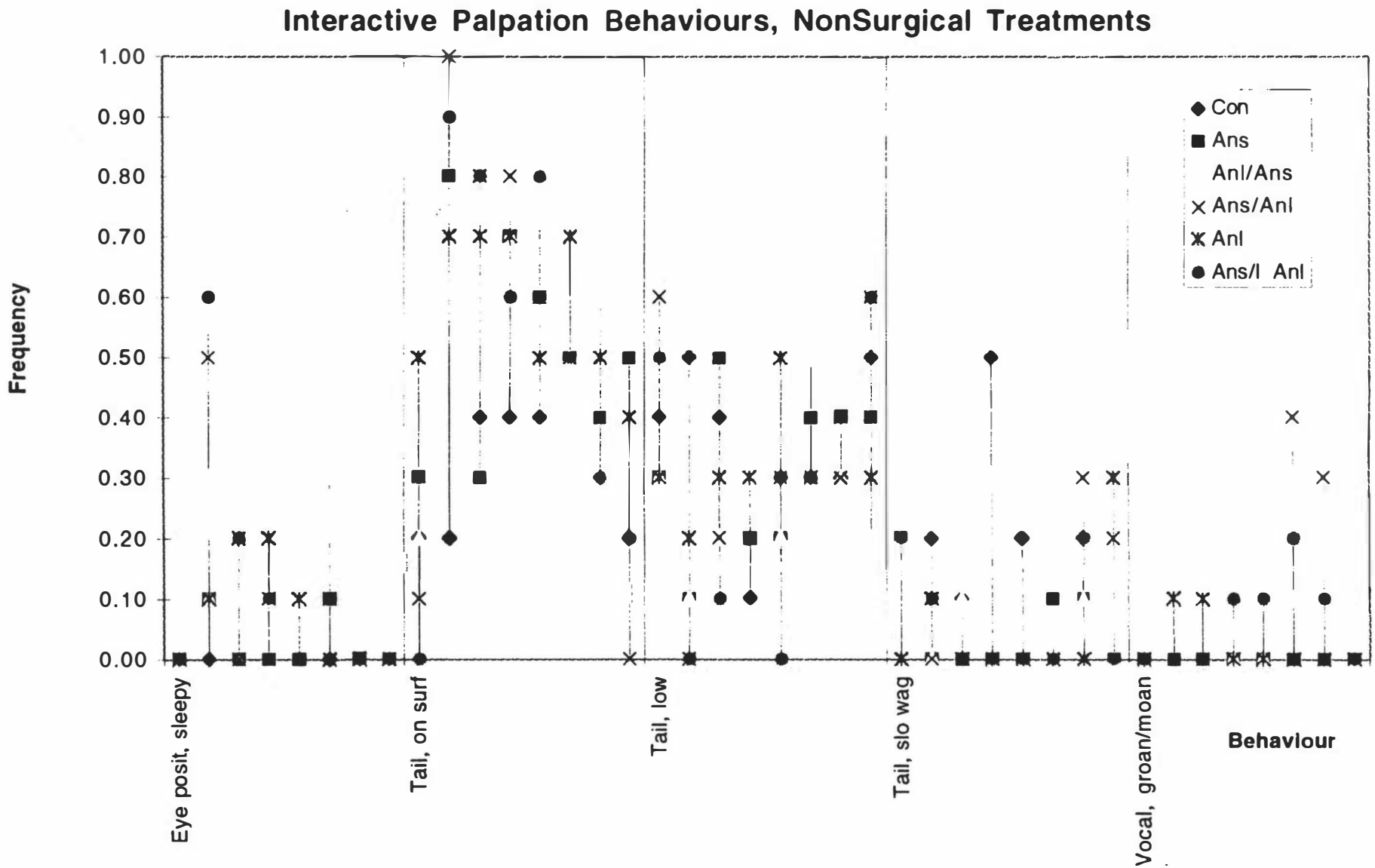


Figure 4.15 Interactive behaviours for the nonsurgical tretments. The sequence of 8 points from a stated behaviour represent the following times:

day before commencement of a treatment, and; 0.5 hr., 1.0 hr., 1.5 hr., 2.0 hr., 3.0 hr., 5.0 hr. and 24 hr. after the treatment.

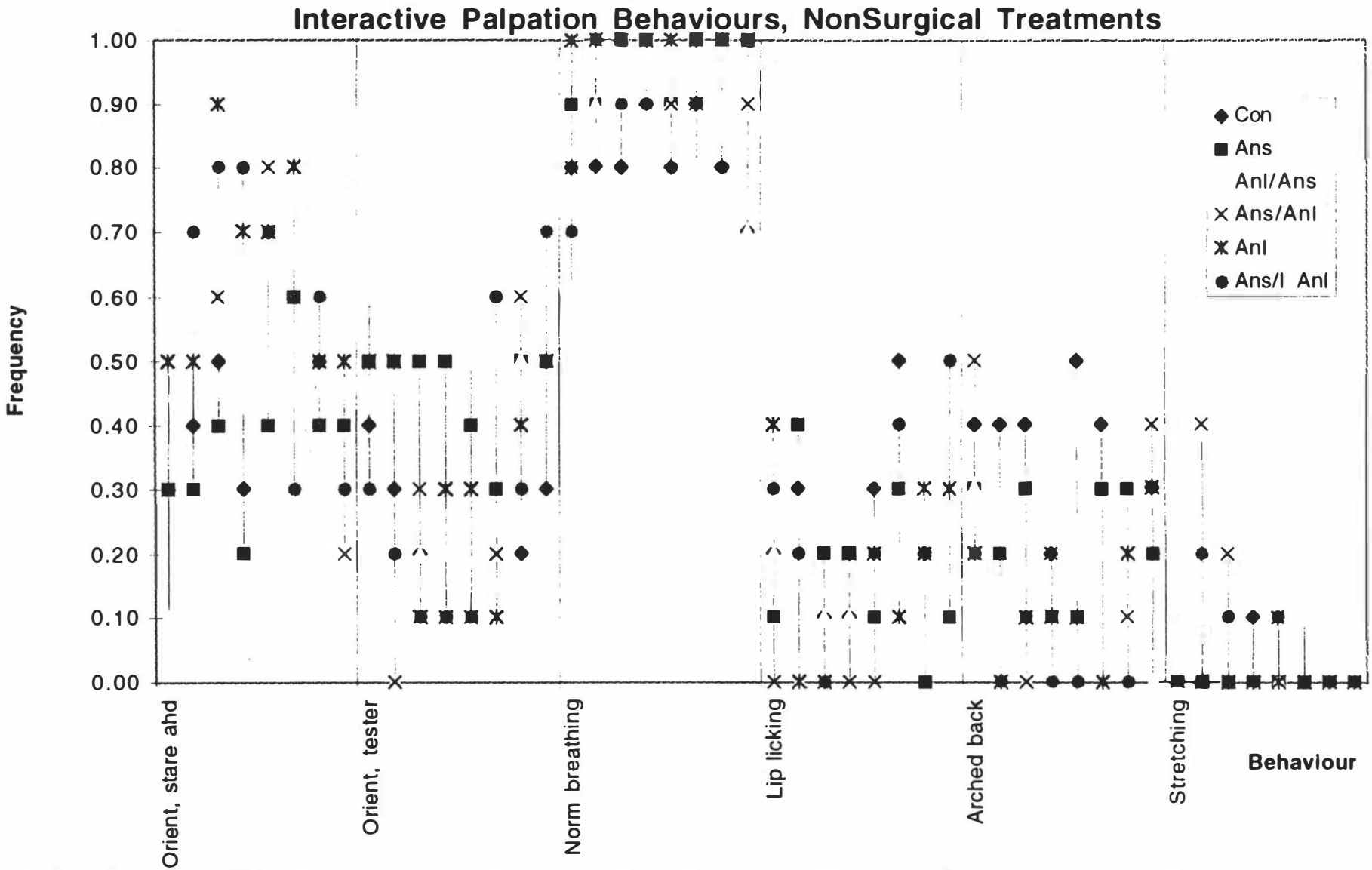


Figure 4.16 Interactive behaviours for the nonsurgical treatments. The sequence of 8 points from a stated behaviour represent the following times:

day before commencement of a treatment, and; 0.5 hr., 1.0 hr., 1.5 hr., 2.0 hr., 3.0 hr., 5.0 hr. and 24 hr. after the treatment.

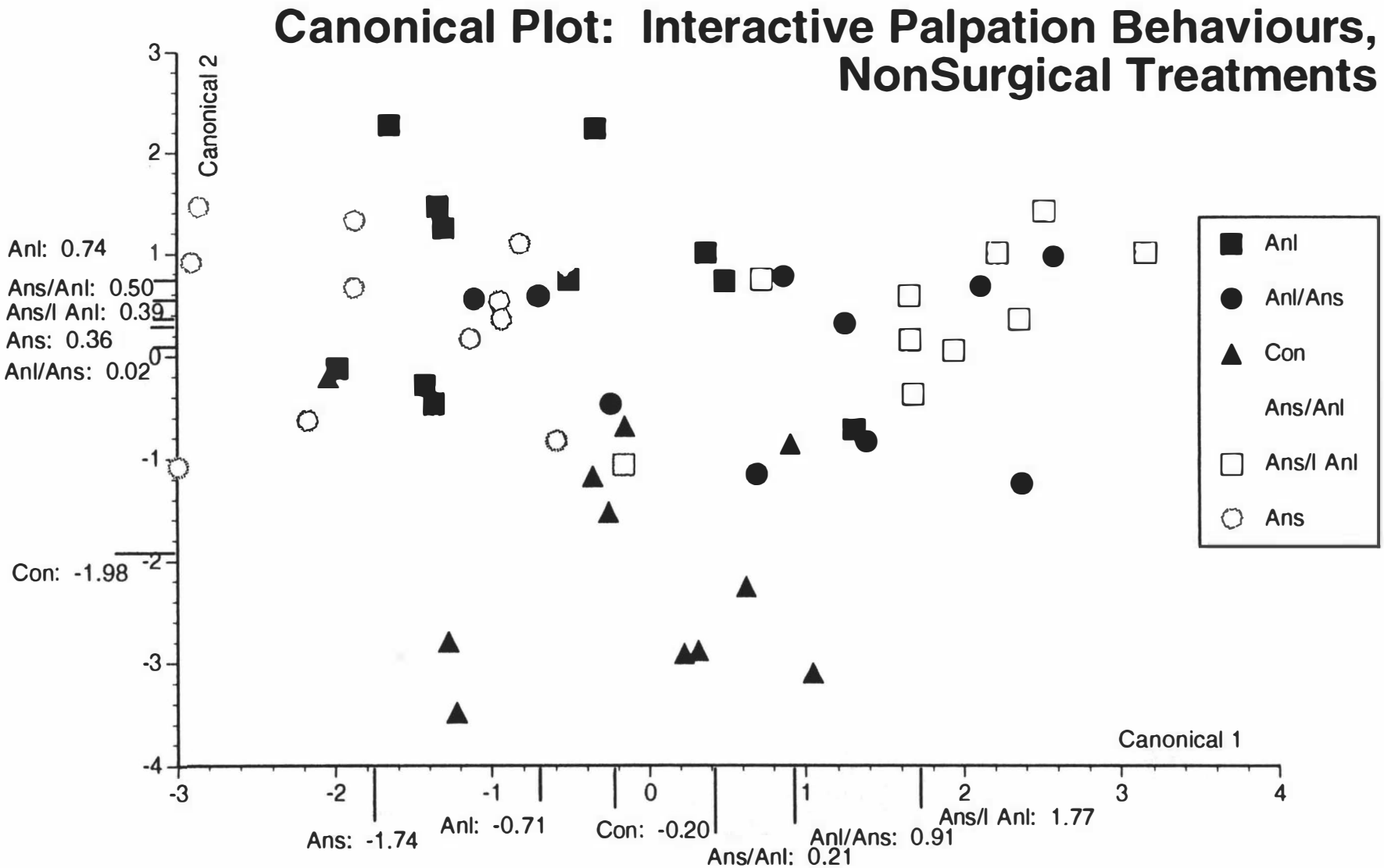


Figure 4.17a Canonical plot of interactive palpation behaviours for the nonsurgical treatments. Values plotted for each bitch in each treatment are canonical discriminant functions (Z), which consists of contributing behaviours (V) with weighting coefficients (c); ie., $Z_1 = c_1V_1 + c_2V_2$ + ..etc. Lines off the axis are group means.

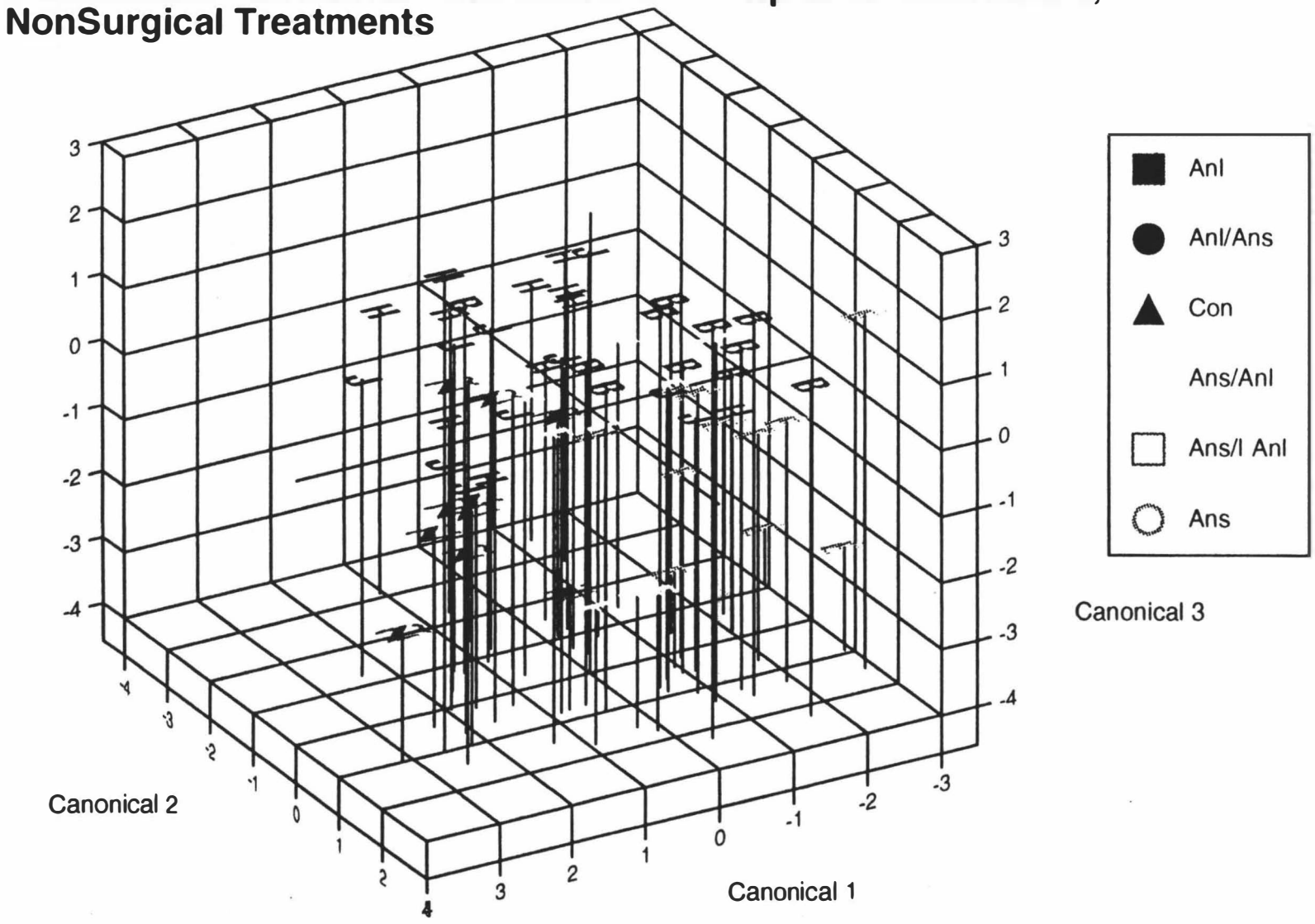


Figure 4.17b 3 dimension plot of interactive palpation behaviours for the nonsurgical treatments. Data plotted is the same as in Figure 4.17a, but with inclusion of the third canonical discriminant function which represents approximately 17% of the between-group differences for this data set.

Animal_____Date_____Treatment_____

NONINTERACTIVE BEHAVIOUR (MINUTE)

EXTUBATION_____		0-2 min present	3-10 min present	11-30 min frequency	31-60 min frequency
1. Awareness					
1.1	awake	❑	❑	❑	❑
1.2	asleep	❑	❑	❑	❑
2. Stationary positions					
2.1	lateral	❑	❑	❑	❑
2.2	sternal curl	❑	❑	❑	❑
2.3	sternal other	❑	❑	❑	❑
2.4	normal sit	❑	❑	❑	❑
2.5	hang sit	❑	❑	❑	❑
2.6	normal stand	❑	❑	❑	❑
2.7	hang stand	❑	❑	❑	❑
3. Position changes					
3.1	number of changes	❑	❑	❑	❑
3.2	torso weight shifts	❑	❑	❑	❑
Modifiers					
3.3	normal speed	❑	❑	❑	❑
3.4	slow speed	❑	❑	❑	❑
3.5	increased thoracic limb weight bearing	❑	❑	❑	❑
3.6	ataxia	❑	❑	❑	❑
4. Motion					
4.1	(walking: 30 sec)	❑	❑	❑	❑
Modifiers					
4.2	normal speed	❑	❑	❑	❑
4.3	slow speed	❑	❑	❑	❑
4.4	increased thoracic limb weight bearing	❑	❑	❑	❑
4.5	ataxia	❑	❑	❑	❑
4.6	first stand	❑	❑	❑	❑

Animal_____Date_____Treatment_____

EXTUBATION_____		0-2 min present	3-10 min present	11-30 min frequency	31-60 min frequency
5. Activities					
5.1	lip licking	❑	❑	❑	❑
5.2	thrashing	❑	❑	❑	❑
5.3	head nodding	❑	❑	❑	❑
5.4	slo motion cage circling	❑	❑	❑	❑
5.5	normal speed cage circling	❑	❑	❑	❑
5.6	head lifts	❑	❑	❑	❑
5.7	quiet alert (5 min)	❑	❑	❑	❑
5.8	drawing legs up	❑	❑	❑	❑
5.9	stretching	❑	❑	❑	❑
5.10	cage digging	❑	❑	❑	❑
5.11	cage licking	❑	❑	❑	❑
5.12	door pawing	❑	❑	❑	❑
5.13	cage sniffing	❑	❑	❑	❑
5.14	grooming	❑	❑	❑	❑
5.15	incision licking	❑	❑	❑	❑
5.16	yawning	❑	❑	❑	❑
5.17	pacing	❑	❑	❑	❑
5.18	trembling	❑	❑	❑	❑
5.19	manipulations	❑	❑	❑	❑
5.20	urination	❑	❑	❑	❑
5.21	defecation	❑	❑	❑	❑
5.22	vomition	❑	❑	❑	❑
5.23	salivation	❑	❑	❑	❑
5.24	paddling	❑	❑	❑	❑

Animal_____Date_____Treatment_____

EXTUBATION_____		0-2 min present	3-10 min present	11-30 min frequency	31-60 min frequency
5.25	Look back	❑	❑	❑	❑
5.26	bandage chew	❑	❑	❑	❑
5.27	IV licking	❑	❑	❑	❑
6.	Breathing				
6.1	pant	❑	❑	❑	❑
6.2	normal	❑	❑	❑	❑
7.	Vocalization				
7.1	whine	❑	❑	❑	❑
7.2	bark	❑	❑	❑	❑
7.3	groan/moan	❑	❑	❑	❑
7.4	howl	❑	❑	❑	❑

Animal_____Date_____Treatment_____

NONINTERACTIVE BEHAVIOUR (1-5 HOURS)

EXTUBATION_____	Pre Sx	1-2	2-3	3-4	4-5
1. Stationary major behaviours					
1.1 lateral rest or sleep	❑	❑	❑	❑	❑
1.2 sternal curl (head on front or rear leg)	❑	❑	❑	❑	❑
1.3 sternal rest or sleep	❑	❑	❑	❑	❑
1.4 lateral awake	❑	❑	❑	❑	❑
1.5 sternal awake	❑	❑	❑	❑	❑
1.6 sit alert	❑	❑	❑	❑	❑
1.6.5 sit other (lazy)	❑	❑	❑	❑	❑
1.6.6 hang sit	❑	❑	❑	❑	❑
1.7 hang stand (15 sec)	❑	❑	❑	❑	❑
1.8 normal stand	❑	❑	❑	❑	❑
2. Position Changes					
2.1 Slow motion posit changes	❑	❑	❑	❑	❑
2.2 norm speed posit changes	❑	❑	❑	❑	❑
2.3 torso weight shifts (not standing)	❑	❑	❑	❑	❑
2.4 thoracic limb weight shifts (standing or sitting)	❑	❑	❑	❑	❑
2.5 drawing legs up	❑	❑	❑	❑	❑
2.6 stretching	❑	❑	❑	❑	❑
3. Movement behaviours					
3.1 attention seeking (5 min) (whining or pawing)	❑	❑	❑	❑	❑
3.2 normal speed cage circling (360 in 15 sec)	❑	❑	❑	❑	❑
3.3 slow speed cage circling (360 in > 1 min)	❑	❑	❑	❑	❑
3.4 escape behaviour (> 5 min)	❑	❑	❑	❑	❑

Animal_____Date_____Treatment_____

EXTUBATION_____	Pre Sx	1-2	2-3	3-4	4-5
4. Short behaviours					
4.1 head lifts	❑	❑	❑	❑	❑
4.2 lip licking	❑	❑	❑	❑	❑
4.3 whine	❑	❑	❑	❑	❑
4.4 cage sniffing	❑	❑	❑	❑	❑
4.5 thrashing	❑	❑	❑	❑	❑
4.6 grooming	❑	❑	❑	❑	❑
4.7 yawning (no vocalization)	❑	❑	❑	❑	❑
4.8 cage licking	❑	❑	❑	❑	❑
4.8.5 door biting	❑	❑	❑	❑	❑
4.9 breathing, pant	❑	❑	❑	❑	❑
4.10 breathing, normal	❑	❑	❑	❑	❑
4.11 urination	❑	❑	❑	❑	❑
4.12 defecation	❑	❑	❑	❑	❑
4.13 cage digging	❑	❑	❑	❑	❑
4.14 door pawing	❑	❑	❑	❑	❑
4.15 head nodding	❑	❑	❑	❑	❑
4.16 incision licking	❑	❑	❑	❑	❑
4.18 bark	❑	❑	❑	❑	❑
4.19 groan/moan	❑	❑	❑	❑	❑
4.20 howl	❑	❑	❑	❑	❑
4.21 pacing (15 sec)	❑	❑	❑	❑	❑
4.22 ataxia	❑	❑	❑	❑	❑
4.23 trembling	❑	❑	❑	❑	❑
4.24 manipulation behaviours	❑	❑	❑	❑	❑
4.25 vomition	❑	❑	❑	❑	❑
4.26 salivation	❑	❑	❑	❑	❑
4.27 look back	❑	❑	❑	❑	❑

Animal_____Date_____Treatment_____

EXTUBATION_____	Pre Sx	1-2	2-3	3-4	4-5
4.28 IV licking	❑	❑	❑	❑	❑
4.29 stand	❑	❑	❑	❑	❑
4.30 bandage chew	❑	❑	❑	❑	❑
4.31 door biting	❑	❑	❑	❑	❑

Animal_____Date_____Treatment_____

PALPATION BEHAVIOUR

EXTUBATION_____	Pre-Sx	0.5	1.0	1.5	2.0	3.0	5.0	24hr
1. Starting positions								
1.1 lateral	☐	☐	☐	☐	☐	☐	☐	☐
1.2 sternal	☐	☐	☐	☐	☐	☐	☐	☐
1.3 sit	☐	☐	☐	☐	☐	☐	☐	☐
1.4 stand	☐	☐	☐	☐	☐	☐	☐	☐
2. Postion changes								
2.1 yes	☐	☐	☐	☐	☐	☐	☐	☐
2.2 no	☐	☐	☐	☐	☐	☐	☐	☐
3. End position								
3.1 lateral	☐	☐	☐	☐	☐	☐	☐	☐
3.2 sternal	☐	☐	☐	☐	☐	☐	☐	☐
3.3 sit	☐	☐	☐	☐	☐	☐	☐	☐
3.4 stand	☐	☐	☐	☐	☐	☐	☐	☐
4. Head position								
4.1 high	☐	☐	☐	☐	☐	☐	☐	☐
4.2 level	☐	☐	☐	☐	☐	☐	☐	☐
4.3 lowered	☐	☐	☐	☐	☐	☐	☐	☐
4.4 hang	☐	☐	☐	☐	☐	☐	☐	☐
4.5 rest on surface	☐	☐	☐	☐	☐	☐	☐	☐
4.6 high alert (ears forward)	☐	☐	☐	☐	☐	☐	☐	☐
4.7 scooping	☐	☐	☐	☐	☐	☐	☐	☐
4.8 tilt	☐	☐	☐	☐	☐	☐	☐	☐
4.9 sway	☐	☐	☐	☐	☐	☐	☐	☐
4.10 sudden head lift	☐	☐	☐	☐	☐	☐	☐	☐
5. Ear position								
5.1 forward alert	☐	☐	☐	☐	☐	☐	☐	☐
5.2 neutral	☐	☐	☐	☐	☐	☐	☐	☐
5.3 back	☐	☐	☐	☐	☐	☐	☐	☐
5.4 alternating	☐	☐	☐	☐	☐	☐	☐	☐
5.5 flat to sides	☐	☐	☐	☐	☐	☐	☐	☐

Animal_____Date_____Treatment_____

EXTUBATION_____	Pre-Sx	0.5	1.0	1.5	2.0	3.0	5.0	24hr
6. Eye position								
6.1 glance/avert	❑	❑	❑	❑	❑	❑	❑	❑
6.2 stare ahead (vacant)	❑	❑	❑	❑	❑	❑	❑	❑
6.3 watch	❑	❑	❑	❑	❑	❑	❑	❑
6.4 wary (head away/eyes toward)	❑	❑	❑	❑	❑	❑	❑	❑
6.5 eyebrow lift	❑	❑	❑	❑	❑	❑	❑	❑
6.6 wide-eyed	❑	❑	❑	❑	❑	❑	❑	❑
6.7 sleppy or lidded	❑	❑	❑	❑	❑	❑	❑	❑
6.8 closed	❑	❑	❑	❑	❑	❑	❑	❑
6.9 frantic searching	❑	❑	❑	❑	❑	❑	❑	❑
7. Tail position								
7.1 on surface	❑	❑	❑	❑	❑	❑	❑	❑
7.2 low	❑	❑	❑	❑	❑	❑	❑	❑
7.3 level	❑	❑	❑	❑	❑	❑	❑	❑
7.4 high	❑	❑	❑	❑	❑	❑	❑	❑
7.5 tuck	❑	❑	❑	❑	❑	❑	❑	❑
7.6 high arch	❑	❑	❑	❑	❑	❑	❑	❑
7.7 no wag/curl	❑	❑	❑	❑	❑	❑	❑	❑
7.8 slow wag/curl	❑	❑	❑	❑	❑	❑	❑	❑
7.9 fast wag/curl	❑	❑	❑	❑	❑	❑	❑	❑
8. Vocalizations								
8.1 whine	❑	❑	❑	❑	❑	❑	❑	❑
8.2 bark	❑	❑	❑	❑	❑	❑	❑	❑
8.3 groan/moan	❑	❑	❑	❑	❑	❑	❑	❑
8.4 yelp/scream	❑	❑	❑	❑	❑	❑	❑	❑

Animal_____Date_____Treatment_____

EXTUBATION_____	Pre-Sx	0.5	1.0	1.5	2.0	3.0	5.0	24hr
9. Orientation								
9.1 stare ahead	❑	❑	❑	❑	❑	❑	❑	❑
9.2 sharp belly	❑	❑	❑	❑	❑	❑	❑	❑
9.3 slow belly	❑	❑	❑	❑	❑	❑	❑	❑
9.4 tester (head/neck toward tester)	❑	❑	❑	❑	❑	❑	❑	❑
9.5 deliberate avert (head away from tester)	❑	❑	❑	❑	❑	❑	❑	❑
9.6 hide	❑	❑	❑	❑	❑	❑	❑	❑
10. Breathing								
10.1 normal	❑	❑	❑	❑	❑	❑	❑	❑
10.2 pant	❑	❑	❑	❑	❑	❑	❑	❑
10.3 catch breath	❑	❑	❑	❑	❑	❑	❑	❑
11. Other behaviours								
11.1 lip licking	❑	❑	❑	❑	❑	❑	❑	❑
11.2 arched back	❑	❑	❑	❑	❑	❑	❑	❑
11.3 rigid stance	❑	❑	❑	❑	❑	❑	❑	❑
11.4 extended neck	❑	❑	❑	❑	❑	❑	❑	❑
11.5 retreat	❑	❑	❑	❑	❑	❑	❑	❑
11.6 escape	❑	❑	❑	❑	❑	❑	❑	❑
11.7 restrained	❑	❑	❑	❑	❑	❑	❑	❑
11.8 stretching	❑	❑	❑	❑	❑	❑	❑	❑
11.9 drawing legs up	❑	❑	❑	❑	❑	❑	❑	❑
11.10 lip lift	❑	❑	❑	❑	❑	❑	❑	❑
11.11 bite/snap	❑	❑	❑	❑	❑	❑	❑	❑

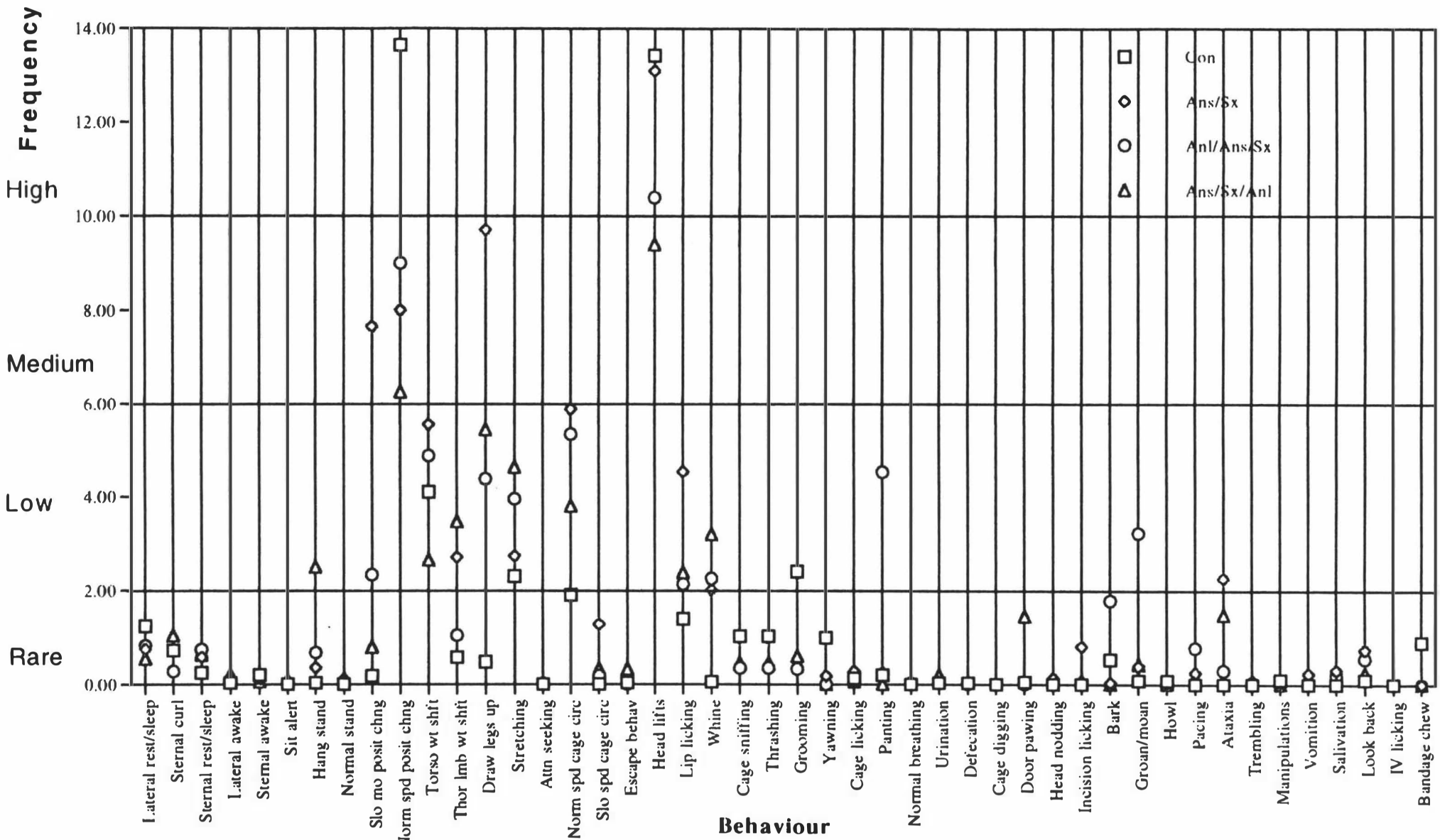


Figure 5.4 Averaged occurrence for each noninteractive hourly behaviour in each surgical treatment. Values plotted represent the average of each behaviour over hours 2-5, inclusive.

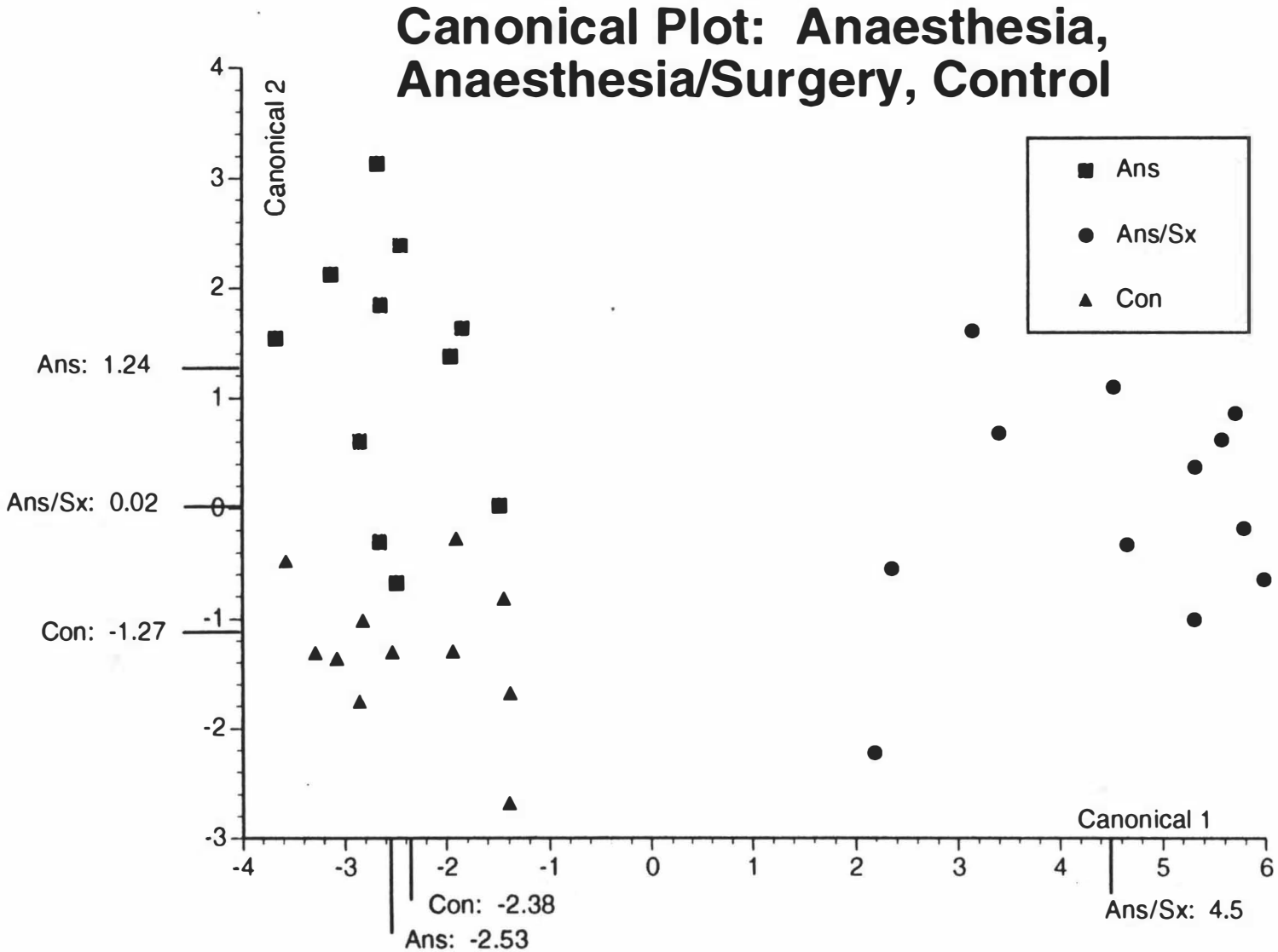


Figure 5.5 Canonical plot of noninteractive hourly behaviours for the indicated treatments. Values plotted for each bitch in each treatment are canonical discriminant functions (Z), which consists of contributing behaviours (V) with weighting coefficients (c); ie., $Z_1=c_1V_1+c_2V_2+$. etc.. Lines off the axis are group means.

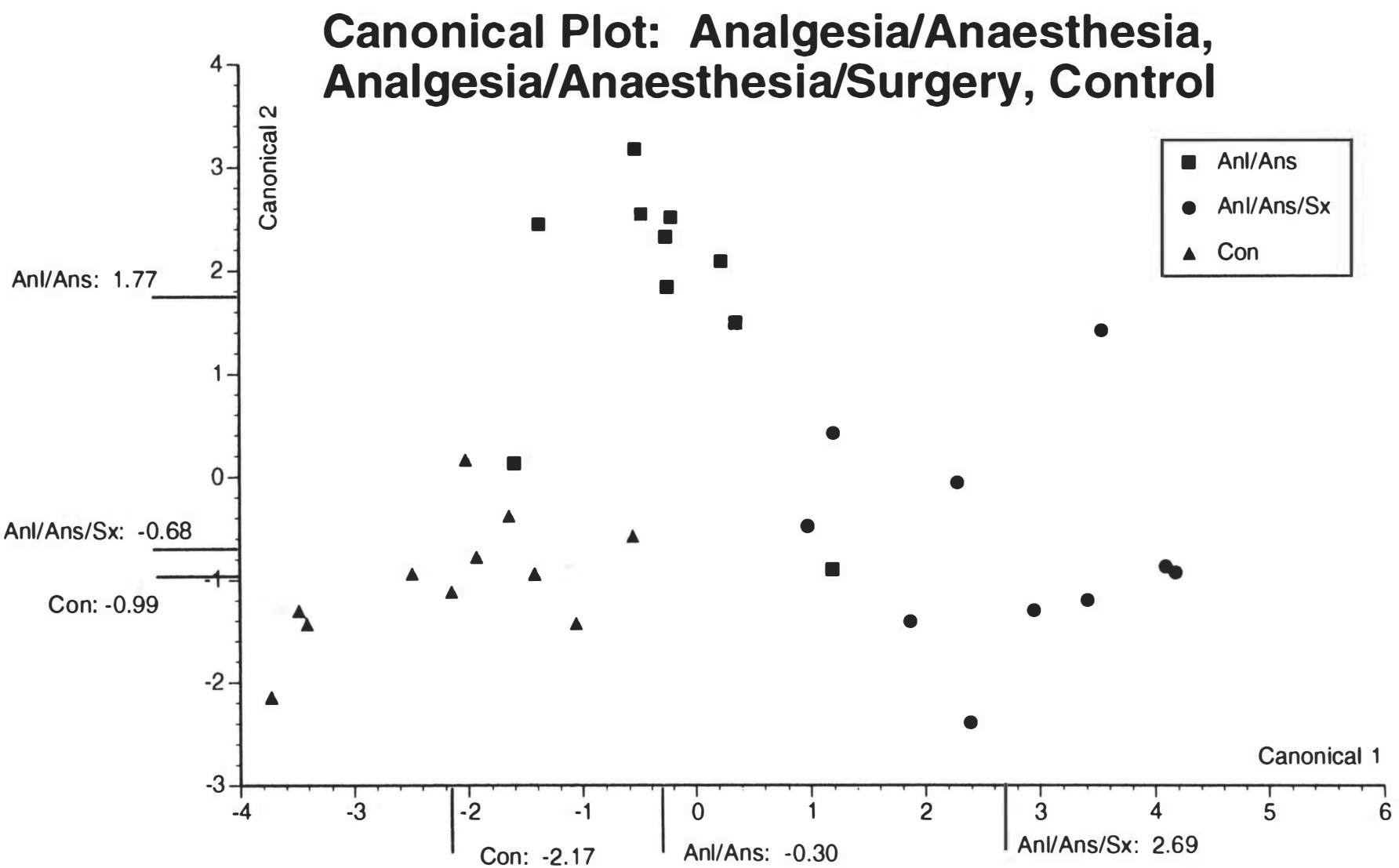


Figure 5.6 Canonical plot of noninteractive hourly behaviours for the indicated treatments. Values plotted for each bitch in each treatment are canonical discriminant functions (Z), which consists of contributing behaviours (V) with weighting coefficients (c); ie., $Z_1=c_1V_1+c_2V_2+$. etc.. Lines off the axis are group means.

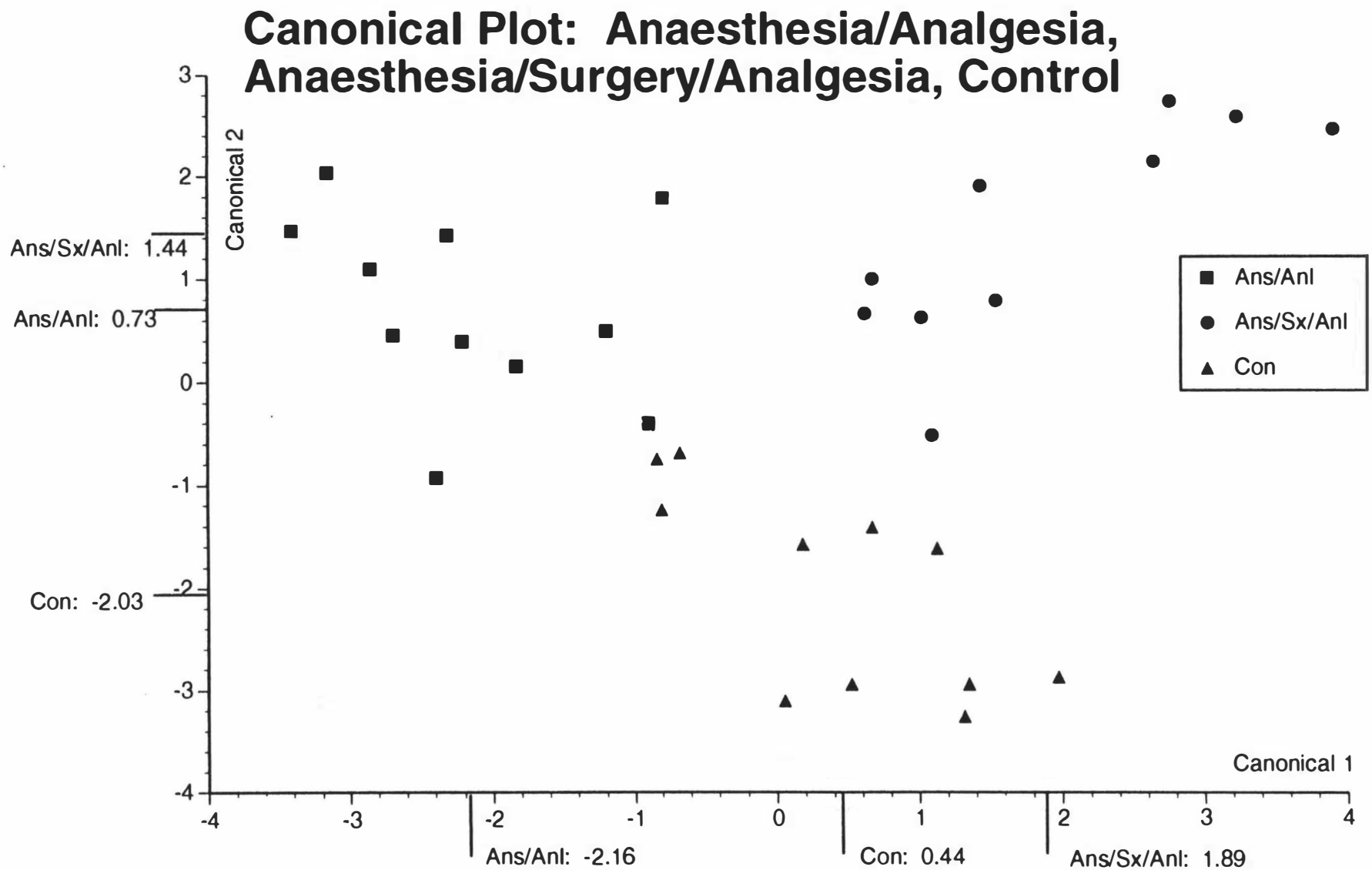


Figure 5.7 Canonical plot of noninteractive hourly behaviours for the indicated treatments. Values plotted for each bitch in each treatment are canonical discriminant functions (Z), which consists of contributing behaviours (V) with weighting coefficients (c); ie., $Z_1=c_1V_1+c_2V_2+$. etc.. Lines off the axis are group means.

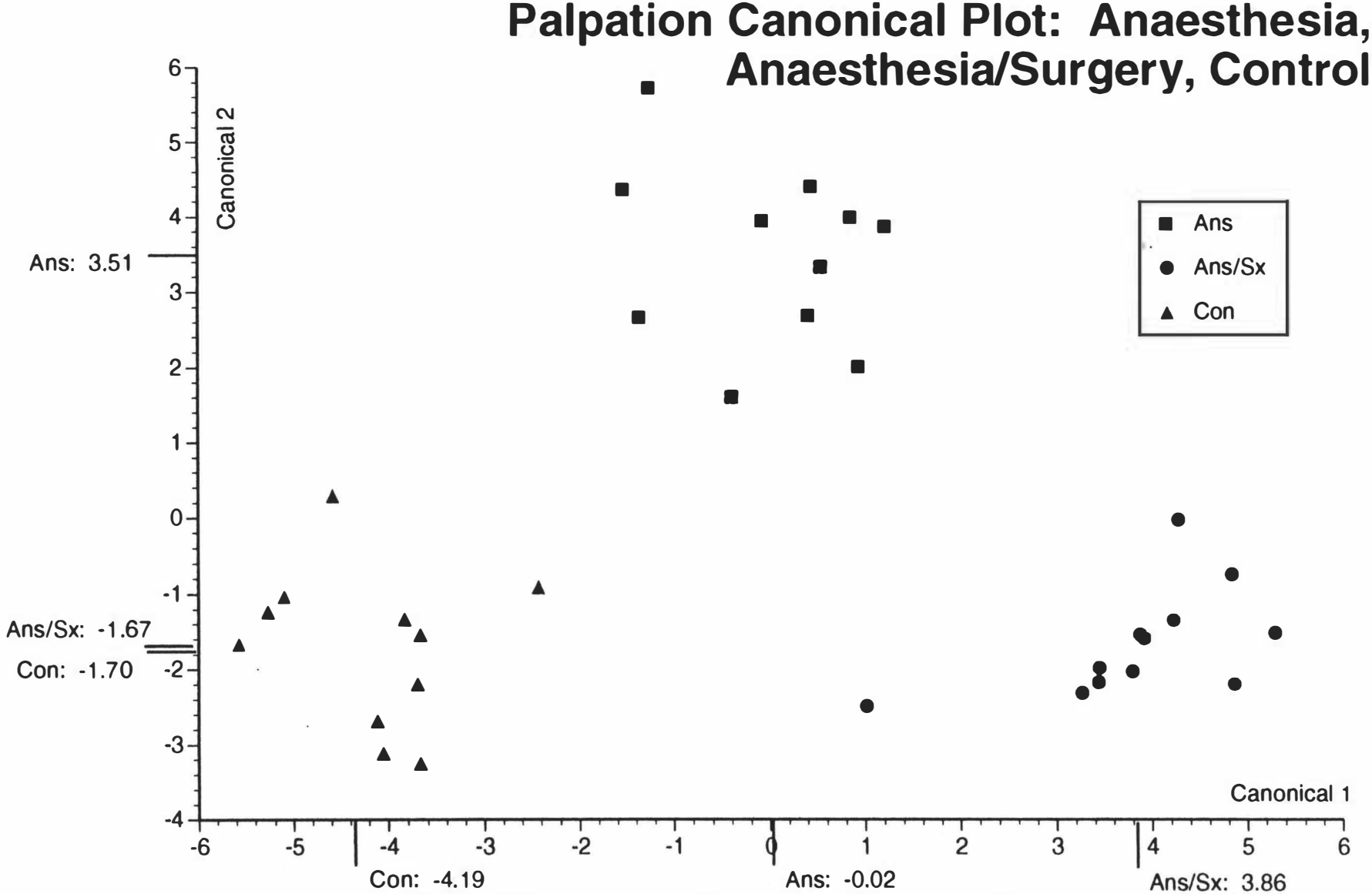


Figure 5.8 Canonical plot of interactive palpation behaviours for the indicated treatments. Values plotted for each bitch in each treatment are canonical discriminant functions (Z), which consists of contributing behaviours (V) with weighting coefficients (c); ie., $Z_1=c_1V_1+c_2V_2+$. etc.. Lines off the axis are group means.

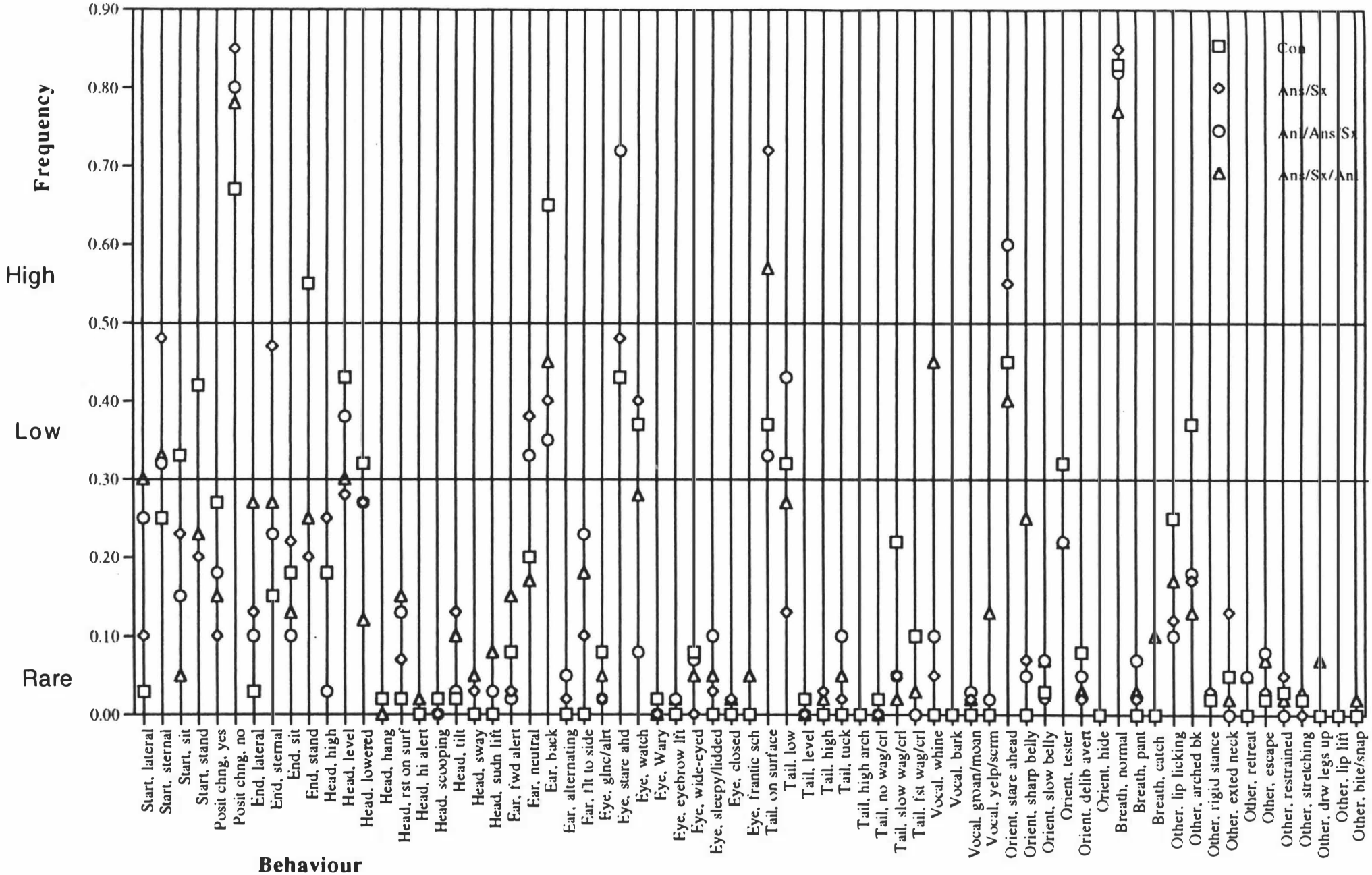


Figure 5.9 Averaged occurrence for each interactive palpation behaviour in each surgical treatment. Values plotted represent the average of each behaviour during the palpations from 121-391 minutes.

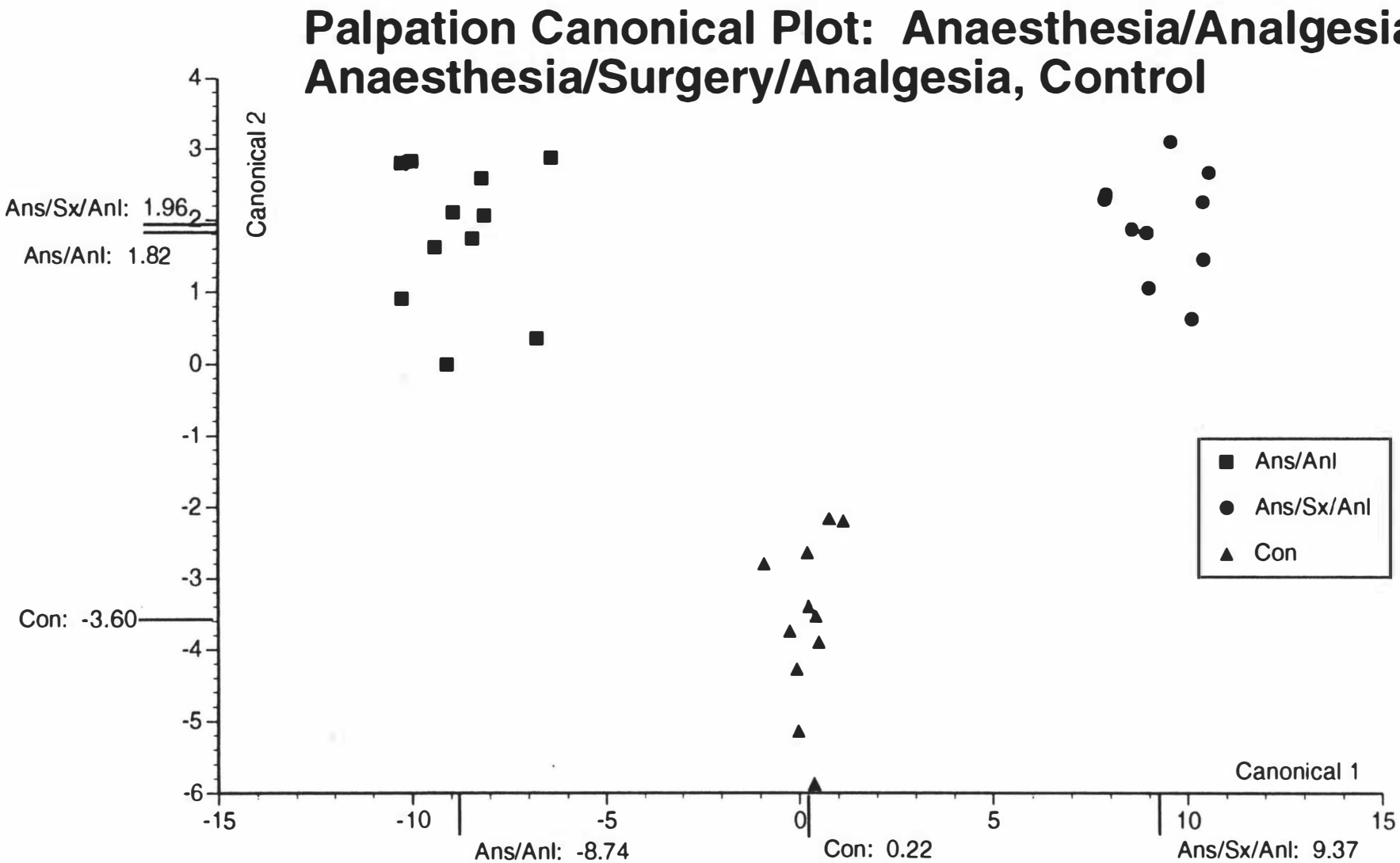


Figure 5.10 Canonical plot of interactive palpation behaviours for the indicated treatments. Values plotted for each bitch in each treatment are canonical discriminant functions (Z), which consists of contributing behaviours (V) with weighting coefficients (c); ie., $Z_1=c_1V_1+c_2V_2+$. etc.. Lines off the axis are group means.

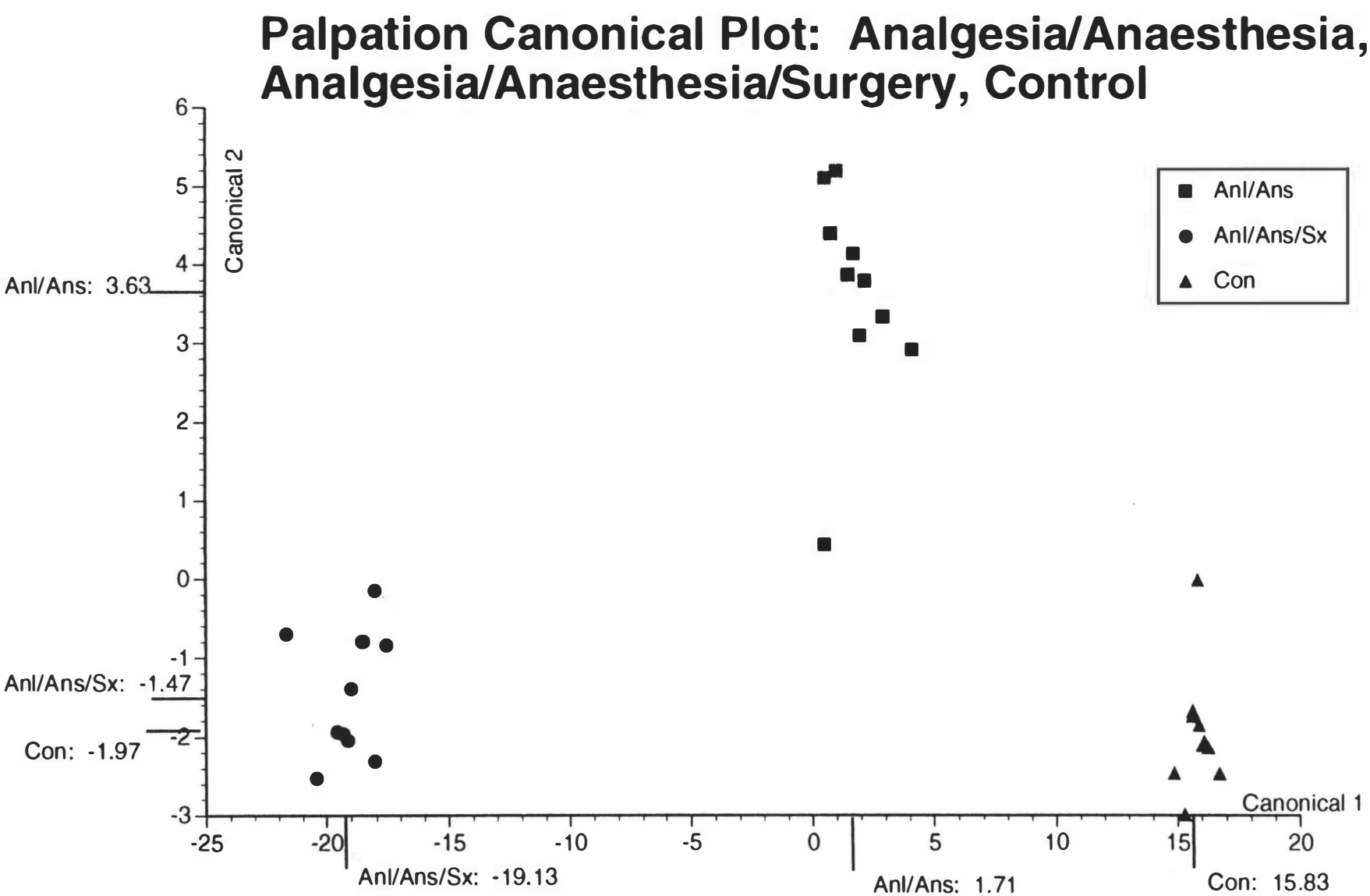


Figure 5.11 Canonical plot of interactive palpation behaviours for the indicated treatments. Values plotted for each bitch in each treatment are canonical discriminant functions (Z), which consists of contributing behaviours (V) with weighting coefficients (c); ie., $Z_1=c_1V_1+c_2V_2+$. etc.. Lines off the axis are group means.

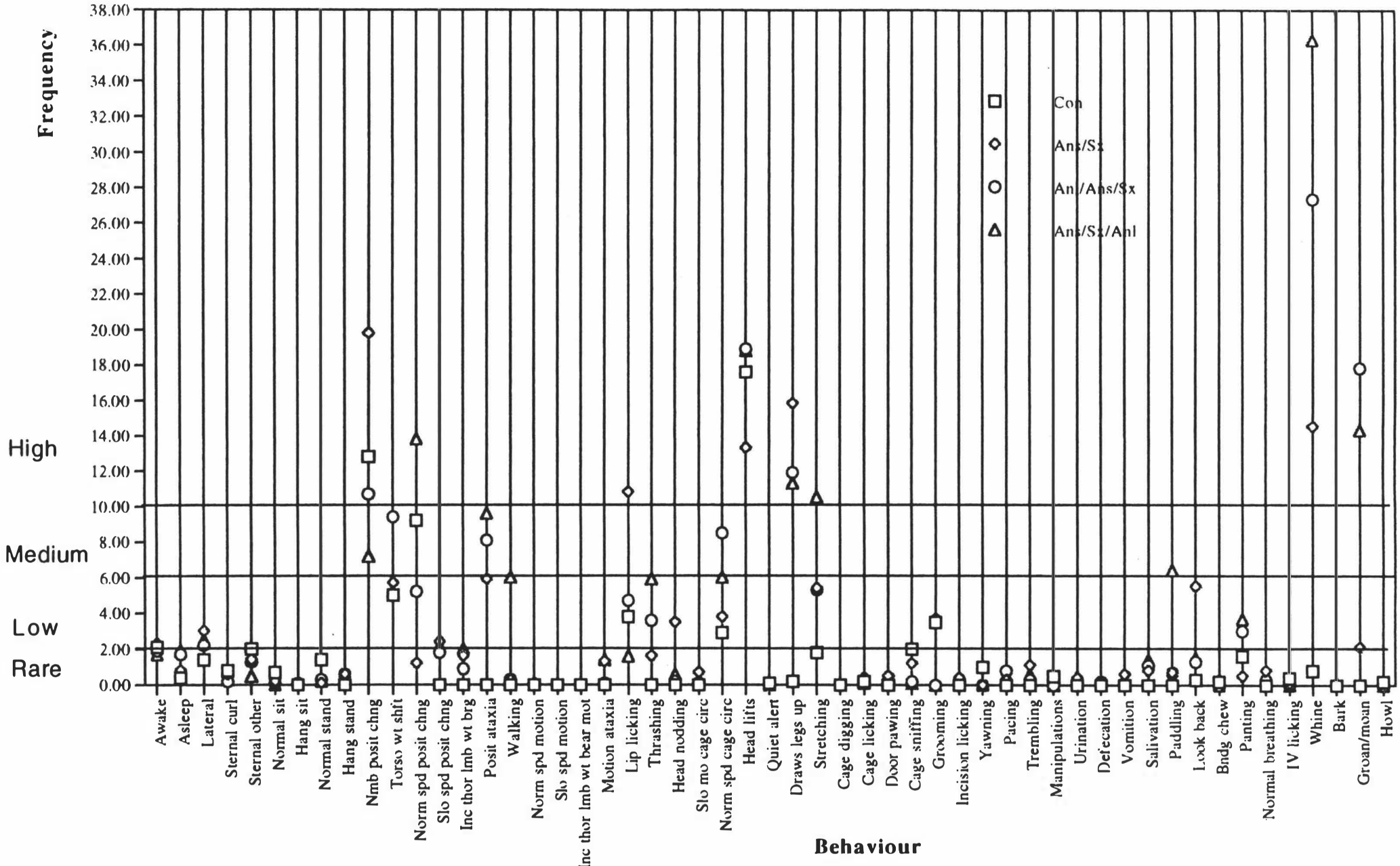


Figure 5.12 Summed occurrence for each noninteractive minute behaviour in each surgical treatment. Values plotted represent the total of each behaviour for each group from 91-151 minutes.

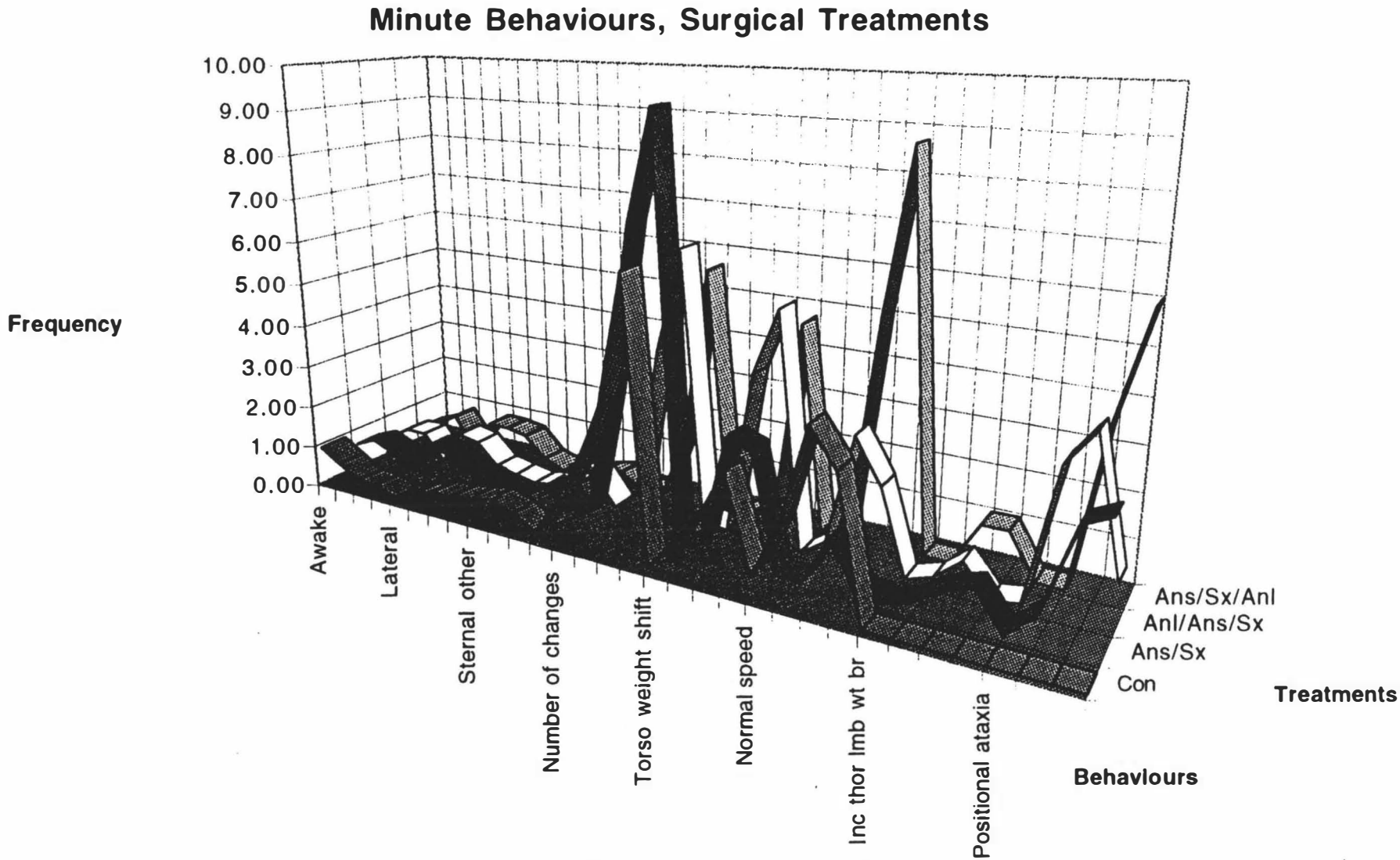


Figure 5.13a 3 dimension graph of minute behaviours for the surgical treatments. Each sequence of 4 points from a stated behaviour is continuous; however, the break between different behaviours is not shown.

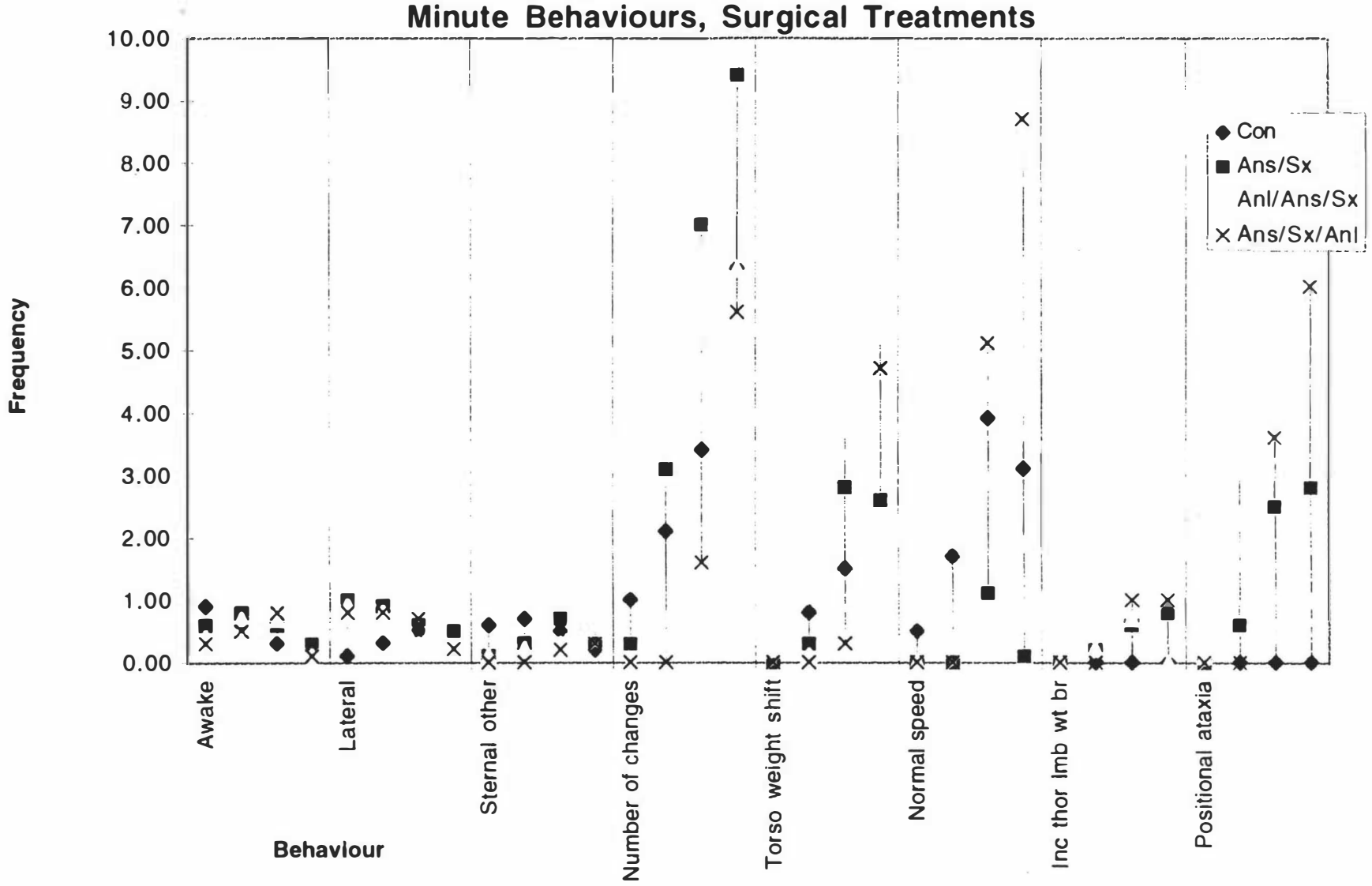


Figure 5.13b 2 dimension graph of minute behaviours for the surgical treatments. This is the same data as appears in Figure 5.13a. The four intervals following a stated behaviour are: 0-2 min., 3-10 min., 11-30 min. and 31-60 min.

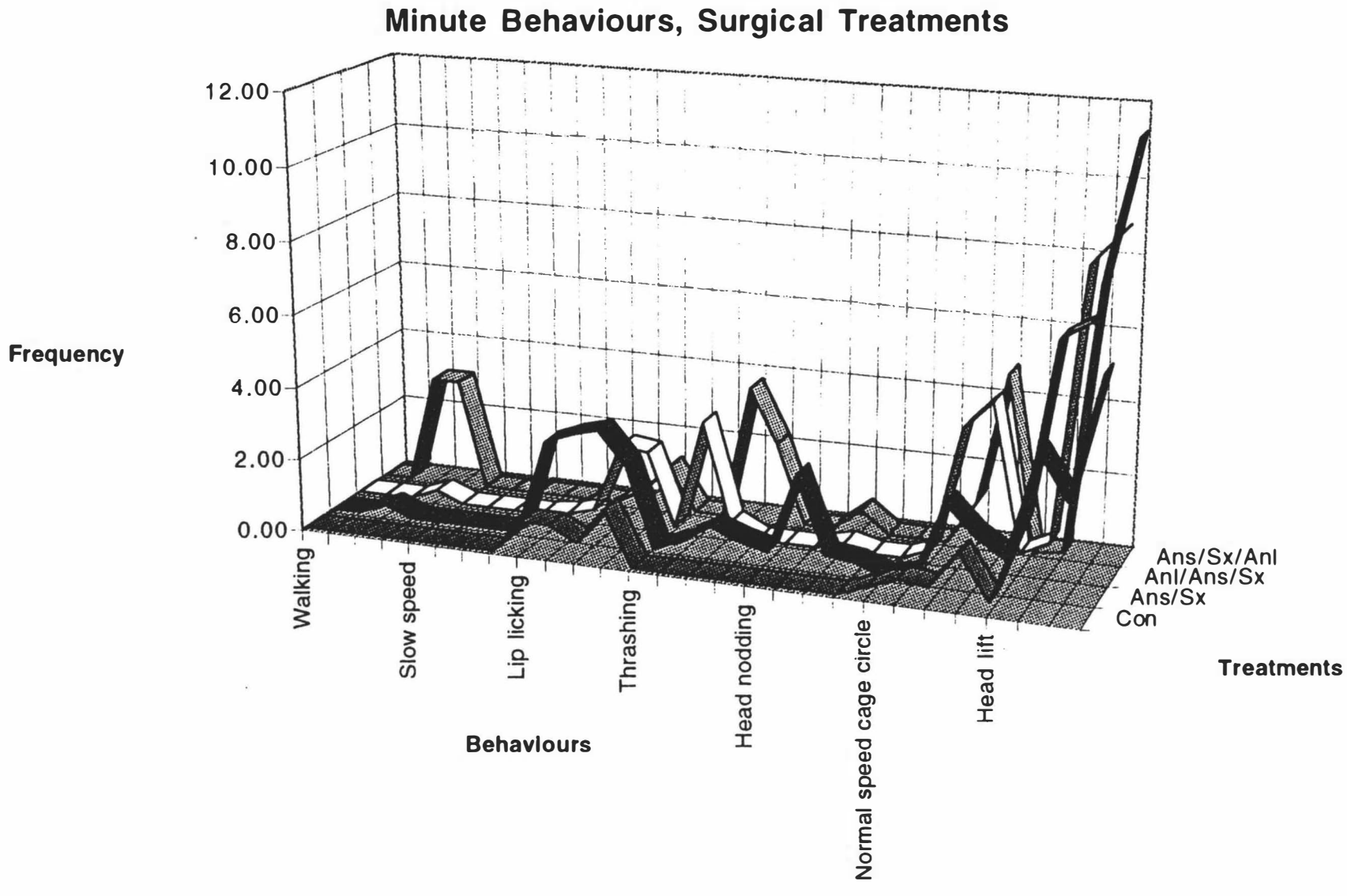


Figure 5.14a 3 dimension graph of minute behaviours for the surgical treatments. Each sequence of 4 points from a stated behaviour is continuous; however, the break between different behaviours is not shown.

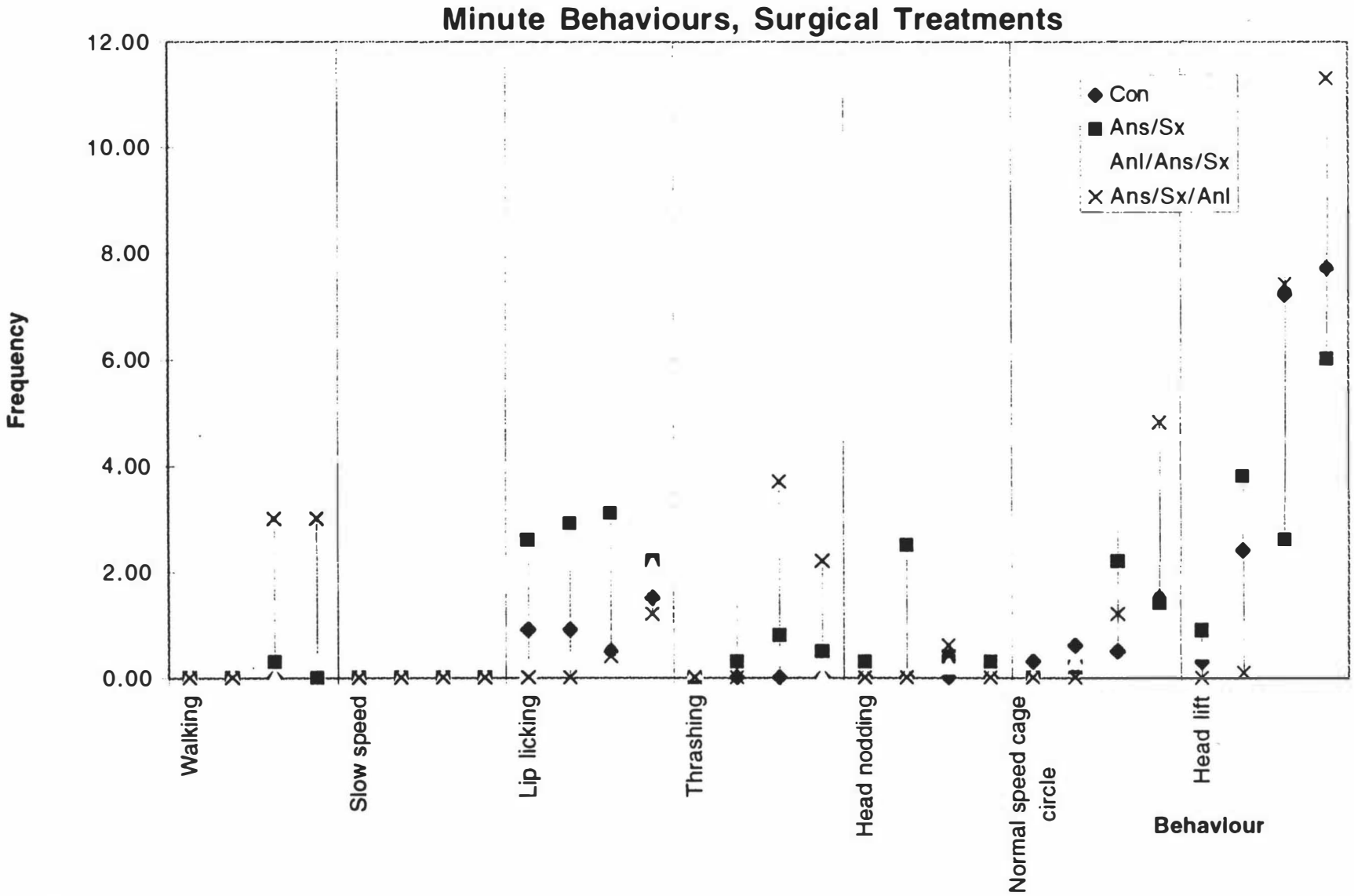


Figure 5.14b 2 dimension graph of minute behaviours for the surgical treatments. This is the same data as appears in Figure 5.14a. The four intervals following a stated behaviour are: 0-2 min., 3-10 min., 11-30 min. and 31-60 min.

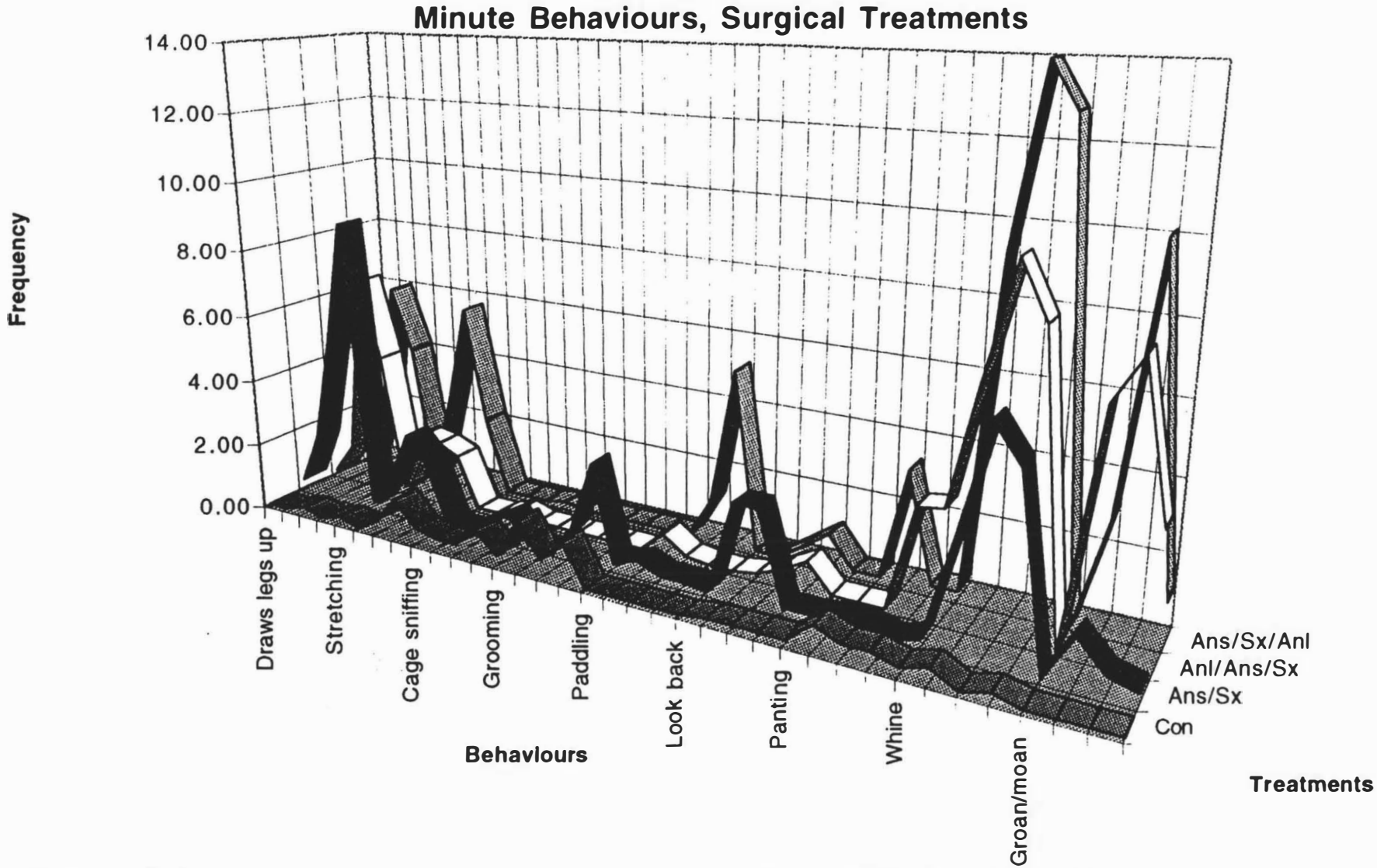


Figure 5.15a. 3 dimension graph of minute behaviours for the surgical treatments. Each sequence of 4 points from a stated behaviour is continuous; however, the break between different behaviours is not shown.

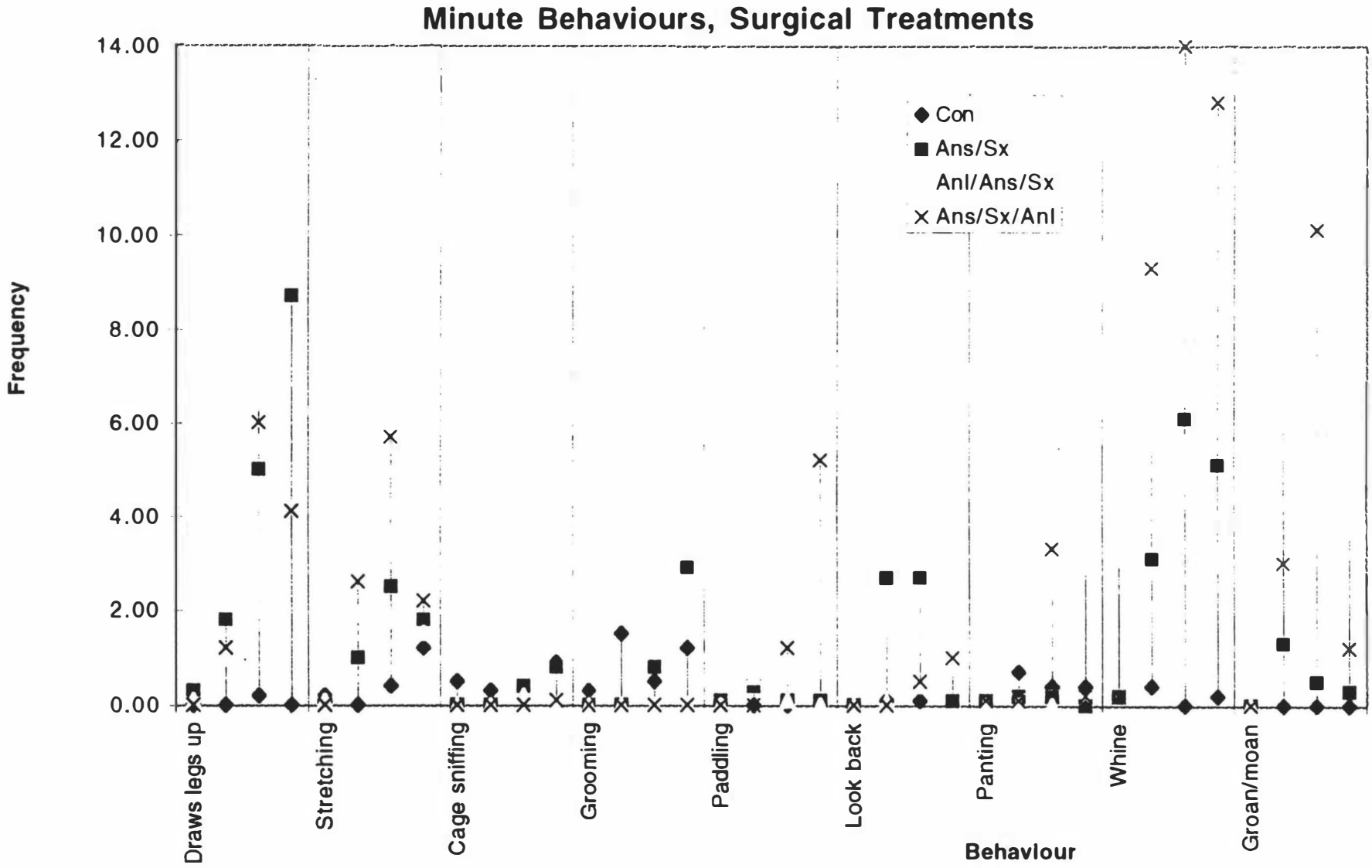


Figure 5.15b 2 dimension graph of minute behaviours for the surgical treatments. This is the same data as appears in Figure 5.15a. The four intervals following a stated behaviour are: 0-2 min., 3-10 min., 11-30 min. and 31-60 min.

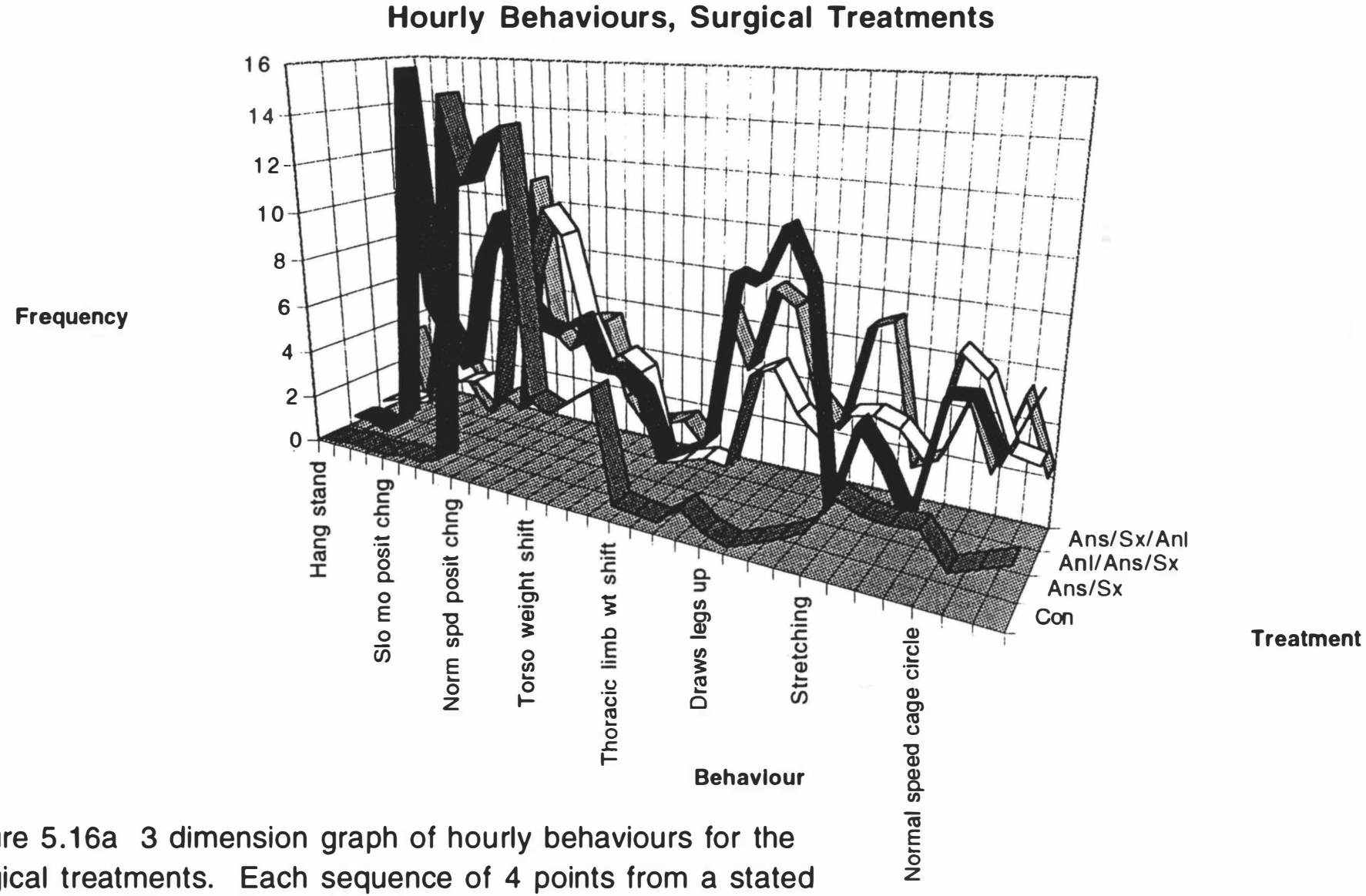


Figure 5.16a 3 dimension graph of hourly behaviours for the surgical treatments. Each sequence of 4 points from a stated behaviour is continuous; however, the break between different behaviours is not shown.

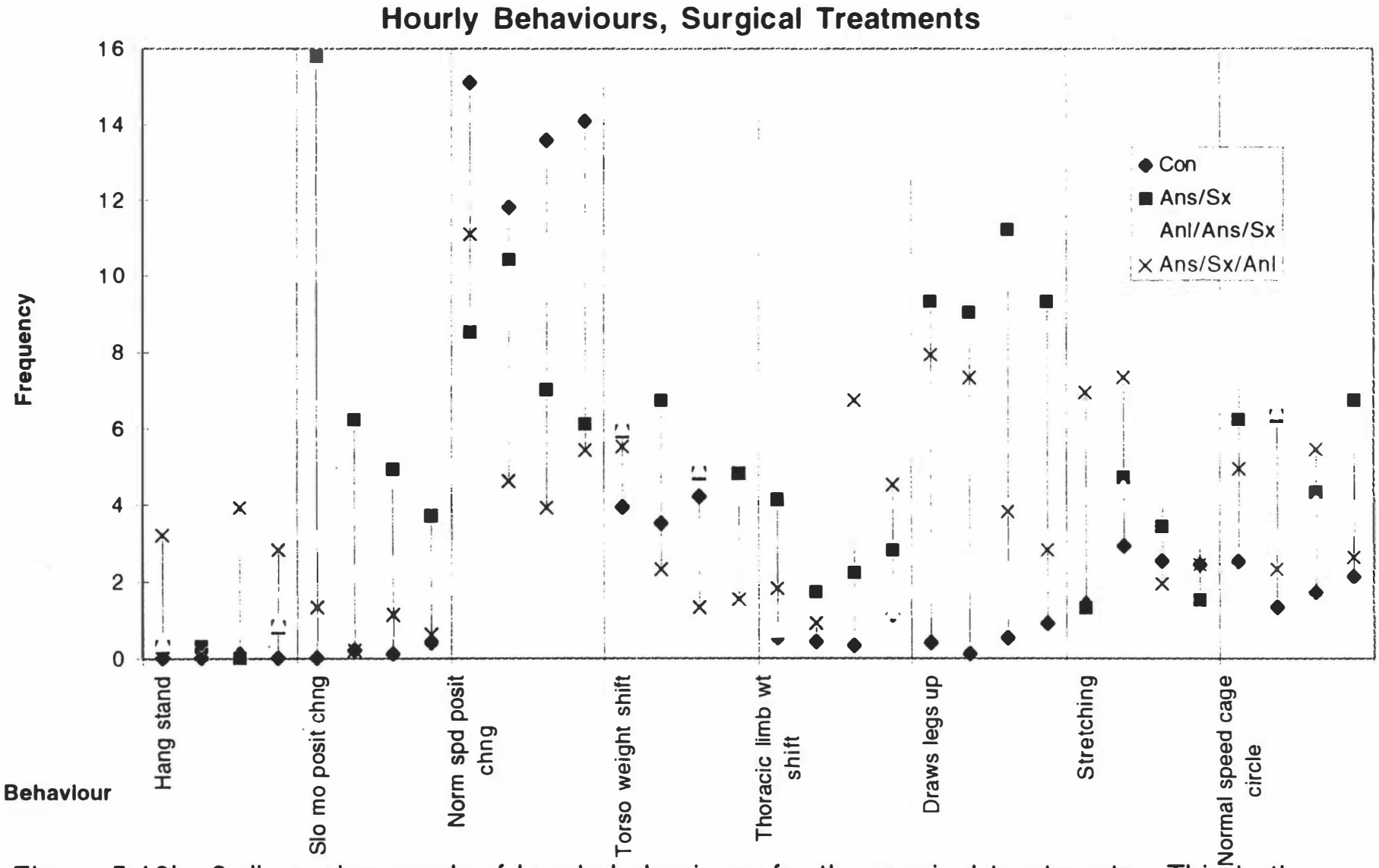


Figure 5.16b 2 dimension graph of hourly behaviours for the surgical treatments. This is the same data as appears in Figure 5.16a. The four intervals following a stated behaviour are: 2nd, 3rd, 4th and 5th hour after extubation.

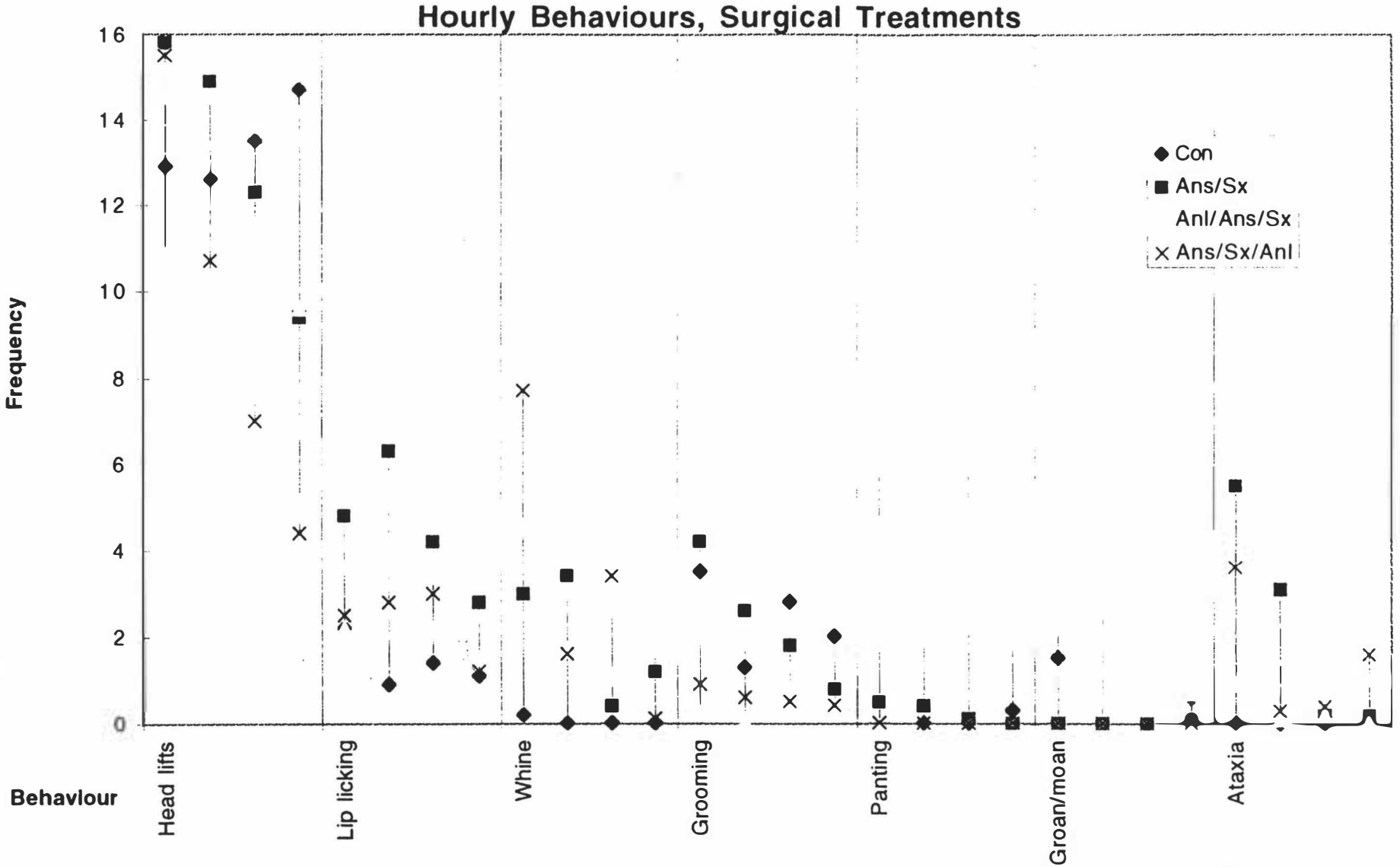


Figure 5.17b 2 dimension graph of hourly behaviours for the surgical treatments. This is the same data as appears in Figure 5.17a. The four intervals following a stated behaviour are: 2nd, 3rd. 4th and 5th hour after extubation.

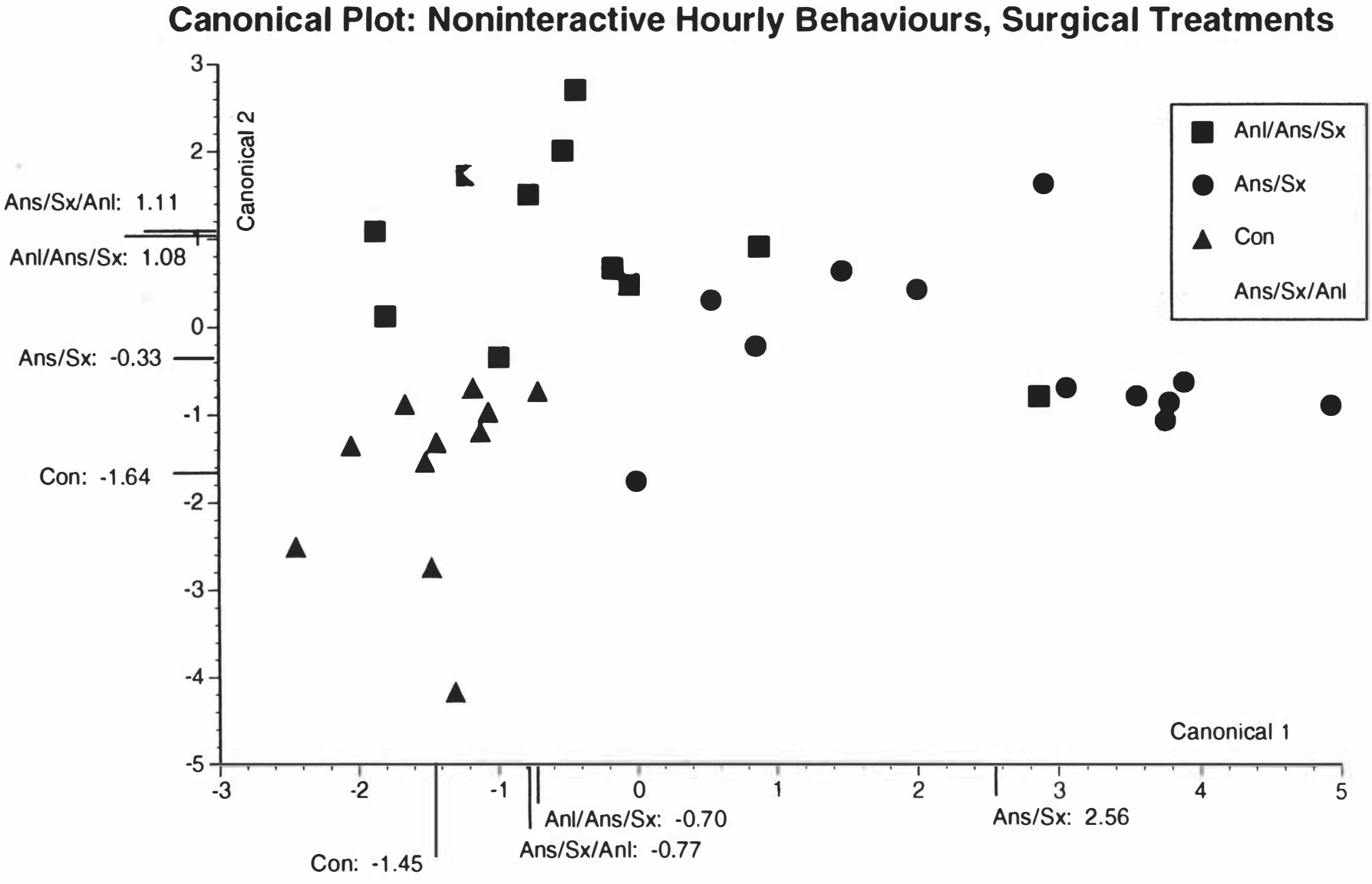


Figure 5.18a Canonical plot of noninteractive hourly behaviours for the surgical treatments. Values plotted for each bitch in each treatment are canonical discriminant functions (Z), which consists of contributing behaviours (V) with weighting coefficients (c); ie., $Z_1=c_1V_1+c_2V_2+.etc..$ Lines off the axis are group means.

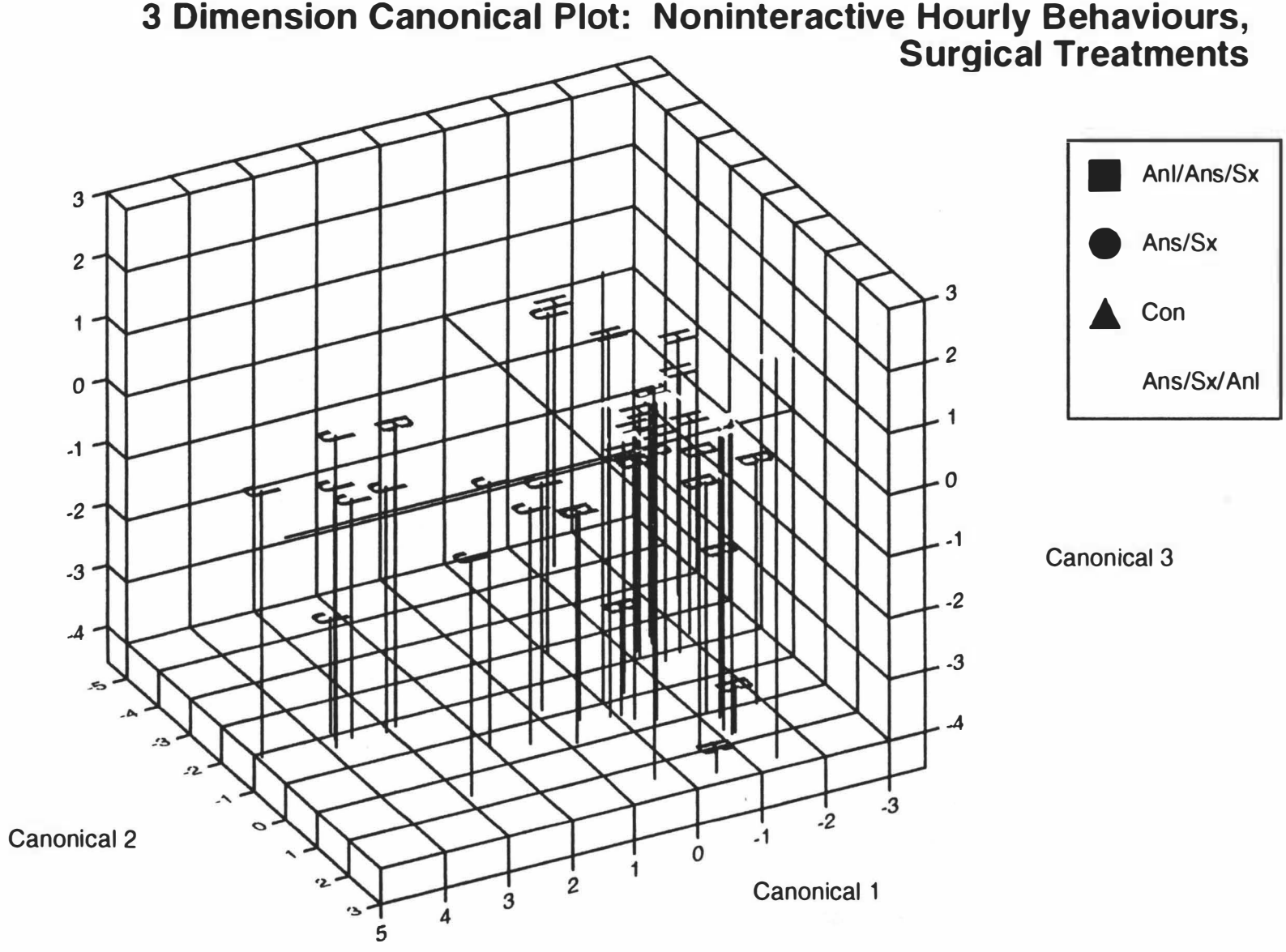


Figure 5.18b 3 dimension plot of noninteractive hourly behaviours for the surgical treatments. Data plotted is the same as in Figure 5.18a but with inclusion of the third canonical discriminant function which represents approximately 11% of the between-group differences for this data set.

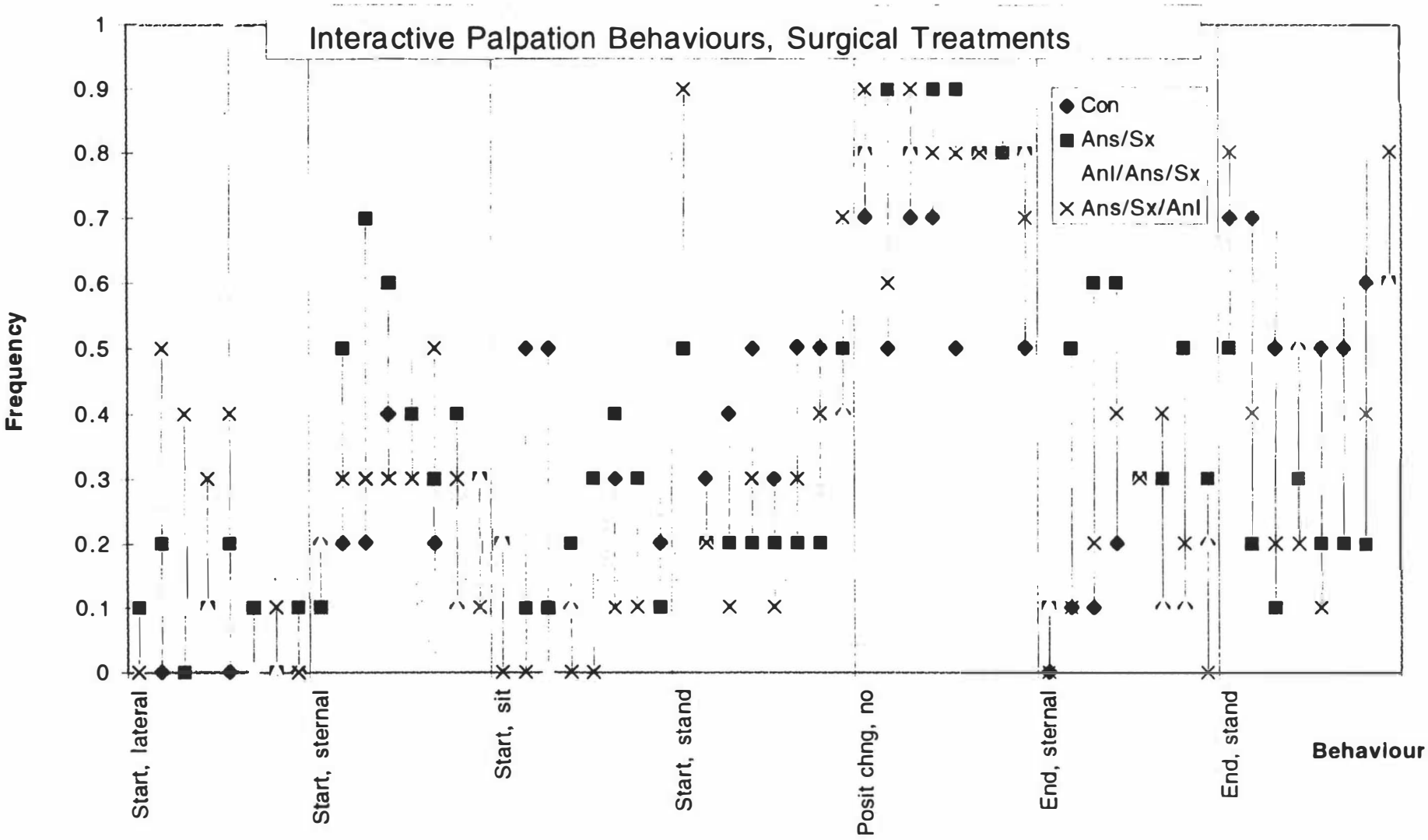


Figure 5.19 Interactive behaviours for the surgical treatments. The sequence of eight points from a stated behaviour represent the following times:
day before commencement of a treatment, and : 0.5 hr., 1.0 hr., 1.5 hr., 2.0 hr., 3.0 hr., 5.0 hr. and 24 hr. after the treatment.

Figure 5.20 Interactive behaviours for the surgical treatments. The sequence of eight points from a stated behaviour represent the following times:

day before commencement of a treatment, and : 0.5 hr., 1.0 hr., 1.5 hr., 2.0 hr., 3.0 hr., 5.0 hr. and 24 hr after the treatment.

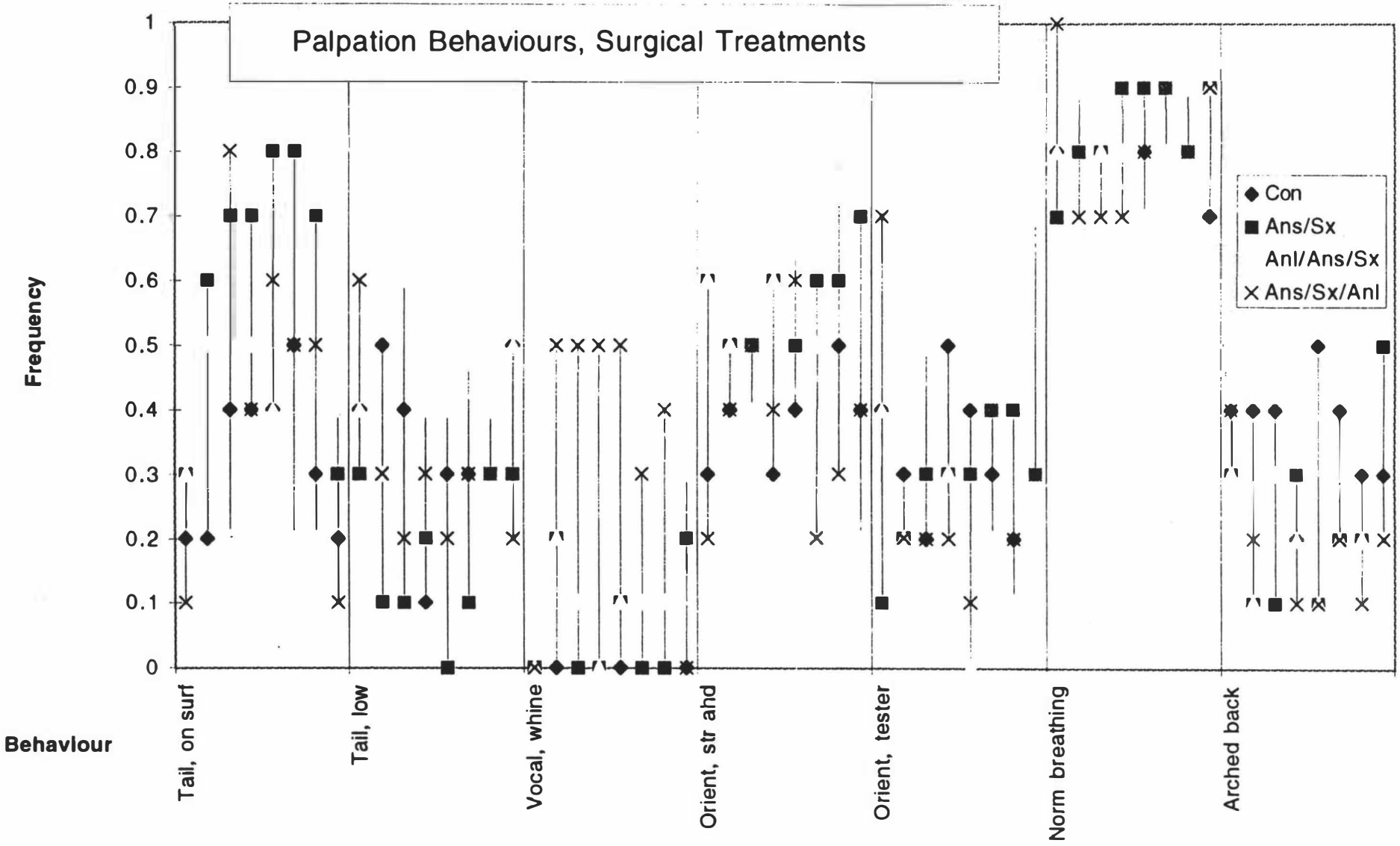


Figure 5.21 Interactive behaviours for the surgical treatments. The sequence of eight points from a stated behaviour represent the following times:

day before commencement of a treatment, and : 0.5 hr., 1.0 hr., 1.5 hr., 2.0 hr., 3.0 hr., 5.0 hr. and 24 hr. after the treatment.

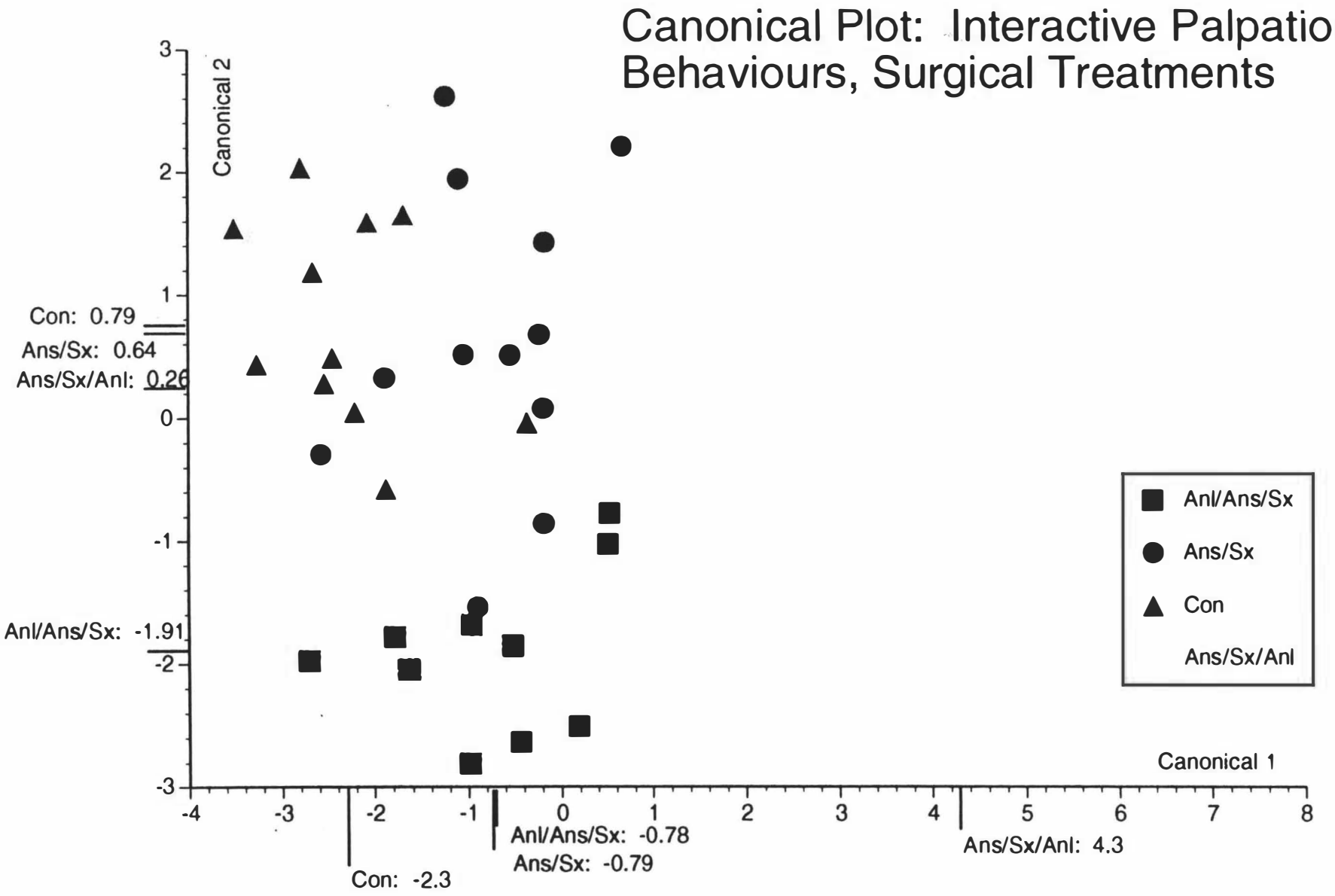


Figure 5.22a Canonical plot of interactive palpation behaviours for the surgical treatments. Values plotted for each bitch in each treatment are canonical discriminant functions (Z), which consists of contributing behaviours (V) with weighting coefficients (c); ie., $Z_1=c_1V_1+c_2V_2$+..etc. Lines off the axis are group means.

3 Dimension Canonical Plot: Interactive Palpation Behaviours, Surgical Treatments

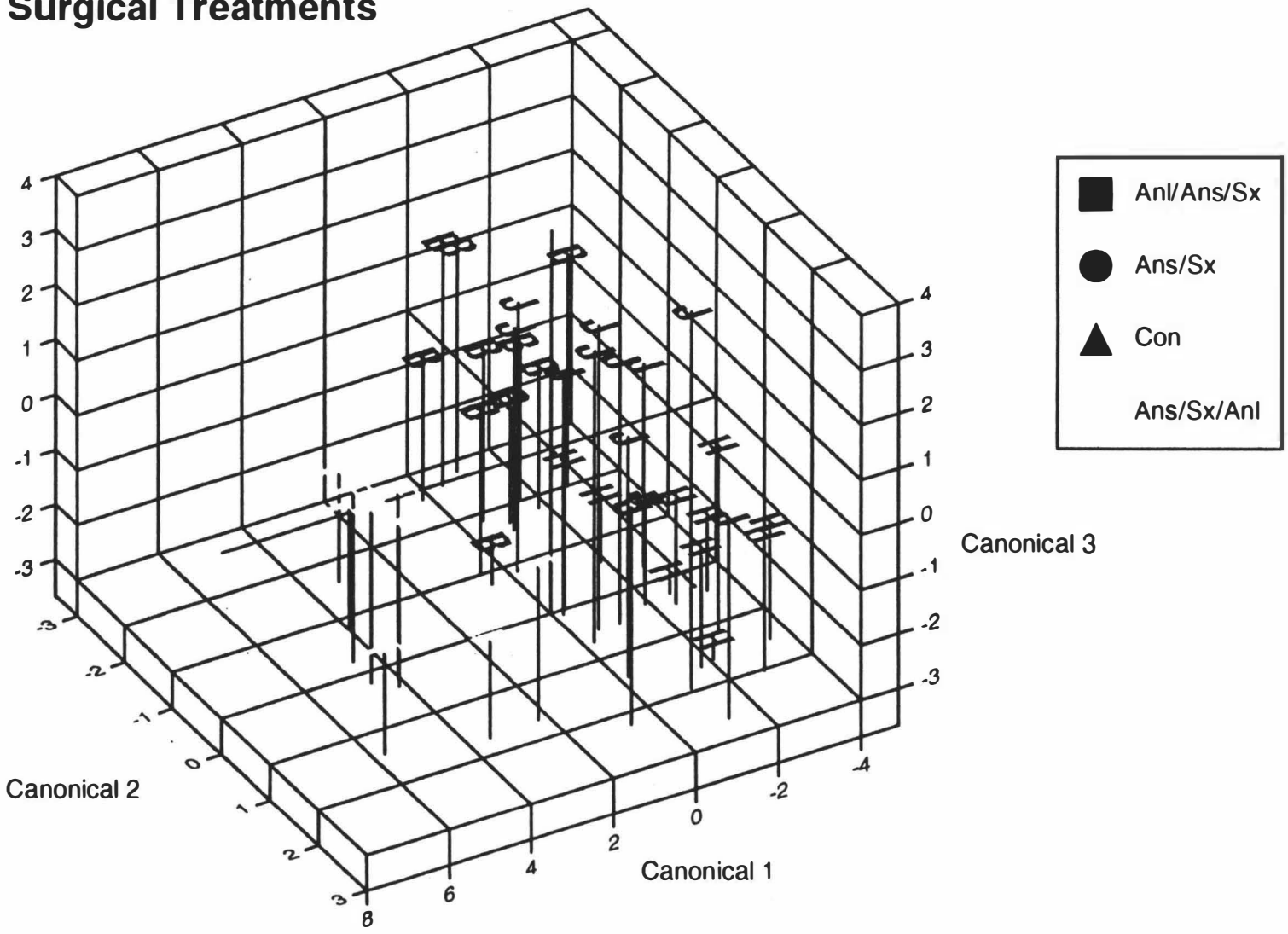


Figure 5.22b 3 dimension plot of interactive palpation behaviours for the surgical treatments. Data plotted is the same as in Figure 5.22a, but with inclusion of the third canonical discriminant function which represents approximately 12% of the between-group differences for this data set.

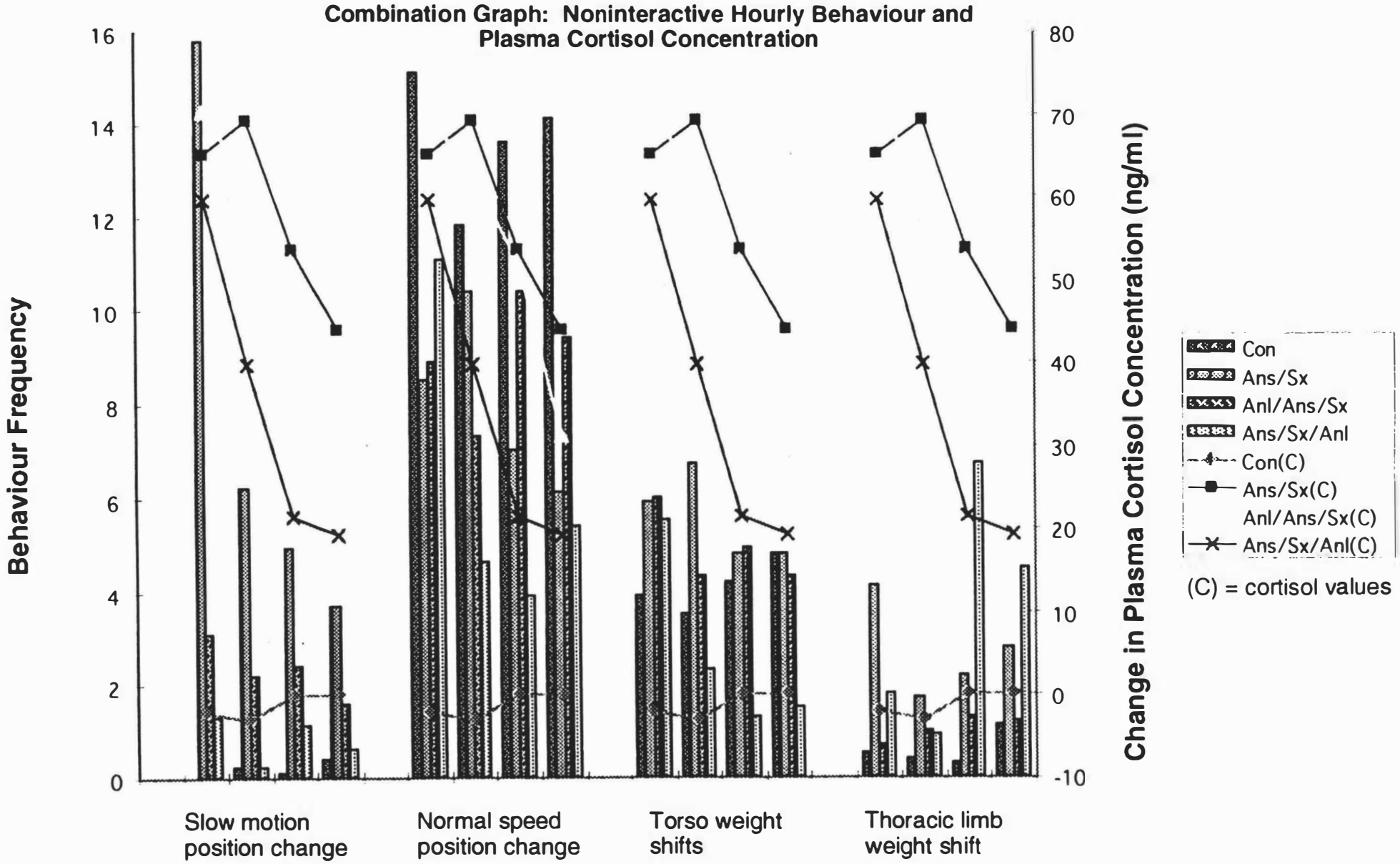


Figure H1 Combination Graph: Hourly behaviour and plasma cortisol concentration. The four intervals following a stated behaviour are: 2nd, 3rd, 4th and 5th hour after extubation. Cortisol values are those seen at the end of the same hourly intervals.

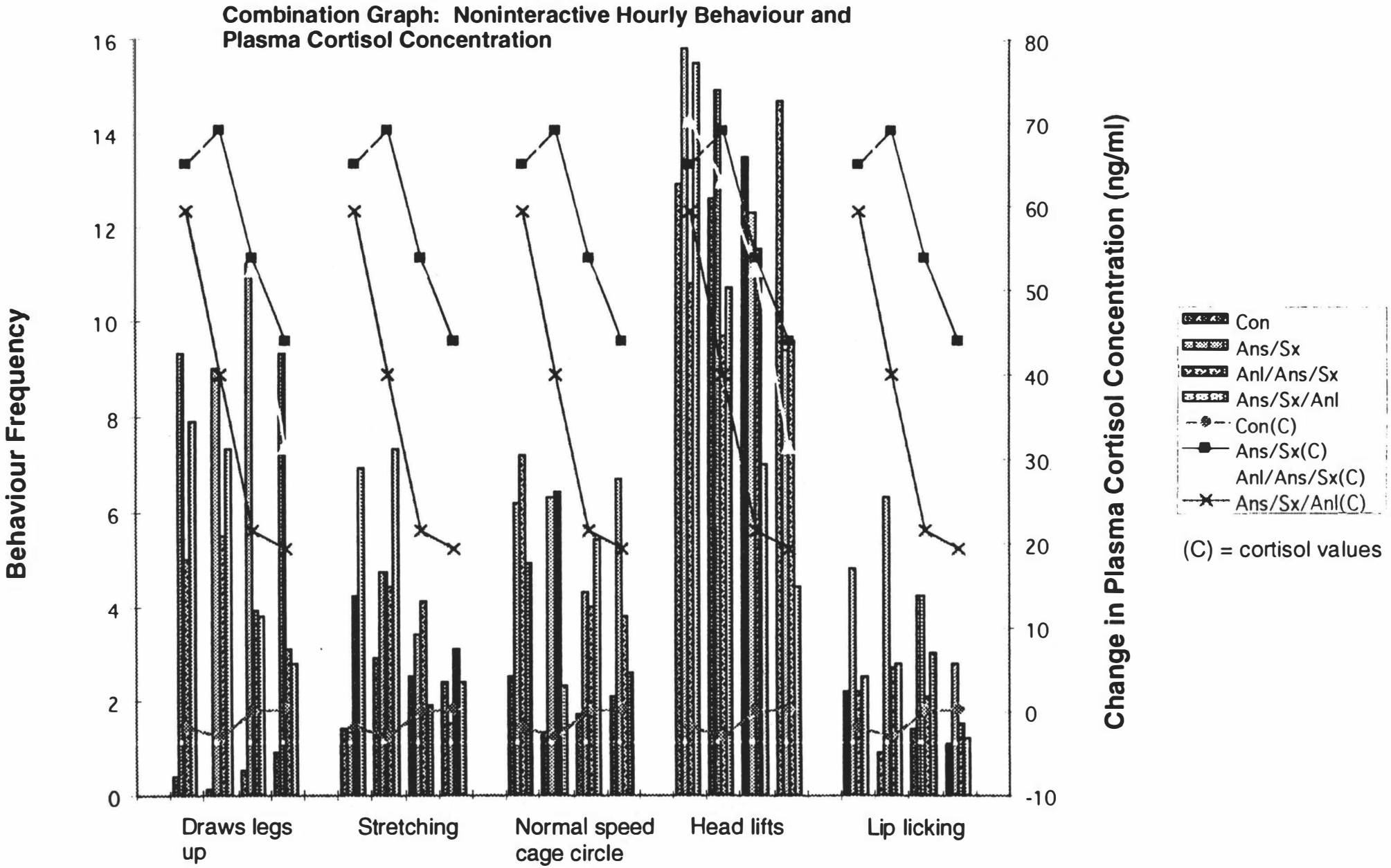


Figure H2 Combination Graph: Hourly behaviour and plasma cortisol concentration. The four intervals following a stated behaviour are: 2nd, 3rd, 4th and 5th hour after extubation. Cortisol values are those seen at the end of the same hourly intervals.

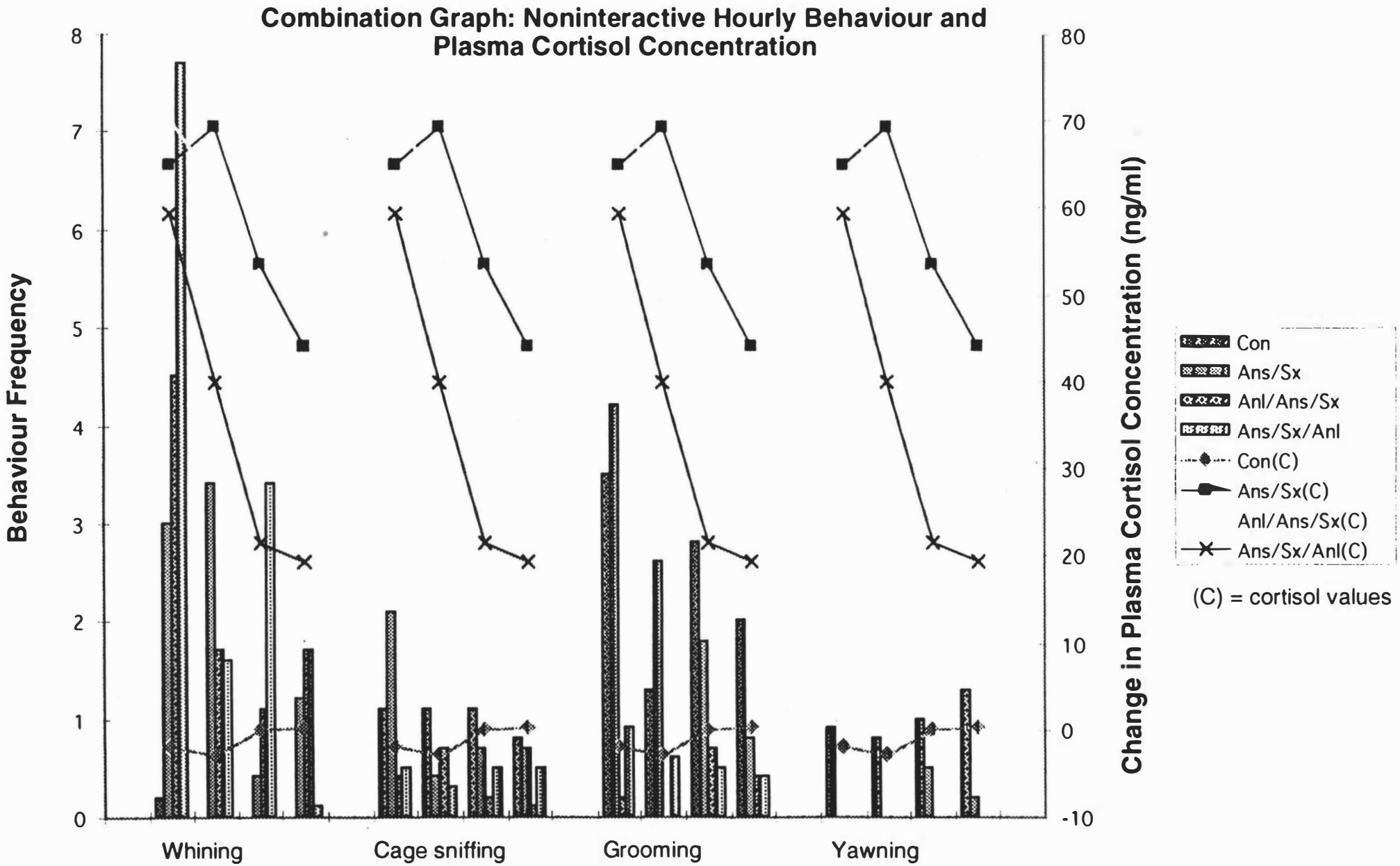


Figure H3 Combination Graph: Hourly behaviour and plasma cortisol concentration. The four intervals following a stated behaviour are: 2nd, 3rd, 4th and 5th hour after extubation. Cortisol values are those seen at the end of the same hourly intervals.

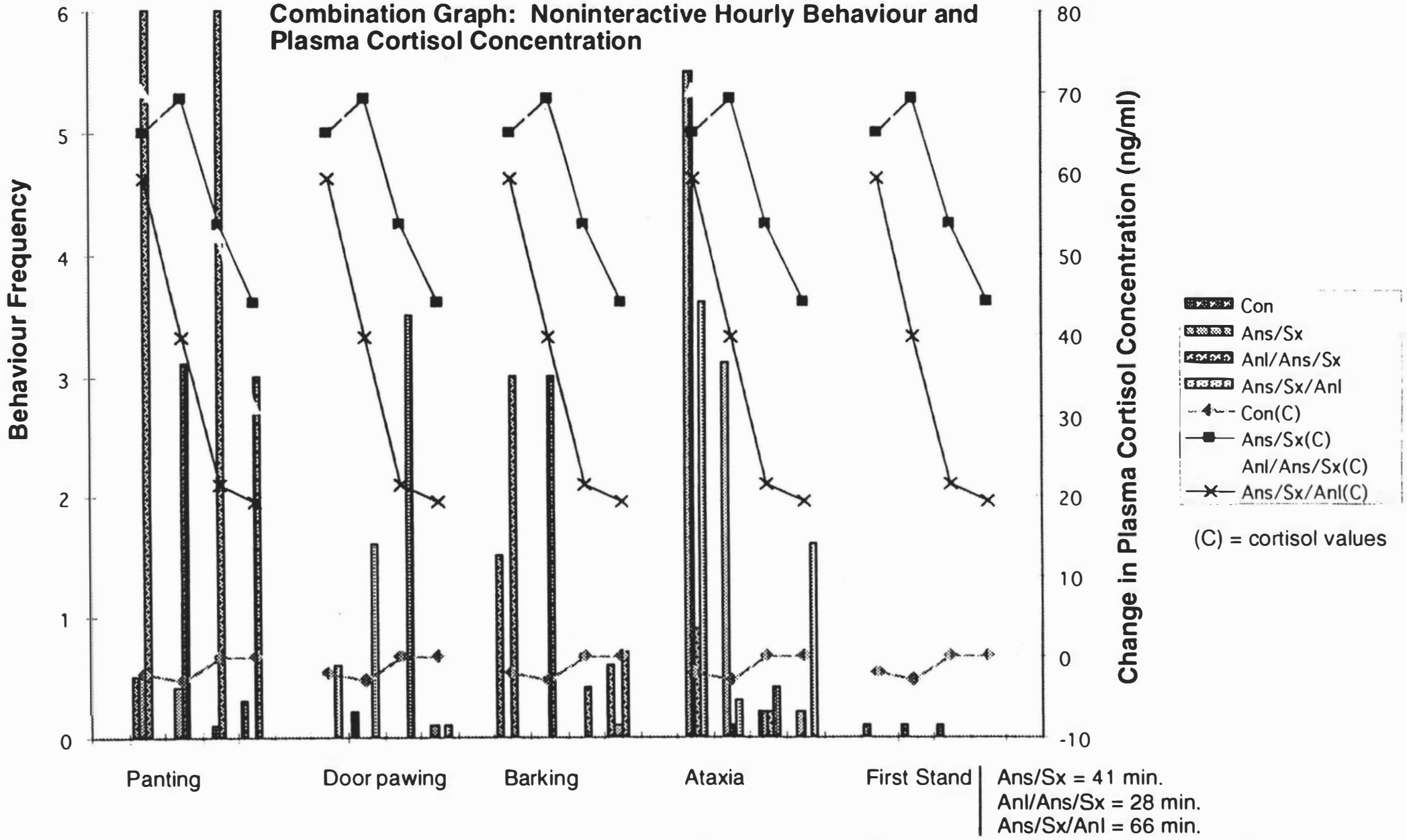


Figure H4 Combination Graph: Hourly behaviour and plasma cortisol concentration. The four intervals following a stated behaviour are: 2nd, 3rd, 4th and 5th hour after extubation. Cortisol values are those seen at the end of the same hourly intervals.

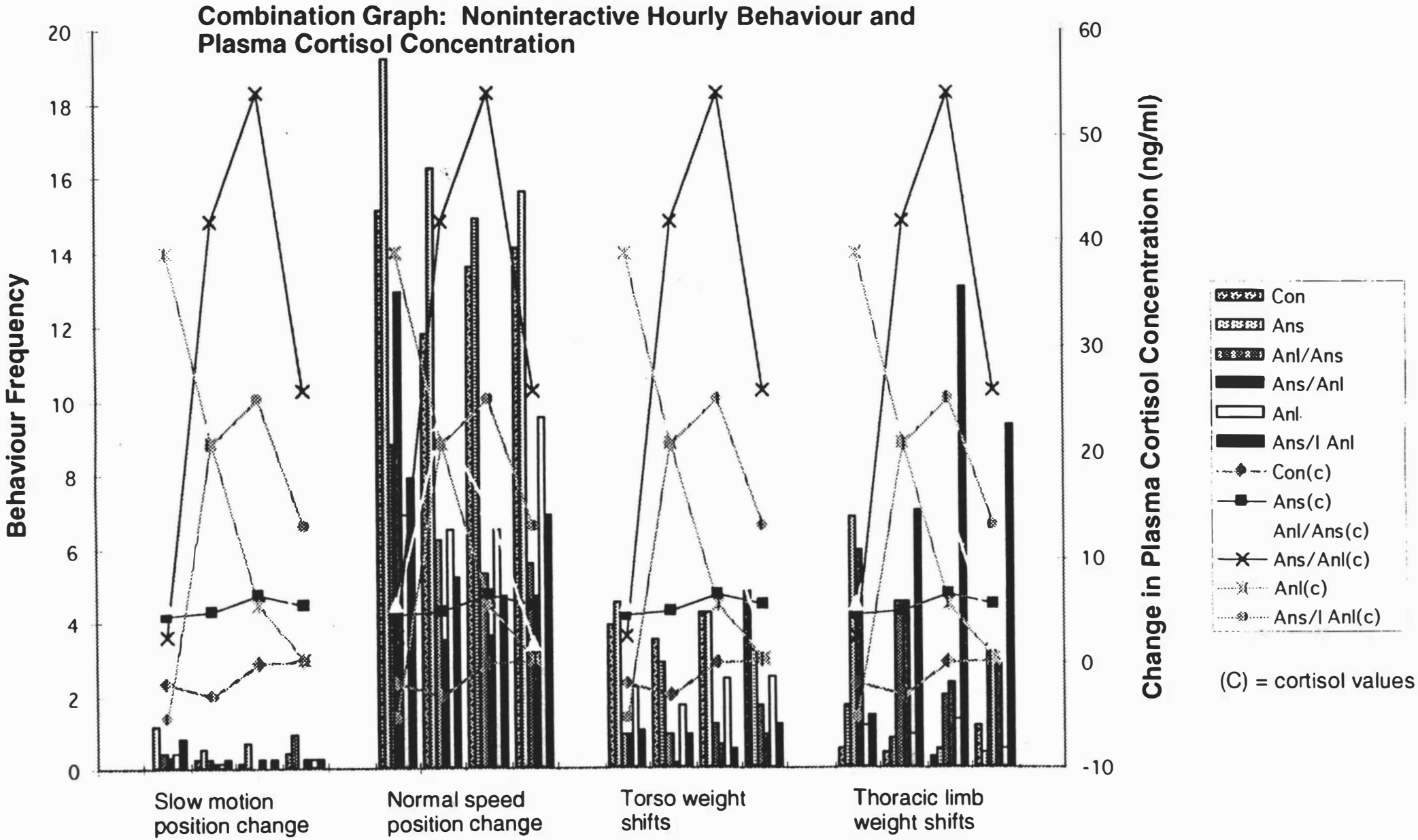


Figure H5 Combination Graph: Hourly behaviour and plasma cortisol concentration. The four intervals following a stated behaviour are: 2nd, 3rd, 4th and 5th hour after extubation. Cortisol values are those seen at the end of the same hourly intervals.

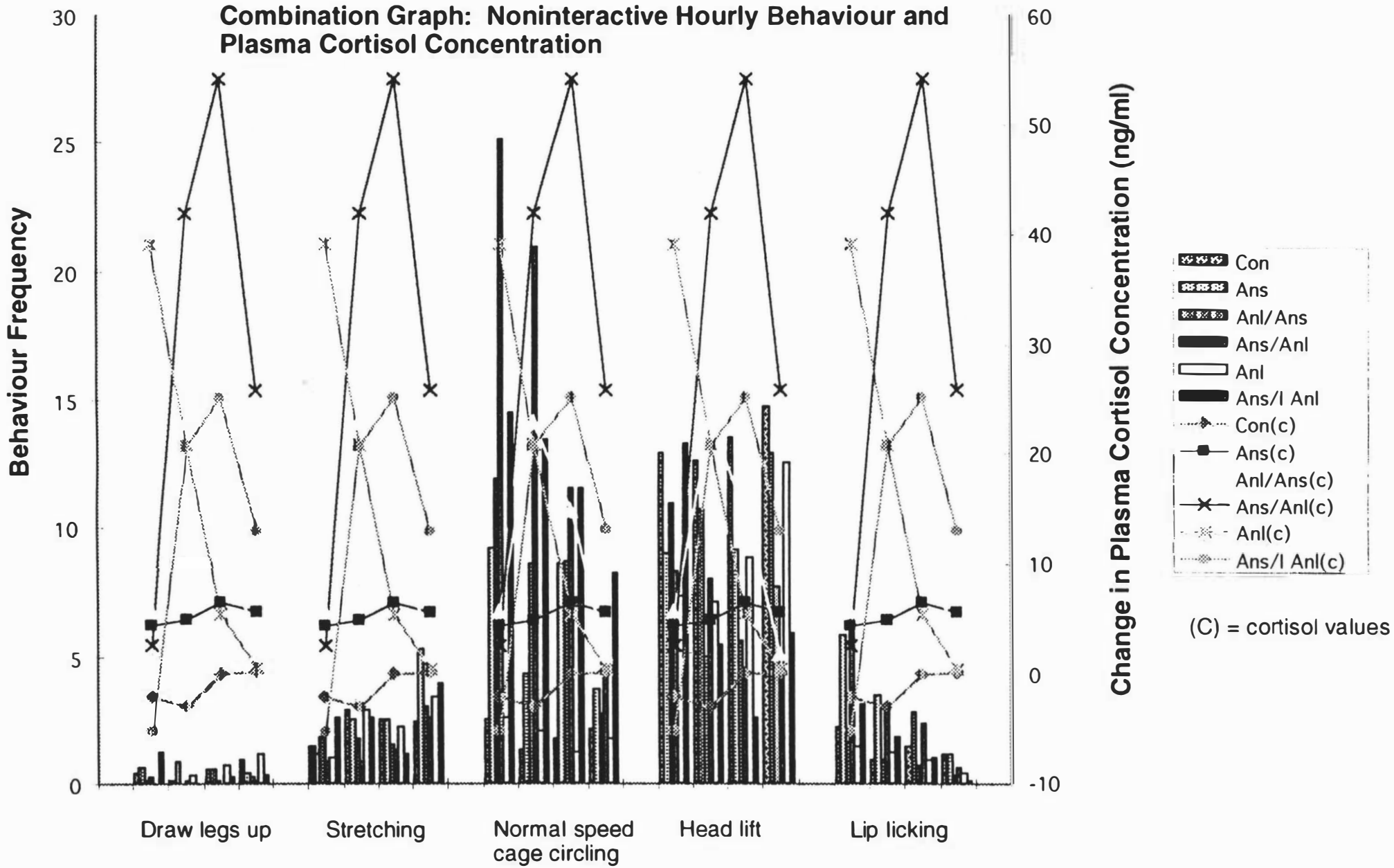


Figure H6 Combination Graph: Hourly behaviour and plasma cortisol concentration. The four intervals following a stated behaviour are: 2nd, 3rd, 4th and 5th hour after extubation. Cortisol values are those seen at the end of the same hourly intervals.

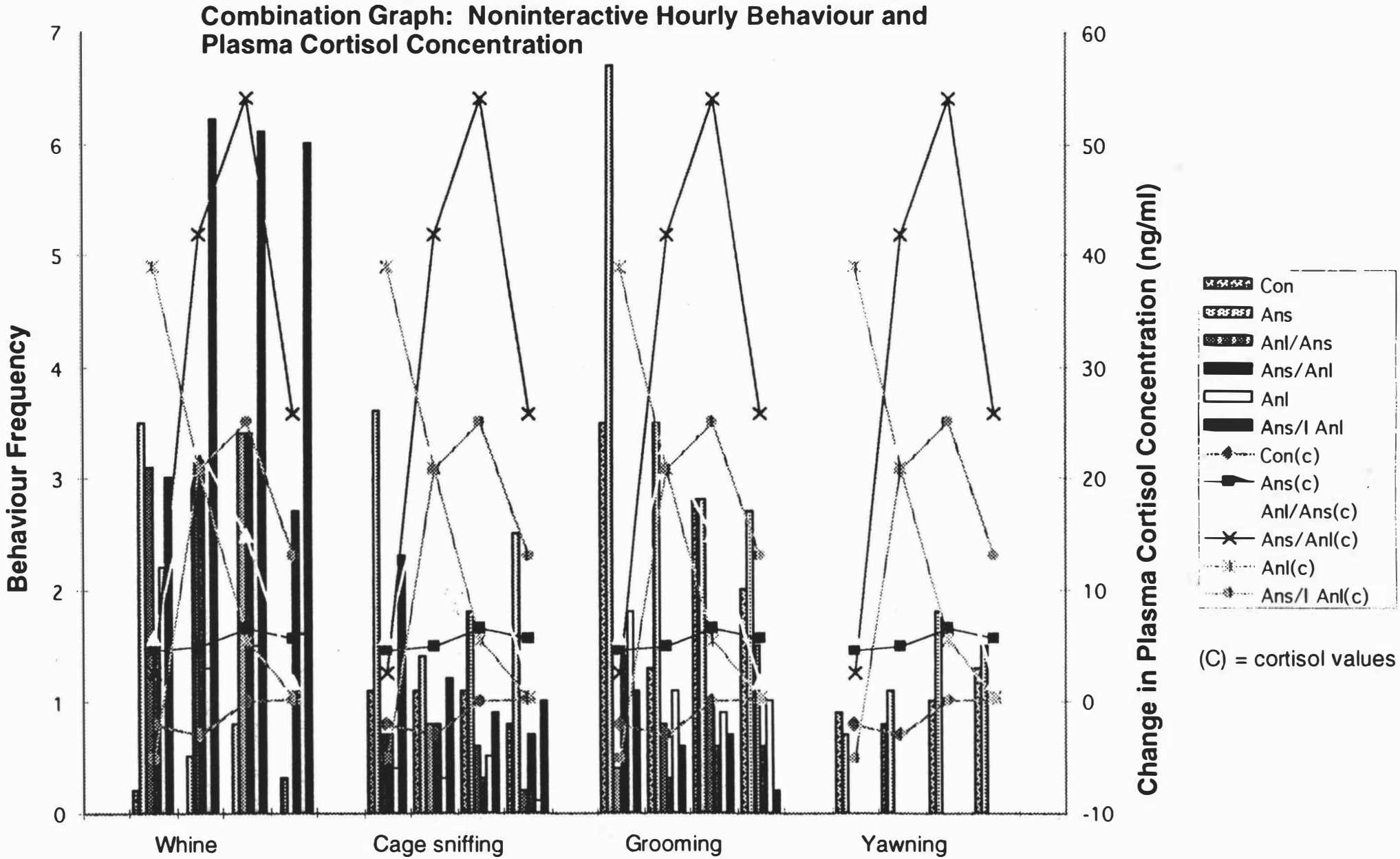


Figure H7 Combination Graph: Hourly behaviour and plasma cortisol concentration. The four intervals following a stated behaviour are: 2nd, 3rd, 4th and 5th hour after extubation. Cortisol values are those seen at the end of the same hourly intervals.

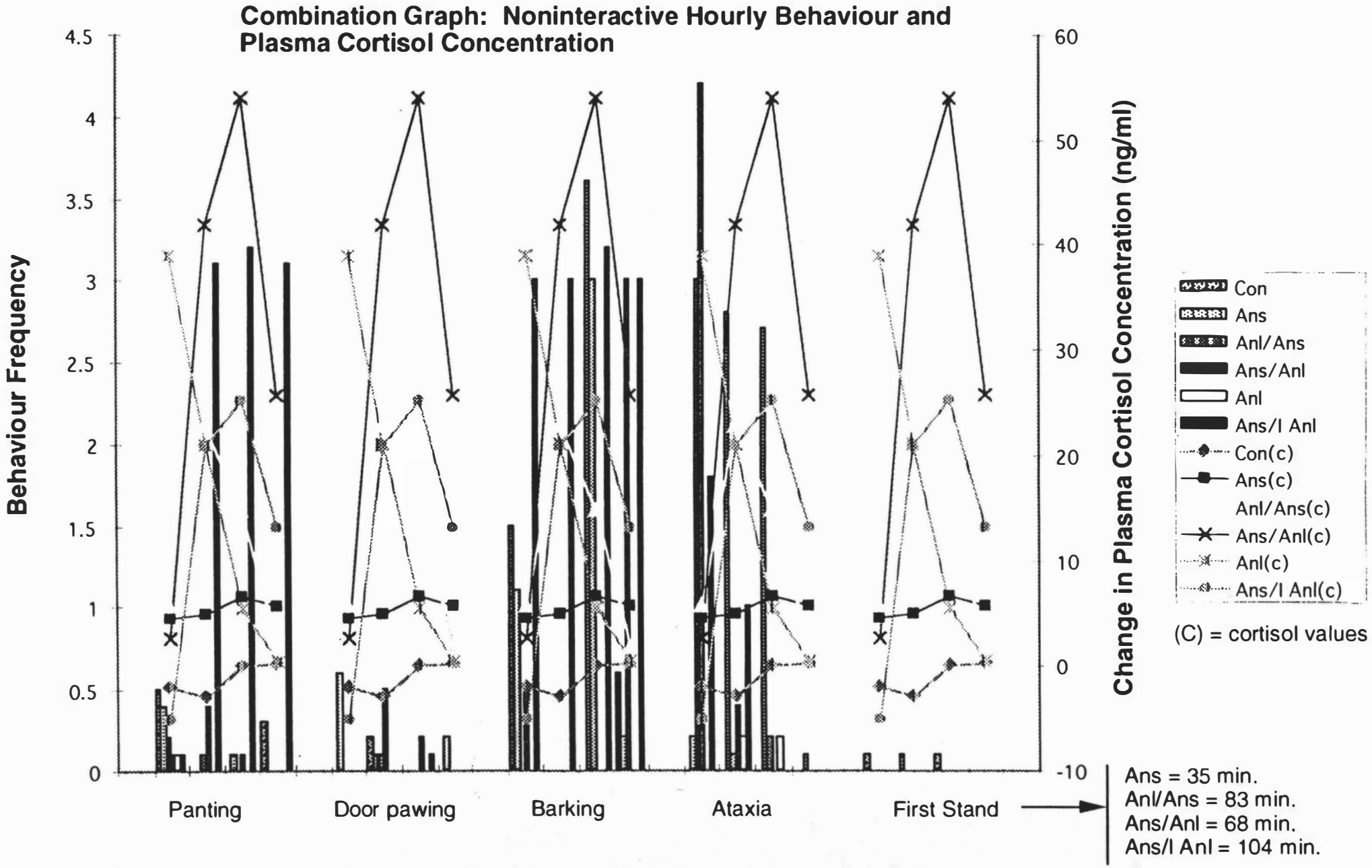


Figure H8 Combination Graph: Hourly behaviour and plasma cortisol concentration. The four intervals following a stated behaviour are: 2nd, 3rd, 4th and 5th hour after extubation. Cortisol values are those seen at the end of the same hourly intervals.

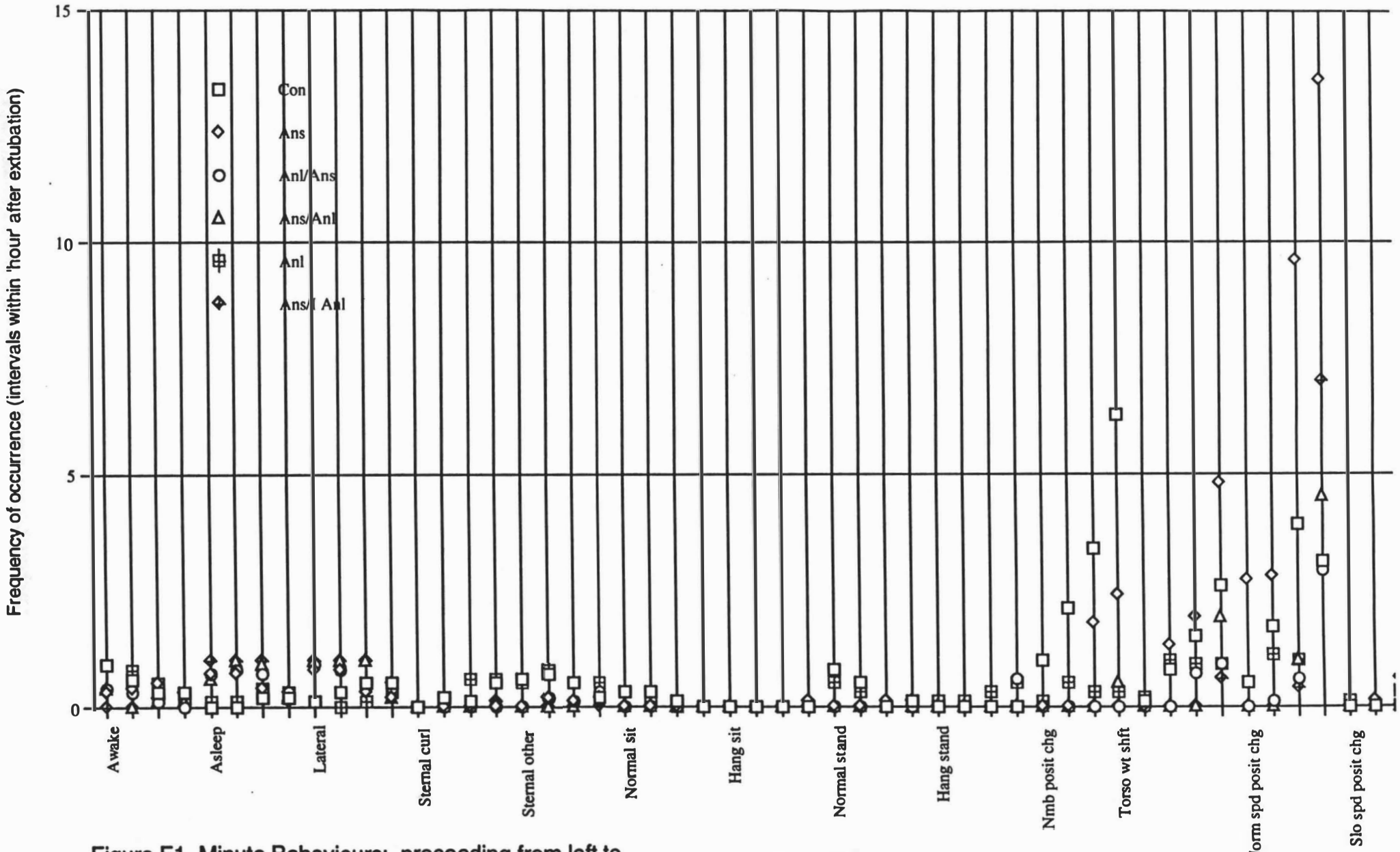
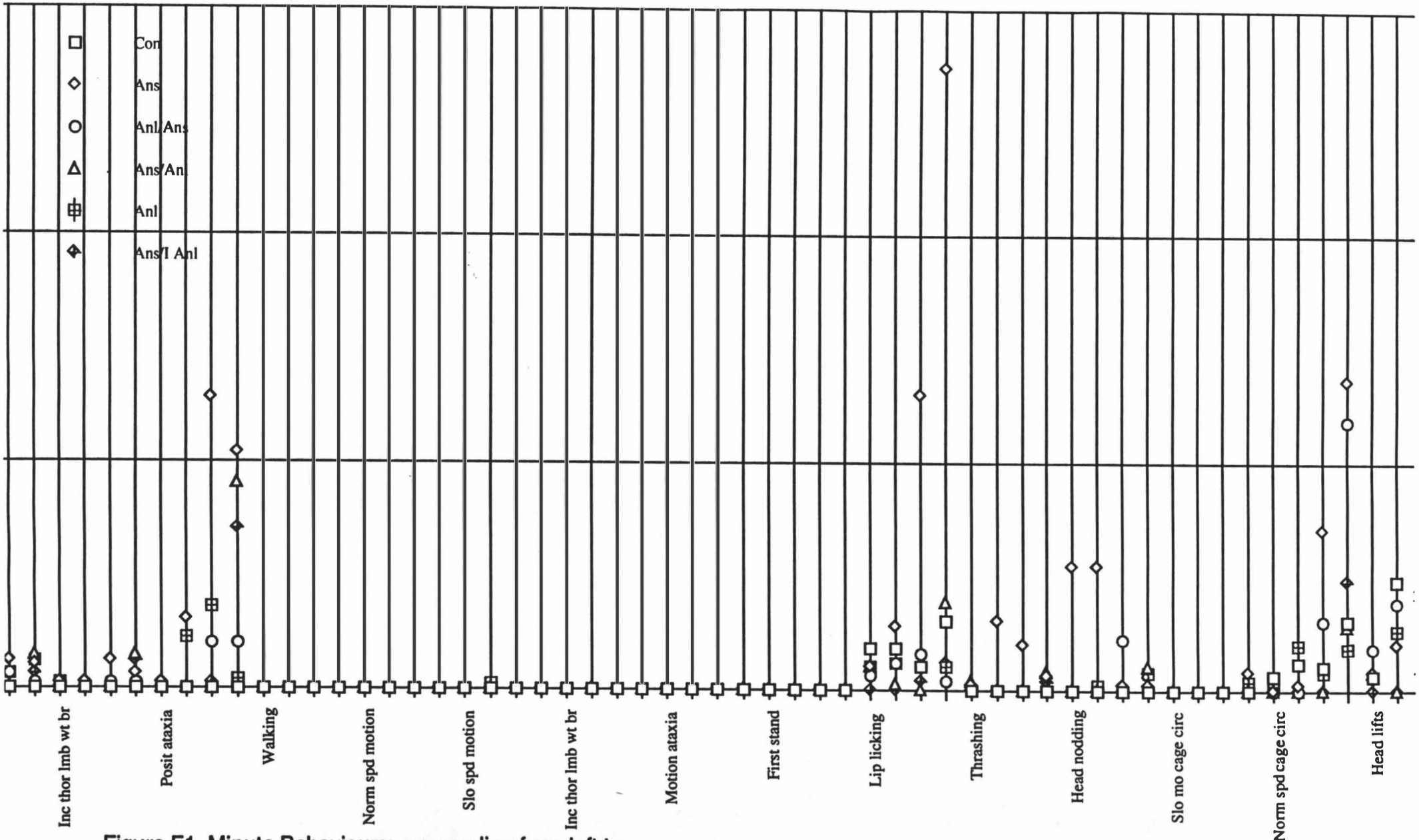


Figure F1 Minute Behaviours: proceeding from left to right, intervals following a stated behaviour are; 0-2 min, 3-10 min, 11-30 min, and 31-60 mins.



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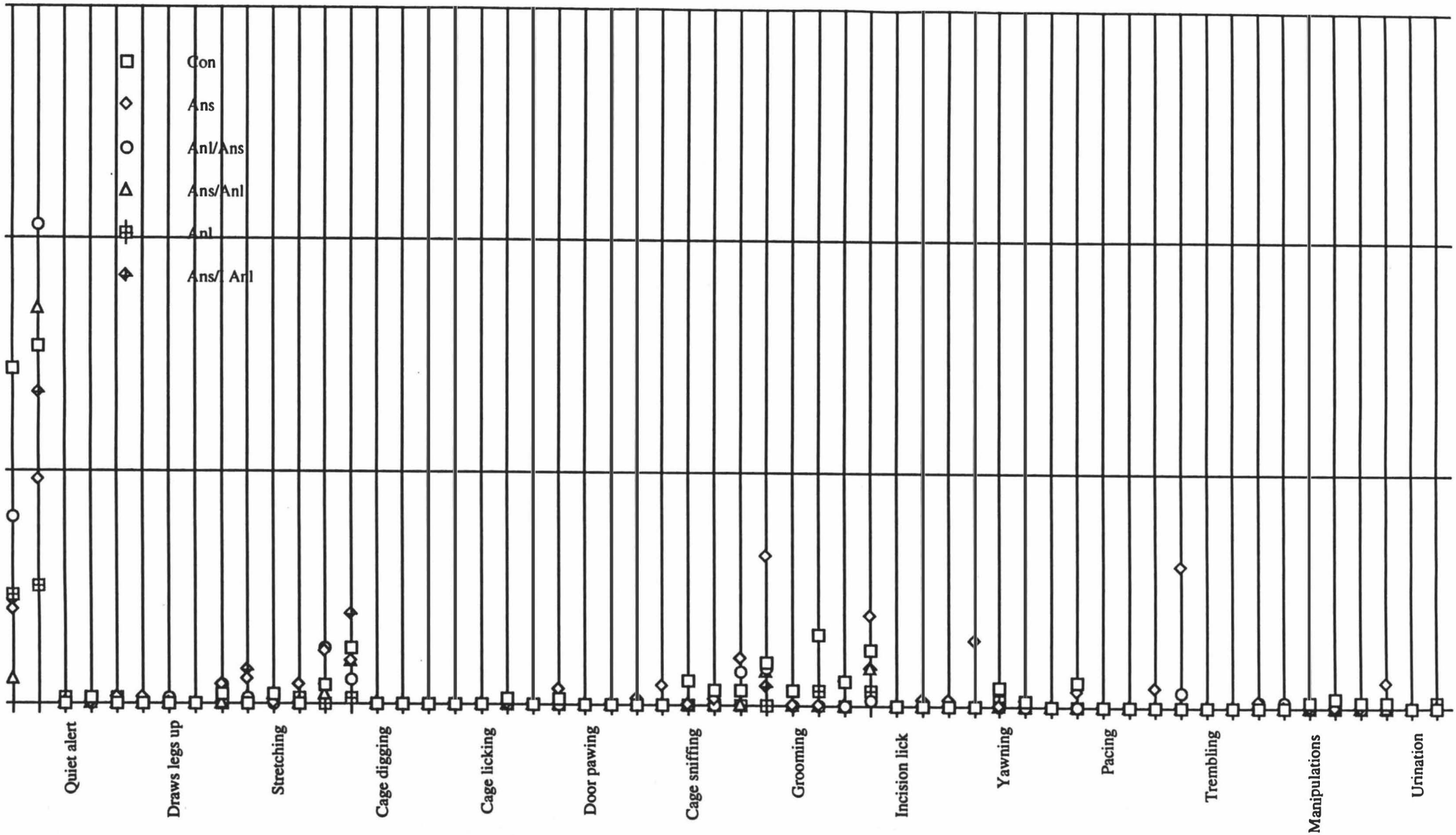
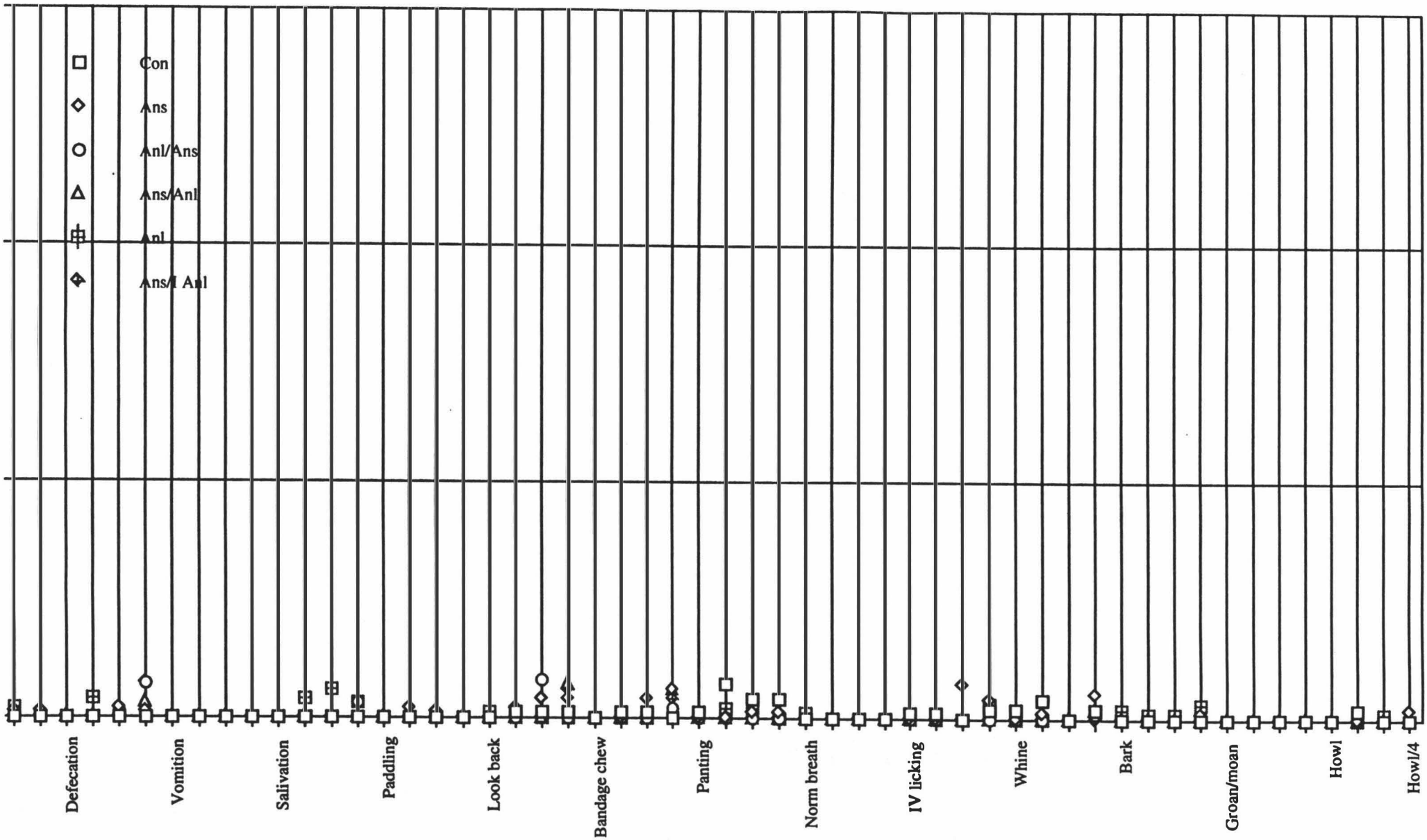


Figure F1 Minute Behaviours: proceeding from left to right, intervals following a stated behaviour are; 0-2 min, 3-10 min, 11-30 min, and 31-60 mins.

Behaviours



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Behaviours

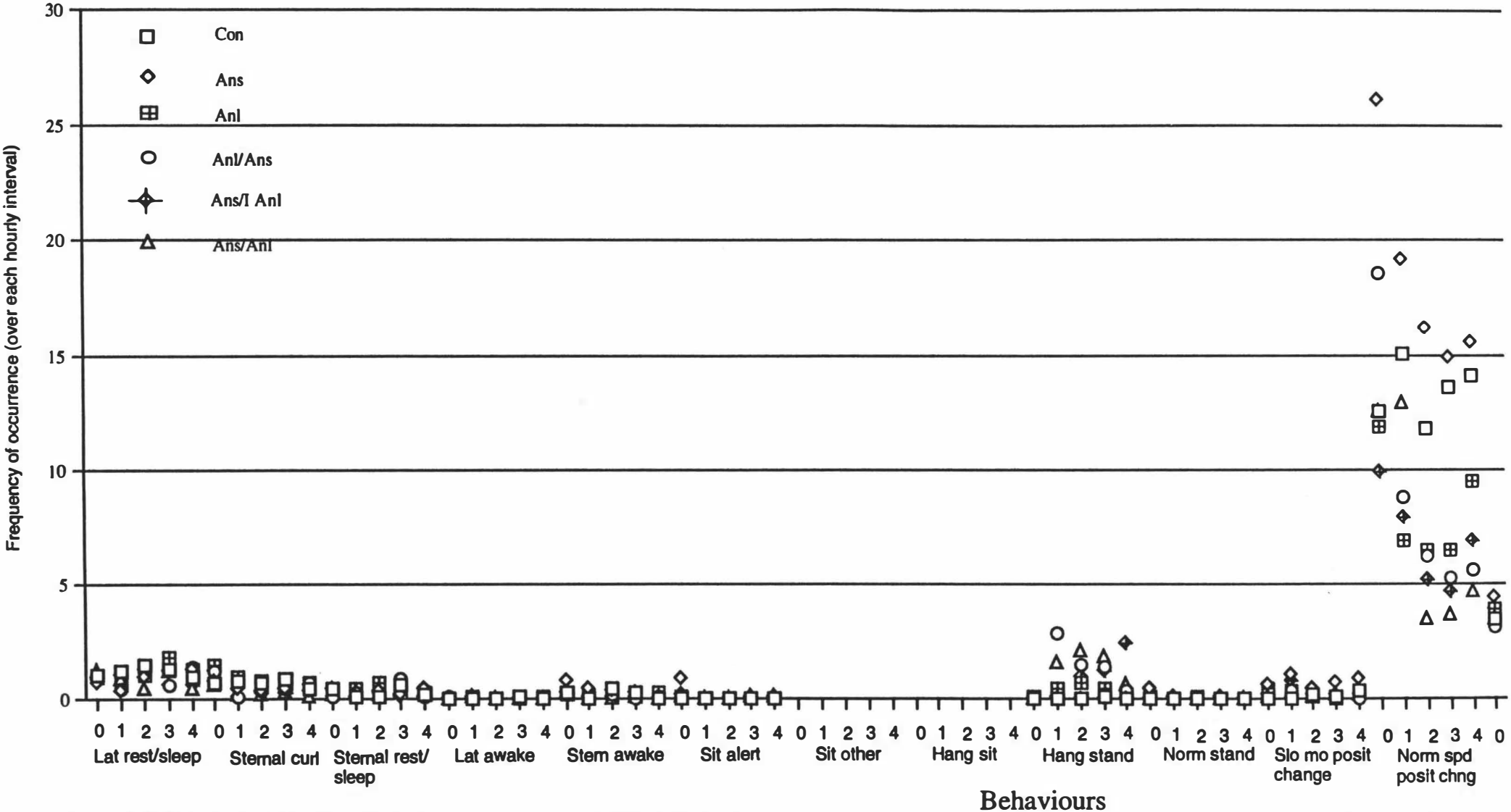
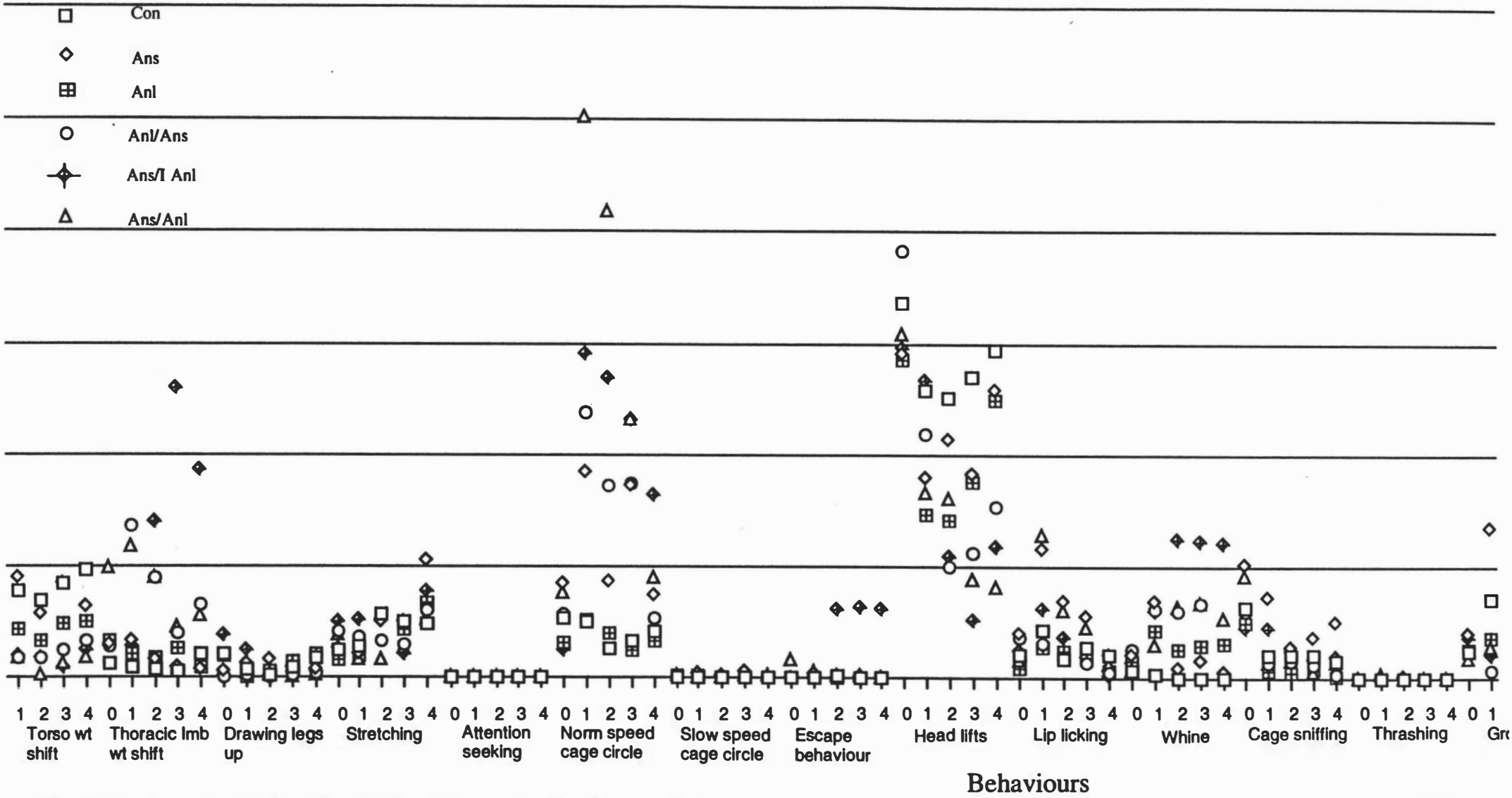


Figure F2 Noninteractive hourly behaviours: observations for trends.
Numbers 0-4 on the X-axis represent interval of sampling: 0=day before treatment; 1=hour 1-2; 2=hour 2-3, etc.



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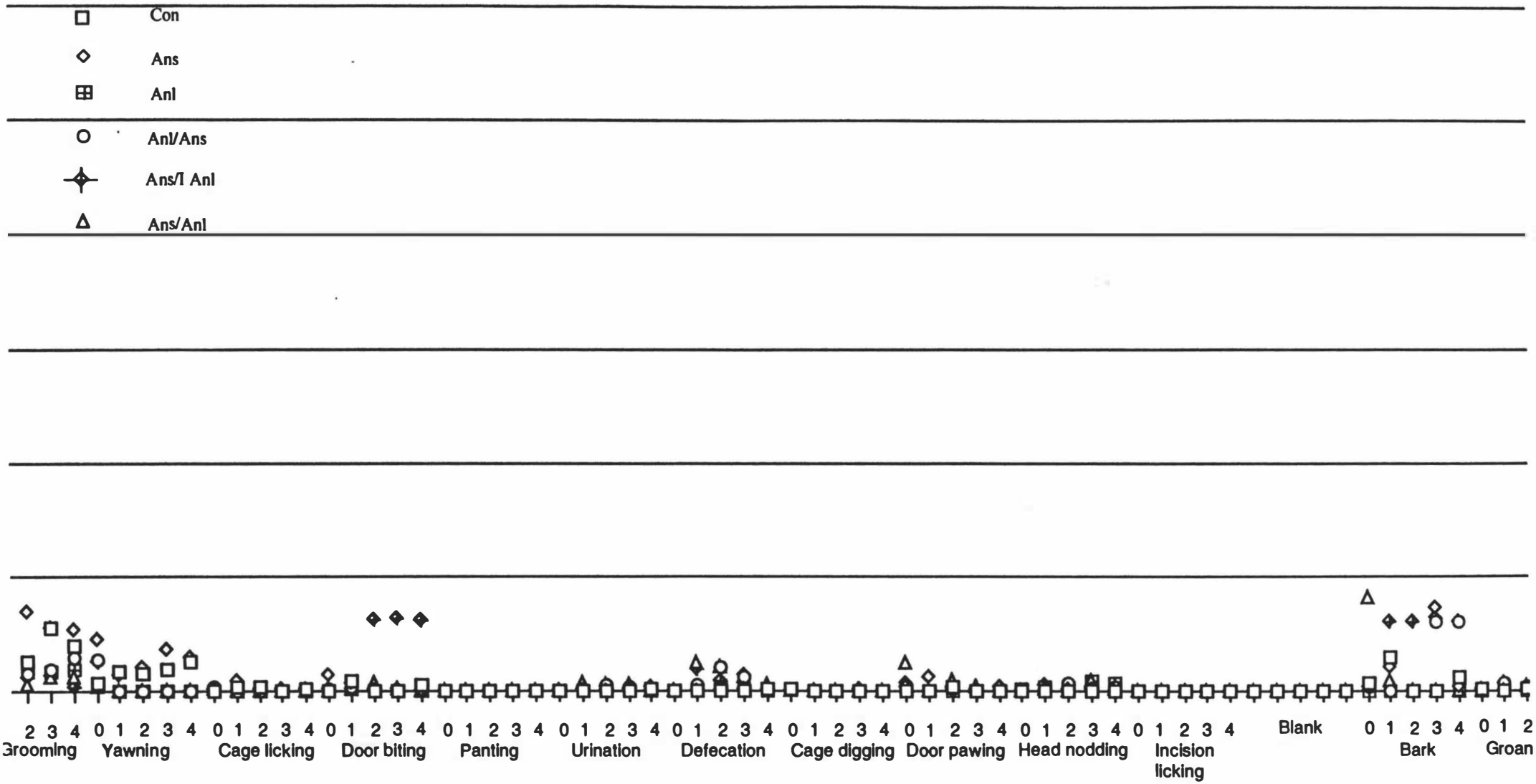

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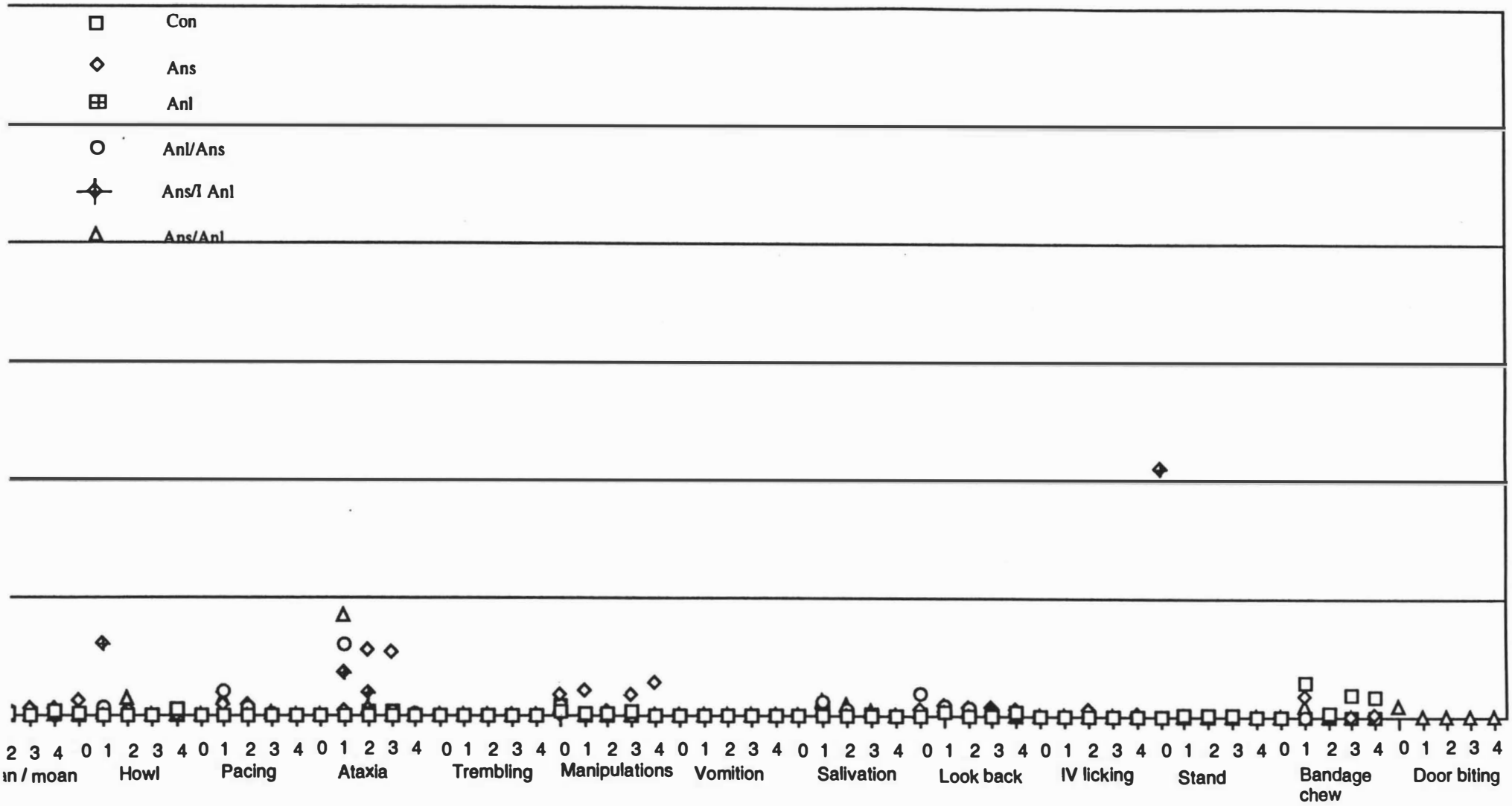

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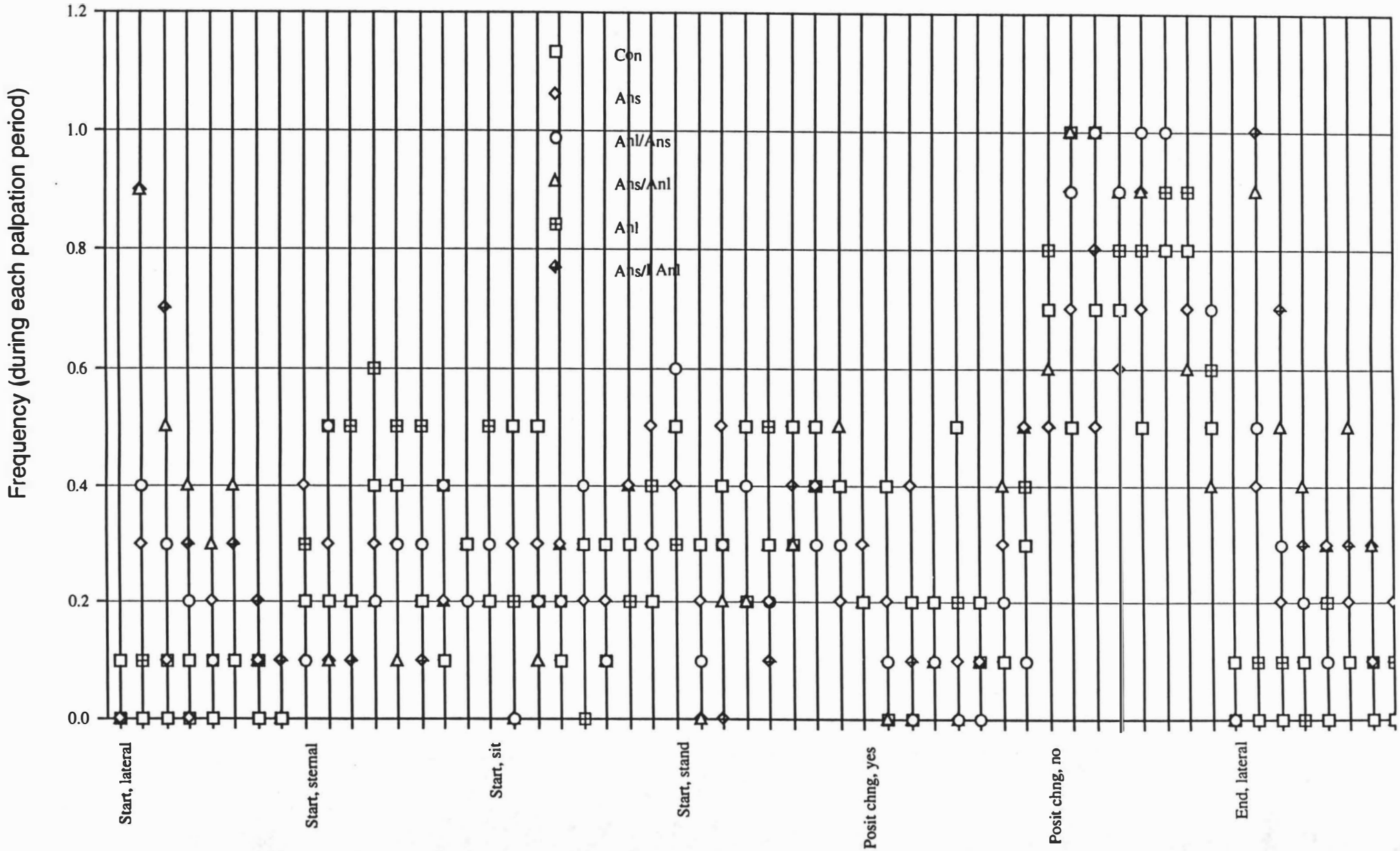
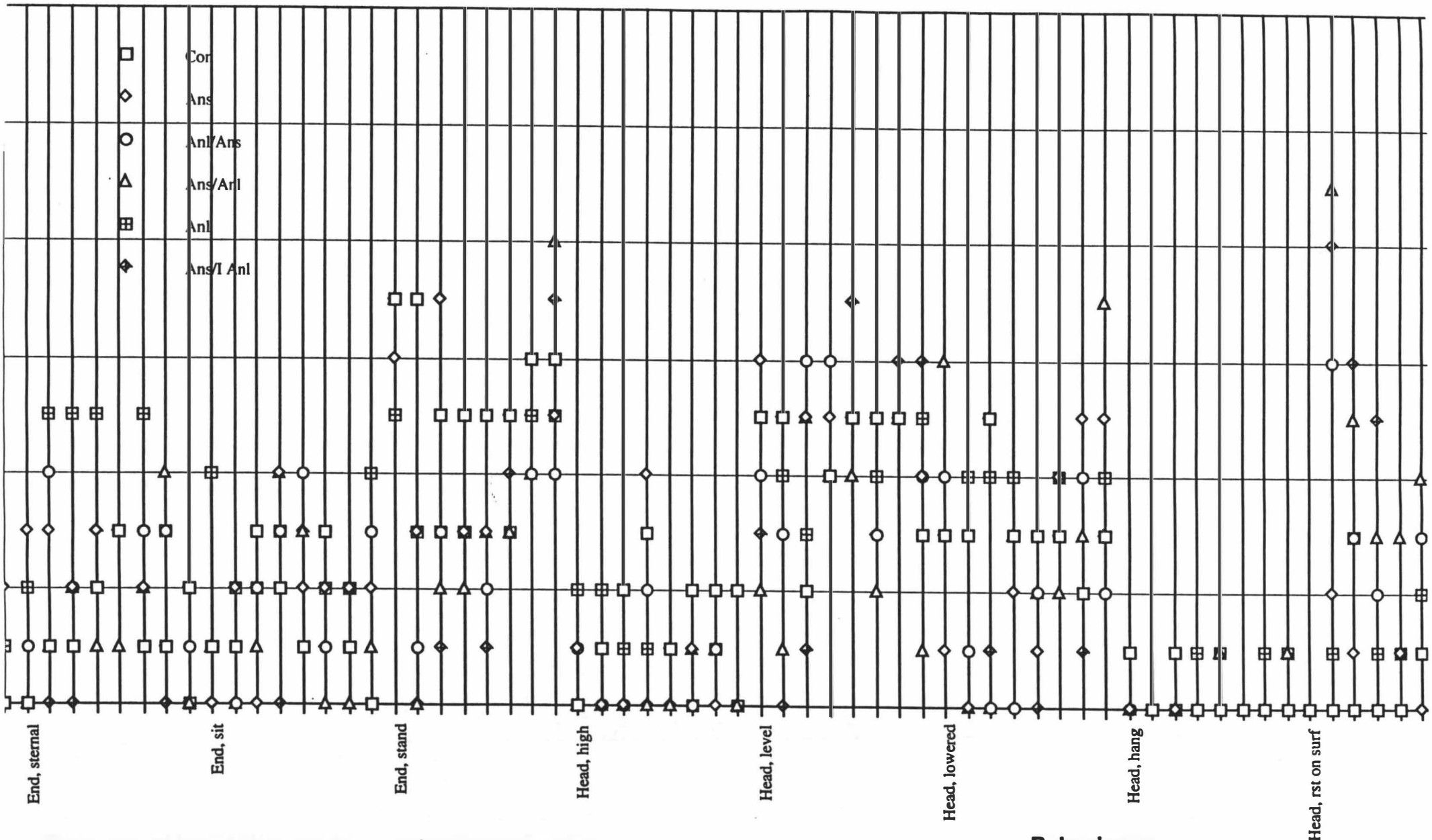


Figure F3 Palpation Behaviours: NonSurgery Treatments.
Proceeding from left to right on the X-axis following each behaviour: Day before surgery, 0.5 hr., 1.0 hr., 1.5 hr., 2.0 hr., 3.0 hr., 5.0 hr., and 24 hrs.



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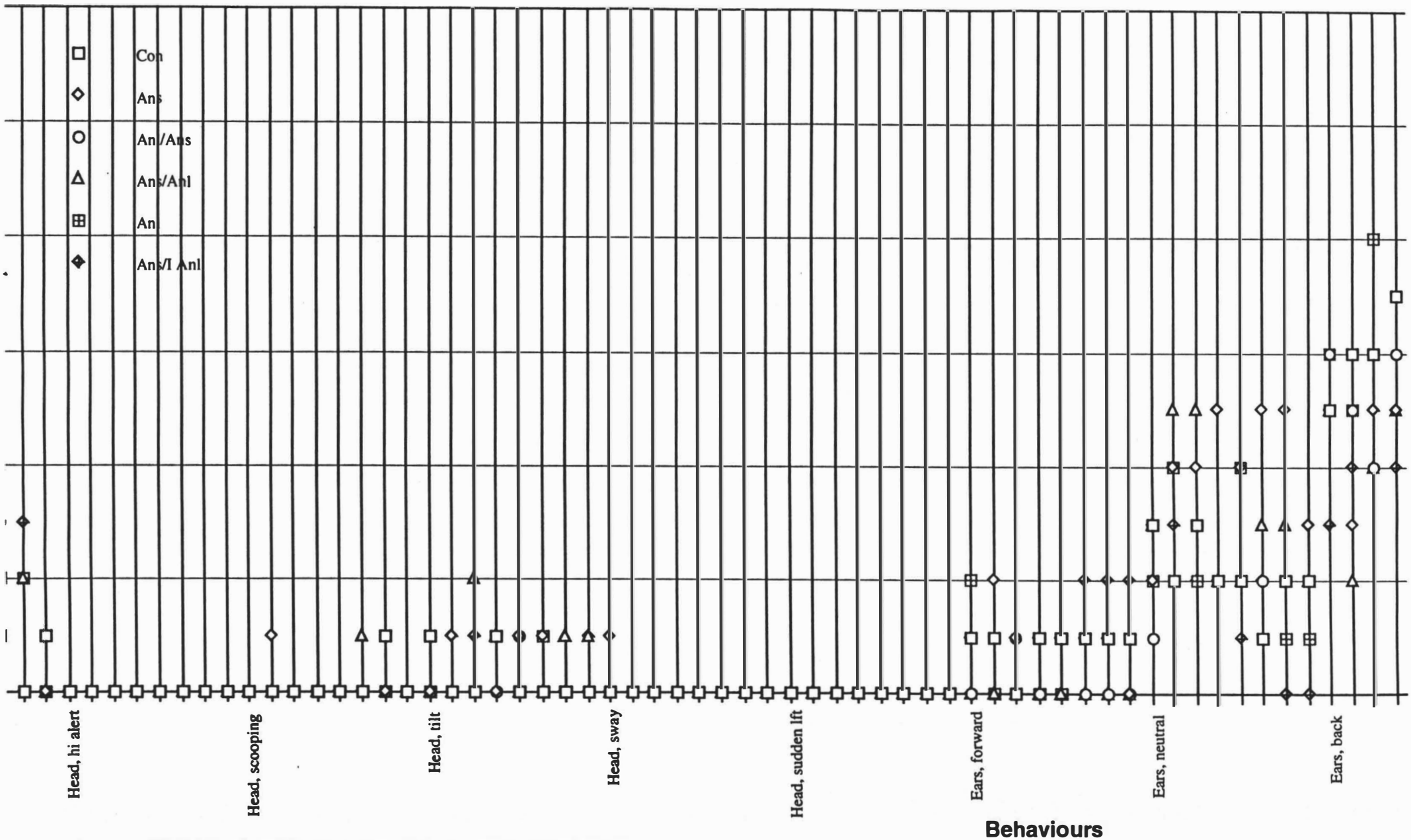

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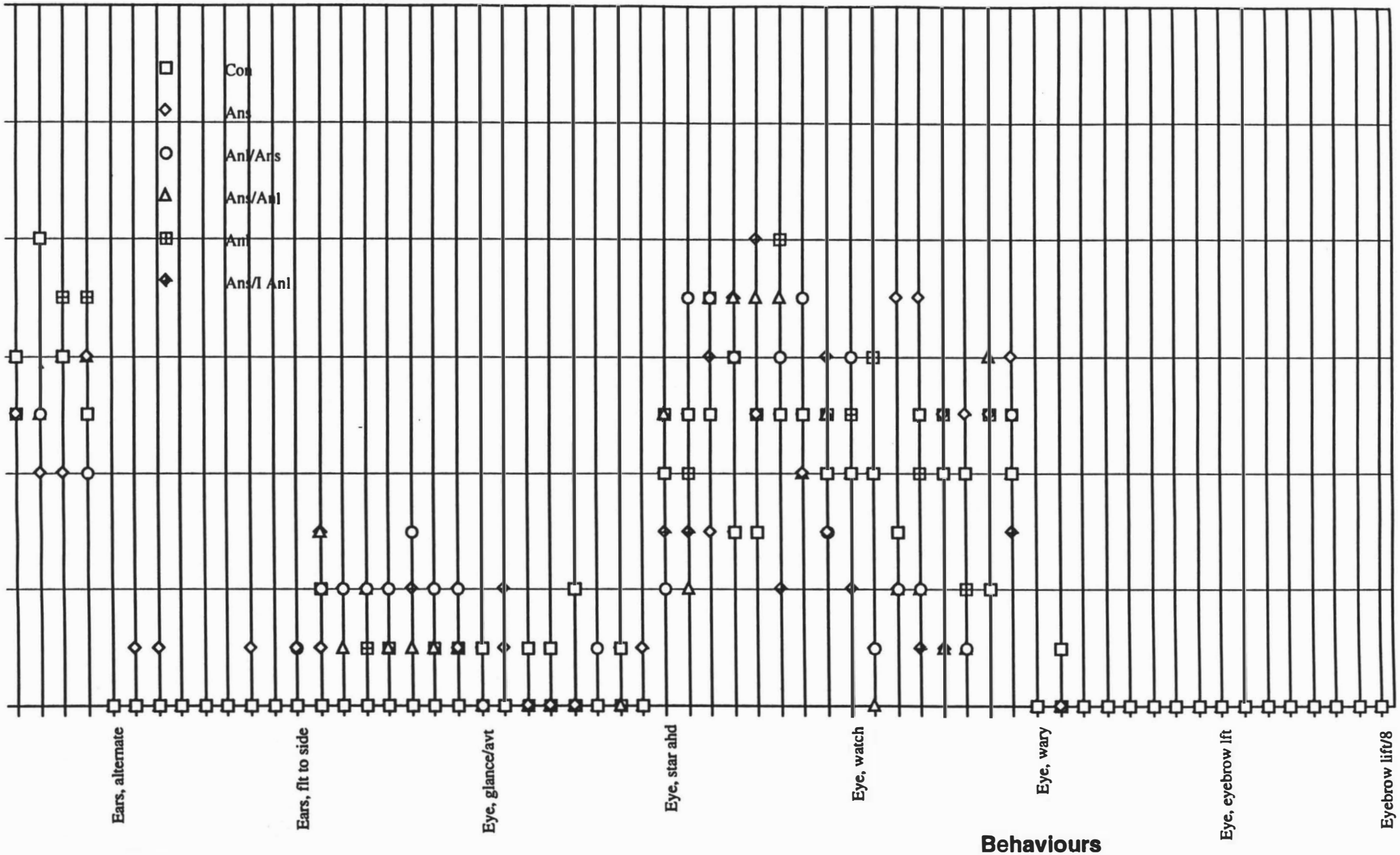
Proceeding from left to right on the X-axis following each behaviour: Day before surgery, 0.5 hr., 1.0 hr., 1.5 hr., 2.0 hr., 3.0 hr., 5.0 hr., and 24 hrs.



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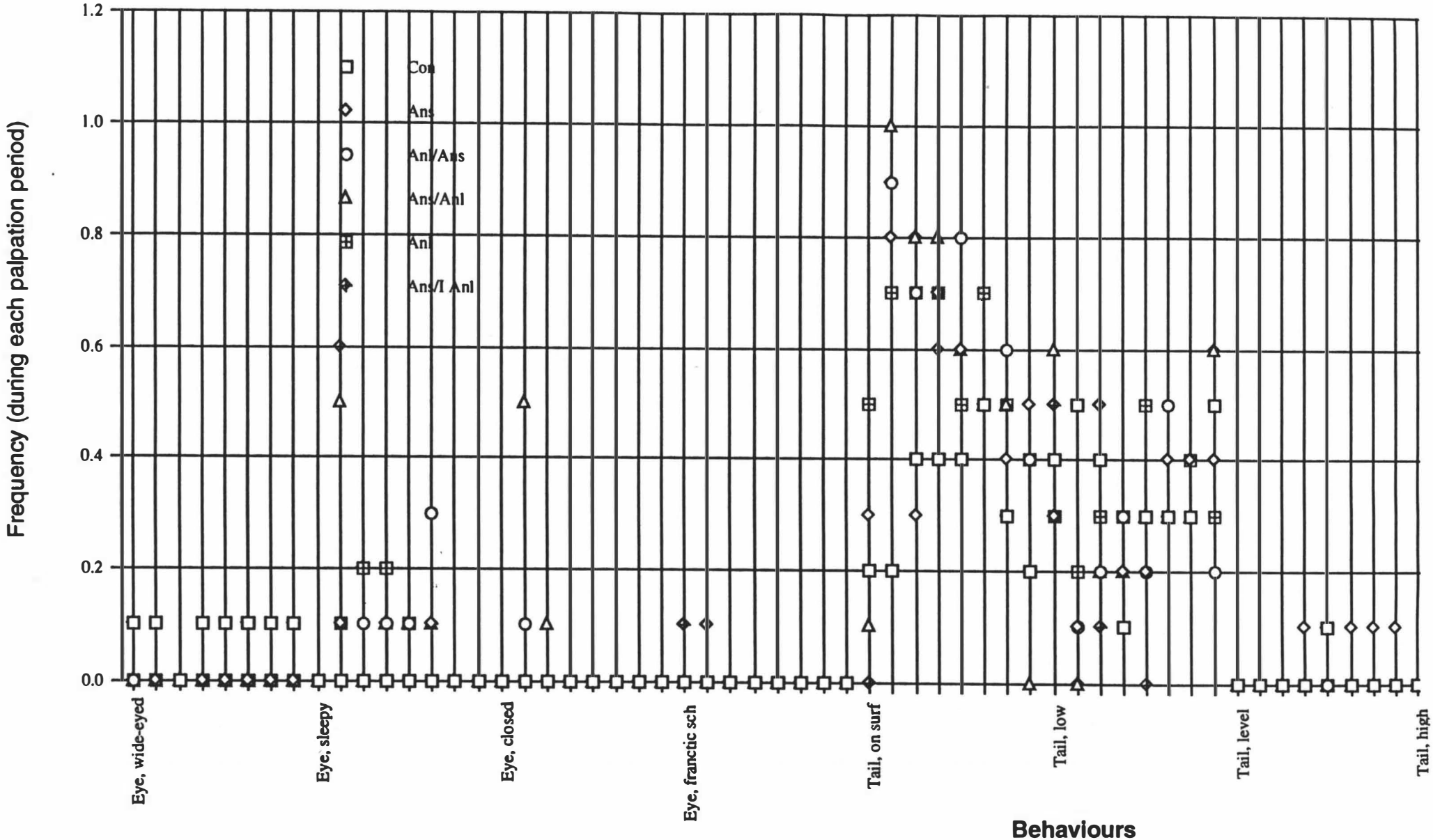

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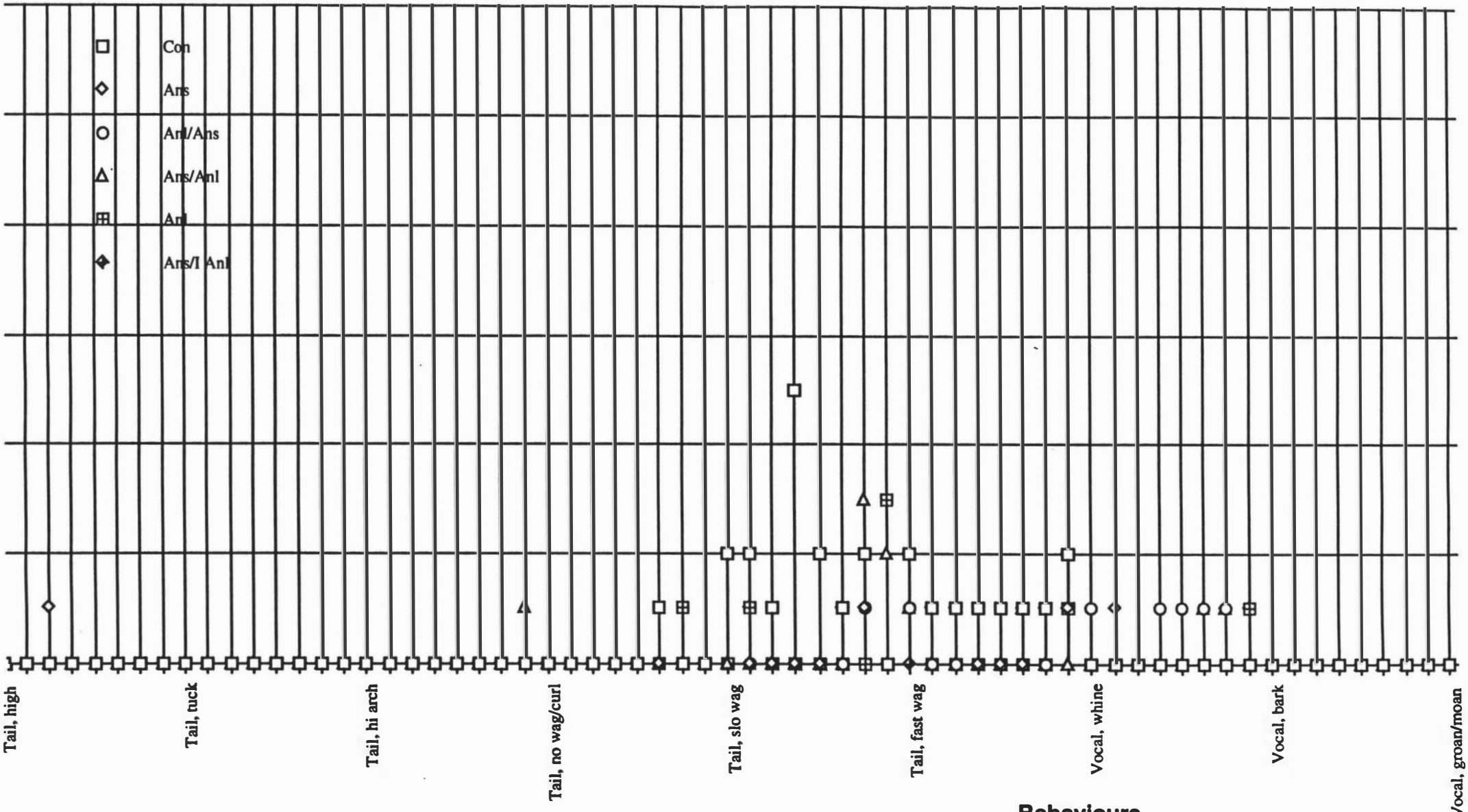

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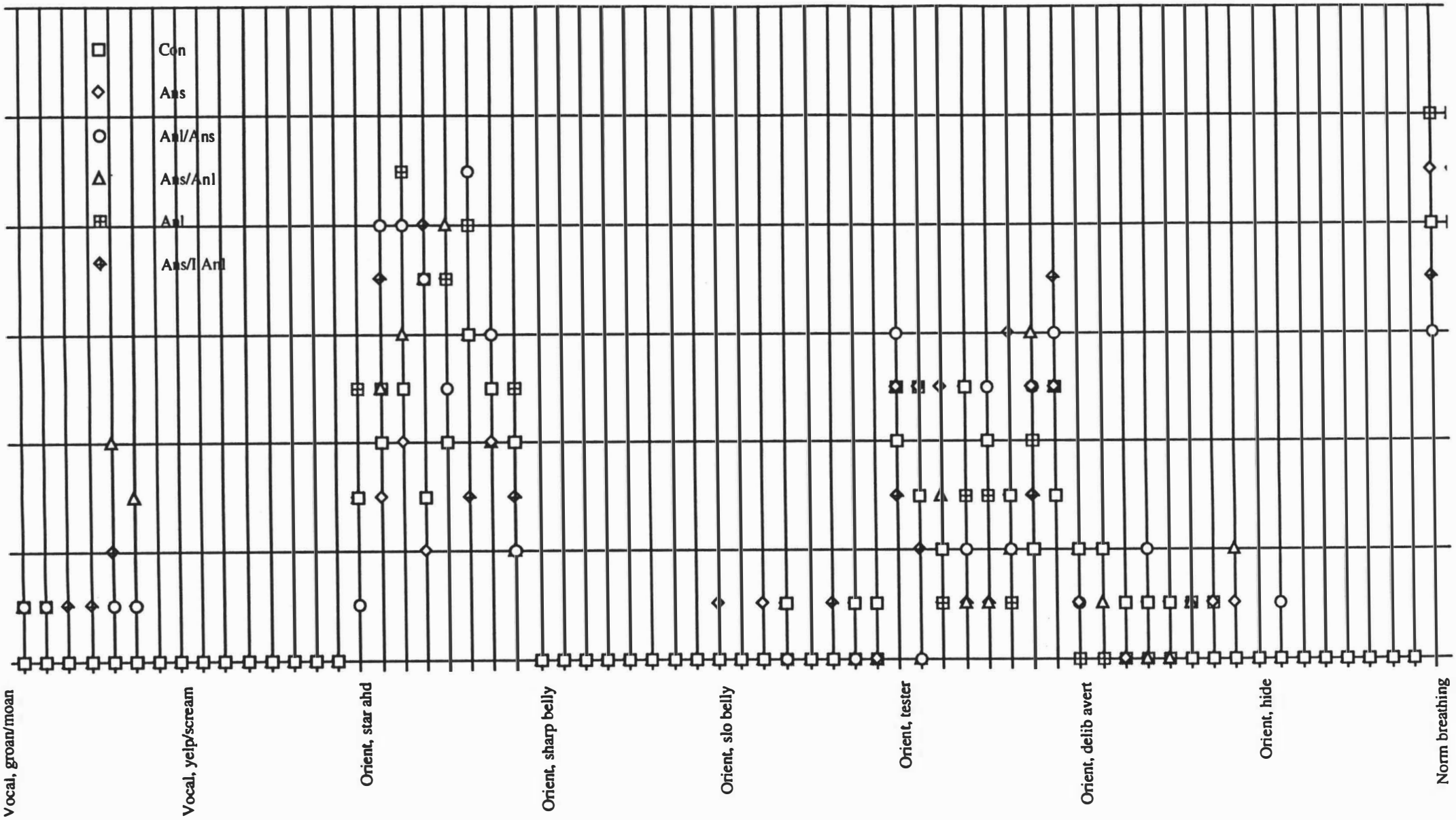

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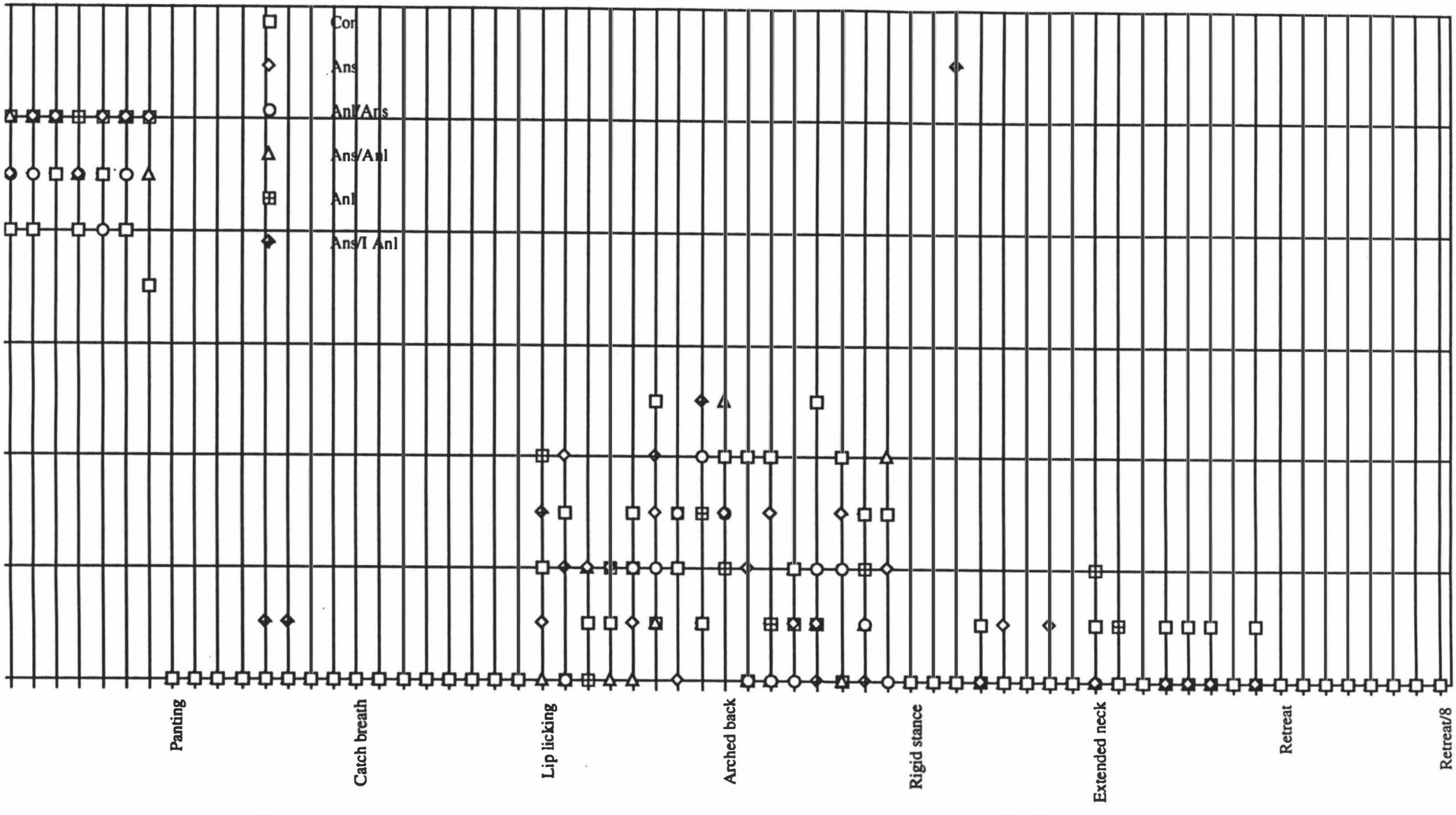

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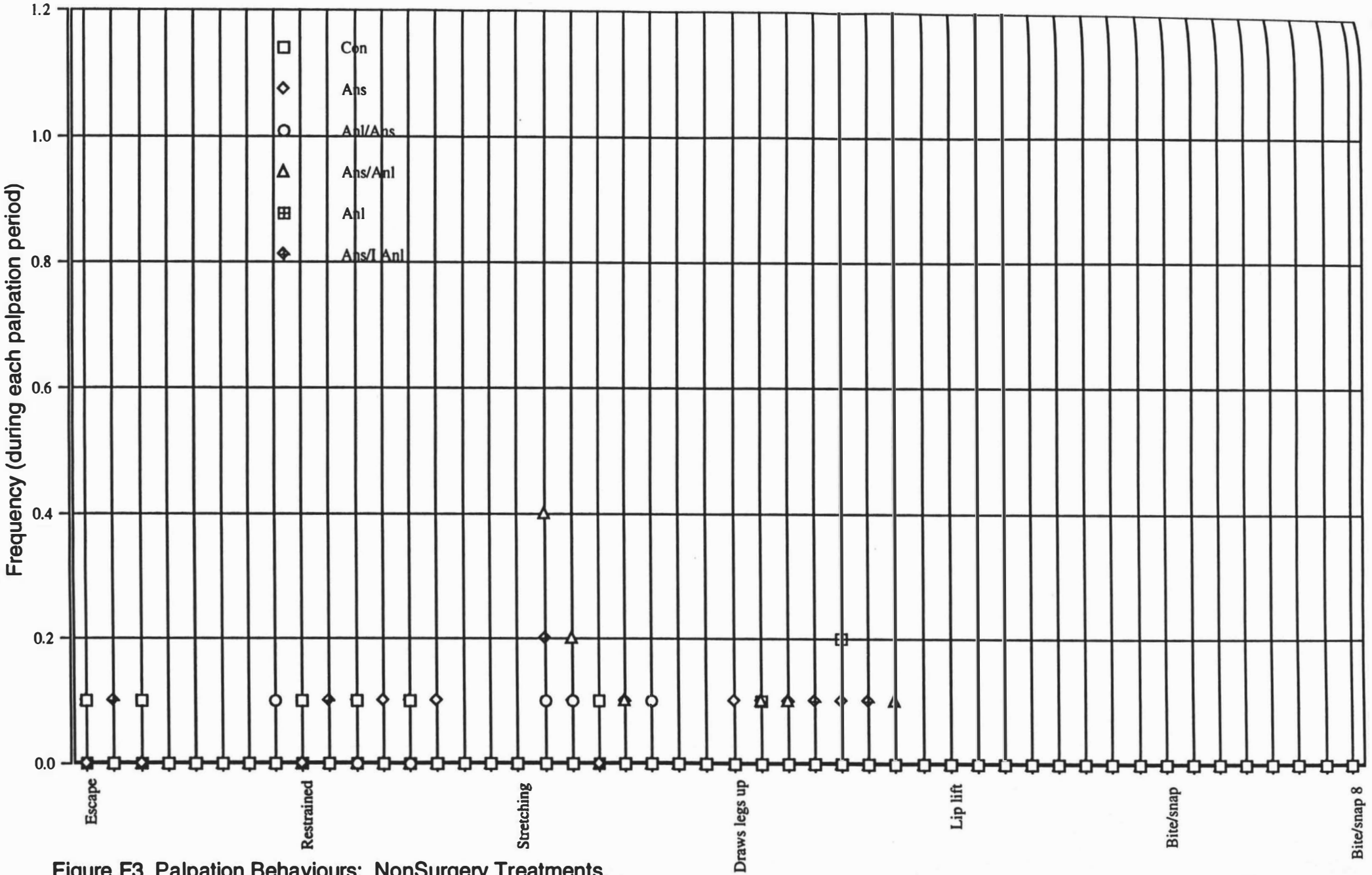

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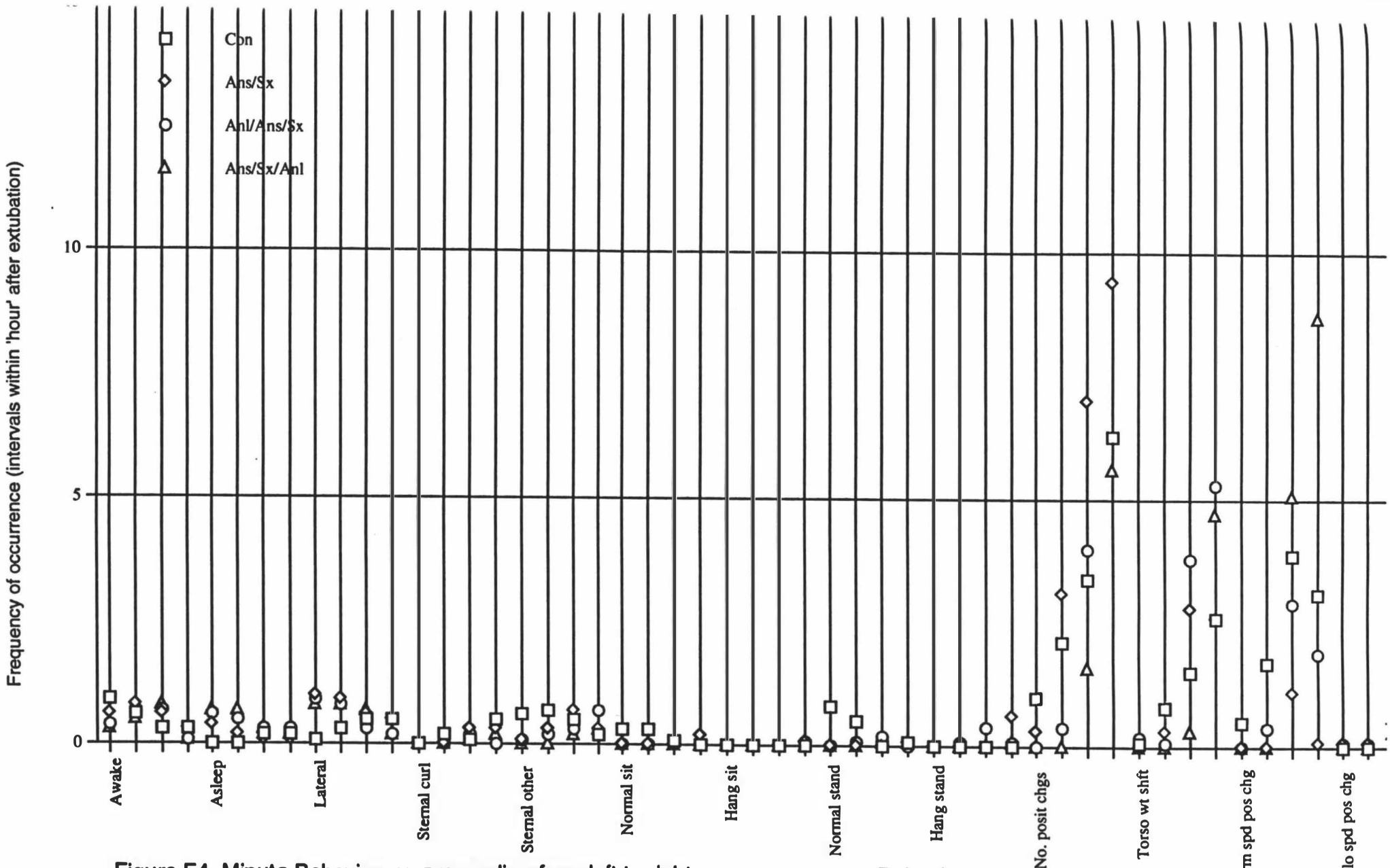
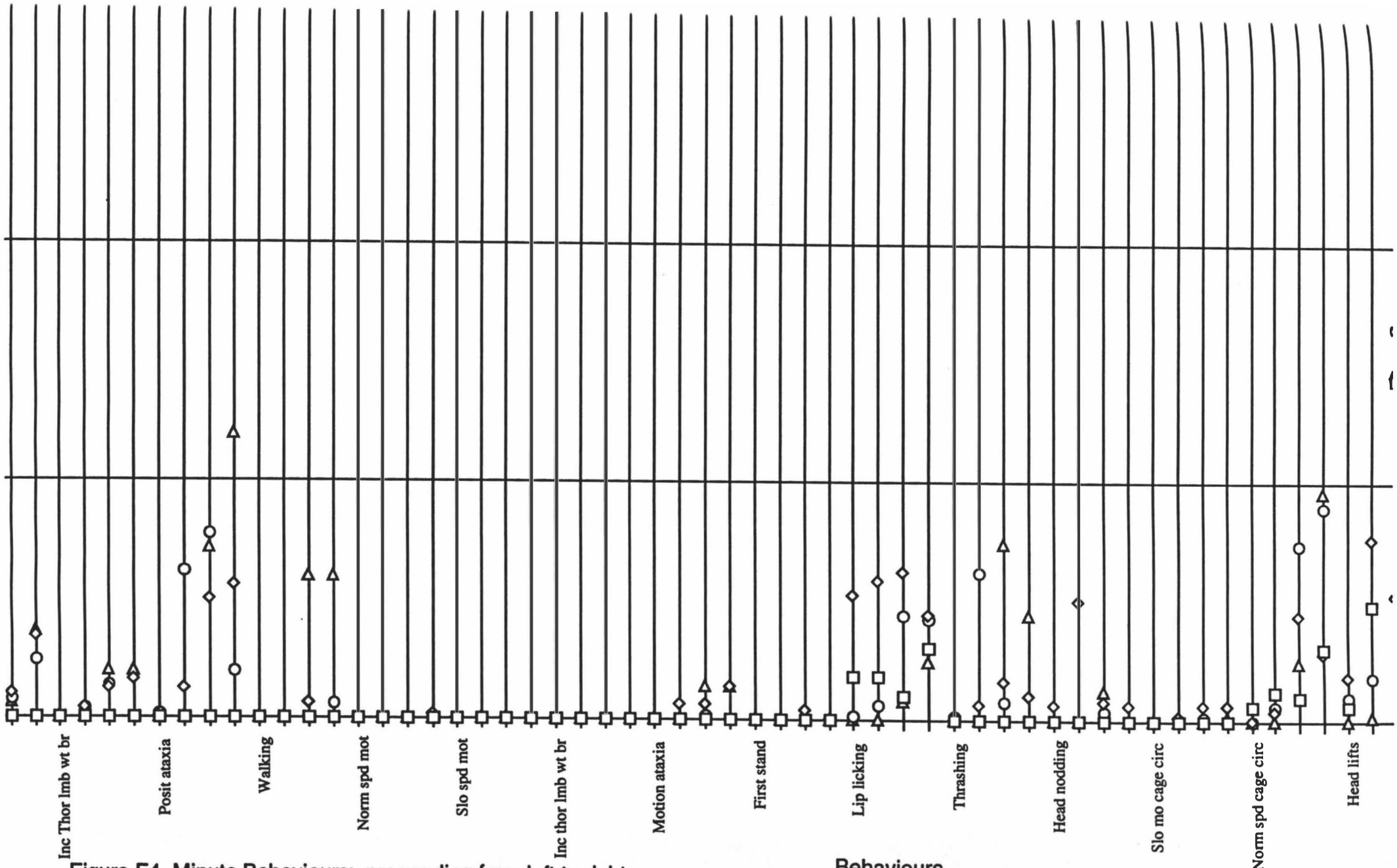


Figure F4 Minute Behaviours: proceeding from left to right, intervals following a stated behaviour are: 0-2 min, 3-10 min, 11-30 min and 31-60 min.



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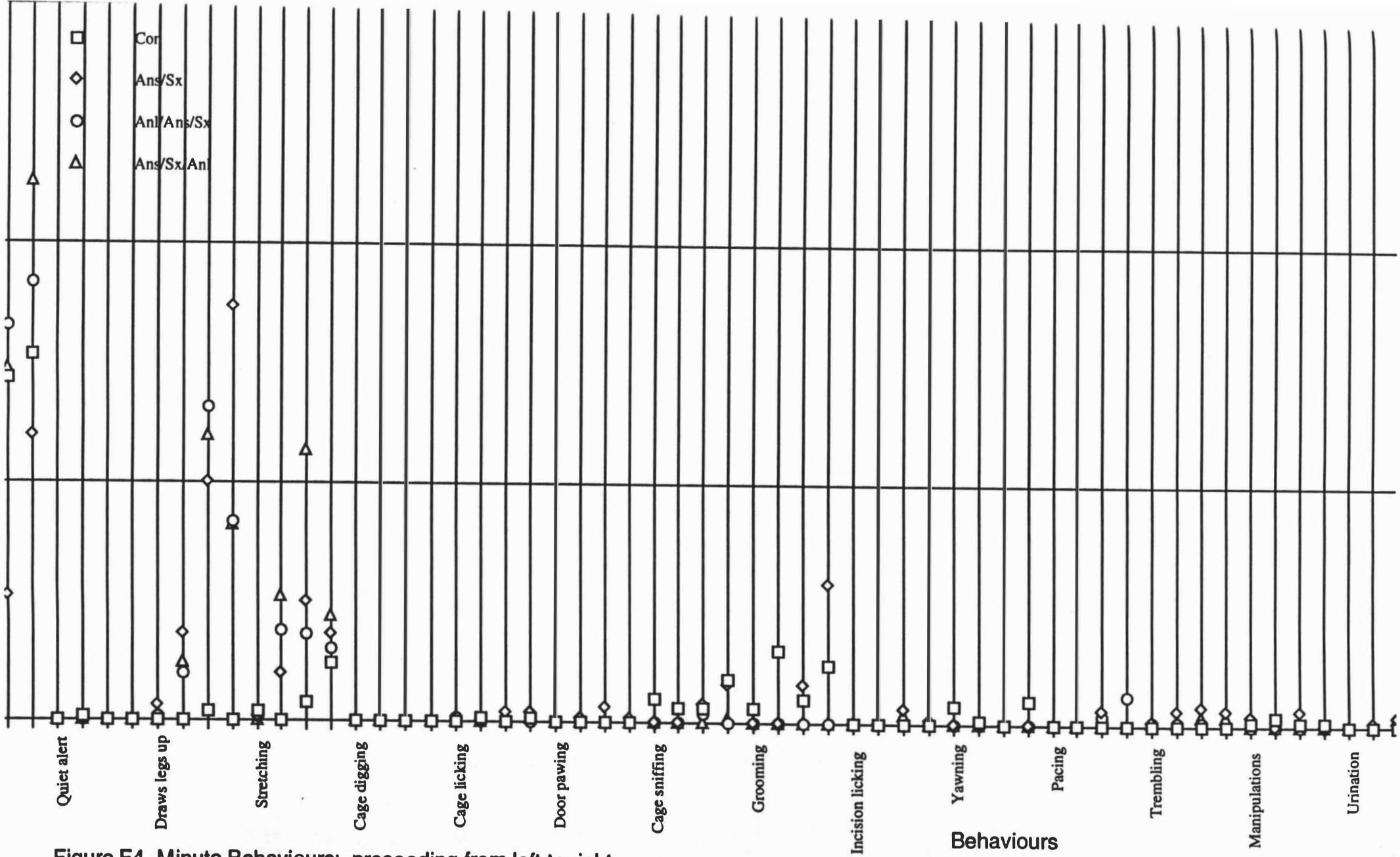

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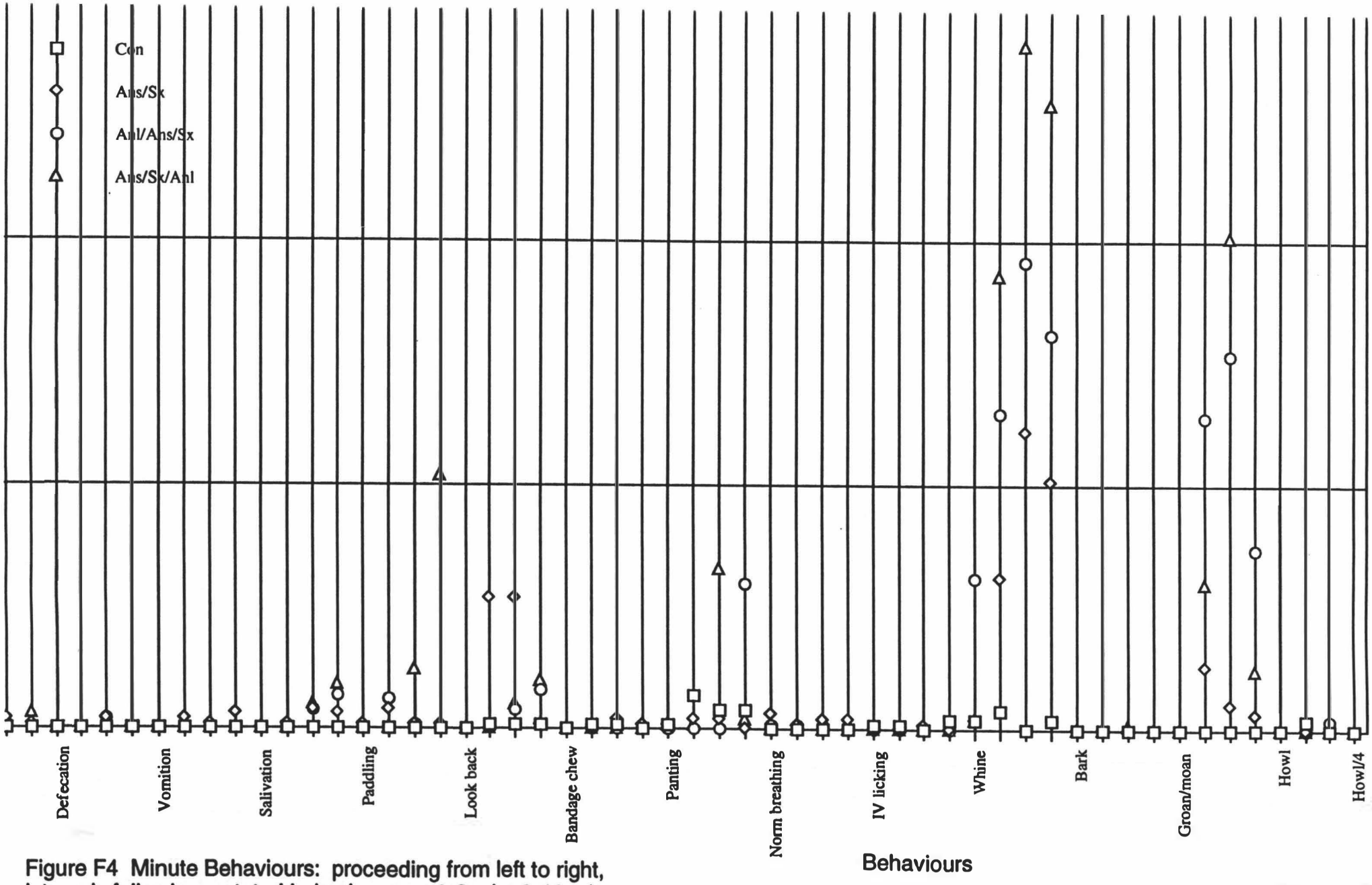

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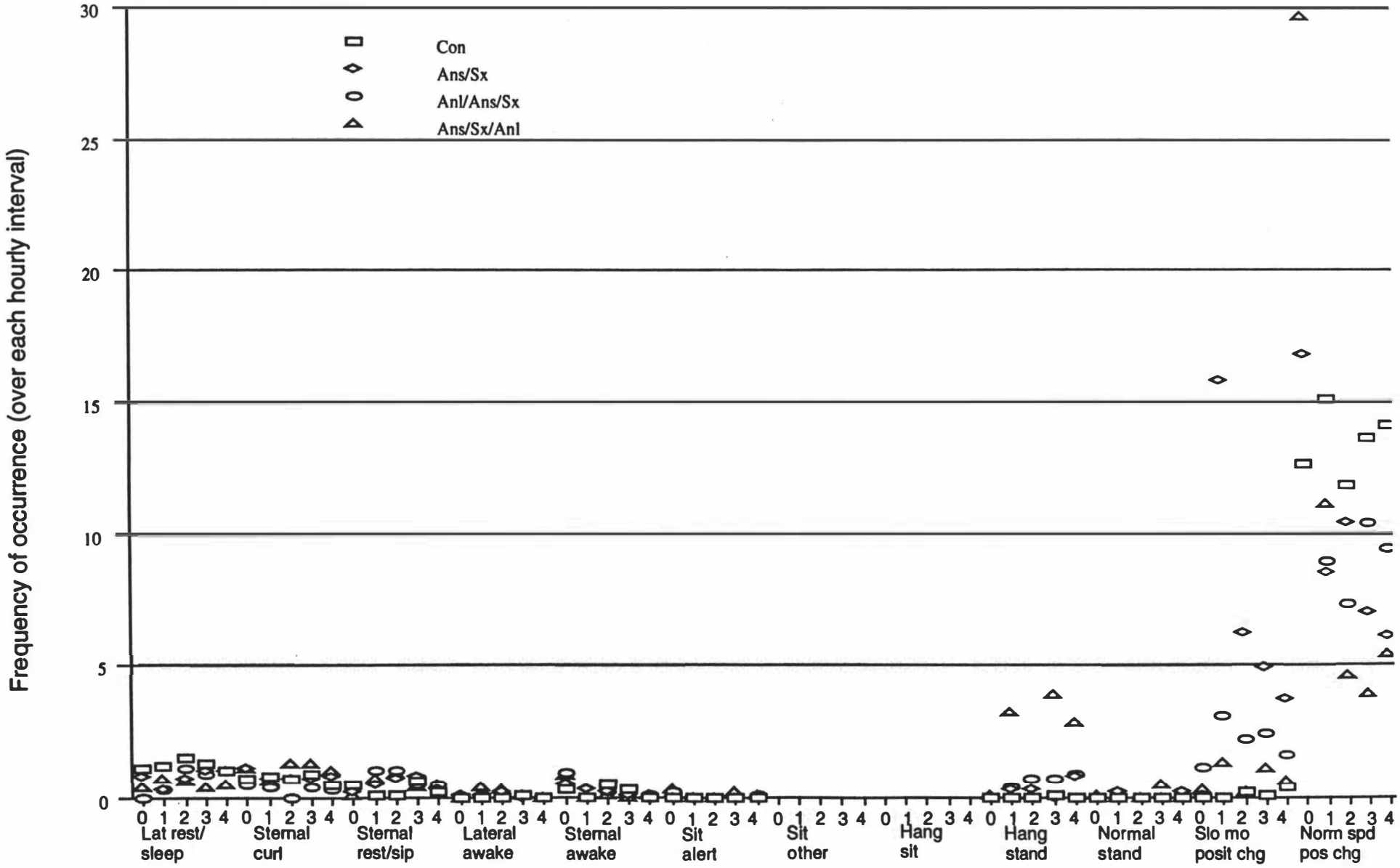
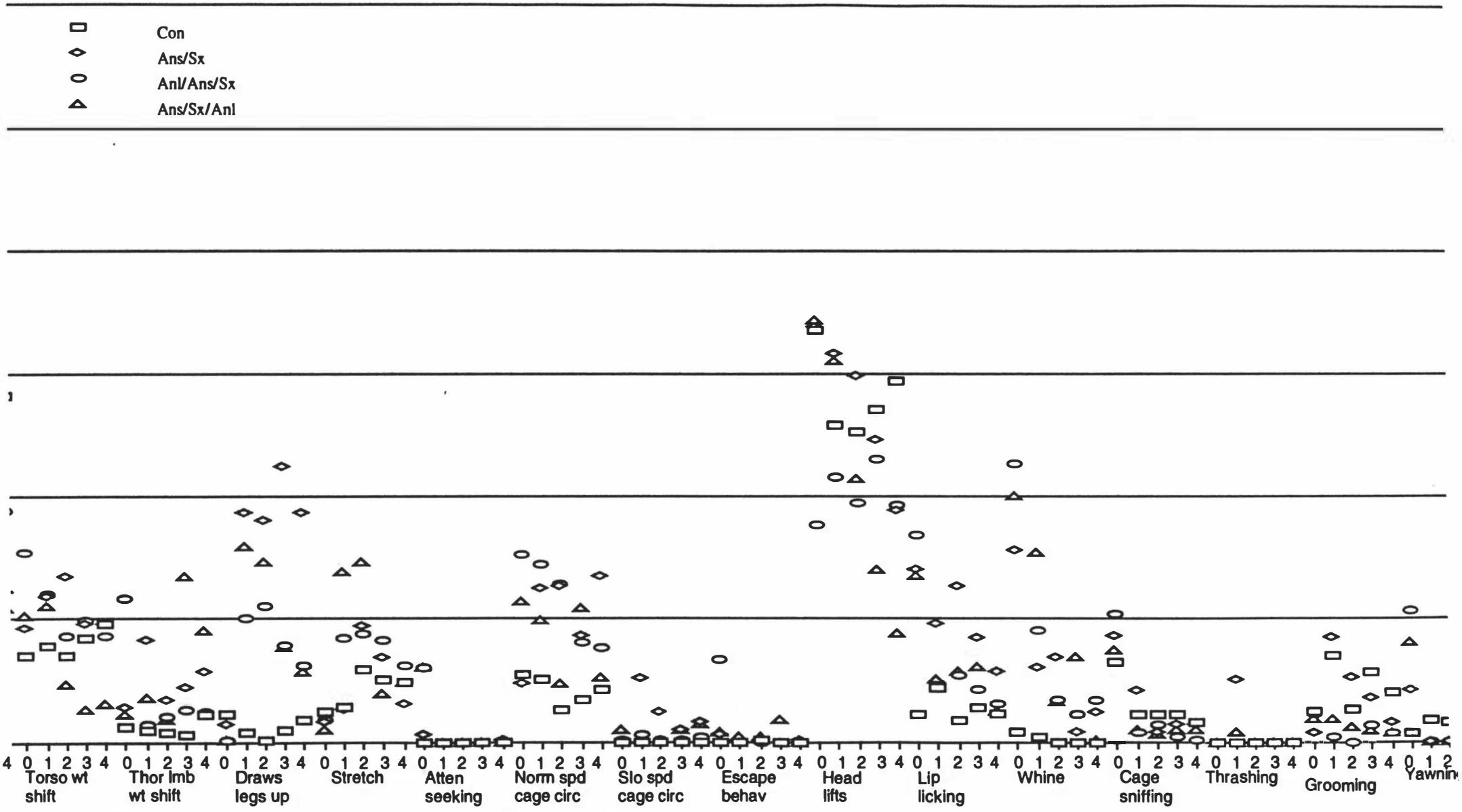


Figure F5 Noninteractive hourly behaviours for the surgical treatments: observation for trends. Numbers 0-4 on the X-axis represent interval of sampling: 0=day before treatment; 1=hour 1-2; 2=hour 2-3, etc.



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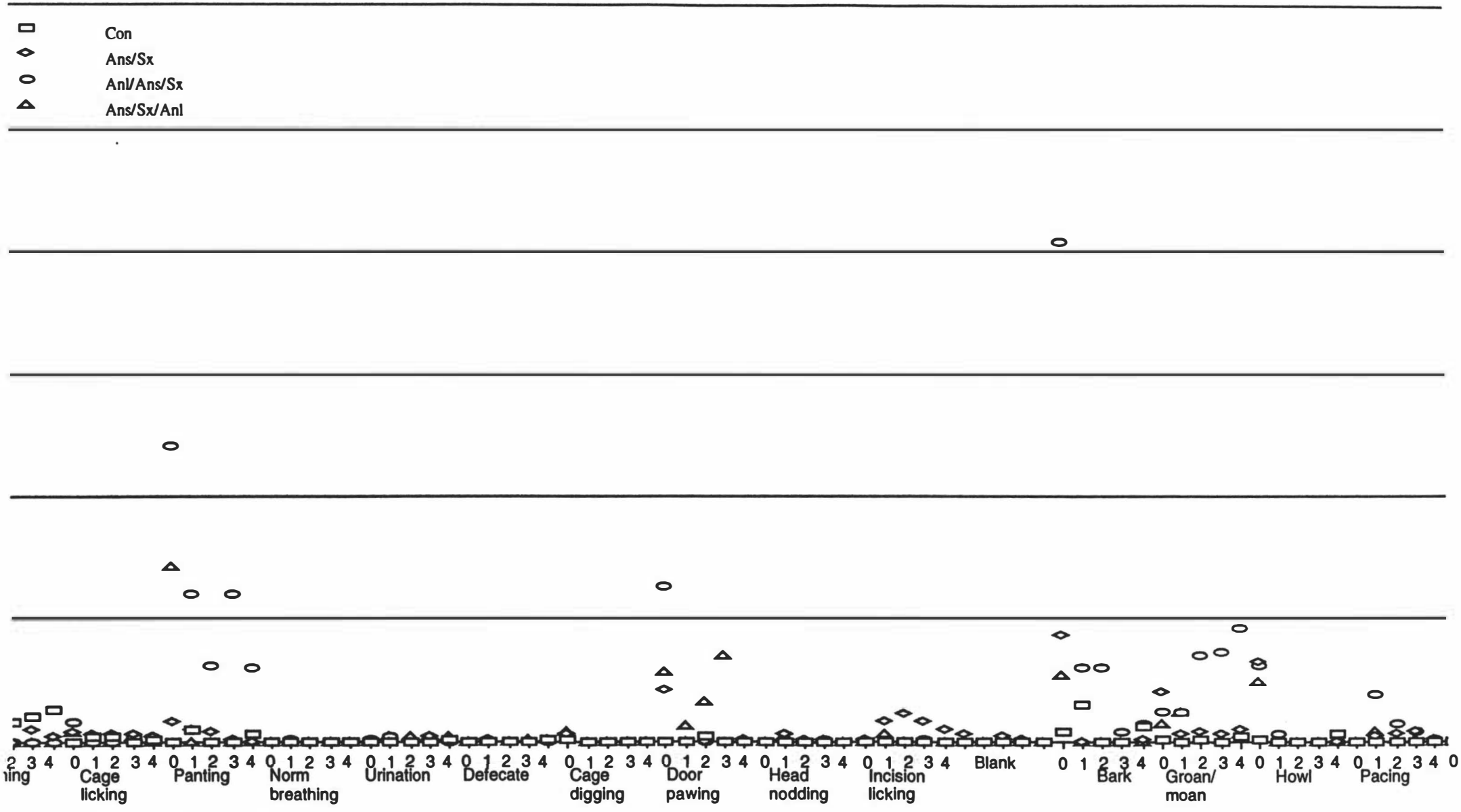

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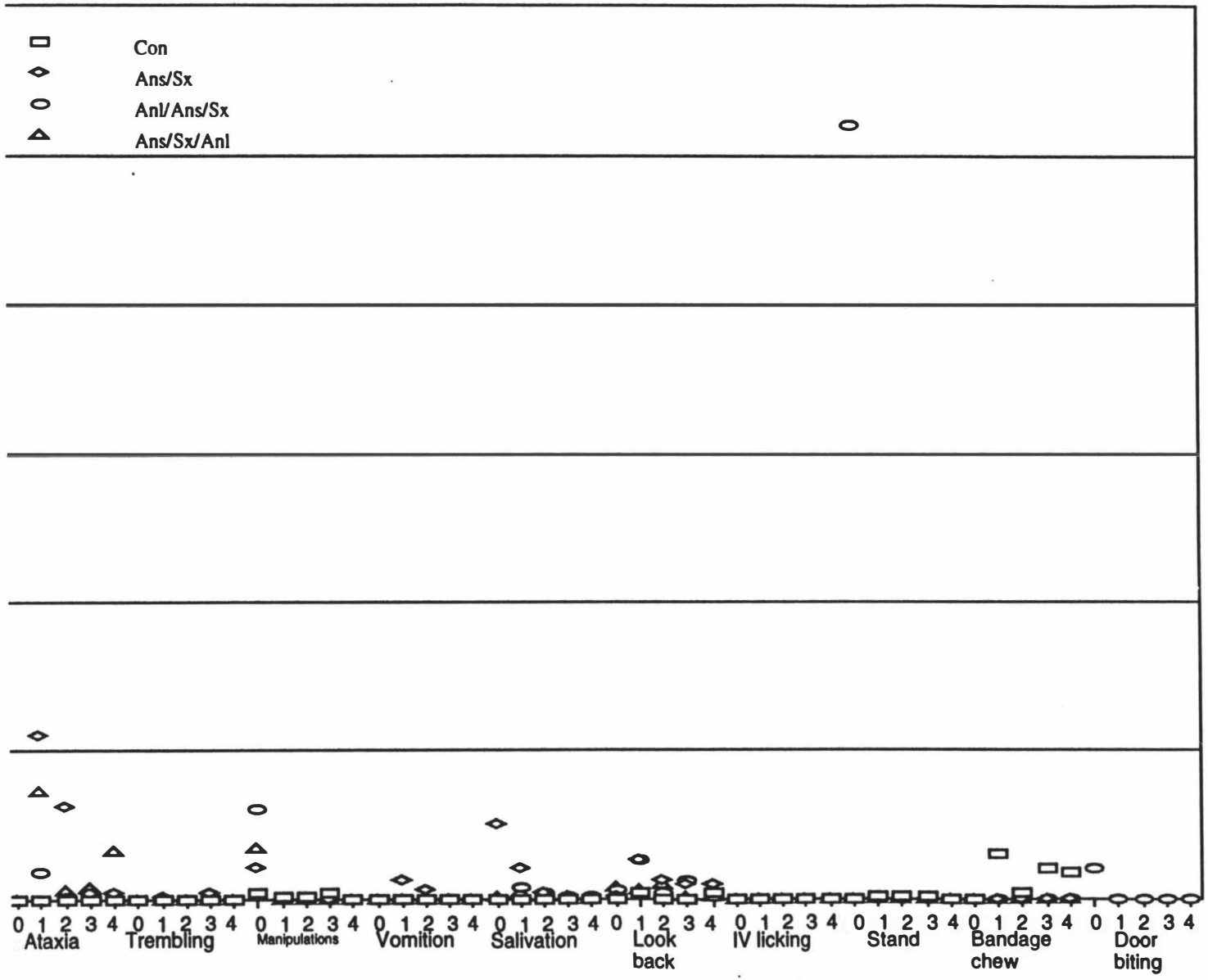

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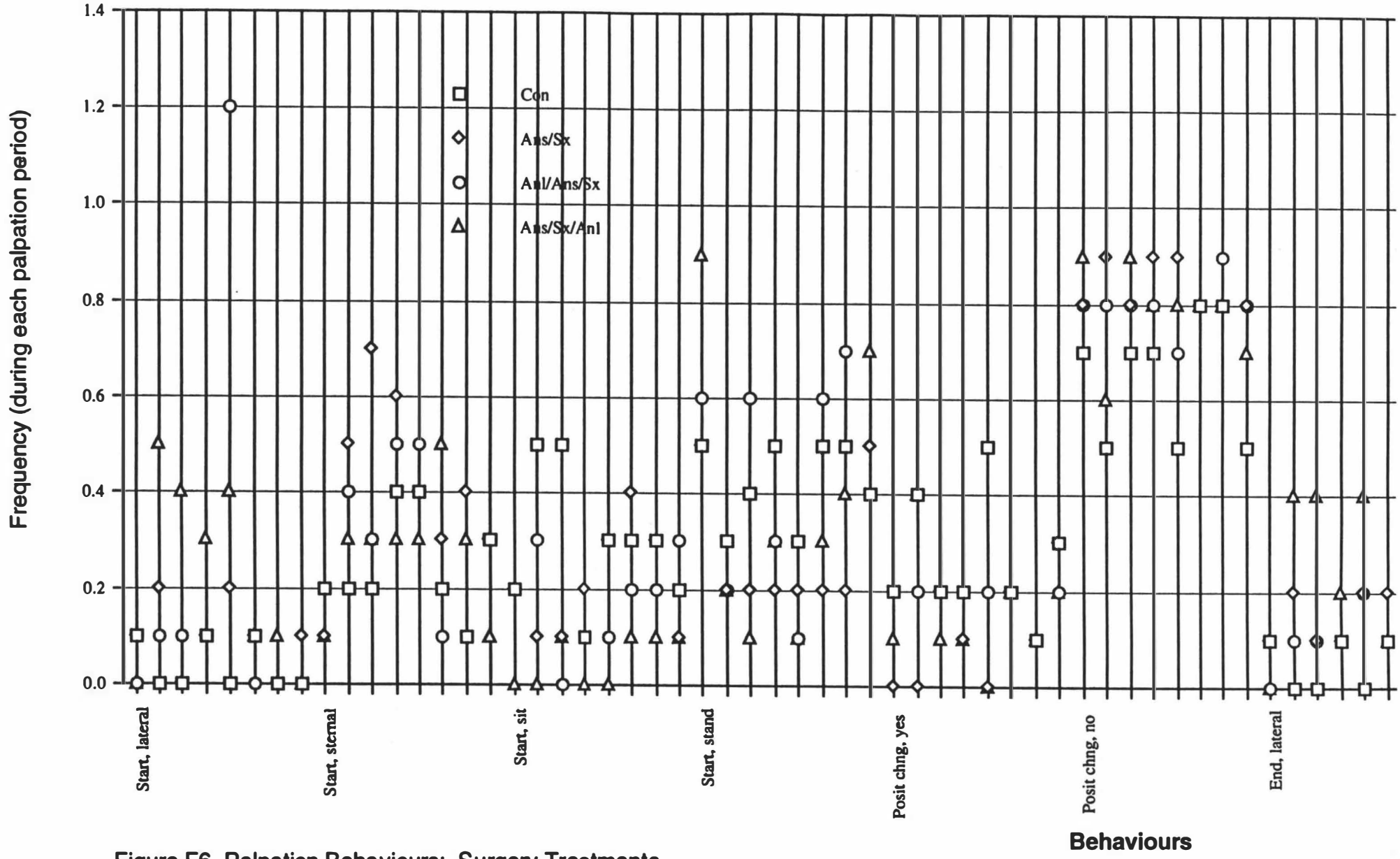
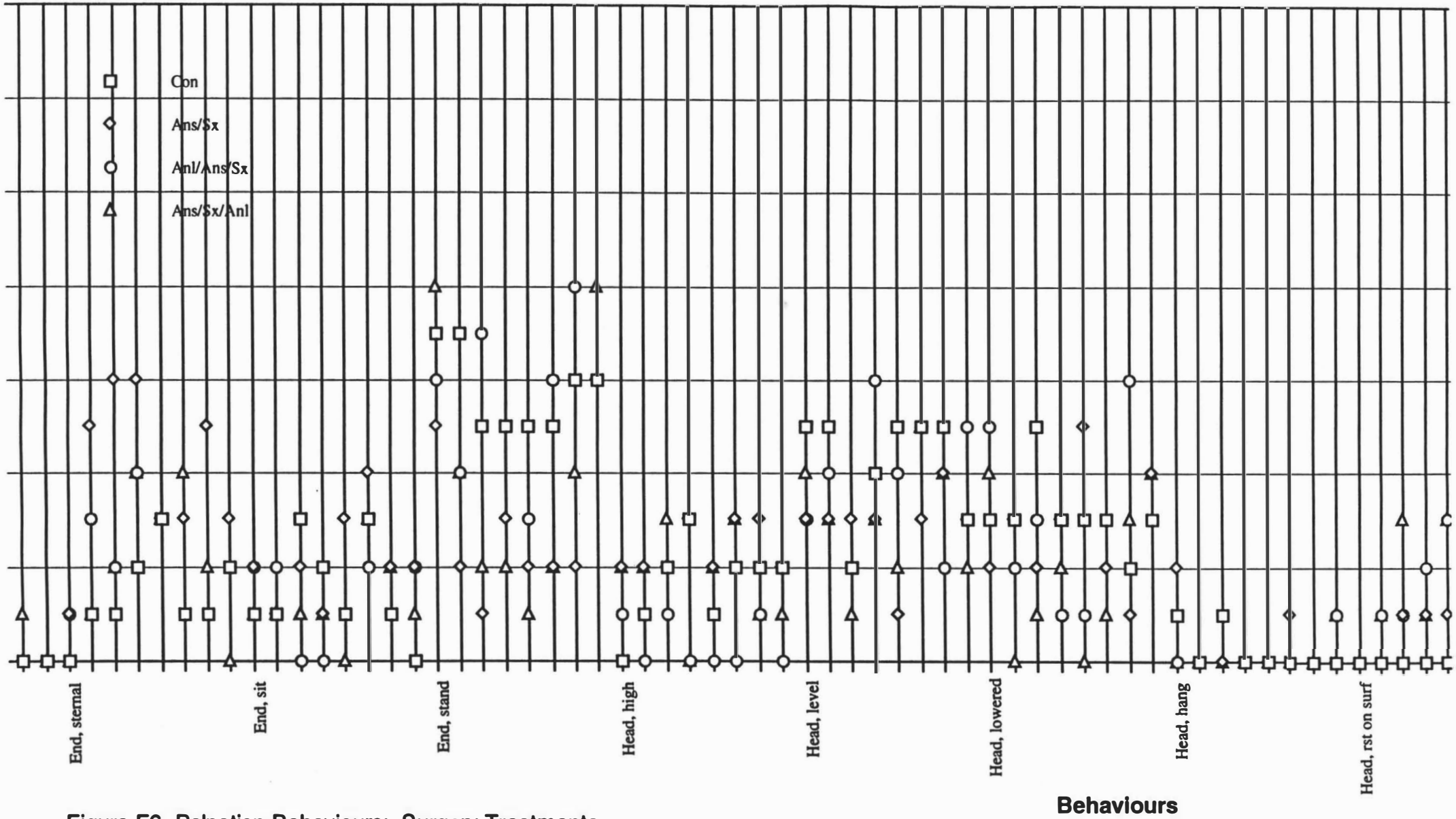


Figure F6 Palpation Behaviours: Surgery Treatments.
Proceeding from left to right on the X-axis following each behaviour: Day before surgery, 0.5 hr., 1.0 hr., 1.5 hr., 2.0 hr., 3.0 hr., 5.0 hr., and 24 hrs.



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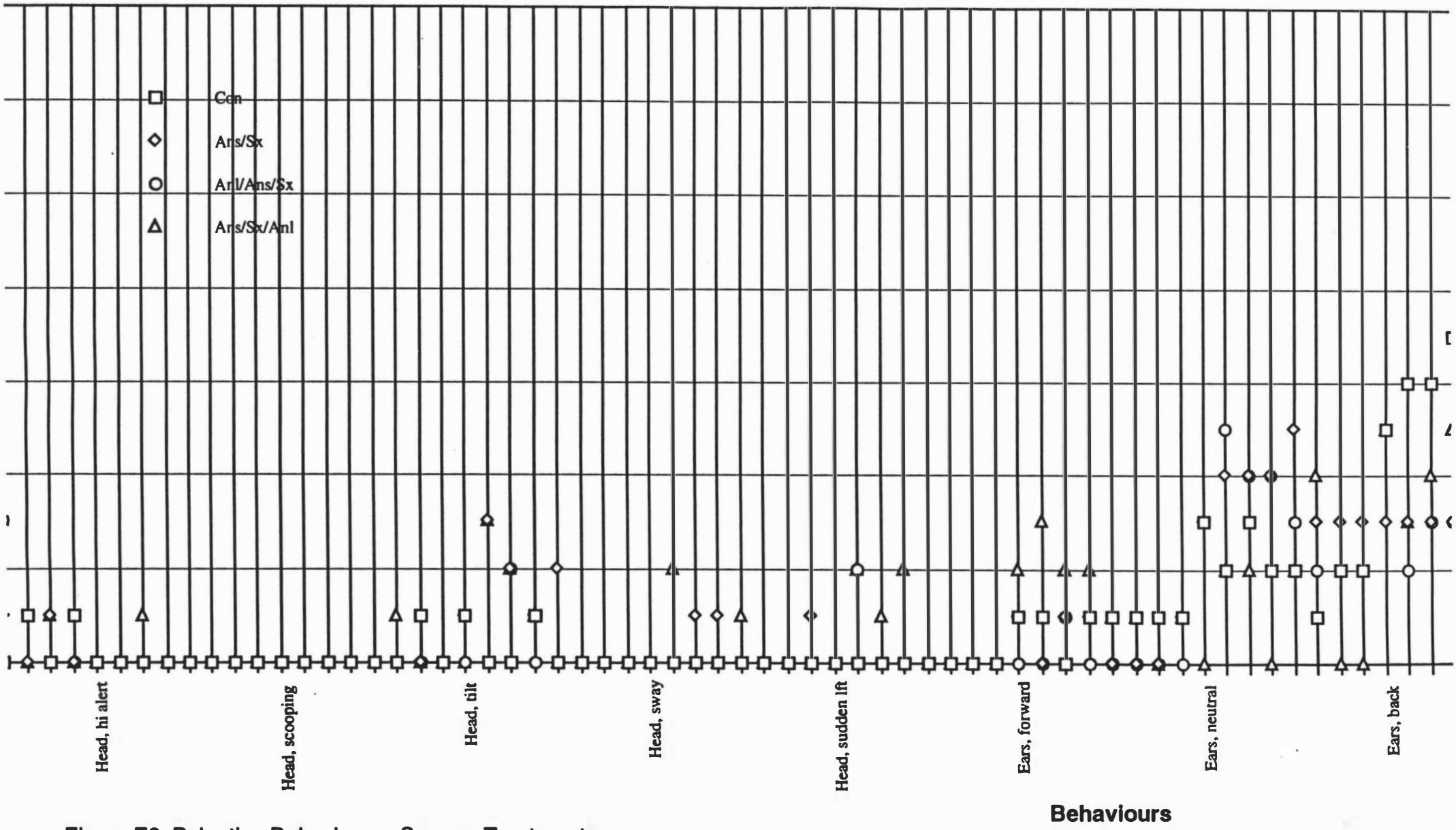

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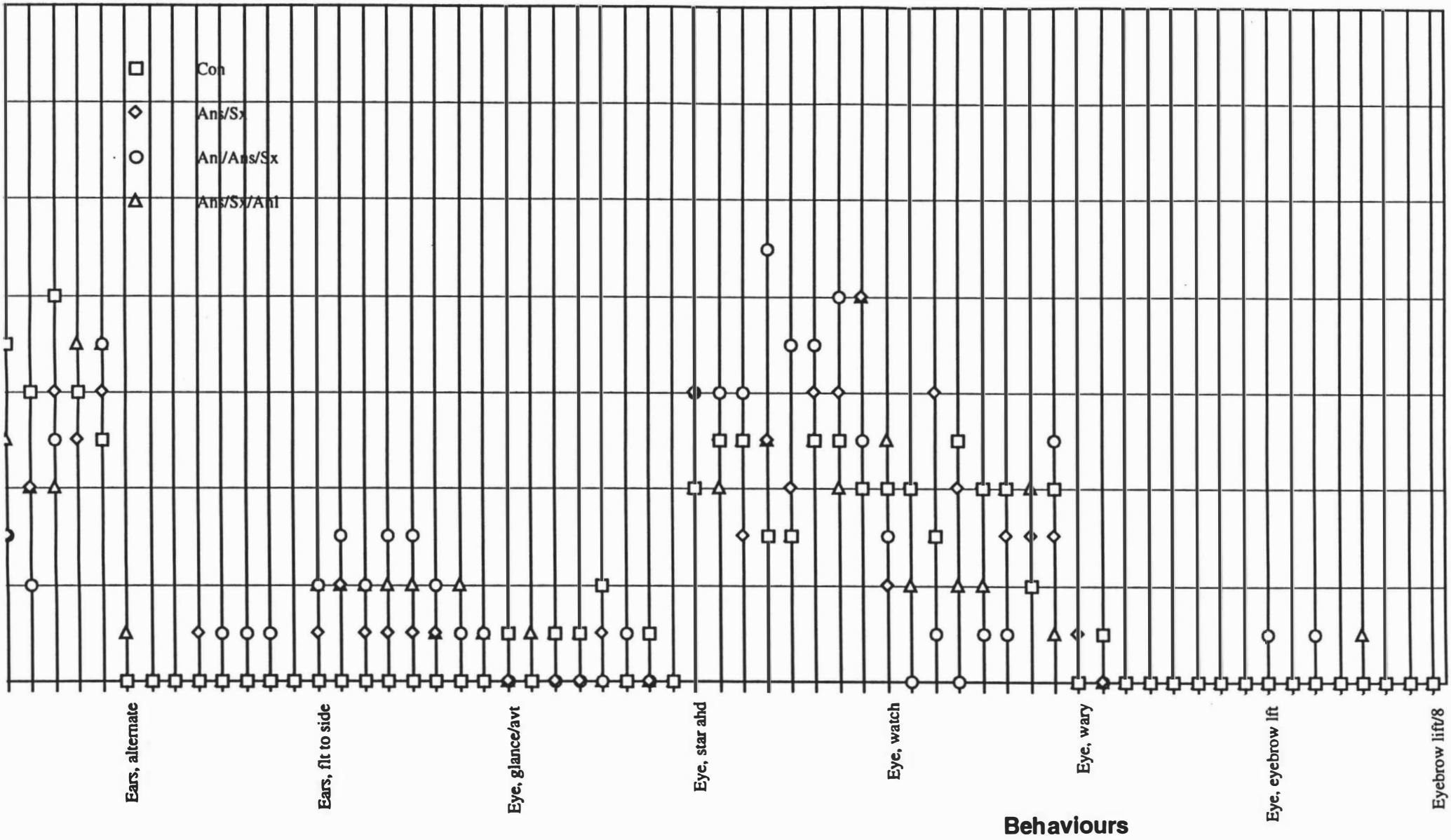

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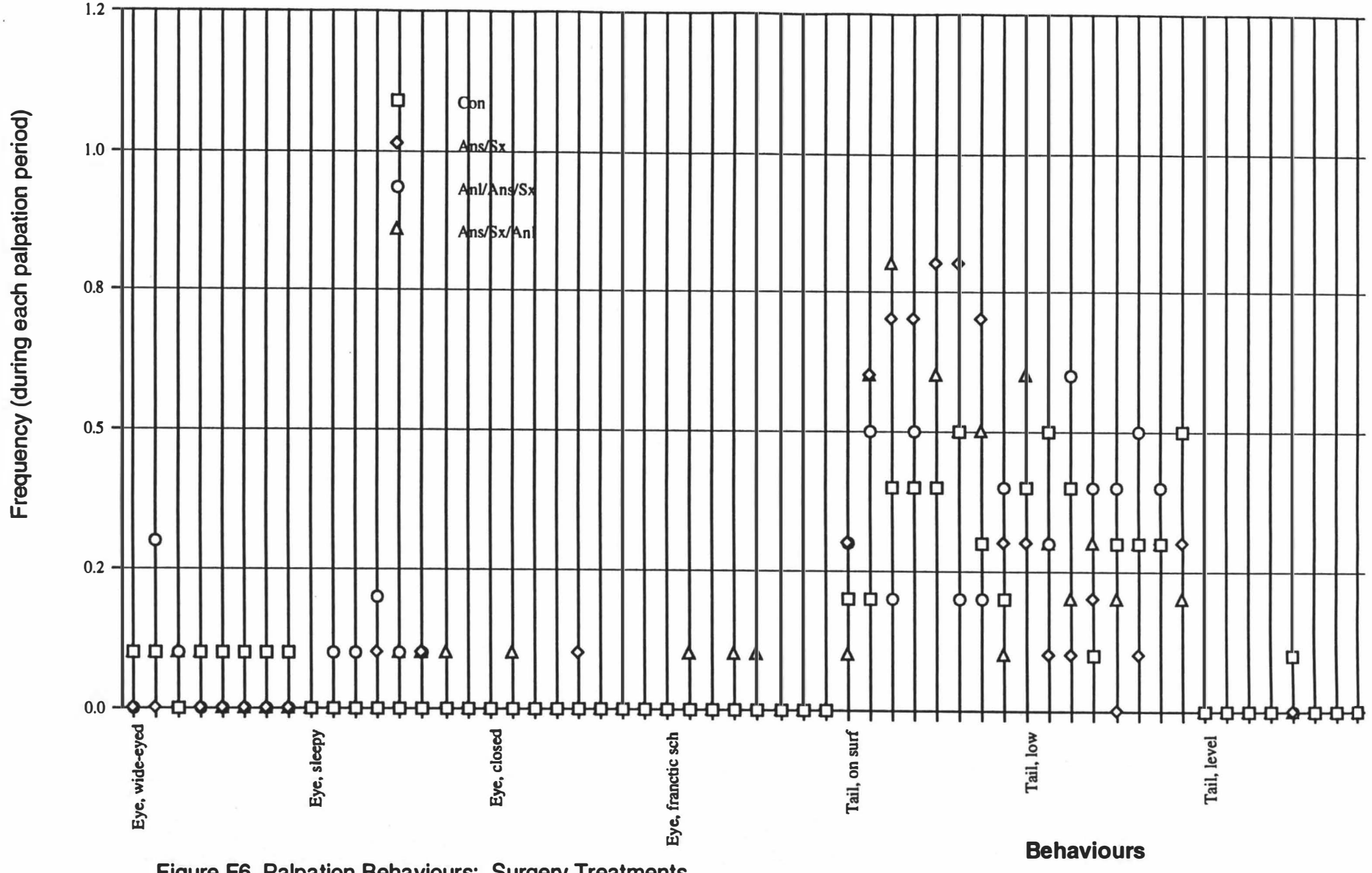

Figure F6 Palpation Behaviours: Surgery Treatments.
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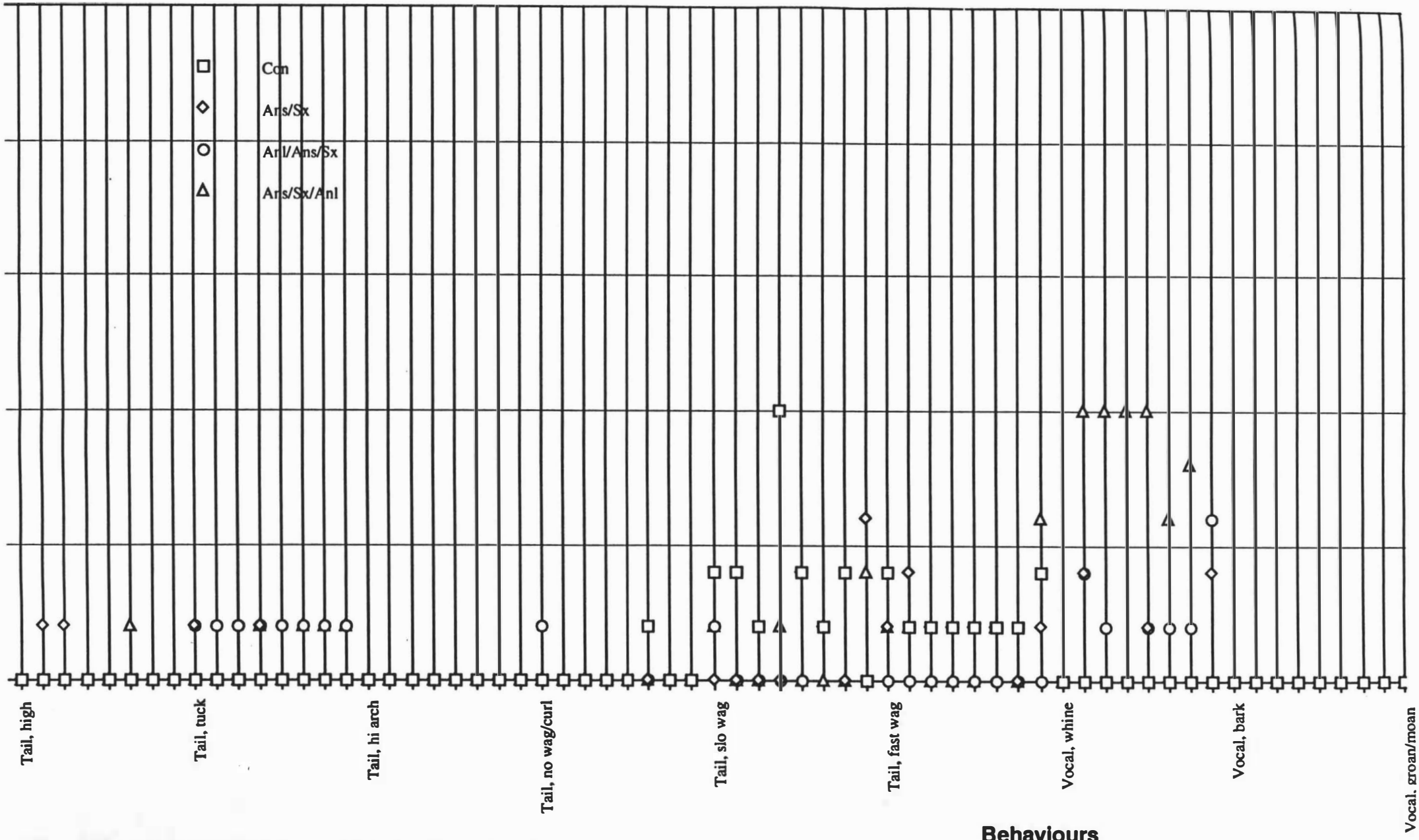

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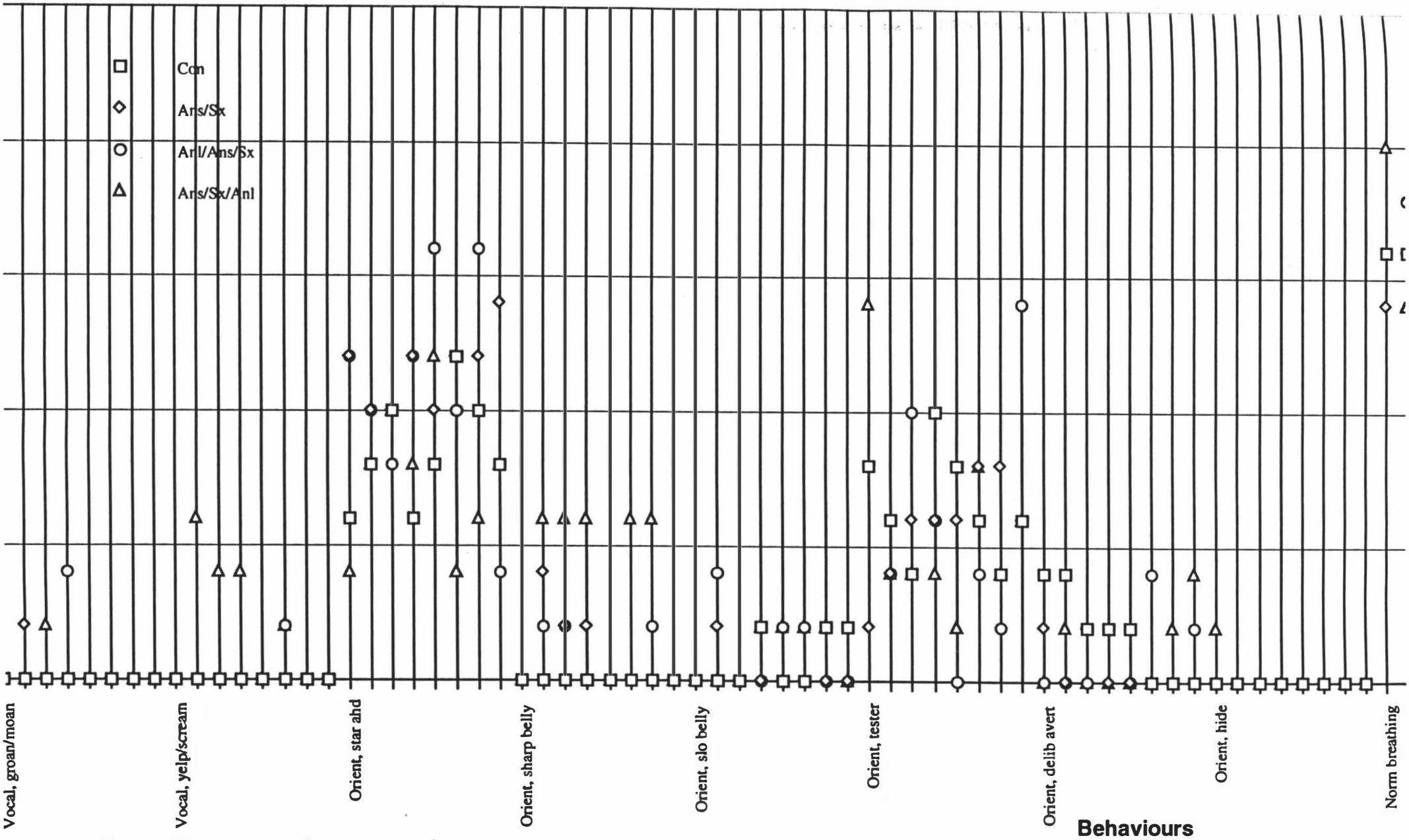

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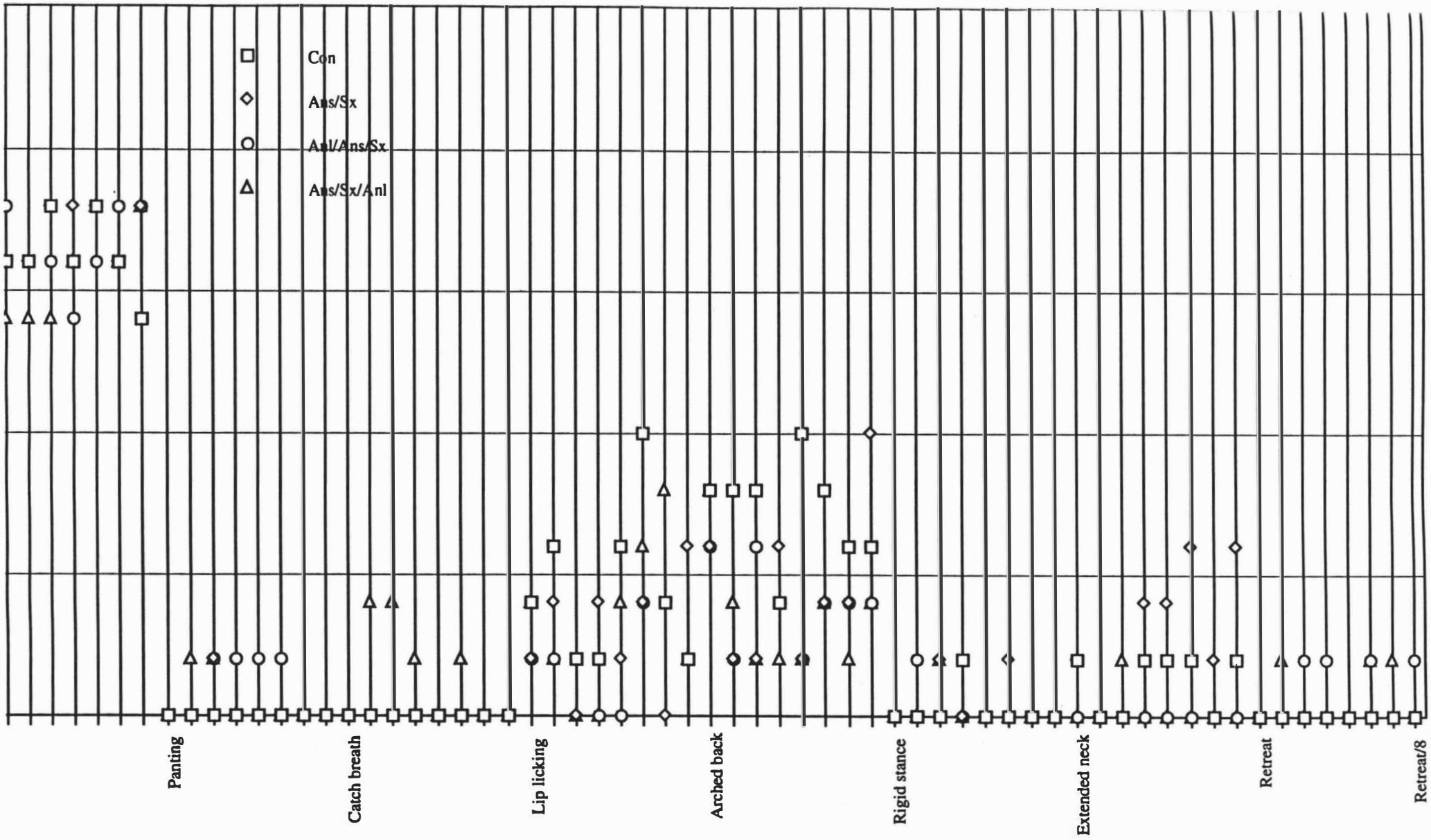

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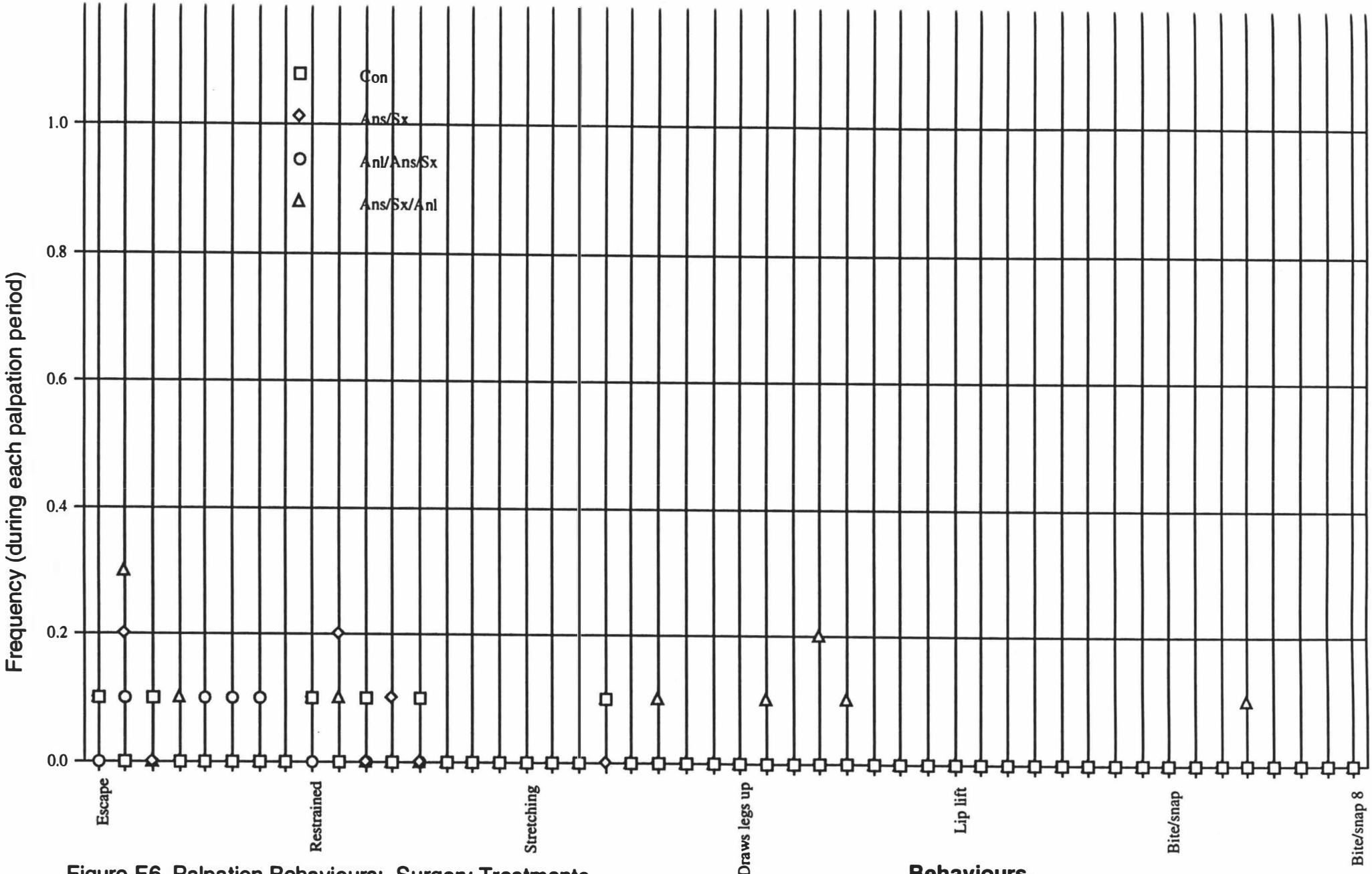


Figure F6 Palpation Behaviours: Surgery Treatments.
Proceeding from left to right on the X-axis following each behaviour: Day before surgery, 0.5 hr., 1.0 hr., 1.5 hr., 2.0 hr., 3.0 hr., 5.0 hr., and 24 hrs.

Appendix A:

Cortisol / RIA

Cortisol (hydrocortisone) is the primary glucocorticoid secreted by the canine adrenal cortex (Reigh, et al., 1950; Farrell, 1954; Farrell and Lamus, 1955). It is released in response to stimulation of adrenocortical cells by adrenocorticotropic hormone (ACTH), a protein produced by the anterior portion of the pituitary gland (adrenohypophysis) (Ganong, et al., 1974). ACTH release is modulated by hypothalamic secretion of a small peptide, corticotropin-releasing factor (CRF). Distress increases and circulating peripheral glucocorticoids decrease ACTH release (Bassett and Hinks, 1969; Ganong, et al., 1974; Ganong, 1994). Half-lives of canine ACTH (Wood et al., 1982) and cortisol (McCormick et al., 1974) are 1.8-2.1 minutes and 50 minutes, respectively. Cortisol secretion varies with the time of day in many species (Krieger, 1974) and in human beings, plasma cortisol is highest in early morning and lowest near midnight (Ganong, et al., 1974; Krieger, 1974; Ganong, 1994). In the rat, a nocturnal animal, plasma cortisol concentration is highest in the afternoon (Krieger, 1974).

Although some investigators (Rijnberk et al., 1968) support existence of a plasma corticosteroid circadian rhythm in the dog, it is generally accepted that cortisol is released episodically, equally distributed throughout the day (Kemppainen and Sartin, 1984) but without evidence of circadian activity (Johnston and Mather, 1978; Kemppainen and Sartin, 1984; Takahashi et al., 1981). Episodically released cortisol in normal dogs appears as peaks five or six times as high as the troughs which explains the wide range of cortisol concentrations determined from normal dogs, even when blood samples were collected the same time each day. Kemppainen and Sartin (1984) reported that bitches showed significantly greater 24-hour mean cortisol (69.5±16.0 nmol/l vs 47.7±4.7 nmol/l) and immunoreactive ACTH levels, numbers of cortisol peaks, and amplitude of iACTH peaks than dogs. The reasons for or effects of such gender differences are unknown. In contrast, Chen and others (1978) measured cortisol concentrations in 56 clinically normal dogs and did not detect differences due to age, gender, body weight, or breed.

(RIA) Normal Plasma Cortisol Levels (Dogs)

(nmol/litre)	Author(s)
53.4±8.3	Johnston & Mather, 1987
86±36	Meijer et al, 1979
13.8-110.4	Cohen & Knieser, 1980
16.5-41.4	Chen et al, 1980
14-110	Lorenz, 1982
20-70	Peterson, Gilbertson and Drucker, 1982
30-160	Rijnberk, van Wees and Mol, 1988

Although generally accepted standards are lacking, plasma corticosteroid concentrations are most frequently used as a measure of distress (Moberg, 1987). Plasma corticosteroid levels can rise within one minute of exposure to a stimulus (Knol et al., 1992) with behavioural, autonomic nervous or neuroendocrinologic responses. Accordingly, basal plasma cortisol values have been shown to be significantly lower for dogs tested in the home environment compared to dogs tested in a veterinary hospital (Vial et al., 1979). In a variety of species including the dog, blood for hormone determinations is often collected by intravenous catheter, or by venipuncture. Collection of blood may induce a distress response including changes in circulating hormone concentrations, which must be recognised in endocrine research. In pursuit of a non-invasive measurement techniques for physiological experiments, studies in various species have shown that concentrations of cortisol in saliva relate closely to plasma levels of the free hormone cortisol (Cooper et al., 1989; Vincent and Michell, 1992). The correlation coefficient of cortisol in dog saliva and plasma is reported as 0.877 (Vincent and Michell, 1992). However, Knol and others (1992) have shown that venipuncture does not influence plasma levels of cortisol in trained, male experimental dogs.

In human beings plasma cortisol becomes elevated from surgical stimuli. Cortisol elevations are related to rises in ACTH (Cooper and Nelson, 1962) and correlate to the severity of the surgical procedure and its

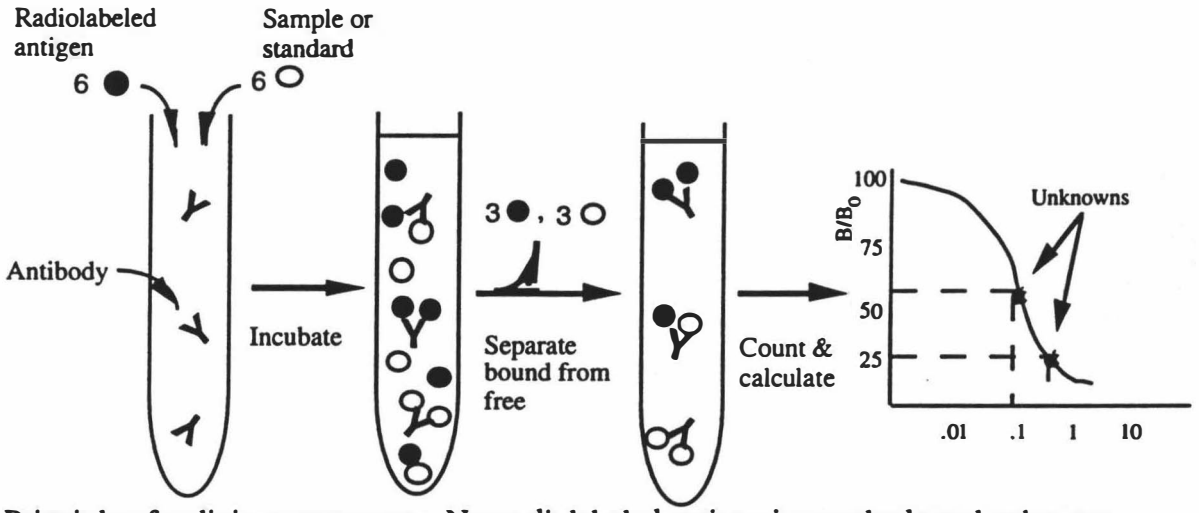
duration (Sandberg et al., 1954; Madsen et al., 1976). Graded cortisol responses to surgical procedures in the dog are reported to be similar to those in humans (Schmidt and Booker, 1982). Opiate alkaloids and opioid peptides uniformly inhibit ACTH and cortisol release in human beings (Grossman, 1988); a discovery that has lead to their use to thwart the detrimental effects of cardiovascular surgery (George et al., 1974). In a similar manner the opioid fentanyl has been used in both adults and preterm babies undergoing surgery (Dubois et al., 1982; Anand et al., 1987).

Plasma cortisol concentrations have been measured by five methods: the fluorometric method (Chastain and Ganjam, 1986), competitive protein binding (CPB) (Scott, 1979), radioimmunoassay (RIA) (Owens and Drucker, 1977), enzyme linked immunosorbent assay (Feldman and Nelson, 1987), and high performance liquid chromatography (Lothrop and Oliver, 1984). The fluorometric techniques measure corticosterone as well as cortisol and nonspecific fluorescence can lead to falsely elevated values. Consequently, the values obtained with this method tend to be higher than values obtained with CPB or RIA methods (Mulnix, 1975). Differences in RIA methods include the preparation of the antibody, type of radioisotope, separation of bound and unbound antigen, extraction procedure and the length of incubation time (Skelly et al., 1973).

Most investigators measure cortisol in plasma rather than serum because the canine erythrocyte has been shown to take up and rapidly concentrate large quantities of cortisol and in varying amounts (Phillip and Marotta, 1971). If blood samples are left unseparated and at room temperature, cortisol levels will decline with time. Many authors have advised that plasma should be separated within 30 minutes of collection, and the plasma should then be stored at 4°C. If there is likely to be a delay of more than eight hours in reaching the laboratory, then the plasma should be frozen (Lorenz, 1982; Scott, 1979). This recommendation is not supported by Olson and others (1981) who found that serum or plasma could be left uncentrifuged for up to 40 hours at 4°C without cortisol levels declining significantly. However, prolonged storage of serum at room temperature was found detrimental, especially for samples having high concentrations of cortisol.

Before 1960, it was very difficult to measure accurately substances present in small amounts in blood and other body fluids using the chemical methods and bioassays then available. Yalow and Berson (1960) reported a method for the quantitative measurement of insulin based on a competitive binding assay, and in the same year a similar method for plasma thyroxine measurement was developed. Since then, a great number of substances, particularly hormones, have been measured using the 'radioimmunoassay' technique.

Advantages of the RIA system over earlier techniques lies in its ability to detect very small amounts, measure only one hormone among a group, accuracy, and reproducibility.



Principle of radioimmunoassays. Nonradiolabeled antigen in standards and unknown samples compete with a fixed quantity of radiolabeled antigen for a limited number of specific antibody-binding sites. After incubation, the bound and unbound radiolabeled antigen is separated and radioactivity is determined. Concentrations of antigen in unknown samples are calculated from the standard curve which is plotted, in this case, with log hormone concentration on the abscissa and counts per minute (cpm) of radiolabeled hormone in assay tubes containing standards and unknown samples (B) divided by cpm in tubes containing buffer (B_O)X100 on the ordinate.

For measuring extremely low concentrations of hormones, a substance that specifically binds with the hormone is first found. For instance, antibodies can usually be developed that will bind specifically with a given hormone. Then a mixture is made of three different elements: (1) a fluid from the animal to be assayed, (2) the antibody, and (3) an approximate equivalent amount of purified hormone of the type to be measured but that has been tagged with a radioactive isotope. However, one specific condition must be met: there must be too little antibody for both of the hormones from

the two separate sources to combine completely. Therefore, the natural hormone and the radioactive hormone compete for the binding sites on the antibody; the quantity of each of the two hormones, the natural and the radioactive, that will bind is proportional to its concentration. After binding is complete, the antibody-hormone complex is separated from the remainder of the solution, and the quantity of radioactive hormone that has bound with the antibody is measured by means of radioactive counting techniques. If a large amount of radioactive hormone has bound, then it is clear that there was only a small amount of natural hormone to compete. Conversely, if only a small amount of radioactive hormone has bound, there was a very large amount of natural hormone to compete for the binding sites. Thus, by the use of an appropriate calibration curve, a very precise measurement of the quantity of the natural hormone in the test fluid can be achieved. As little as a fraction of a picogram (one-trillionth of a gram) of vasopressin per millilitre of assay fluid has been measured in this way.

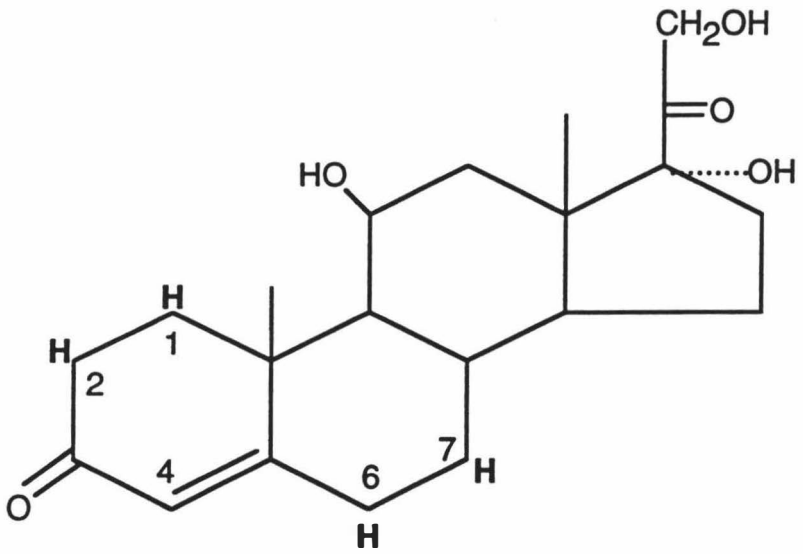
Once a specific antibody, a purified preparation of antigen for standards, and a radiolabeled antigen are obtained, the radioimmunoassay must be thoroughly validated to determine reliability before it can be used to quantify the antigen. Four criteria of assay validity should be examined whenever a radioimmunoassay is used to measure antigen in a different species, medium, or tissue extract and whenever a previously validated assay in one laboratory is used in another laboratory. The criteria for validating radioimmunoassays are specificity, accuracy, precision, and sensitivity. *Specificity* is defined as the extent of freedom from interference by substances other than the one intended to be measured. *Accuracy* is the degree to which measurements of an antigen agree with the exact amount that is present. *Precision* is the degree to which a series of measurements on the same sample agrees with the mean concentration; and *sensitivity* is the smallest amount of hormone that can be distinguished from no hormone (Reimers, 1982).

Several other competitive binding techniques for assay of minute quantities of hormones have also been employed. One of these is to use--in place of antibody--the specific carrier globulins of plasma that are natural binding agents for some hormones. The carrier globulin is substituted for the antibody in the assay process, and then the assay is carried out in exactly

the same way as the radioimmunoassay procedure. This technique is used mainly for the assay of cortisol. Cortisol is also known (pharmacologically) as hydrocortisone.

Cortisol

[1,2,6,7-^{3}H] Cortisol



Standard international units of measurement are generally nanomoles per litre (nmol/l), although micromoles per litre (µmol/l) have also been adopted. Other units are µg/dl and ng/ml.

Conversion Factors

To make the necessary conversion multiply by the appropriate figure given below:

To convert to	From nmol/l	From µmol/l	From µg/dl	From ng/ml
nmol/l		1000	27.6	2.76
µmol/l	0.001		0.0276	0.00276
µg/dl	0.0362	36.2		0.1
ng/ml	0.362	362	10	

Normal Reference Range for Basal Cortisol Levels in the Dog

By radio-immunoassay (RIA): 20-250 nmol/l (0.7-9 µg/dl), although many laboratories quote an upper limit which is lower, e.g. frequently 170 nmol/l (=6 µg/dl) and even 110 nmol/l (=4 µg/dl).

Cortisol Radio-ImmunoAssay

The following is an account of the reagents and process used for cortisol RIA in this study.

Reagents

1. Redistilled dichloromethane [industrial grade] (Shell, NZ).
2. Cortisol standards in ethanol (Sigma Chemical Co., USA).
3. ^{3}H Cortisol [1,2,6,7 ^{3}H Cortisol] (Amersham)
4. Antiserum. Cortisol antiserum F3-314 (Endocrine Sciences Products. California, USA)
5. Bovine Gamma-globulin (Serva Feinbiochemical Gmbh & Co., Heidleberg)
6. PEG 4000 16.2% in distilled water (BDH, Poole, U.K.)
7. Scintillation fluid 1 litre: 4g PPO + 100mg POPOP
   333ml Triton X-100 + 667ml Toluene
   (All "Scintrain" from BDH, U.K.)
8. Scintillation counter. Wallac 1409
   Liquid scintillation counter, Wallac Oy, Finland. [Soil Sciences Dept., Massey]

PBS gel buffer:

15ml 0.5M Na_2HPO_4
5ml 0.5M NaH_2PO_4
Add 8.1g NaCL
0.1g Thimerosal
1g Gelatin
Make up to 1 litre with DDH_2O pH to 7.3

Day 1

100µl sample was extracted in 5ml redistilled DCM by shaking for 10 minutes. It was then centrifuged @1000 rpm/5 min to allow two layers to form and settle. Tubes were then frozen overnight. Control plasma samples were also extracted.

Day 2

DCM was poured off from frozen plasma into glass tubes and dried down @37°C under an air blower. 0.5 ml absolute ethanol was added to the dry tube giving a sample dilution of 1 in 5. This was vortexed to allow the ethanol to take up any cortisol on the tube wall.

100µl of cortisol standard in ethanol was pipetted in duplicate into polypropylene tubes. 100µl of samples were also pipetted in duplicate of controls in quadruplicate. All tubes were dried down under air @37°C.

Bovine Gamma Globulin was diluted to 0.015g/ml in PBS gel buffer. Antiserum was used at a dilution of 1/2000 in PBS gel buffer. Tracer was used at 10,000cpm/100µl. Extra tubes were labelled for total count and blank.

Reagents were added to the tubes as follows:

	Standards	Samples	Blank	Total Counts
BGG	100µl	100µl	100µl	-
PBS gel	-	-	100µl	-
Antiserum	100µl	100µl	-	-
Tracer	100µl	100µl	100µl	100µl
D. H_2O	-	-	-	900µl

After adding all reagents to the tubes (in duplicate), the tubes were covered with parafilm and vortexed. They were then placed in the cold room overnight at 4°C.

16.2% PEG 4000 in distilled water was perpared enough for 1ml addition to all tubes except Total Counts, and were left stirring in the cold room overnight.

Day 3

Separating bound from free: ^3H Cortisol was precipitated by adding 1ml 6.2% PEG 4000, vortexed, then left standing for 10 minutes @4°C. Tubes were then spun @4°C for 20 minutes at 2,500rpm.

The supernatant was aspirated from all tubes (except TC) and 1ml H_2O was added to all tubes (except TC). Vortexing and then sonicating for 10 minutes redissolved the precipitate.

The content of each tube was poured into a scintillation vial and 6ml of scintillation fluid was added.

Vials were then counted for 2 minutes each for ^{3}H in a Wollac 1409 liquid scintillation counter.

The lowest detectable concentration was 0.14µg/ml.

The inter-assay and intra-assay coefficients of variation were 19.55% and 11.35%, respectively.

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Appendix A

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Appendix B

Noninteractive Behaviour after Ovariohysterectomy

MINUTE RECORDINGS

1. Awareness

1.1 Awake

Mandatory features:

1. The eyes remain open for any portion of the period.

1.2 Asleep

Mandatory features:

1. The eyes remain fully closed for 5 minutes or more.
2. If the animal's head lifts during the period, it is awake.

2. Stationary Positions

2.1 Lateral

Mandatory features:

1. Lateral recumbency with both front and rear limbs outstretched.
   Include animals whose body is partially prevented from going fully lateral by a cage wall.
2. The head and tail rest laterally on the cage floor.
3. The animal need not remain in this position for the entire period.

2.2 Sternal curl

Mandatory features:

1. Sternal recumbency with both rear legs to one side.
2. Both front legs curled under the thorax to one side OR outside front leg may be straight out forward.
3. The head is curled back towards the abdomen on the concave side and rests either on a rear leg OR on the inside front leg. The head must NOT be resting on the floor between the two forelimbs.
4. The tail rests on the cage surface, on the same side as the rear legs, and curls close to the legs.
5. The animal needs to remain in this position for 5 minutes.

2.3 Sternal other

Mandatory features:

1. Sternal recumbency with the rear legs both under the animal, one rear leg to one side, both rear legs to one side, or both rear legs facing backwards.

2. The front limbs may be both outstretched, or one limb may be folded over.
3. The head is on a surface, either between the front legs, over one paw, or resting against the cage wall.
4. The animal needs to remain in this position for 5 minutes.

2.4 Normal sit

Mandatory features:

1. The animal sits with its posterior touching the cage floor.
2. The animal needs to remain in this position for 5 minutes.
3. The head position may include low, level, high, or high alert but not hang.

2.5 Hang sit

Mandatory features:

1. The head is hanging and the nose may be shoved into a corner or the floor of the corner or is dropped to the cage floor remote from a corner.
2. The animal is sitting and has an arched back with most of its weight supported by the thoracic limbs.
3. The animal remains in this position for at least **15 seconds**.

Optional/Subjective features:

1. The animal may head nod, however, for most of the 15 seconds or more the head is in a hanging position.
2. A glassy stare is often seen.

2.6 Normal stand

Mandatory features:

1. The animal stands and remains stationary for at least **15 seconds**.
2. Weight shifts and minor limb position changes are allowed, but the torso must be stationary to distinguish it from pacing or circling or position changes.
3. The back is not arched and the head does not hang (except to sniff, etc.)

2.7 Hang stand

Mandatory features:

1. The nose is shoved into a corner or the floor of the corner or is dropped to the cage floor remote from a corner.
2. The animal is standing and has an arched back with a hanging head and tail.
3. The animal remains in this position for at least **15 seconds**.

Optional/Subjective features:

1. Hang standing often occurs with cage circling, but can occur as an isolated behaviour.
2. The animal may head nod, however, for most of the 15 seconds or more the head is in a hanging position.
3. A glassy stare is often seen.

3. Position changes

3.1 Number of position changes

Mandatory features:

1. This is simply a total of all the position changes observed in that period.
2. These are movements that occur BETWEEN stationary behaviours.
3. These movements result in either part of or the entire torso being in a different location compared with the beginning location.
4. These movements are to be recorded as separate from the Torso Weight Shift category.

Optional/Subjective features:

1. Examples include moving to or from any of these positions.
   a. lateral
   b. sternal
   c. sit
   d. stand
2. Cage circling (slow or normal speed) may be associated with any of these; if so, record position change AND the appropriate type of cage circling.

3.2 Torso weight shifts

Mandatory features:

1. These are movements that occur WITHIN the stationary behaviour including all sternal, lateral, and sitting positions.
2. These movements result in either part of or the entire torso being shifted to either a different location compared with the beginning location, or to another location and immediately followed by a return to the initial location.
3. The animal does NOT stand; the forelimbs are NOT fully extended during the location shift.

POSITION CHANGE MODIFIERS

3.3 Normal speed

Mandatory features:

1. These are any position change characterised by a speed comparable to the movements of the animal observed during the baseline videotaping.

3.4 Slow speed

Mandatory features:

1. When compared against the baseline preoperative videotape, the animal moves more slowly when changing position, and requires a longer period of time to complete equivalent movements.
2. When the animal walks, it takes short, slow steps when compared to baseline.
3. The front limbs are often used to slowly get the body up or down.

3.5 Increased thoracic limb weight bearing

Mandatory features:

1. The animal must be standing or sitting.
2. There must be some clear indication of increased weight bearing on the forelimbs:
   a. The purest form, seen in small dogs, is walking with the weight on the front legs and the rear legs off the ground.
   b. Larger dogs arch their backs and/or extend their heads as they move, but don't actually lift the rear legs.
   c. In a sitting position, the animal may sit with the rear legs extended forward and move forward with excessive reliance on the forelimbs to support weight.

3.6 Ataxia

Mandatory features:

1. Consists of exaggerated, uncoordinated body movements such as unconsciously "falling" from a posture.
2. Must be seen in at least one of the following behaviours:
   a. standing
   b. sitting
3. This is recorded together with a position change if appropriate.

Optional/Subjective features:

1. Head ataxia is often seen.
2. Typically occurs in the first 1-4 hours following extubation when the dog is recovering from anaesthesia.

4. Motion

4.1 Walking

Mandatory features:

1. These animals are standing and walking about.
2. These movements result in the entire torso being in a different location compared with the beginning location.
3. These movements are to be recorded as separate from the position change categories since they do not immediately result in a new stationary behaviour.
4. These animals walk with no or only brief pauses for **at least 30 seconds**.

Optional/Subjective features:

1. This is a motion whose purpose is not clearly intended as part of a position change.

MODIFIERS

4.2 Normal speed

Mandatory features:

1. These are any position change characterised by a speed comparable to the movements of the animal observed during the baseline videotaping.

4.3 Slow speed

Mandatory features:

1. When compared against the baseline preoperative videotape, the animal moves more slowly when changing position, and requires a longer period of time to complete equivalent movements.
2. When the animal walks, it takes short, slow steps when compared to baseline.
3. The front limbs are often used to slowly get the body up or down.

4.4 Increased thoracic limb weight bearing

Mandatory features:

1. The animal must be commencing or in motion.
2. There must be some clear indication of increased weight bearing on the forelimbs:
   a. The purest form, seen in small dogs, is rising to a walk with the weight on the front legs and the rear legs off the ground.
   b. Larger dogs arch their backs and/or extend their heads as they move, but don't actually lift the rear legs.
   c. The dog may continue a forward movement with excessive reliance on the forelimbs to support weight.

4.5 Ataxia

Mandatory features:

1. Consists of exaggerated, uncoordinated body movements such as unconsciously "falling" while walking.
2. Must be seen in movement.
3. This is recorded together with a position change if appropriate.

Optional/Subjective features:

1. Head ataxia is often seen.
2. Typically occurs in the first 1-4 hours following extubation when the dog is recovering from anaesthesia.

4.6 First stand

Mandatory features:

1. First postural stand on all 4 limbs unsupported by the cage walls.

Optional/Subjective features:

1. Animal may stumble from this position in a state of ataxia.

5.0 Activities

5.1 Lip licking

Mandatory features:

1. The animal opens his mouth partially to widely and licks its lips at least once.

5.2 Thrashing

Mandatory features:

1. Consists of poorly co-ordinated body movements that must include at least one of the following:
   a. body rolling
   b. banging against the cage wall
   c. at least 1 limb is moved back and forth in the air
   d. head throwing

Optional/Subjective features:

1. Typically occurs in the first 1-2 hours after extubation while the animal is recovering from anaesthesia.

5.3 Head nodding

Mandatory features:

1. The animal must be either standing, sitting, or in sternal recumbency.
2. The head is initially level with the torso (standing) or the head and neck is horizontal or higher (sitting or sternal recumbency).
3. The head drops ventral at least 2 cm.

4. The eyes are closed or partially closed during the drop.
5. The animal does this at least 2 times in a row.

Optional/Subjective features:

1. These are animals that appear to be "nodding off" to sleep.

5.4 Slow motion cage circling

Mandatory features:

1. These animals circle the cage at least 360 degrees without lying down.
2. The animal completes **1 revolution in no less than 60 seconds.**
3. Eyes are open.
4. The tail hangs low.

Optional/Subjective features:

1. This behaviour usually occurs in association with hang standing or head nodding. The animal takes a few short steps, hangs in a corner, takes a few more short steps, hangs in the next corner, etc..
2. The circling is slow enough that it can often only be recognised as such on fast forward.
3. The behaviour usually ends with head nodding and sinking into a sternal position while hanging in a corner.
4. The eyes often exhibit a glassy stare (vacant).
5. The body often looks hunched or arched.
6. This movement may be part of another position change; if so, both cage circling and the other position change are recorded.

5.5 Normal speed cage circling

Mandatory features:

1. The animal's eyes are open and it is standing.
2. The animal circles within the cage at least one time and at least 360 degrees in one continuous movement **not interrupted by pauses.**
3. The animal completes a revolution in **no more than 1 minute.**

Optional/Subjective features:

1. May be seen in conjunction with escape behaviour.
2. This movement may be part of another position change; if so, both cage circling and the other position change are recorded.

5.6 Head lifts

Mandatory features:

1. The animal is in any of the lateral or sternal positions.
2. The animal's head is initially on the cage floor or resting on a forelimb.

3. The animal's head is lifted so that none of its weight remains on the cage floor or forelimbs.

Optional/Subjective features:

1. The eyes may be open or closed.

5.7 Quiet alert

Mandatory features:

1. The eyes remain open for the entire period (5 minutes).
2. There are no vocalisations.

Optional/Subjective features:

1. The animal may orient, held lift, or head tilt during this activity.

5.8 Drawing legs up

Mandatory features:

1. The animal is in lateral, sternal or dorsal recumbency.
2. The animal draws up the rear limbs.

Optional/Subjective features:

1. The animal may roll over onto its back and stretch out the front limbs.
2. This behaviour is seen in both awake and asleep (eyes closed) animals.
3. The animal may simultaneously "tuck" its abdomen.

5.9 Stretching

Mandatory features:

1. The animal is either in lateral or sternal recumbency or is standing.
2. If lateral, the extensor muscle groups are active in stretching the limbs. May be seen as an extension of the rear limbs and a head raise. Torso muscle contractions may or may not be readily apparent.
3. If sternal, both forelimbs exhibit activation of the extensor muscle groups in stretching the limbs.
4. If standing, the animal exhibits either:
   a. stretching first the thoracic and then the pelvic limbs, or;
   b. stretching all 4 limbs at once and arching the back at the same time.

5.10 Cage digging

Mandatory features:

1. Animal is awake and standing.
2. Animal uses one or both forelimbs to scratch/dig at cage floor.

Optional/Subjective features:

1. The animal may vocalise during this activity.

5.11 Cage licking

Mandatory features:

1. Animal is awake and is standing or in sternal recumbency.
2. The animal licks at cage or cage door at least once.

5.12 Door pawing

Mandatory features:

1. The animal is awake, standing or sitting, and oriented towards the door or cage front.
2. The animal presses 1 or both forelimbs to the door at least once.

5.13 Cage sniffing

Mandatory features:

1. The animal sniffs the floor or walls or door of the cage with at least one inspiration.

5.14 Grooming

Mandatory features:

1. May be one of the following behaviours:
   a. licking of skin other than incision
   b. licking of anus or vulva
   c. chewing at skin
   d. "wet dog shake"
2. These behaviours must NOT be directed at the incision itself.

Optional/Subjective features:

1. This behaviour may be seen at the venipuncture site.

5.15 Incision licking

Mandatory features:

1. Includes licking, chewing, or scratching directed at the skin wound itself.

5.16 Yawning

Mandatory features:

1. Must NOT occur with any vocalisation except a whine.

5.17 Pacing

Mandatory features:

1. The animal's eyes are open and it is standing.
2. Is a stereotyped movement consisting of walking to and fro within the confines of the cage for **at least 15 seconds**.

5.18 Trembling

Mandatory features:

1. A high-frequency vibration of all, or a major portion of, the animal's body.

Optional/Subjective features:

1. Will be seen most frequently in the first 1-2 hours following extubation as the animal recovers from hypothermia.

5.19 Manipulations

Mandatory features:

1. Includes such behaviour as playing with the cage light or wiring.

5.20 Urination

5.21 Defecation

5.22 Vomition

5.23 Salivation

5.24 Paddling

Mandatory features:

1. Animal is in a lateral or dorsal position.
2. Two or more limbs are in motion as if walking.

Optional/Subjective features:

1. Animal may be asleep or awake.
2. Typically occurs in first 1-2 hours after extubation while recovering from anaesthesia.

5.25 Look back

Mandatory features:

1. The animal turns its head, focusing attention to the abdomen or flank area.

Optional/Subjective features:

1. The animal does not groom at the end of this redirected orientation.
2. The animal may be in any position.

5.26 Bandage chew

Mandatory features:

1. The animal actively chews at the IV catheter / bandage.
2. The behaviour is more active than simply licking the area.

5.27 IV licking

Mandatory features:

1. The animal merely licks the IV catheter / bandage.

Optional/Subjective features:

1. The animal may be in any position.

6.0 Breathing

6.1 Pant

Mandatory features:

1. The animal's mouth is open at least partially.
2. The respirations are rapid (>60/minute) and are characterised by shallow, easy breaths with completely passive exhalation.

Optional/Subjective features:

1. The tongue may or may not be protruded.

6.2 Normal

Mandatory features:

1. Includes all other patterns besides pant.

7.0 Vocalisation "Persistent" vocalisations are recorded as intervals of activity, broken by other behaviours such as position changes.

7.1 Whine

Mandatory features:

1. A high pitched, long duration sound produced during exhalation.

Optional/Subjective features:

2. Frequently occurs in the presence of other behaviours including attention seeking, sternal awake, and escape behaviour.
3. Tends to occur over the majority of an exhalation.

7.2 Bark

Mandatory features:

1. A loud, short duration sound produced during exhalation.

Optional/Subjective features:

1. The animal is usually sitting, standing, or sternal awake.

7.3 Groan/moan

Mandatory features:

1. A soft, long-duration sound produced during exhalation.
2. The mouth is closed or only slightly opened.

7.4 Howl

Mandatory features:

1. A loud, plaintive, long-duration sound produced during exhalation. It is either monophonic or may be broken by very short yelps.
2. The head is either horizontal or the nose is upturned.
3. The mouth is slightly to moderately opened and the lips are not drawn back.

Noninteractive Behaviour After Ovariohysterectomy

HOURLY RECORDINGS

1. Stationary major behaviours

1.1 Lateral rest or sleep

Mandatory features:

1. Lateral recumbency with both front and rear limbs outstretched. Include animals whose body is partially prevented from going fully lateral by cage wall.
2. Eyes closed.
3. The head and tail rest laterally on the cage floor.
4. No vocalisations.
5. Must remain in this position **at least 5 minutes.**
6. There must be no head lifts during this time.

Optional/Subjective features:

1. These animals appear very relaxed and often fall into a deep sleep.

1.2 Sternal curl

Mandatory features:

1. Sternal recumbency with both rear legs to one side.
2. Both front legs curled under the thorax to one side OR outside front leg may be straight out forward.
3. The head is curled back towards the abdomen on the concave side and rests either on a rear leg OR on the inside front leg. The head must NOT be resting on the floor between the two forelimbs.
4. The tail rests on the cage surface, on the same side as the rear legs, and curls close to the legs.
5. No vocalisations
6. Eyes closed
7. Must remain in this position **at least 5 minutes.**

Optional/Subjective features:

1. This is often a deep sleep position, particularly for small dogs. Occasionally, this position is assumed while the animal is resting, but not asleep.

1.3 Sternal rest or sleep

Mandatory features:

1. Sternal recumbency with the rear legs both under the animal, one rear leg to one side, both rear legs to one side, or both rear legs facing backwards.

2. The front limbs may be both outstretched, or one limb may be folded over.
3. The head is on a surface, either between the front legs, over one paw, or resting against the cage wall.
4. No vocalisations
5. The eyes are closed
6. Must remain in this position **at least 5 minutes.**

Optional/Subjective features:

1. This category covers all sternal positions except sternal curl. Animals in these positions are usually resting or in a light sleep, although an occasional animal will go into a deep sleep.

1.4 Lateral awake

Mandatory features:

1. Body positions are as for lateral rest/sleep.
2. The eyes are open.
3. Must remain in this position **at least 5 minutes**.

Optional/Subjective features:

1. Vocalisations may be present.
2. Some animals will head lift.

1.5 Sternal awake

Mandatory features:

1. The body position and position changes are as for sternal rest/sleep.
2. Vocalisations may or may not be present, and consist of whines or pant/whines.
3. The eyes are open.
4. The animal ear lifts or orients to room sounds.
5. must remain in this position **at least 5 minutes.**

Optional/Subjective features:

1. Grooming usually occurs in this position.
2. There may be head lifts.

1.6 Sit alert

Mandatory features:

1. The animal is sitting and eyes are open for **at least 5 minutes.** Position change(s) may not occur during this time.
2. No head nodding.
3. The animal may orient to sights and sounds outside of the cage and demonstrate at least one of the following:
   a. orienting of head and/or body

b. lifting ears
c. tilting head in response to auditory stimulus.

4. These animals do NOT exhibit the vocalisations or door pawing that characterise the Attention Seeking category.

1.6.5 Sit other (lazy)

Mandatory features:

1. The animal is sitting and eyes are open for **at least 5 minutes.** Position change(s) may not occur during this time.
2. The animal is not alert and may show head nodding.
3. The animal may orient to sights and sounds outside of the cage and demonstrate at least one of the following:
   a. orienting of head and/or body
   b. lifting ears
   c. tilting head in response to auditory stimulus.
4. These animals do NOT exhibit the vocalisations or door pawing that characterise the Attention Seeking category.

1.6.6 Hang sit

Mandatory features:

1. The nose is shoved into a corner or the floor of the corner or is dropped to the cage floor remote from a corner.
2. The animal has an arched back with a hanging head.
3. The animal remains in this position for **at least 15 seconds.**

Optional/Subjective features:

1. Hang sitting often occurs as an isolated behaviour.
2. The animal may head nod, however, for most of the 15 seconds or more the head is in a hanging position.
3. A glassy stare is often seen.

1.7 Hang stand

Mandatory features:

1. The nose is shoved into a corner or the floor of the corner or is dropped to the cage floor remote from a corner.
2. The animal has an arched back with a hanging head and tail.
3. The animal remains in this position for **at least 15 seconds.**

Optional/Subjective features:

1. Hang standing often occurs with cage circling, but can occur as an isolated behaviour.
2. The animal may head nod, however, for most of the 15 seconds or more the head is in a hanging position.
3. A glassy stare is often seen.

1.8 Normal stand

Mandatory features:

1. The animal is supported by all 4 limbs, back is straight, and the head is level or high.
2. Weight shifts and minor limb position changes are allowed, but the torso must be stationary to distinguish it from pacing or circling or position changes.
3. The animal may orient to sights and sounds outside the cage and demonstrate at least one of the following:
   a. orienting of head and/or body
   b. lifting ears
   c. tilting head in response to auditory stimulus.

2.0 Position Changes

2.1 Slow motion position changes

Mandatory features:

1. These are movements that occur BETWEEN stationary behaviours.
2. These movements result in either part of or the entire torso being in a different location compared with the beginning location.
3. These movements are to be recorded as separate from the Torso Weight Shift category.
4. When compared against the baseline preoperative videotape, the animal moves more slowly when changing equivalent movements.
5. When the animal walks, it takes short, slow steps when compared to baseline.

Optional/Subjective features:

1. Examples include moving to or from any of these positions:
   a. lateral
   b. sternal
   c. sit
   d. stand
2. Cage circling (slow or normal speed) may be associated with any of these: if so, record position change AND the appropriate type of cage circling.
3. The front limbs are often used to slowly get the body up or down.

2.2 Normal speed position changes

Mandatory features:

1. These are movements that occur BETWEEN stationary behaviours.
2. These movements result in either part of or the entire torso being in a different location compared with the beginning location.
3. These movements are to be recorded as separate from the Torso Weight Shift category.
4. These are any position changes characterised by a speed comparable to the movements of the animal observed during the baseline videotaping.

Optional/Subjective features:

1. Examples include moving to or from any of these positions:
   a. lateral
   b. sternal
   c. sit
   d. stand
2. Cage circling (slow or normal speed) may be associated with any of these; if so, record position change AND the appropriate type of cage circling.

2.3 Torso weight shifts

Mandatory features:

1. These are movements that occur WITHIN the stationary behaviours including all sternal, lateral, and sitting positions.
2. These movements result in either part of or the entire torso being shifted to either a different location compared with the beginning location, or to another location and immediately followed by a return to the initial location.
3. The animal does NOT stand; the forelimbs are NOT fully extended during the location shift.

2.4 Thoracic limb weight shift

Mandatory features:

1. The animal must be standing or sitting.
2. There must be some clear indication of increased weight bearing on the forelimbs:
   a. The purest form, seen in small dogs, is walking with the weight on the front legs and the rear legs off the ground.
   b. Larger dogs arch their backs and/or extend their heads as move, but don't actually lift the rear legs.

c. In a sitting position, the animal may sit with the rear legs extended forward and move forward with excessive reliance on the forelimbs to support weight.

2.5 Drawing legs up

Mandatory features:

1. The animal is in lateral, sternal or dorsal recumbency.
2. The animal draws up the rear limbs.

Optional/Subjective features:

1. The animal may roll over onto its back and stretch out the front limbs.
2. This behaviour is seen in both awake and asleep (eyes closed) animals.
3. The animal may simultaneously "tuck" its abdomen.

2.6 Stretching

Mandatory features:

1. The animal is either in lateral or sternal recumbency or is standing.
2. If lateral, the extensor muscle groups of all 4 limbs are active in stretching the limbs. Torso muscle contractions may or may not be readily apparent.
3. If sternal, both forelimbs exhibit activation of the extensor muscle groups in stretching the limbs.
4. If standing, the animal exhibits either:
   a. stretching first the thoracic and then the pelvic limbs, or
   b. stretching all 4 limbs at once and arching the back at the same time.

Optional/Subjective features:

1. The animal may yawn and curl the tongue during a stretch. Record this separately as a yawn.
2. The animal may wind up in a different position or location. Do NOT record this as a separate position change category if it occurs during the active stretch.

3.0 Movement Behaviours

3.1 Attention seeking

Mandatory features:

1. The animal is standing or sitting at the door opening.
2. The head position varies from level to high alert, with the animal orienting, head tilting, and ear lifting to room sounds and people.
3. Must continue in this behaviour for **at least 5 minutes.**

4. The animal solicits attention by at least one of the following:
   a. vocalisations ranging from an occasional whine or bark/whine to constant whining. Most occur at least once.
   b. pawing at the door at least once.

Optional/Subjective features:

1. Tail lifting and wagging may occur in association with vocalisations.
2. When not waiting at the door, the animal may circle the cage or pace.
3. Manipulation behaviours are common

3.2 Normal speed cage circling

Mandatory features:

1. The animal's eyes are open and it is standing.
2. The animal circles within the cage at least one time and at least 360 degrees in one continuous movement **not interrupted by pauses.**
3. The animal completes a revolution **within 15 seconds.**

Optional/Subjective features:

1. May be seen in conjunction with escape behaviour.
2. May be more commonly seen in large dogs.
3. This movement may be part of another position change; if so, both cage circling and the other position change are recorded.

3.3 Slow speed cage circling

Mandatory features:

1. These animals circle the cage at least 360 degrees without lying down.
2. The animal completes **1 revolution in no less than 60 seconds.**
3. Eyes are open
4. The tail hangs low.

Optional/Subjective features:

1. This behaviour usually occurs in association with hang standing or head nodding. The animal takes a few short steps, hangs in a corner, takes a few more short steps, hangs in the next corner, etc..
2. The circling is slow enough that it can often only be recognised as such on fast forward.
3. The behaviour usually ends with head nodding and sinking into a sternal position while hanging in a corner.

4. The eyes often exhibit a glassy stare.
5. The body often looks hunched or arched.
6. This movement may be part of another position change; if so, both cage circling and the other position change are recorded.

3.4 Escape behaviour

Mandatory features:

1. These animals display constant motion for **>5 minutes.**
2. During this time their activities are directed towards at least one of the following:
   a. paw at door
   b. dig at cage floor
   c. lick the door
   d. sniff cage surfaces

Optional/Subjective features:

1. Panting
2. Vocalisation
3. They are usually less alert to room sounds than the attention seeking animal.

4.0 Short Behaviours "Persistent" vocalisations are recorded as intervals of activity, broken by other behaviours such as position changes.

4.1 Head lifts

Mandatory features:

1. The animal is in any of the lateral or sternal positions.
2. The animal's head is initially on the cage floor or resting on a forelimb.
3. The animal's head is lifted so that none of its weight remains on the cage floor or forelimbs.

Optional/Subjective features:

1. The eyes may be opened or closed.

4.2 Lip licking

Mandatory features:

1. The animal opens its mouth partially to widely and licks its lips at least once.

4.3 Whine

Mandatory features:

1. A high pitched, long duration sound produced during exhalation.

Optional/Subjective features:

1. Frequently occurs in the presence of other behaviours including attention seeking, sternal awake, and escape behaviour.
2. Tends to occur over the majority of an exhalation.

4.4 Cage sniffing

Mandatory features:

1. The animal sniffs the floor or walls or door of the cage with at least one inspiration.

4.5 Thrashing

Mandatory features:

1. Consists of poorly coordinated body movements that must include at least one of the following:
   a. body rolling
   b. banging against the cage wall
   c. at least 1 limb is moved back and forth in the air
   d. head throwing

Optional/Subjective features:

1. Typically occurs in the first 1-2 hours after extubation while the animal is recovering from anaesthesia.

4.6 Grooming

Mandatory features:

1. Must be one of the following behaviours:
   a. licking of skin other than incision
   b. licking of anus or vulva
   d. chewing at skin
   e. scratching
   f. "wet dog shake"
2. These behaviours must NOT be directed at the incision itself.

Optional/Subjective features:

1. This behaviour may be seen at the venipuncture site.

4.7 Yawning

Mandatory features:

1. Must NOT occur with any vocalisation except a whine.

4.8 Cage licking

Mandatory features:

1. Animal is awake and is standing or in sternal recumbency.
2. Animal licks at cage or cage door at least 1 time.

4.8.5 Door biting

Mandatory features:

1. Animal is awake, but may be in any position.
2. Animal engages the cage door with its teeth at least 1 time.

4.9 Breathing, pant

Mandatory features:

1. The animal's mouth is open at least partially.
2. The respirations are rapid (>60/minute) and are characterised by shallow, easy breaths with completely passive exhalation.

Optional/Subjective features:

1. The tongue may or may not be protruded.

4.10 Breathing, normal

Mandatory features:

1. Includes all other patterns besides pant.

4.11 Urination

4.12 Defecation

4.13 Cage digging

Mandatory features:

1. Animal is awake and standing
2. Animal uses one or both forelimbs to scratch/dig at cage floor.

Optional/Subjective features:

1. The animal may vocalise during this activity.

4.14 Door pawing

Mandatory features:

1. The animal is awake, standing or sitting, and oriented towards the door or cage front.
2. The animal presses 1 or both forelimbs to the door at least once.

4.15 Head nodding

Mandatory features:

1. The animal must be either standing, sitting, or in sternal recumbency.

2. The head is initially level with the torso (standing) or the head and neck is horizontal or higher (sitting or sternal recumbency).
3. The head drops ventrally at least 2 cm.
4. The eyes are closed or partially closed during the drop.
5. The animal does this at least 2 times in a row.

Optional/Subjective features:

1. These are animals that appear to be "nodding off" to sleep.

4.16 Incision licking

Mandatory features:

1. Includes licking, chewing, or scratching directed at the skin wound itself.

4.17 (blank: omission error)

4.18 Bark

Mandatory features:

1. A loud, short duration sound produced during exhalation.

Optional/Subjective features:

1. The animal is usually sitting, standing, or sternal awake.

4.19 Groan/moan

Mandatory features:

1. A soft, long-duration sound produced during exhalation.
2. The mouth is closed or only slightly opened.

4.20 Howl

Mandatory features:

1. A loud, plaintive, long-duration sound produced during exhalation. It is either monophonic or may be broken by very short yelps.
2. The head is either horizontal or the nose is upturned.
3. The mouth is slightly to moderately opened and the lips are not drawn back.

4.21 Pacing

Mandatory features:

1. The animal's eyes are open and it is standing.
2. Is a stereotyped movement consisting of walking to and fro within the confines of the cage for **at least 15 seconds.**

Optional/Subjective features:

1. Large dogs may not be able to pace because of the confines of the cage. If they move to and fro with their forelimbs but keep their hind limbs relatively stationary, record this as pacing.

4.22 Ataxia

Mandatory features:

1. Consists of exaggerated, uncoordinated body movements such as unconsciously "falling" from a posture.
2. Must be seen in at least one of the following behaviours:
   a. standing
   b. walking
   c. sitting

Optional/Subjective features:

1. Head ataxia is often seen
2. Typically occurs in the first 1-4 hours following extubation when the animal is recovering from anaesthesia.

4.23 Trembling

Mandatory features:

1. A high-frequency vibration of all, or a major portion of, the animal's body.

Optional/Subjective features:

1. Will be seen most frequently in the first 1-2 hours following extubation as the animal recovers from hypothermia.

4.24 Manipulation behaviours

Mandatory features:

1. Includes activities such as playing with the cage light or wiring.

4.25 Vomition

4.26 Salivation

4.27 Look back

Mandatory features:

1. The animal turns its head, focusing attention to the abdomen or flank area.

Optional/Subjective features:

1. The animal does not groom at the end of this redirected orientation.

2. The animal may be in any position.

4.28 IV licking

Mandatory features:

1. The animal merely licks the IV catheter / bandage.

Optional/Subjective features:

1. The animal may be in any position.

4.29 First stand

Mandatory features:

1. First postural stand on all 4 limbs unsupported by the cage walls.

Optional/Subjective features:

1. Animal may stumble from this position in a state of ataxia.

4.30 Bandage chew

Mandatory features:

1. The animal actively chews at the IV catheter / bandage.
2. The behaviour is more active than simply licking the area.

4.30 Door biting (same as 4.8.5: duplication error)

Mandatory features:

1. The animal chews on the bars of the cage door.

Optional/Subjective features:

1. The animal may be in any position.

PALPATION BEHAVIOUR After Ovariohysterectomy

1.0 Starting Positions

1.1 Lateral

Mandatory features:

1. Lateral recumbency with both front and rear limbs outstretched. Include animals whose body is partially prevented from going fully lateral by the cage wall.
2. The head and tail rest laterally on the cage floor.
3. The animal is in this position at the onset of being palpated.

Optional/Subjective features:

1. These animals appear very relaxed and are often in a deep sleep.

1.2 Sternal

Mandatory features:

1. Includes both sternal recumbency and sternal curl positions as defined in the hourly observations. The animal is in this position at the onset of being palpated.

1.3 Sit

Mandatory features:

1. The animal is sitting with its posterior in contact with the cage floor at the onset of being palpated.

1.4 Stand

Mandatory features:

1. The animal is standing and no part of the torso is in contact with the cage floor. The animal is in this position at the onset of being palpated.

2.0 Position Changes

2.1 Yes

Mandatory features:

1. The animal is in a position different from the starting position **when the palpator withdraws his hand** from the animal.

2.2 No

Mandatory features:

1. The animal is in the same position as the starting position **when the palpator withdraws his hand.**

3.0 End Position

3.1 Lateral

Mandatory features:

1. Lateral recumbency with both front and rear limbs outstretched. Include animals whose body is partially prevented from going fully lateral by the cage wall.
2. The head rests laterally on the cage floor.
3. The animal is in this position when the palpator withdraws his hand.

Optional/Subjective features:

1. These animals appear very relaxed and are often in a deep sleep.

3.2 Sternal

Mandatory features:

1. Includes both sternal recumbency and sternal curl positions as defined in the hourly observations. The animal is in this position when the palpator withdraws his hand.

3.3 Sit

Mandatory features:

1. The animal is sitting with its posterior in contact with the cage floor when the palpator withdraws his hand.

3.4 Stand

Mandatory features:

1. The animal is standing and no part of the torso is in contact with the cage floor. The animal is in this position when the palpator withdraws his hand.

4.0 Head Position: **All head positions are determined at the time the palpator withdraws his hand.**

4.1 High

Mandatory features:

1. The animal is standing, sitting, or in sternal recumbency.
2. The head is not in contact with the cage floor.
3. The neck is above the horizontal when the animal is standing or sternal, or is in line with the torso or higher if the animal is sitting.
4. The head is in a "neutral" position with the muzzle close to horizontal.

4.2 Level

Mandatory features:

1. The animal is standing, sitting, or in sternal recumbency.
2. The head is not in contact with the cage floor.
3. The neck is horizontal or higher when the animal is standing or sternal, or is in line with the torso if the animal is sitting.
4. The head is in a "neutral" position.

4.3 Lowered

Mandatory features:

1. The animal is standing, sitting, or sternal.
2. The head is not in contact with the cage floor.
3. The neck is horizontal or below horizontal.

4.4 Hang

Mandatory features:

1. The animal is standing or sitting, or is sternal with its neck elevated above horizontal.
2. The nose is pointed ventrally.

4.5 Rest on surface

Mandatory features:

1. The animal is in sternal or lateral recumbency.
2. The side or ventrum of the muzzle is in contact with the floor of the cage.

4.6 High alert

Mandatory features:

1. Same as the "high" category with the addition of:
   a. the ears are "forward alert"
   b. the head is never lower than horizontal

4.7 Scooping

Mandatory features:

1. The animal is standing, sitting, or in sternal recumbency.
2. The head is not in contact with the cage floor.
3. This occurs only **during contact with the palpator.**
4. The ears are neutral, back, or flat to the sides.
5. The nose is clearly elevated above horizontal.
6. The head is moved forward while the nose is elevated.

Optional/Subjective features:

1. This behaviour often occurs while the animal is being petted or otherwise touched on the top of the head.

4.8 Tilt

Mandatory features:

1. The animal is standing, sitting, or in sternal recumbency.
2. The head is not in contact with the cage floor.
3. The head is **rotated about its long axis** to either side when viewed from the front.

4.9 Sway

Mandatory features:

1. The animal is standing, sitting, or in sternal recumbency.
2. The head is not in contact with the cage floor.
3. The head is **rotated to the left or right about its short axis** when viewed from the front.

4.10 Sudden head lift

Mandatory features:

1. the animal abruptly lifts its head at least 2 cm in response to palpation.

5.0 Ear Position **All ear positions are determined at the time the palpator withdraws his hand.**

5.1 Forward alert

Mandatory features:

1. Prick-ear breeds: The ears are both erect but no effort is made to draw them towards the midline and orient them.
2. Lop-ear and other breeds: The base of the ears are relaxed and not elevated.

5.2 Neutral

Mandatory features:

1. Prick-ear breeds: The base of both ears are pulled caudally and the ear flaps are directed caudally. The ear flaps do not contact the head or neck.
2. Lop-ear and other breeds: The base of the ears are pulled caudally and the ear flaps are back to various degrees.

Optional/Subjective features:

1. This position is usually accompanied by other features of aggression.

5.3 Back

Mandatory features:

1. Prick-ear breeds: The base of both ears are pulled caudally and the ear flaps are directed caudally. The ear flaps do not contact the head or neck.
2. Lop-ear and other breeds: The base of the ears are pulled caudally and the ear flaps are back to various degrees.

Optional/Subjective features:

1. The head is usually oriented towards a specific sight or sound.

5.4 Alternating

Mandatory features:

1. The ears are clearly changed from one position to another at least once.

5.5 Flat to sides

Mandatory features:

1. Prick-ear breeds: The base of both ears are relaxed and the ear flaps are directed laterally at a right angle to the head.
2. Lop-ear and other breeds: The base of the ears are pulled extremely caudal and the ear flaps of non-lop-ears are pulled medially as well and may contact the head or neck.

6.0 Eye Position **All eye positions are determined at the time the palpator withdraws his hand.**

6.1 Glance/avert

Mandatory features:

1. The eyes are fully opened.
2. The animal purposefully **averts his vision away from the palpator.**

Optional/Subjective features:

1. The animal may first glance at the palpator and make a brief or no eye contact.

6.2 Stare ahead

Mandatory features:

1. The eyes are fully opened.
2. The eyes are **oriented straight ahead**, ie., along the same axis as the head.
3. Neither the head or eyes are oriented towards the palpator.

Optional/Subjective features:

1. The eyes may have a "glazed" appearance and appear to not be focused on anything nearby.

6.3 Watch

Mandatory features:

1. The eyes are fully opened.
2. the eyes are oriented to and **focused on some particular object**--either the palpator, the cage door, or some object immediately outside the cage door.

6.4 Wary

Mandatory features:

1. The eyes are fully opened.
2. The head is oriented away from the palpator.
3. The eyes are oriented towards the palpator.

6.5 Eyebrow lift

Mandatory features:

1. The eyes are fully opened.
2. There is **noticeable creasing or furrowing of the skin at the brow.**

Optional/Subjective features:

1. This is often associated with watching without the head orientation--in other words, the animal directs his vision to some identifiable object but does not turn his head.

6.6 Wide-eyed

Mandatory features:

1. The eyes are fully opened and the lids maximally retracted.

Optional/Subjective features:

1. The animal may show other subjective signs of fear.

6.7 Sleepy or lidded

Mandatory features:

1. The eyes are not closed but are not opened fully.

6.8 Closed

Mandatory features:

1. Both eyelids are completely closed.

6.9 Frantic searching

Mandatory features:

1. The eyes are closed at the beginning of palpation.
2. The eyes are fully opened at the end of palpation.
3. The eyes (and often the head) will dart back and forth at least once.

Optional/Subjective features:

1. These animals are asleep at the onset and become startled and momentarily search frantically for orientation.

7.0 Tail Position **All tail positions are determined at the time the palpator withdraws his hand**

7.1 On surface

Mandatory features:

1. The animal is in lateral, sternal, or sitting position.
2. The entire tail remains on the surface of the cage floor.

7.2 Low

Mandatory features:

1. The animal is standing or in motion (walk).
2. The tail is draped ventrally so as to **contact the perineum.**
3. The majority of the body of the tail is parallel to the hind limbs.

7.3 Level

Mandatory features:

1. The animal is standing or in motion (walk).
2. The tail is actively pulled away from contact with the perineum and hind limbs, but remains below the horizontal.

Optional/Subjective features:

1. Animals with naturally arched tails will be recorded as level if the tail tip does not point towards their back.

7.4 High

Mandatory features:

1. The animal is standing or in motion (walk).
2. The tail is actively lifted above the horizontal
3. The tail does not touch the cage floor.

Optional/Subjective features:

1. Animals with naturally arched tails will be recorded as High if the tail tip points toward their back.

7.5 Tuck

Mandatory features:

1. The animal is standing or in motion (walk).
2. The tail is actively drawn close to the body and the bulk of the tail is flush with the perineum.

Optional/Subjective features:

1. The end of the tail may be parallel to the rear limbs or touching the caudal abdomen.

7.6 High arch

Mandatory features:

1. The animal is standing or in motion (walk).
2. The tail is actively curled dorsally.
3. The tip is pointed anywhere from straight up to towards the sacrum.
4. The tail does not rest on the cage floor.

Optional/Subjective features:

1. Animals with naturally arched tails will be recorded as High Arch if the tail tip touches their back.

7.7 No wag/curl

Mandatory features:

1. The animal may be in any position
2. The tail is not swung back and forth at all during the entire period of palpation.

7.8 Slow wag/curl

Mandatory features:

1. The animal may be in any position.
2. The tail is swung back and forth slowly at least once at any point during the entire palpation.
3. There is no noticeable movement of the hips or sacrum associated with the wag.

7.9 Fast wag/curl

Mandatory features:

1. The animal may be in any position
2. The tail is swung back and forth rapidly, >once/second, at least one time during the entire palpation.

Optional/Subjective features:

1. The animal may move her hips and pelvis to assist.

8.0 Vocalisations **All vocalisations are observed during the palpation.**

8.1 Whine

Mandatory features:

1. A high pitched, long duration sound produced during exhalation.

Optional/Subjective features:

1. Frequently occurs in the presence of other behaviours including attention seeking, sternal awake, and escape behaviour.
2. Tends to occur over the majority of an exhalation.

8.2 Bark

Mandatory features:

1. A loud, short duration sound produced during exhalation.

Optional/Subjective features:

1. The animal is usually sitting, standing, or sternal awake.

8.3 Groan/moan

Mandatory features:

1. A soft, long-duration sound produced during exhalation.
2. The mouth is closed or only slightly opened.

8.4 Yelp/scream

Mandatory features:

1. A loud, short-to-long duration, high pitched sound produced during exhalation.
2. The mouth is opened widely.

9.0 Orientation **All orientation behaviours are observed during the palpation.**

9.1 Stare ahead

Mandatory features:

1. The head and eyes are oriented directly ahead of the torso.
2. The eyes are open.
3. The eyes are not focused or oriented to any identifiable object.

Optional/Subjective features:

1. Frequently associated with Extended Neck.

9.2 Sharp belly

Mandatory features:

1. The animal may be in any position.
2. The animal abruptly and quickly turns its head towards the belly.

Optional/Subjective features:

1. The animal need not turn fully, but it must be tending to point towards the belly.

9.3 Slow belly

Mandatory features:

1. The animal may be in any position.
2. The animal slowly turns its head towards the belly.

Optional/Subjective features:

1. The animal need not turn fully, but it must be tending to point towards the belly.

9.4 Tester

Mandatory features:

1. The animal orients its head and neck towards the tester or his hand during palpation.

Optional/Subjective features:

1. The animal may orient its eyes as well.

9.5 Deliberate avert

Mandatory features:

1. The animal purposefully turns its head away from the tester and or his hand during the palpation.

Optional/Subjective features:

1. The animal will often avert its eyes at the same time.
2. The animal may turn its neck and torso away from the tester as well.

9.6 Hide

Mandatory features:

1. The animal seeks to or actually does place his head under or behind the tester's torso or possibly his arm.

10.0 Breathing **All breathing observations occur during a palpation**

10.1 Normal

Mandatory features:

1. Includes all other patterns besides pant.

10.2 Pant

Mandatory features:

1. The animal's mouth is open at least partially.
2. The respirations are rapid (>60/minute) and are characterised by shallow, easy breaths with completely passive exhalation.

Optional/Subjective features:

1. The tongue may or may not be protruded.
2. Most dogs that are panting prior to palpation stop panting during the palpation.

10.3 Catch breath

Mandatory features:

1. The animal abruptly suspends its breathing rhythm and inhales more deeply one time.
2. This is superimposed upon the basic breathing pattern.

11.0 Other Behaviours **All other observations occur during the palpation.**

11.1 Lip licking

Mandatory features:

1. The animal opens her mouth partially to widely and licks its lips or tongue at least once.

11.2 Arched back

Mandatory features:

1. The animal must be standing or sitting.
2. The curvature of the back increases noticeably with the T-L section rising above the rest of the back.

Optional/Subjective features:

1. This is easily missed in animals that are sitting.

11.3 Rigid stance

Mandatory features:

1. The animal must be standing or sitting.
2. The animal remains rigidly immobile during the palpation.

3. The head and neck are either oriented directly ahead, or the animal may perform a slow or sharp turn to the belly.

Optional/Subjective features:

1. The animals tend to stare straight ahead.

11.4 Extended neck

Mandatory features:

1. The animal is in any body position.
2. The animal actively extends its neck and elevates it slightly.
3. The nose elevates dorsally.

Optional/Subjective features:

1. These animals tend to stare ahead during this behaviour.

11.5 Retreat

Mandatory features:

1. The animal is oriented with its head forward facing the palpator or the cage door.
2. The animal is sitting or standing.
3. The animal backs up towards the rear of the cage.

11.6 Escape

Mandatory features:

1. The animal is oriented with its head forward facing the cage door.
2. The animal is standing, sitting, or crouched.
3. The animal attempts to move out the cage opening.

Optional/Subjective features:

1. The animal will frequently be restrained and throw their head in an effort to free itself.

11.7 Restrained

Mandatory features:

1. The palpator's arm and/or hand must be in contact with the animal's head or neck in an effort to prevent forward movement or attempts to bite or retreat.

Optional/Subjective features:

1. This category should include animals that are wrapped with a towel for purposes of restraint.

11.8 Stretching

Mandatory features:

1. The animal is either in a lateral or sternal recumbency or is standing.
2. If lateral, the extensor muscle groups of all 4 limbs are active in stretching the limbs. Torso muscle contractions may or may not be readily apparent.
3. If sternal, both forelimbs exhibit activation of the extensor
4. If standing, the animal exhibits either:
   a. stretching first the thoracic and then the pelvic limbs, or
   b. stretching all 4 limbs at once and arching the back at the same time.

Optional/Subjective features:

1. The animal may yawn and curl the tongue during a stretch. Record this separately as a yawn.
2. The animal may wind up in a different position or location. Do NOT record this as a separate position change category if it occurs during the active stretch.

11.9 Drawing legs up

Mandatory features:

1. The animal is in lateral, sternal or dorsal recumbency.
2. The animals draws up the rear limbs.

Optional/Subjective features:

1. The animal may simultaneously "tuck" its abdomen.

11.10 Lip lift

Mandatory features:

1. The animal is in any body position.
2. The animal actively elevates one or both lips to bare its teeth in response to palpation. The teeth need not be exposed to satisfy this behaviour.

11.11 Bite/snap

Mandatory features:

1. The animal may be in any body position.
2. The animal actively bites or snaps its teeth.
3. This includes animals that make contact with the palpator, dogs that attempt to make contact but miss, and animals that bite into the air but are not orienting towards the palpator.

Appendix C:

Analgesia / Butorphanol

Peripherally acting analgesics are classified as steroidal antiinflammatory drugs, nonsteroidal antiinflammatory drugs (NSAIDs), local anaesthetics (analgesics), and opioids. The analgesic effect of nonsteroidal antiinflammatory drugs, as with steroids, is attributable mainly to their antiprostaglandin activity. All nonsteroidal antiinflammatory drugs have a therapeutic ceiling that limits their use as analgesic agents for mild to moderate pain (Potthoff and Carithers, 1989). Moderate to severe postoperative pain is best treated by systemic opioid agonists, drugs such as morphine and its derivatives, by local or regional analgesia or anaesthesia, or by these combinations. "These drugs work both centrally and at the site of tissue injury and are best initiated prior to surgery, before prostaglandin synthesis begins" (Hansen, 1993).

In 1806 Serturner reported the isolation of a pure substance in opium that he named morphine, after Morpheus, the Greek god of dreams. After the development of totally synthetic entities with morphine-like actions, the word *opioid* was coined to refer in a generic sense to all drugs, natural and synthetic, with morphine-like actions. With time, opioid has also been used to refer to antagonists of morphine-like drugs as well as to receptors that combine with such agents. In 1973, following a methodological approach developed by Goldstein and co-workers, three groups of investigators independently described stereospecific binding sites for opioid drugs in the mammalian nervous system.

Opioid analgesics interact at selective endogenous recognition sites (opioid receptors) in the CNS as well as other tissues (Martin, 1984). Endogenous opiopeptins are released in response to nociception and other stimuli and interact with the opioid receptors selectively distributed in the brain and spinal cord (Akil et al., 1984). These endogenous opiopeptins are derived from larger precursor peptides and include: ß-endorphin; dynorphins, including dynorphin, dynorphin B, and neo-endorphins; and enkephalins, principally methionine-enkephalin and leucine-enkephalin. The enkephalin sequence is also an integral component of ß-endorphin and dynorphin molecules.

The CNS, spinal cord, and other responsive tissues, such as the gastrointestinal tract, contain various opioid receptor types. Based on different pharmacological characteristics observed in both *in vitro* and *in vivo* studies, at least five major opioid receptor subtypes have been postulated: mu (Martin et al., 1976), kappa (Martin et al., 1976), delta Lord et al., 1977), sigma (Martin et al., 1976), and epsilon (Wuster et al., 1980, Wuster et al., 1981). The binding of opioid analgesics to these loci gives rise to their characteristic pharmacological profiles.:

μ receptors, mainly responsible for supraspinal analgesia, euphoria, respiratory depression and physical dependency;

κ receptors, mainly responsible for spinal analgesia, miosis, and sedation;

σ receptors, mainly responsible for dysphoria, hallucinations, respiratory stimulation, and various vasomotor effects; and

others such as δ receptors that illicit typical opioid responses but that have distinct ligand affinities and occur in the CNS as well as in smooth muscle (Jenkins, 1987).

Types of Receptors and the Effects They Mediate

	μ	κ	σ
Analgesia	supraspinal	spinal	—
Ventilation	—	—	slight —
Mental State	euphoria	sedation	dysphoria
Addiction	serious	minimal	none
Pupil	miosis	miosis	mydriasis
Respiration	±	no change	+
Heart Rate	—		+
T°	—		
Behaviour	indifference	sedation	delirium

Enkephalin, endorphin, and dynorphin are the three distinct opioid systems in the CNS (Hollt, 1986). High opioid receptor density is evident in the dorsal horn of the spinal cord and certain subcortical regions in the brain. Several brain opioid binding sites are concerned with nociception transmission (mesolimbic system): i.e., nucleus raphe magnus and locus ceruleus in the brain stem, midbrain periaqueductal gray area, and several

thalamic and hypothalamic nuclei. Opioid analgesics interacting with these receptors raise the discomfort threshold. Opioids also appear to inhibit the release of substance P centrally, which in turn, may be responsible for the depression of transmission of impulses in certain central relays (Jenkins, 1987).

Several neurochemical effects have been ascribed to opioid compounds (Frank, 1985). Among the most widely accepted are interference with calcium influx into select target neurons with resultant reduction of neurotransmitter release. This presynaptic inhibition of excitatory neurotransmitter release may involve acetylcholine, glutamic acid, norepinephrine, dopamine, 5-hydroxytryptamine (5-HT), and substance P, as well as other mediators. Opioids may also inhibit adenylate cyclase, thus lowering intracellular cyclic adenosine monophosphate values whereas amounts of cyclic guanosine monophosphate often increase concurrently.

Inferences have been drawn that attempt to relate pharmacological effects of opioid drugs to interactions with a particular constellation of receptors. For example, analgesia is thought to involve activation of μ receptors (largely at supraspinal sites) and κ receptors (principally within the spinal cord); δ receptors may also be involved, but the relative contribution of spinal and supraspinal sites is controversial. Moreover, a given opioid drug may interact to a variable extent with multiple types of receptors and act as an agonist, a partial agonist, or an antagonist at each (Martin, 1983). Present understanding of the detailed pharmacodynamic properties of opioid agonists and antagonists is in its infancy (Jaffe and Martin, 1992).

Even though the affinity of morphine for μ receptors is only about tenfold that for κ and δ receptors, it is likely that morphine and other morphine-like opioid agonists produce analgesia primarily through interaction with μ-opioid receptors. Consequences of μ-receptor activation include respiratory depression, miosis, reduced gastrointestinal motility, and feelings of well-being (euphoria).

Certain benzomorphan relatives of pentazocine interact quite selectively with κ receptors. These agonists produce analgesia that is undiminished in animals made tolerant to μ agonists and that results from actions primarily

in the spinal cord; they cause less intense miosis and respiratory depression than do μ agonists. Instead of euphoria, κ agonists produce dysphoric, psychotomimetic effects (disorientated and/or depersonalised feelings) (Pfeiffer et al., 1986).

The consequences of stimulating δ opioid receptors in man are uncertain because of the lack of selective agonists that can cross the blood-brain barrier. In animals, relatively specific δ agonists produce analgesia and positive reinforcing effects at supraspinal sites and antinociception for thermal stimuli at spinal sites (Heyman et al., 1988).

The consequences of the activation of μ and δ receptors are usually very similar or identical and are distinctly different from those resulting from activation of κ receptors. For example, stimulation of either μ (locus ceruleus neurons) or δ (enteric neurons) receptors can produce activation inwardly rectifying K+ channels and membrane hyperpolarisation. Both μ and δ agonists can also inhibit adenyl cyclase in many regions of the brain. By contrast, κ agonists have been found to influence Ca^{2+} channels; inhibition of voltage-dependent, dihydropyridine-insensitive (N-type) channels is produced in myenteric and dorsal root ganglion neurons (Jaffe and Martin, 1992).

When therapeutic doses of morphine are given to a presumably normal, pain-free human, the experience is not always pleasant. Nausea is common, and vomiting may also occur. There may be feelings of drowsiness, difficulty in mentation, apathy, and lessened physical activity (Jaffe and Martin, 1992).

The spinal intrathecal injection of opiate alkaloids and peptides in a variety of species including man produces powerful analgesia as defined by spinally and supraspinally mediated measures. The well defined pharmacological profile of these effects on spinal nociceptive processing and the analgesic threshold indicates a specific effect related to an action mediated by opiate receptors in the spinal cord. However, current evidence appears to exclude any notion that a single population of opioid receptors is responsible for the modulation of nociceptive stimuli at the spinal level. Moreover, it appears clear in a well defined model, that 'antinociception' or 'analgesia' is not a univariate phenomenon; different

stimuli reflect the activation of apparently unique *spinal* systems (Schmauss and Yaksh, 1984).

Morphine acts in the hypothalamus to inhibit the release of gonadotropin-releasing hormone (GnRH) and corticotropin-releasing factor (CRF), thus decreasing circulating concentrations of luteinizing hormone (LH), follicle-stimulating hormone (FSH), ACTH, and ß-endorphin: the last two peptides are usually released simultaneously by the pituitary. As a result of the decreased concentrations of pituitary trophic hormones, the concentrations of testosterone and cortisol in plasma decline (Grossman, 1988).

In addition to morphine, codeine, and the semisynthetic derivatives of the natural opium alkaloids, a number of other structurally distinct chemical classes of drugs have pharmacological actions similar to those of morphine. Among the important properties of the opioids that can be altered by structural modification are their affinity for various species of opioid receptors, agonistic versus antagonistic activity, lipid solubility, and resistance to metabolic breakdown.

Butorphanol is a synthetic opioid agonist/antagonist of the benzomorphan series with four to seven times the analgesic potency of morphine on a dose body weight basis. In a study of women undergoing abdominal surgery for hysterectomy, the efficacy of butophanol was found comparable to morphine as a preanaesthetic, and it displayed fewer unwanted side effects (Laffey and Kay, 1984). Compounds like butorphanol produce their responses by binding to opioid receptors, but they either exert no direct action, indicative of competitive antagonists, or they produce variable agonistic effects similar to other opioid agonists such as morphine. Unlike oxymorphone and many of the other opioid drugs, butorphanol is not a scheduled drug (Cornick and Hartsfield, 1992) and does not require documentation of usage for controlling agencies.

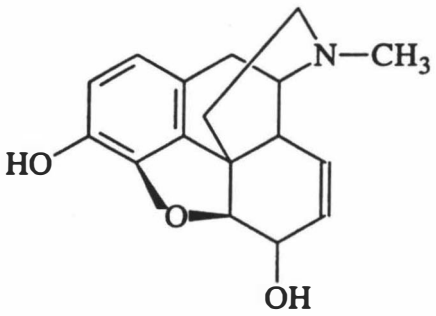
Butorphanol has no notable effect at μ receptors, which are responsible for analgesia, sedation, and depression of the cardiopulmonary system and body temperature (Jaffe and Martin, 1992); however, it does possess agonist activity at κ receptors, which are responsible for analgesia and sedation without depression of the cardiopulmonary system or body

temperature (Jaffe and Martin, 1992). Similarly, butorphanol has agonist activity at σ receptors, which are responsible for autonomic stimulation and dysphoria (Jaffe and Martin, 1992). Although butorphanol is reported to have no effect at the μ receptor, some antagonistic activity of unknown mechanism(s) has been observed (Hosgood, 1990).

Butorphanol can be administered intravenously (IV), intramuscularly (IM), subcutaneously (SC), or by mouth (PO). Action is immediate after IV administration (Jaffe and Martin, 1992) and absorption begins immediately after IM and SC administration (Pfeffer et al., 1980). It is distributed to all tissues, and the mean serum half-life is 1.62 hours Pfeffer et al., 1980). The drug is extensively metabolised by hydroxylation, dealkylation, and conjugation in the liver with <5% of a dose excreted unchanged (Heel et al., 1978). Free and conjugated metabolites are inactive. Excretion is primarily by glomerular filtration (Jaffe and Martin, 1992) with 50% excreted in the first 24 hours (Heel et al., 1978). Ten to 14% of a dose is excreted in the faeces (Heel et al., 1978).

Butorphanol has been used for restraint, as an agent for induction of anaesthesia, in combination with IM anaesthetics, and as an analgesic. Sedation with butorphanol alone is variable and of short duration (Trim, 1983). Trim (1983) has reported that in dogs, butorphanol given at the dose of 0.4 mg/kg IV induces sedation within three minutes. Further, Trim has suggested that sedation decreases after 30 minutes and is absent after 60 minutes.

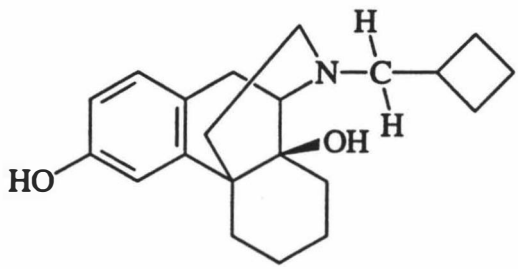
In cats and horses butorphanol induces better visceral than somatic analgesia (Kalpravidh et al., 1984a; Sawyer and Rech, 1987). Reports on the analgesic effects of butorphanol in dogs are limited. In cats, butorphanol given at the dosage of 0.8 mg/kg IV provided somatic analgesia for a mean duration of 118 ± 35 minutes (Sawyer and Rech, 1987). Visceral analgesia was achieved for 350 ± 10 minutes after IV administration at the dosage of 0.1 mg/kg. Although visceral analgesia in cats has been achieved after SC administration at the dosages of 0.1, 0.2, 0.4, and 0.8 mg/kg, maximal intensity and duration (298 ± 45 minutes) of analgesia via this route was observed with administration of 0.4 mg/kg (Sawyer and Rech, 1987).



Morphine

In dogs butorphanol induces few adverse effects (Heel et al., 1978; Trim, 1983); however, slight cardiopulmonary depression was observed in dogs given 0.4 mg/kg, IV. It is not recommended that butorphanol be administered to pregnant animals or animals with liver disease (Booth, 1988).

Butorphanol was designed by I.J. Pachter in 1972 to preserve the useful properties of morphine while eliminating its deficiencies. It was conceived as a member of the nalorphine-cyclazocine-cyclorphan class of narcotic antagonist-



Butorphanol

agonist drugs. These substances show potent analgesia with sedation, but minimal euphoria. Their chronic administration followed by deprivation does not lead to compulsive drug-seeking behaviour. Because of their dysphoric effects, the class has not been found useful in analgesic therapy. To minimise dysphoric properties butorphanol was designed to include the 14-hydroxy group characteristic of the pure narcotic antagonist, naloxone (Caruso et al., 1979).

Butorphanol has become a popular drug for clinical use because: 1) it is nonscheduled, 2) it can be administered by various routes, 3) it has a wide safety margin in a broad range of animal species, 4) it is considered to provide good analgesia and sedation, and 5) butorphanol is relatively

short-acting, therefore convenient for efficacious use in 'routine' procedures and it is easily 'topped up' for longer duration of effects when needed.

Butorphanol in Clinical Use

Few studies have evaluated the use of butorphanol in the dog. As a preanaesthetic agent, butorphanol reduced the amount of sodium thiamylal needed for anaesthesia, indicating that it's analgesic effect reduced the dose requirement of anaesthetic agents (Short et al., 1987). This was, in fact, the observation made in dogs anaesthetised with atropine and enflurane (Murphy and Hug, 1981). Changes in the minimum alveolar concentration for enflurane were used to determine the analgesic effects of butorphanol. Butorphanol given IV at dose levels of 0.1 and 0.3 mg/kg reduced the anaesthetic quantitative requirement by 11% and 16%, respectively (Murphy and Hug, 1981; Murphy and Hug, 1982).

The cardiovascular effects of butorphanol have been evaluated in both halothane (Greene et al., 1990) and isoflurane (Tyner et al., 1989) anaesthetised dogs. Butorphanol administration in isoflurane anaesthetised dogs caused significant reductions in mean, systolic, and diastolic arterial blood pressures; cardiac output; and rate-pressure product. Transient, but statistically significant decreases in heart rate, mean and diastolic arterial blood pressures, and rate-pressure product were observed after butorphanol administration in halothane anaesthetised dogs. Cardiac index, stroke volume, and systemic vascular resistance did not significantly change. Except for the decrease in heart rate, changes in the values of the cardiovascular variables measured after butorphanol administration did not appear to be clinically relevant (Greene et al., 1990).

Two papers have reported the dose-response of butorphanol to visceral nociceptive threshold in dogs. Both studies evaluated increasing doses of butorphanol using a colonic balloon for minimal threshold nociceptor stimulation. Because distention of the colon is considered to induce pain as the only subjective sensory consequence (Guyton, 1986), the dog's reaction was taken to be a nociceptive response. One study (Sawyer et al., 1991) administered butorphanol subcutaneously while the other

administered it intravenously (Houghton et al., 1991). Previous studies reported that IV administration may induce small decreases in heart rate and arterial blood pressure (Trim, 1983), while SC administration in the dog resulted in no significant changes in heart rate or arterial blood pressure (Raffe and Lipowitz, 1985).

In the SC administration study there was no significant difference in the duration of effect between the 0.4 mg/kg and the 0.8 mg/kg dosages, suggesting that there was not a clearly optimal dose, but rather a range between 0.2 mg/kg and 0.8 mg/kg; and the lack of an increase in duration of analgesia or sedation with higher dosages, compared with lower dosages suggested a ceiling influence. Bradycardia was evident at both low and high dosages, contrasting to the report of Raffe and Lipowitz (1985) who reported no significant changes in heart rate with butorphanol given SC. Many of the dogs continued to display some sedation beyond the point when analgesia was no longer demonstrated. This observation suggests that the degree of sedation should not be used as the sole factor in judging the presence of analgesia in dogs, because animals may appear to be slightly sedated without significant visceral analgesia. The relatively short duration (23 to 53 minutes) of visceral analgesia provided by the butorphanol for this cited study (Sawyer et al., 1991) is in contrast to the much longer duration of 169-350 minutes reported in cats (Sawyer and Rech, 1987). Differences may be attributable to more rapid metabolism in the dog or because of a possible species difference in the response pattern of kappa opioid receptors. Unlike the effects of butorphanol in cats, butorphanol in the dog appeared to act, in the dosages tested, in a manner similar to that found with μ opioid agonist analgesics (Jaffe and Martin, 1992). That is, the effects of higher dosages were of greater magnitude than lower dosages. If continuous analgesia is needed, results suggest that the effective dose be repeated after 45 to 60 minutes (Sawyer et al., 1991).

In the IV administration study the longest mean duration of antinociception occurred at the 0.4 mg/kg dose with a mean time of 38 ± 9 minutes, although one of the eight dogs demonstrated a 75 minute duration of antinociception at the 0.4 mg/kg dose of butorphanol. Arterial blood pressure and pulse rate did not vary at antinociceptive doses, and mild sedation was observed which generally lasted longer than the

antinociceptive effects at all doses. No discomfort or undesirable behavioural effects that directly related to intravenous administration of any dose of butorphanol was observed. As in the SC study, the degree of sedation did not correlate with the degree of antinociception. Contrasting the cat: the longest and greatest magnitude of analgesic effect induced by butorphanol in the cat has been shown to be 0.1 mg/kg *IV*, and 0.4 mg/kg *SC* (Sawyer and Rech, 1987).

Finally, although the analgesic effects of butorphanol are less pronounced than those of oxymorphone, use of butorphanol as part of a neuroleptanalgesic combination in the dog has been trialed and found efficacious with the potential advantage of decreased panting (Cornick and Hartsfield, 1992).

Butorphanol produces minimal cardiopulmonary effects in humans, dogs, and horses when administered in analgesic doses, although tachycardia persisting for up to one hour has been reported in ponies (Heel et al, 1978). Experimental observations in horses and ponies indicated that butorphanol was 10 to 17 times more potent than pentazocine on a dose-body weight basis in combating superficial and visceral pain (Kalpravidh et al., 1984b). The analgesic effects of butorphanol in horses are dose related, with IV dosage of 0.4 mg/kg producing significant relief from experimentally induced superficial pain for 30 minutes and from visceral pain for 90 minutes (Kalpravidh et al., 1984a). Peak relief was seen at 15 minutes. Experimental and clinical reports of analgesic effects in humans and ponies, however indicate that reduced dosages (0.22 mg/kg IV) can be used to produce visceral analgesia lasting for two to four hours (Reed and Bayly, 1980; Kalpravidh et al., 1984b). In the pony study (Kalpravidh et al., 1984b) butorphanol provided 60 minutes of analgesia from superficial nociceptor stimuli. Butorphanol was less effective than xylazine in increasing visceral pain threshold in ponies, but was more effective than morphine, levorphanol, and flunixin in comparative studies using a balloon-induced colic model (Kalpravidh et al., 1984b).

Butorphanol dosages in excess of 0.22 mg/kg IV are associated with an increased frequency of excitatory behaviour, shivering, and ataxia in horses and ponies (Robertson et al., 1981; Kalpravidh et al., 1984b). These increased motor activities might be induced by dopamine released

by morphine-like compounds, as reported in cats (Dhasmana et al., 1972). Dopamine is the immediate precursor of norepinephrine. In certain parts of the brain, catecholamine synthesis stops at dopamine and this amine is secreted as a synaptic transmitter. Many dopaminergic neurons have their cell bodies in the midbrain. They are localised in the nigrostriatal system, which is related to motor function (Ganong, 1994). Dose-related increases in motor activity and ataxia, lasting one to two hours, are reported in horses given butorphanol IV (Robertson et al., 1981; Kalpravidh et al., 1984a).

As a premedication in humans, butorphanol has demonstrated efficacy comparable to meperidine (Delpizzo, 1976). Administered IM postoperatively for pain relief, butorphanol demonstrated significant dose-related analgesic activity at doses of 2 mg and 4 mg with maximum pain relief provided approximately one hour after administration (Gilbert et al., 1976; Andrews, 1977). Following IV administration of butorphanol (2 mg) in humans analgesic activity was evident in one minute and peak analgesic activity was evident in four to five minutes. Substantial analgesic activity (patient analogue scale) persisted for one to four hours (DelPizzo, 1976; Lippmann et al., 1977).

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Appendix C

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Appendix E : (Chapter 4)

Processes for Determining Distinct Group Differences
From Noninteractive Hourly and Interactive Palpation Behaviours

Tables included within this appendix were used in the derivation of resultant data presented in the text of Chapter 4.

Low (2-6)	Medium (7-10_	High (>10)
		Normal speed position changes
		Normal speed cage circling
		Head lifts
	Thoracic limb weight shifts	
Torso weight shifts		
Stretching		
Escape behaviours		
Lip licking		
Whine		
Cage sniffing		
Grooming		
Bark		
Panting		

Table E1. Hourly behavioural frequencies for the nonsurgery groups (averaged occurrence per hour over the second through fifth hour after 'extubation') without reference to treatment.

0.3-0.5 (Low)	≥0.5 (High)
	Position Changes No
	End Position Stand
	Ear Position Back
	Eye Position Stare ahead
	Eye Position Watch
	Tail Position On surface
	Orientation Stare ahead
	Breathing Normal
Starting Position Lateral	
Starting Position Sternal	
Starting Position Sit	
Starting Position Stand	
End Position Lateral	
End Position Sternal	
Head Position Level	
Head Position Lowered	
Head Position Rest on surface	
Ear Position Neutral	
Tail Position Low	
Orientation Tester	
Other Arched back	

Table E2. Notable palpation behaviours with averaged frequencies ≥0.3 observed from 121-391 minutes for the nonsurgical groups.

SCC	Behaviour	*Order*	CS	Behaviour
1.68	End: sternal	*1*	0.35	Head: rest on surface
1.57	Start: lateral	*2*	0.34	Start: lateral
-1.53	Eyes: watch	*3*	-0.30	Eyes: watch
-1.26	Eyes: stare ahead	*4*	-0.22	Head: lowered
-1.06	End: lateral	*5*	0.20	End: lateral
-0.87	Start: sternal	*6*	0.19	Position change: no
0.86	Head: rest on surface	*7*	-0.19	Ears: neutral
0.80	End: sit	*8*	0.16	Eyes: stare ahead
0.75	End: stand	*9*	0.16	Orientation: stare ahead
-0.68	Ears: neutral	*10*	-0.16	Position change: yes
0.65	Tail: low	*11*	0.15	Eyes: sleepy
0.64	Other: lip licking	*12*	-0.15	Other: arched back
-0.53	Ears: back	*13*	0.14	Other: lip licking
-0.41	Tail: on surface	*14*	-0.13	End: stand
-0.39	Start: stand	*15*	-0.10	Start: sternal
-0.38	Position change: yes	*16*	-0.08	Start: stand
0.36	Orientation: stare ahead	*17*	-0.08	End: sternal
0.35	Head: level	*18*	0.06	Tail: on surface
-0.34	Position change: no	*19*	-0.06	Tail: low
0.26	Orientation: tester	*20*	-0.05	Orientation: tester
0.15	Tail: slow wag	*21*	-0.04	Start: sit
0.07	Other: arched back	*22*	-0.04	Ears: back
-0.06	Start: sit	*23*	0.02	Head: level
-0.05	Head: lowered	*24*	-0.02	Tail: slow wag
0.02	Eyes: sleepy	*25*	0.00	End: sit

Table E3. Canonical 1 ordering of both SCC and CS coefficients for palpation behaviours in the nonsurgical groups. SCC= Pooled within-class standardised canonical coefficients, CS= pooled within canonical structure correlations.

Rank	Behaviour
1	Start: lateral
2	Eyes: watch
3	Head: rest on surface
4	End: lateral
5	Eyes: stare ahead
6	Ears: neutral
7	End: sternal
8	Start: sternal
9	End: stand
10	Other: lip licking
10	Position change: no
11	Orientation: stare ahead
11	Position change: yes
12	Head: lowered
13	Tail: low
14	Start: stand
15	Tail: on surface
16	End: sit
17	Other: arched back
18	Ears: back
19	Eyes: sleepy
20	Orientation: tester
21	Head: level
22	Start: sit
23	Tail: slow wag

Table E4. Palpation behaviour ranking from the collation of ordering by SCC and CS coefficients (canonical 1).

SCC	Behaviour	*Order*	CS	Behaviour
-2.31	Tail: on surface	*1*	-0.38	Tail: slow wag
1.89	Eyes: stare ahead	*2*	-0.34	Other: arched back
1.53	Eyes: watch	*3*	0.30	End: lateral
0.96	End: lateral	*4*	0.30	Head: rest on surface
0.89	End: sit	*5*	0.28	Start: lateral
0.83	End: sternal	*6*	0.26	Tail: on surface
-0.80	Tail: slow wag	*7*	-0.21	End: stand
0.68	Position change: no	*8*	0.20	Eyes: sleepy
-0.64	End: stand	*9*	0.18	Eyes: stare ahead
-0.58	Tail: low	*10*	0.18	Position change: no
0.55	Head: lowered	*11*	0.18	Orientation: stare ahead
-0.53	Other: arched back	*12*	-0.12	Start: stand
0.43	Position change: yes	*13*	0.10	End: sternal
0.42	Head: rest on surface	*14*	-0.10	Position change: yes
-0.37	Start: lateral	*15*	-0.08	Ears: back
0.32	Orientation: tester	*16*	-0.08	Other: lip licking
-0.31	Other: lip licking	*17*	-0.07	Start: sit
-0.28	Start: sit	*18*	0.06	Start: sternal
0.26	Head: level	*19*	0.06	Ears: neutral
-0.22	Start: stand	*20*	0.05	End: sit
-0.17	Start: sternal	*21*	0.04	Orientation: tester
-0.14	Ears: back	*22*	0.03	Eyes: watch
0.13	Eyes: sleepy	*23*	0.03	Tail: low
0.68	Ears: neutral	*24*	0.02	Head: level
-0.01	Orientation: stare ahead	*25*	-0.02	Head: lowered

Table E5. Canonical 2 ordering of both SCC and CS coefficients for interactive palpation behaviours in the nonsurgical groups as used for the distinction of the Control group. SCC= Pooled within-class standardised canonical coefficients, CS= pooled within canonical structure correlations.

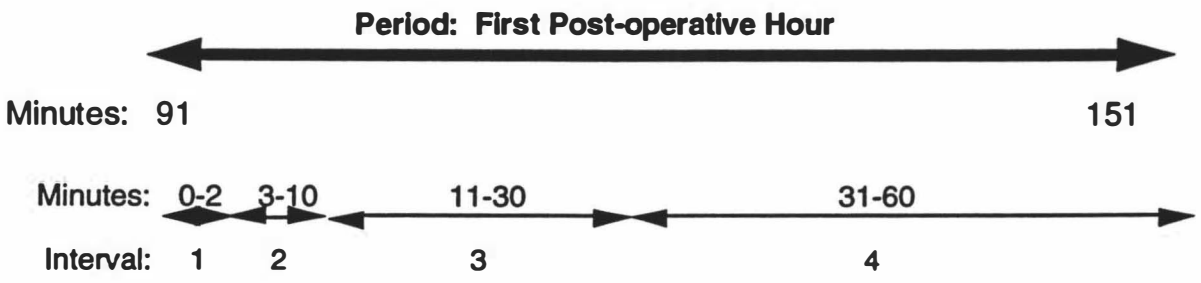
Appendix F

Behavioural Changes: Emphasis on Behaviour

Those data presented in Chapters 4 and 5 identified behaviours as they supported differences in treatments, noting characteristics of each treatment and then comparing treatments. The following presentation focuses on the behaviours with comparisons across treatments, but giving emphasis to the specific behaviour. The data is the same as that presented in Chapters 4 and 5; however, it is presented from a different perspective. (Reference Appendix B for a detailed description of the behaviour terms.)

Nonsurgery Treatments

Minute Behaviours



Those minute behaviours of more notable occurrence for the nonsurgery treatments were:

Low (2-6)	Medium (7-11)	High (>10)
		Number of position changes
		Normal speed position change
		Position ataxia
		Lip licking
		Normal speed cage circling
		Head lifts
	Torso weight shifts	
Awake		
Asleep		
Lateral		
Sternal other		
Thrashing		
Head nodding		
Cage sniffing		
Grooming		
Pacing		

Table 4.8. Low, Medium and High frequencies of minute behaviours in all of the nonsurgery treatments (ie, >2 occurrences during the first postoperative hour).

Number of position changes. The Control group showed greater frequency over the first hour (91-151 minutes) than any other group. Only the Anaesthesia and the Anaesthesia/Analgesia groups showed activity of this behaviour within the other non-Control treatments: Control>Anaesthesia> Anaesthesia/Analgesia ($P<0.05$). (Figure 4.7a & 4.7b)

Normal speed position changes. The Anaesthesia group showed a relatively high level of this activity. During the last interval of this hour ranked treatment activity was: Anaesthesia >>

Anaesthesia/Immediate Analgesia >Anaesthesia/Analgesia > Control ≈ Analgesia/Anaesthesia (Figure 4.7a & 4.7b). Summing frequencies of this behaviour over the four intervals for the first hour after 'extubation' yielded: Anaesthesia>>Control> Anaesthesia/Immediate Analgesia> Analgesia=Anaesthesia/Analgesia> Analgesia/Anaesthesia (Figure 4.6).

Ataxia. This behaviour was not seen in the Control treatment. While ataxia had a medium (6.4) occurrence within the Anaesthesia treatment, it was rare-to-low for the other groups. This behaviour was highest during the third interval of the hour for the Anaesthesia group. During the fourth interval of the hour the Anaesthesia, Anaesthesia/Analgesia and Anaesthesia/Immediate Analgesia groups showed low frequency while the Analgesia/Anaesthesia and the Analgesia groups showed rare frequency (Figure 4.6).

Lip licking. The Anaesthesia treatment resulted in a high total frequency of this behaviour during the hour after extubation: significantly greater ($P<0.05$) than the other treatments. Only the Control, Anaesthesia/Analgesia and Analgesia groups also showed this behaviour, hourly totals being in the bottom range of low (Figure 4.6, 4.7a and 4.7b)

Normal speed cage circling. Activity of this behaviour was significantly greater ($P<0.05$) for the Anaesthesia and the Analgesia/Anaesthesia groups than for any other treatment (Figure 4.8a & 4.8b). The lowest total frequency of this behaviour during the first 'post-extubation' hour was seen in the Anaesthesia/Analgesia treatment (Figure 4.6).

Head lifts. This behaviour was seen with high total frequency among all treatments (Figure 4.6). During the third interval of the hour the Control group showed medium frequency (7.2), nearly twice that of the next closest group (Analgesia/Anaesthesia at 4.0). During the fourth interval of the hour this behaviour was greater than 2 in all groups with a range of 10.3 (Analgesia/Anaesthesia)

to 2.5 (Analgesia), and in the following order: Analgesia/Anaesthesia > Anaesthesia/Analgesia> Control > Anaesthesia/Immediate Analgesia > Anaesthesia > Analgesia (Figure 4.8a & 4.8b). The Analgesia group showed the lowest total frequency among all the treatments (Figure 4.6).

Torso weight shifts. Only during the last interval of the hour did any of the groups show activity greater than 2 for this behaviour. During this last interval the Control group showed a frequency of 2.6 while the Anaesthesia group showed a frequency almost twice that value at 4.8 (Figure 4.7a & 4.7b).

Awake. Only the Control and the Analgesia groups showed this behaviour, and at the very low limits of low (2.10 and 2.40, respectfully) (Figure 4.6).

Asleep. Only those bitches given the combination of anaesthesic and analgesic showed relevant (>2.0, over the hour) frequencies of this behaviour (Figure 4.6), and among those groups activity was never greater than 1.0 during any of the four intervals (Figure F1).

Lateral, stationary. The most frequent occurrence was seen in the bitches receiving both anaesthetic and analgesic: Anaesthesia/Immediate Analgesia>Anaesthesia/Analgesia> Analgesia/Anaesthesia>Anaesthesia>Control>Analgesia (Figure 4.6); however, total occurrence for any treatment was still only low (Anaesthesia/I Analgesia=3.50). During the first three of the four intervals Anaesthesia/Immediate Analgesia and Anaesthesia/Analgesia showed the highest frequencies among all the groups, while Analgesia was the lowest. During the fourth interval of the hour all groups showed similar frequencies of this behaviour.

Sternal, other. Bitches in the Analgesia group showed a significantly higher ($P<0.05$) frequency of this behaviour than other groups, although total frequency over the hour period was low (2.3).

Thrashing. Total frequency over the hour was significantly higher ($P<0.05$) in the Anaesthesia group than in any other group (Figure 4.6).

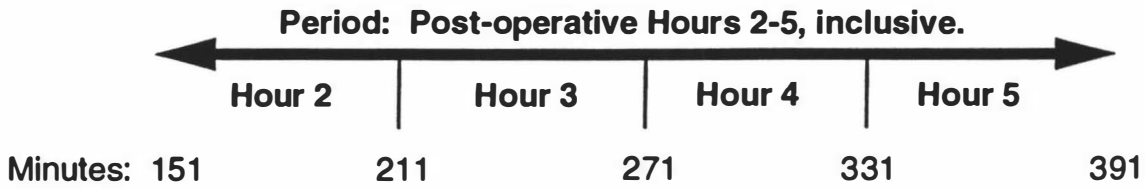
Head nodding. Total frequency over the hour was significantly higher ($P<0.05$) in the Anaesthesia group than in any other group (Figure 4.6). Most occurrences were in the early part of the postextubation hour (Figure F1).

Cage sniffing. This behaviour was rarely seen in any of the treatments. An exception was within the Anaesthesia group during the fourth interval of the hour when frequency rose to 3.2 (Figure 4.8a & 4.8b).

Grooming. This behaviour was seen with low total frequency in both the Control and the Anaesthesia groups; however, activity in these two groups was significantly greater ($P<0.05$) than in any of the other groups.

Pacing. This behaviour was rarely seen following any of the treatments. An exception was within the Anaesthesia group during the fourth interval of the hour when frequency rose to 3.0 (Figure 4.8a & 4.8b).

Hour Behaviours



The entire postoperative period thereby consisted of the combined minute and hourly behaviour periods.

Those hourly (noninteractive) behaviours of more notable occurrence for the nonsurgery treatments were:

Low (2-6)	Medium (7-10_	High (>10)
		Normal speed position changes
		Normal speed cage circling
		Head lifts
	Thoracic limb weight shifts	
Torso weight shifts		
Stretching		
Escape behaviours		
Lip licking		
Whine		
Cage sniffing		
Grooming		
Bark		
Panting		

Table E1. Hourly behaviour frequencies (averaged occurrence per hour over the second to sixth hour after 'extubation').

The only stationary behaviour appearing with an interval (1 hour period) frequency greater than 2 was hang stand. This behaviour was not seen in the Control group or in any of the other groups during the hour of observation on the day of admission (day 1). The hang stand behaviour was not seen in the Control or Anaesthesia groups on day 2. However, this behaviour was seen after the administration of analgesic and the combination of anaesthetic and analgesic, and in the following order of frequency over the postextubation period: Analgesia/Anaesthesia > Anaesthesia/ Analgesia > Anaesthesia/ Immediate Analgesia>Analgesia. During the postextubation period this behaviour showed little change in frequency within the Anaesthesia/Analgesia group, decreased in the Analgesia/Anaesthesia group and increased in the Anaesthesia/Immediate Analgesia group.

Normal speed position change. Both the Anaesthesia and the Control groups showed significantly greater ($P<0.05$) average frequency of this behaviour than any other group (Figure 4.9a & 4.9b). Over time, frequency decreased in both the Anaesthesia and the Analgesia/Anaesthesia groups (Figure F2).

Normal speed cage circle. The Control group showed rare activity of this behaviour. However, all groups given anaesthesic showed significantly greater ($P<0.05$) activity of this behaviour than those not administered anaesthesic. The following groups, all of which demonstrated a decrease in frequency over time, showed relative frequency as indicated: Anaesthesia/Analgesia > Anaesthesia/Immediate Analgesia > Analgesia/Anaesthesia > Anaesthesia (Figure 4.9a & 4.9b).

Head lifts. All groups showed a medium or high level of activity on the day of admission (day 1). After extubation all groups, excepting Anaesthesia/Immediate Analgesia, showed activity less than the Controls. During the second hour after extubation the Anaesthesia/Immediate Analgesia group showed a frequency similar to the Controls. During the last hour of observation (5th hour post-extubation) the order of frequency coincided with the time of analgesic administration in those treatments receiving butorphanol, ie. Control>Analgesia/Anaesthesia >

Anaesthesia/Immediate Analgesia > Anaesthesia/Anaesthesia (Figure 4.9a & 4.9b).

Thoracic limb weight shift. The Control, Anaesthesia and Analgesia groups rarely showed this behaviour. Average activity of this behaviour was significantly greater ($P<0.05$) in the treatments receiving both anaesthetic and analgesic than in those treatments not receiving both. Activity the second hour after extubation was rare (<2) in the treatments receiving both anaesthetic and analgesia, but activity increased thereafter (Figure 4.9a & 4.9b).

Torso weight shifts. Average frequency of this behaviour was significantly greater ($P<0.05$) for both the Control and the Anaesthesia groups than for the other groups.

Stretching. This behaviour occurred infrequently (low) among all groups excepting after the treatment of Anaesthesia/Analgesia, when it was lower, but not significantly.

Escape behaviour. This behaviour was significantly greater ($P<0.05$) in the Anaesthesia/Immediate Analgesia group than in any of the other groups, in which it was virtually unseen.

Lip licking. This behaviour was seen in all groups, but significantly more frequently ($P<0.05$) in the Anaesthesia and the Anaesthesia/Analgesia groups. It was highest in the Anaesthesia and Anaesthesia/Analgesia groups during the second postextubation hour. This behaviour decreased over time in all groups (Figure 4.10a & 4.10b).

Whine. This behaviour was very rarely seen in the Control group (<0.5 on day one, and <0.3 on the second post-extubation hour). All other groups showed activity greater than the Controls, although with frequencies still <5 per interval. An exception was the Anaesthesia/Immediate Analgesia group, where activity was significantly greater ($P<0.05$) than in any other group (Figure 4.10a & 4.10b).

Cage sniffing. This behaviour was present in each group, but it was significantly greater ($P<0.05$) in the Anaesthesia group, where it was low (average: 2.33 per interval). Activity of cage sniffing over any postextubation hourly period was less for each group than activity during the hour of cage introduction on day 1.

Grooming. All groups demonstrated this behaviour, but rarely, excepting the Control and the Anaesthesia group (Figure 4.10a & 4.10b). With time, a decrease in activity was seen in both groups.

Barking. Frequency of this behaviour varied within groups over the postextubation period; however, low frequencies were consistent in the Analgesia and the Anaesthesia/Analgesia group and high frequency was consistent in the Anaesthesia/Immediate Analgesia group, making this latter group significantly greater ($P<0.05$) in average frequency than all the others.

Panting. This behaviour was significantly greater ($P<0.05$) in the Anaesthesia/Immediate Analgesia group than in all other groups, where it was virtually not present (Figure 4.5). Panting was consistently maintained at approximately 2.4 over the last three hours of the period.

Palpation Behaviours

Period: Post-operative Hours 1-5, inclusive.

Minutes: 91 121 151 181 211 271 391

Those palpation (interactive) behaviours for nonsurgery treatments of more notable occurrence were:

Low (0.3-0.5)	High (>0.5)
	Position Changes No
	End Position Stand
	Ear Position Back
	Eye Position Stare ahead
	Eye Position Watch
	Tail Position On surface
	Orientation Stare ahead
	Breathing Normal
Starting Position Lateral	
Starting Position Sternal	
Starting Position Sit	
Starting Position Stand	
End Position Lateral	
End Position Sternal	
Head Position Level	
Head Position Lowered	
Head Position Rest on surface	
Ear Position Neutral	
Tail Position Low	
Orientation Tester	
Other Arched back	

Table E2. Palpation behaviours for all groups with frequencies ≥0.3.

Position Changes: Yes, and: No. Both of these observations show that in all groups position changes were infrequent (Figure 4.12).

End Position: Stand. All groups showed this behaviour. The Control group showed this behaviour with high frequency over the entire postoperative period, while the Anaesthesia/Analgesia and the Anaesthesia/Immediate Analgesia groups showed an increasing frequency over time (Figure 4.13).

Ear Position: Back. The Control and the Analgesia groups showed a significantly greater ($P<0.05$) averaged frequency of this behaviour than the other groups (Figure 4.14).

Eye Position: Stare ahead. All groups showed this behaviour with low to high frequency. Although there was wide variability in frequency of this behaviour within all the groups, the Control and the Anaesthesia groups showed significantly lower ($P<0.05$) averaged frequency of this behaviour than any of the other groups, all of which were administered analgesic (Figure 4.14).

Eye Position: Watch. All groups excepting Anaesthesia showed this behaviour, and with great variability between palpations. Within the Anaesthesia group frequency was maintained in the high range for all palpations, making this behaviour significantly higher ($P<0.05$) in the Anaesthesia group than in the other groups when averaged over all palpations (Figure 4.14).

Tail Position: On surface. All groups excepting Controls showed this behaviour with high frequency. The Control group showed a significantly lower ($P<0.05$) averaged frequency of this behaviour than the other groups (Figure 4.15). With time the Analgesia/Anaesthesia group showed a decrease in frequency of this behaviour while the Anaesthesia group showed an increase (Figure F3).

Orientation: Stare ahead. This behaviour was seen in all groups, and with low and high frequency. Both the Control and the Anaesthesia groups showed a low averaged frequency while the other groups showed a high averaged frequency (Figure 4.16). The averaged frequency in the Anaesthesia group was significantly lower ($P<0.05$) than in any group receiving both anaesthetic and analgesic (Figure

4.11 and 4.16). Over time a decreasing frequency of this behaviour was seen in both the Analgesia and the Anaesthesia/Immediate Analgesia groups.

Starting Position: Lateral. Average frequencies for the Anaesthesia/Analgesia and the Anaesthesia/Immediate Analgesia groups were significantly ($P<0.05$) greater than the other groups, both being in the low range (Figure 4.17). Both the Analgesia/Anaesthesia and the Anaesthesia/Immediate Analgesia groups showed decreasing frequencies over time (Figure F3).

Starting Position: Sternal. All groups showed this behaviour (Figure 4.12). While both the Anaesthesia/Analgesia and the Anaesthesia/Immediate Analgesia groups showed the lowest averaged frequency of this behaviour, the Analgesia group showed a significantly greater average frequency ($P<0.05$) than all other groups (Figure 4.11).

Starting Position: Sit. All groups showed this behaviour, and with wide variability, yet in the rare-to-low frequency range (Figure 4.12). Controls showed the highest averaged frequency of this behaviour, while the Analgesia group showed the lowest (Figure 4.11). The Anaesthesia group showed an increased frequency of this behaviour over time.

Starting Position: Stand. All groups showed this behaviour with wide variability, yet in the rare-to-low frequency range (Figure 4.12). Controls showed the highest averaged frequency of this behaviour while the Anaesthesia/Immediate Analgesia group showed the lowest (Figure 4.11). The Anaesthesia/Analgesia group showed an increased frequency of this behaviour with time.

End Position: Lateral. This behaviour was most rarely seen in the Control and Analgesia groups (Figure 4.13). Averaged frequency of this behaviour was significantly greater ($P<0.05$) in the Anaesthesia/Analgesia and the Anaesthesia/Immediate Analgesia groups (Figure 4.11). Over time a decrease in frequency was seen in the Anaesthesia/Analgesia group.

End Position: Sternal. This behaviour was rare for all groups excepting the treatment administered analgesic. This behaviour was significantly greater in averaged frequency ($P<0.05$) for the Analgesia group than for all other groups (Figure 4.11).

Head Position: Level. All groups showed this behaviour, and with an averaged frequency in the low range (Figures 4.11 and 4.13).

Head Position: Lowered. The Control and the Analgesia groups showed the highest average frequency of this behaviour while the Anaesthesia/Immediate Analgesia group showed the lowest (Figure 4.11). With time increases in frequency were seen in the Anaesthesia, Analgesia/Anaesthesia and Anaesthesia/Analgesia groups (Figure 4.13).

Head Position: Rest on surface. This behaviour was very rarely seen in the Control group (Figure 4.14). The Anaesthesia/Analgesia and the Anaesthesia/Immediate Analgesia groups showed significantly higher ($P<0.05$) averaged frequency of this behaviour than all the other groups.

Ear Position: Neutral. Low averaged frequency of this behaviour was seen in both the Anaesthesia and the Anaesthesia/Analgesia groups, while all other groups showed rare averaged frequency (Figure 4.11 and 4.14).

Tail Position: Low. All groups showed this behaviour in the high-rare to bottom-low averaged frequency range (Figure 4.11). The Anaesthesia/Immediate Analgesia group showed the lowest averaged frequency of all groups.

Orientation: Tester. All groups showed this behaviour and with considerable variability (Figure 4.16). The Anaesthesia group showed a significantly greater ($P<0.05$) averaged frequency of this behaviour than all other groups (Figure 4.11)

Other: Arched back. The Control and the Anaesthesia groups showed a significantly greater ($P<0.05$) averaged frequency of this

behaviour than all other groups (Figure 4.11). Averaged frequency in the Control group (low) was greater than in the Anaesthesia group (rare).

Surgery Treatments

Minute Behaviours

Those minute behaviours of more notable occurrence for the surgery treatments were:

2-6 (Low)	7-10 (Medium)	>10 (High)
		Head lifts
		Whine
		Groan/moan
		Number of position changes
		Lip licking
		Normal speed position changes
		Draws legs up
		Stretching
	Torso weight shifts	
	Ataxia	
	Normal speed cage circling	
	Paddling	
Awake		
Lateral position		
Sternal other		
Head nodding		
Increased thoracic limb weight bearing		
Slow speed position changes		
Cage sniffing		
Grooming		
Thrashing		
Look back		
Pant		
Walking		

Table 5.13 Notable minute behavioural frequencies (total >2 from 91-151 minutes) for the surgery groups.

Head lifts. All groups showed a total frequency of this behaviour in the high range (Figure 5.12). The lowest frequency among the groups was seen in the Anaesthesia/Surgery group.

Whine. Totalled whining in the Control group was significantly less ($P<0.05$) than in the other groups (Figures 5.15a & 5.15b). Over the hour of observation group frequencies were Consistent between intervals:
Anaesthesia/Surgery/Analgesia>Analgesia/Anaesthesia/Surgery>
Anaesthesia/Surgery>>Control.

Groan/moan. This behaviour was not seen in the Control group, and was rarely seen in the Anaesthesia/Surgery group (Figures 5.15a & 5.15b). Totalled groaning/moaning was significantly higher ($P<0.05$) in the Analgesia/Anaesthesia/Surgery and the Anaesthesia/Surgery/Analgesia groups than in the Control and Anaesthesia/Surgery groups (Figure 5.12).

Number of position changes. The Anaesthesia/Surgery group showed a significantly greater ($P<0.05$) totalled frequency than all other groups (Figure 5.12). Totalled frequencies ranked by treatment were: Anaesthesia/Surgery>>Control>
Analgesia/Anaesthesia/Surgery>Anaesthesia/Surgery/Analgesia.

Lip licking. During the first two intervals of the post-extubation hour lip licking was virtually unseen in either of the groups administered analgesic; however, it was seen in both the Control and Anaesthesia/Surgery groups (Figures 5.14a & 5.14b). The total frequency of this behaviour over the hour was significantly greater ($P<0.05$) in the Anaesthesia/Surgery group than in all other groups.

Normal speed position changes. Total activity of this behaviour over the hour was significantly lower ($P<0.05$) than Controls in the Anaesthesia/Surgery and Analgesia/Anaesthesia/Surgery groups, but significantly higher than Controls ($P<0.05$) in the Anaesthesia/Surgery/Analgesia group.

Drawing legs up. This behaviour was virtually unseen in the Controls (Figures 5.15a & 5.15b). Total frequency in all surgery groups was significantly greater ($P<0.05$) than Controls, and total frequency of the Anaesthesia/Surgery group was significantly greater ($P<0.05$) than the surgery groups not receiving analgesic.

Stretching. Rare-to-low total frequency of this behaviour over the observation period was seen in all the groups excepting Anaesthesia/Surgery/Analgesia (Figure 5.12). Total frequency in the Anaesthesia/Surgery/Analgesia group was high and was significantly greater ($P<0.05$) than all other groups. Total frequency of this behaviour was lowest in the Controls.

Torso weight shifts. Most all of the surgery groups showed activity equal to or greater than activity of the Control group (Figures 5.13a & 5.13b). Total frequency of this behaviour in the Analgesia/Anaesthesia/Surgery group was approximately twice that of any other group (Figure 5.12).

Ataxia. The Control group did not demonstrate this behaviour while all the surgery groups did, spanning the medium frequency range over the hour (Figure 5.4).

Normal speed cage circling. This behaviour was common to all groups (Figures 5.14a & 5.14b), and was seen within the low or medium total frequency range (Figure 5.12). Controls showed the lowest frequency.

Paddling. Paddling was virtually unseen in any group other than the Anaesthesia/Surgery/Analgesia group (Figures 5.15a & 5.15b), in which the frequency was significantly greater ($P<0.05$) than in any other group.

Awake. All groups showed similar frequencies over the hour period; low-to-rare (Figure 5.12).

Lateral position. All groups showed similar frequencies over the hour period; low-to-rare (Figure 5.12), however, frequencies were lowest in the Control group.

Sternal other. All groups showed similar frequencies over the hour period; low-to-rare (Figure 5.12).

Head nodding. Total activity in the Anaesthesia/Surgery group was significantly greater ($P<0.05$) than in all other groups, where total activity was virtually unseen (Figure 5.12).

Slow speed position change. This behaviour was seen in all the surgery groups, and with similar frequencies: rare-to-low (Figure 5.12); however, this behaviour was not seen in the Control group.

Grooming. Grooming was seen in only two groups: Control and Anaesthesia/Surgery (Figures 515a & 5.15b), where frequencies were similar: low (Figure 5.12).

Thrashing. This behaviour was not seen in the Controls (Figures 5.14a & 5.14b), seen with rare total frequency in the Anaesthesia/Surgery group, and seen with low frequency in both the Analgesia/Anaesthesia/Surgery and the Anaesthesia/Surgery/Analgesia groups (Figure 5.12).

Look back. This behaviour was also virtually unseen in the Control group (Figures 5.15a & 5.15b). Frequency of this behaviour was significantly greater ($P<0.05$) in the Anaesthesia/Surgery group than in any other group (Figure 5.12).

Pant. Panting was observed in low frequency (2-6) for the Anaesthesia/Surgery/Analgesia and Analgesia/Anaesthesia/Surgery groups, being even lower in the Controls and Anaesthesia/Surgery group (Figure 5.12).

Walking. This behaviour was virtually unseen in all groups excepting Anaesthesia/Surgery/Analgesia (Figures 5.14a & 5.14b), where

frequency over the hour was significantly greater than in all other groups (Figure 5.12).

Hour Behaviours

Those hourly (noninteractive) behaviours of more notable occurrence for the surgery treatments were:

2-6 (Low)	7-10 (Medium)	>10 (High)
		Head lifts
		Normal speed position change
	Slow motion position change	
	Slow motion position change	
	Drawing legs up	
Grooming		
Panting		
Hang stand		
Ataxia		
Whine		
Groan/moan		
Stretching		
Normal speed cage circling		
Lip licking		
Torso weight shifts		
Thoracic limb weight shift		

Table 5.15 Hourly behavioural frequencies that occurred as low, medium or high without regard to (surgical) treatment.

Within the stationary behaviours, the only behaviour appearing with a frequency greater than 2 was hang stand. This behaviour was not seen in the Control group or in any of the other groups during the hour of observation on the day of admission. However, the hang stand position was expressed postoperatively by all three surgery groups and in the

following order: Anaesthesia/Surgery/Analgesia >> Anaesthesia/Analgesia ≈ Analgesia/Anaesthesia.

Head lifts. While this behaviour occurred with medium frequency in the Anaesthesia/Surgery/Analgesia group, it occurred with high frequency in all other groups (Figure 5.4). With time there was a decrease in this behaviour within both the Anaesthesia/Surgery and the Anaesthesia/Surgery/Analgesia groups (Figures 5.17a & 5.17b).

Normal speed position change. There was substantial variability (range 13-55) among the groups on the day of admission. However, this variability was reduced (range 4-14) during the postoperative period (Figures 5.16a & 5.16b). There was significantly greater ($P<0.05$) frequency of this behaviour in the Controls than in any of the other groups. With time there was a decrease in frequency of this behaviour in the Anaesthesia/Surgery group.

Slow motion position change. This behaviour was virtually unseen in the Controls (Figures 5.16a & 5.16b). The frequency of this behaviour in the Anaesthesia/Surgery treatment was significantly greater ($P<0.05$) than in all other treatments (Figure 5.4).

Draws legs up. This behaviour very rarely appeared in the Control group, but occurred with low and medium frequency in the surgery groups (Figures 5.16a & 5.16b). Occurrence in the Anaesthesia/Surgery group was significantly greater ($P<0.05$) than in any other group (Figure 5.4). While frequency decreased over time in both the Analgesia/Anaesthesia/Surgery and the Anaesthesia/Surgery/Analgesia groups, a high-medium frequency was maintained in the Anaesthesia/Surgery group.

Grooming. This behaviour was seen with similar frequency in the Control and Anaesthesia/Surgery groups, where frequencies were significantly greater ($P<0.05$) than in the Analgesia/Anaesthesia/Surgery and the Anaesthesia/Surgery/Analgesia groups (Figure 5.4).

Panting. On the day of admission a wide variability (0-12) in this behaviour was seen. After extubation only the Analgesia/Anaesthesia/Surgery group showed this behaviour (low frequency), and with an averaged frequency significantly greater ($P<0.05$) than all other groups. (Figures 5.17a & 5.17b)

Hang stand. This behaviour was virtually unseen in the Control group. With time the Anaesthesia/Surgery/Analgesia group maintained a constant low frequency of 'hang stand' which was significantly greater ($P<0.05$) than all other group (Figure 5.4).

Ataxia. This behaviour was not seen in the Control group (Figures 5.17a & 5.17b). Ataxia was significantly lower in frequency for the Analgesia/Anaesthesia/Surgery group than for the other surgery groups (Figure 5.4).

Whine. Whining was significantly lower ($P<0.05$) in frequency for the Controls than for any of the surgery groups (Figure 5.4). For all three of the surgery groups this behaviour decreased over time (Figures 5.17a & 5.17b).

Stretching. Stretching occurred with low frequency in all of the groups (Figure 5.4). For the second and third hours post-extubation this behaviour was highest in the postoperative analgesia group (Figures 5.16a & 5.16b), and over time decreases in frequency of this behaviour were seen in both the Anaesthesia/Surgery/Analgesia and the Anaesthesia/Surgery groups.

Normal speed cage circle. All the surgery groups showed a frequency greater than the Controls, and the postoperative analgesia group showed less occurrence than the other surgery groups (Figures 5.16a & 5.16b). Frequency for the Controls was significantly less ($P<0.05$) than for the other groups (Figure 5.4). With time frequency of this behaviour was sustained in the Anaesthesia/Surgery group while it decreased in the Analgesia/Anaesthesia/Surgery group.

Lip licking. This behaviour was seen with rare frequency in Control bitches, but with low frequency in the surgery groups (Figures 5.17a & 5.17b). Frequency was significantly lower ($P<0.05$) in the Control and significantly higher ($P<0.05$) in the Anaesthesia/Surgery group than in all other groups, respectively. With time decreases in frequency were seen in both the Anaesthesia/Surgery and the Anaesthesia/Surgery/Analgesia groups.

Torso weight shifts. All groups showed this behaviour and with low frequency (Figure 5.4). Comparing frequencies: Anaesthesia/Surgery > Analgesia/Anaesthesia/Surgery > Control > Anaesthesia/Surgery/Analgesia.

Thoracic limb weight shifts. The Control group showed infrequent occurrence of this behaviour (Figures 5.16a & 5.16b). Frequency of activity was significantly greater ($P<0.05$) than Controls in both the Anaesthesia/Surgery and the Anaesthesia/Surgery/Analgesia groups, and over time there was an increase in frequency within the Anaesthesia/Surgery group.

Palpation Behaviours

Those palpation (interactive) behaviours of more notable occurrence for surgery treatments were:

Low (0.3-0.5)	High (≥0.5)
	Starting Position Lateral
	Position Changes No
	End Position Stand
	Ear Position Back
	Eye Position Stare ahead
	Tail Position On surface
	Orientation Stare ahead
	Breathing Normal
Starting Position Sternal	
Starting Position Sit	
Starting Position Stand	
End Position Sternal	
Head Position Level	
Head Position Lowered	
Ear Position Neutral	
Eye Position Watch	
Tail Position Low	
Vocalisation Whine	
Orientation Tester	
Other Arched back	

Table 5.20 Notable palpation behaviours with frequencies ≥0.3 observed from 121-391 minutes for the surgery groups.

Starting Position: Lateral. All groups showed a frequency in the rare range (Figure 5.9), with Controls showing the lowest frequency. Frequency in the Anaesthesia/Surgery/Analgesia treatment was consistently higher for all palpations, although this frequency decreased over time (Figure 5.19).

Position Changes: Yes, and: No. Both of these observations show that in all groups position changes over the palpation periods were infrequent. This was least true in the Control group (Figure 5.19).

End Position: Stand. All groups showed this behaviour (Figure 5.19). Frequency in both the Control and the Analgesia/Anaesthesia/Surgery groups were significantly greater ($P<0.05$) than in the Anaesthesia/Surgery or the Anaesthesia/Surgery/Analgesia group (Figure 5.9). With time both the Analgesia/Anaesthesia/Surgery and the Anaesthesia/Surgery/Analgesia groups showed increasing frequency of this behaviour.

Ear Position: Back. This behaviour was seen in all groups: however, the Control group tended to show the higher frequencies. All three surgery groups revealed increasing frequency over time, while the Control group showed a decreasing frequency (Figure 5.20).

Eye Position: Stare ahead. All groups excepting Analgesia/Anaesthesia/Surgery showed low frequency of this behaviour (Figure 5.9). The Analgesia/Anaesthesia/Surgery group showed a significantly greater ($P<0.05$) frequency than the other groups. With time the Anaesthesia/Surgery bitches demonstrated an increase in this behaviour (Figure 5.20).

Tail Position: On surface. All groups displayed this behaviour (Figure 5.21). Frequency was low for the Control and Analgesia/Anaesthesia/Surgery groups, and high for the Anaesthesia/Surgery and Anaesthesia/Surgery/Analgesia groups (Figure 5.9). With time, this behaviour decreased in frequency in the Anaesthesia/Surgery/Analgesia bitches, but remained at a constant high frequency within the Anaesthesia/Surgery group.

Orientation: Stare ahead. This behaviour was seen in all groups and with great variability (Figure 5.21). Frequency was low for the Control and Anaesthesia/Surgery/Analgesia groups and high for the Anaesthesia/Surgery and Analgesia/Anaesthesia/Surgery groups (Figure 5.9).

Breathing: Normal. All groups showed this behaviour, and with high frequency (Figure 5.21).

Starting Position: Sternal. All groups displayed this behaviour. During the observation periods the Anaesthesia/Surgery bitches demonstrated this behaviour with the greatest frequency (Figure 5.19), although frequency of this behaviour decreased over time in these bitches.

Starting Position: Sit. This behaviour was seen with rare frequency in all groups excepting Controls, in which it was seen in low frequency (Figure 5.19). Frequency in the Anaesthesia/Surgery/Analgesia bitches was significantly lower ($P<0.05$) than in the other groups (Figure 5.9).

Starting Position: Stand. All groups displayed this behaviour. Controls and the Analgesia/Anaesthesia/Surgery group displayed greater frequency of this behaviour than the Anaesthesia/Surgery/Analgesia and the Anaesthesia/Surgery bitches. With time the Anaesthesia/Surgery/Analgesia group showed an increase in frequency of this behaviour (Figure 5.19).

End Position: Sternal. This behaviour was least seen in the Control bitches (Figure 5.19). The Anaesthesia/Surgery group showed this behaviour with significantly greater ($P<0.05$) frequency than any other group (Figure 5.9). With time a decrease in frequency of this behaviour was seen in both the Anaesthesia/Surgery and the Anaesthesia/Surgery/Analgesia groups.

Head Position: Level. All groups showed this behaviour. Although there was little difference among the groups, the Control bitches tended to show the highest frequency (Figure 5.20). With time this behaviour decreased in frequency within the Analgesia/Anaesthesia/Surgery group.

Head Position: Lowered. There was considerable variability in this behaviour among the groups, although frequency was consistently higher in the Controls (Figure 5.20). Frequency of this behaviour was significantly lower ($P<0.05$) in the Anaesthesia/Surgery/Analgesia bitches (Figure 5.9).

Ear Position: Neutral. This behaviour was least frequently seen in the Anaesthesia/Surgery/Analgesia bitches. It was expressed more frequently (low frequency) in both the Analgesia/Anaesthesia/Surgery and the Anaesthesia/Surgery groups than in the Control group (Figure 5.20).

Eye Position: Watch. All groups displayed this behaviour, and with considerable variability. The Analgesia/Anaesthesia/Surgery bitches showed a significantly lower ($P<0.05$) frequency of this behaviour than the other groups (Figure 5.9), and within this group frequency of occurrence increased markedly over the 5th hour after extubation (Figure 5.20).

Tail Position: Low. This behaviour was seen in all groups, and with marked variability (Figure 5.9). The lowest frequency was seen in the Anaesthesia/Surgery bitches and the highest frequency was seen in the Analgesia/Anaesthesia/Surgery bitches (Figure 5.9).

Vocalisation: Whine. This behaviour was not seen in the Control bitches (Figure 5.21). Frequency of this behaviour was significantly greater ($P<0.05$) in the Anaesthesia/Surgery/Analgesia bitches than in the other groups (Figure 5.9). A high frequency of this behaviour was sustained in the Anaesthesia/Surgery/Analgesia bitches over the first four palpation periods.

Orientation: Tester. All groups showed this behaviour, and with large variability (Figure 5.21).

Other: Arched back. All surgery groups displayed this behaviour as rare (Figure 5.9). In contrast, the Controls showed a significantly greater ($P<0.05$) frequency of this behaviour (low range).

Appendix G: (Chapter 5)

Processes for Determining Distinct Group Differences From Noninteractive Hourly and Interactive Palpation Behaviours

Tables included within this appendix were used in the derivation of resultant data presented in the text of Chapter 5.

SCC	Behaviour	*Order*	CS	Behaviour
2.24	Slow motion position change	1	0.86	Slow motion position change
1.4	Hang stand	2	0.6	Draws legs up
1.34	Draws legs up	3	0.48	Hang stand
-0.71	Stretching	4	-0.44	Normal speed position change
0.62	Normal speed cage circling	5	0.39	Thoracic limb weight shift
-0.48	Head lifts	6	0.34	Lip licking
-0.35	Ataxia	7	-0.25	Cage sniffing
-0.28	Cage sniffing	8	0.24	Torso weight shift
0.26	Panting	9	0.22	Whine
-0.26	Grooming	10	0.2	Ataxia
-0.24	Normal speed position change	11	-0.18	Bark
0.18	Torso weight shift	12	-0.14	Grooming
-0.17	Whine	13	0.11	Normal speed cage circling
-0.12	Lip licking	14	0.1	Head lifts
-0.05	Thoracic limb weight shift	15	0.08	Panting
0	Bark	16	0.03	Stretching

Table G1. Ordering of hourly behaviours in the Anaesthesia, Anaesthesia/Surgery and Control groups by canonical 1 SCC and CS coefficients. SCC = Pooled within-class standardised canonical coefficients, CS = pooled within canonical structure correlations.

SCC	Behaviour	*Order*	CS	Behaviour
1.29	Draws legs up	*1*	0.59	Draws legs up
-1.04	Head lifts	*2*	0.52	Slow motion position change
0.8	Stretching	*3*	-0.52	Grooming
-0.65	Normal speed position change	*4*	-0.43	Cage sniffing
0.64	Panting	*5*	0.38	Stretching
0.63	Slow motion position change	*6*	0.35	Panting
-0.38	Cage sniffing	*7*	-0.3	Normal speed position change
-0.26	Grooming	*8*	0.28	Whine
-0.24	Whine	*9*	0.24	Normal speed cage circle
0.21	Normal speed cage circle	*10*	-0.21	Head lifts
-0.15	Lip licking	*11*	0.19	Lip licking
-0.13	Hang stand	*12*	0.16	Bark
-0.09	Thoracic limb weight shift	*13*	0.14	Hang stand
0.08	Torso weight shift	*14*	0.09	Torso weight shift
-0.07	Ataxia	*15*	0.08	Ataxia
-0.04	Bark	*16*	0.02	Thoracic limb weight shift

Table G2. Ordering of hourly behaviours in the Analgesia/Anaesthesia, Analgesia/Anaesthesia/Surgery and Control groups by canonical 1 SCC and CS coefficients. SCC = Pooled within-class standardised canonical coefficients, CS = pooled within canonical structure correlations.

SCC	Behaviour	*Order*	CS	Behaviour
-1.65	Normal speed cage circle	1	0.6	Draws legs up
1.07	Ataxia	2	-0.56	Normal speed cage circle
1	Lip licking	3	0.52	Stretching
0.77	Draws legs up	4	0.5	Torso weight shift
-0.71	Panting	5	0.35	Slow motion position change
0.67	Normal speed position change	6	0.34	Head lifts
0.58	Hang stand	7	-0.14	Lip licking
0.39	Grooming	8	0.14	Normal speed position change
-0.36	Thoracic limb weight shift	9	-0.13	Thoracic limb weight shift
0.28	Stretching	10	-0.11	Panting
0.23	Head lifts	11	0.07	Hang stand
0.22	Torso weight shift	12	0.07	Grooming
0.19	Slow motion position change	13	-0.05	Cage sniffing
0.18	Whine	14	0.01	Ataxia
-0.09	Bark	15	0.01	Whine
-0.09	Cage sniffing	16	0	Bark

Table G3. Ordering of hourly behaviours in the Anaesthesia/Analgesia, Anaesthesia/Surgery/Analgesia and Control groups by canonical 1 SCC and CS coefficients. SCC = Pooled within-class standardised canonical coefficients, CS = pooled within canonical structure correlations.

SCC	Behaviour	*Order*	CS	Behaviour
14.67	End: stand	1	0.33	Eye position: watch
6.87	Eye position: watch	2	0.3	Tail: slow wag
-5.57	Start: stand	3	0.29	End: lateral
4.66	End: sternal	4	-0.23	Vocal: whine
4.37	End: sit	5	0.22	Head: level
-4.11	Head: high	6	-0.2	Orient: stare ahead
-3.79	Head: lowered	7	0.19	Tail: low
-3.55	Other: lip licking	8	-0.19	Start: sternal
-3.01	Tail: low	9	-0.18	Eyes: stare ahead
2.72	Eyes: stare ahead	10	-0.18	Position change: no
2.58	Other: arched back	11	0.18	Ears: neutral
2.5	End: lateral	12	0.18	Orient: tester
2.48	Eyes: sleepy/lidded	13	-0.18	Start: sit
1.69	Orient: stare ahead	14	-0.17	End: sternal
-1.51	Vocal: whine	15	-0.15	Head: high
1.36	Position change: no	16	-0.15	Ears: back
-1.19	Start: sternal	17	0.14	Position change: yes
-1.08	Tail: slow wag	18	0.13	End: stand
1.07	Position change: yes	19	-0.12	Other: arched back
-0.87	Ears: neutral	20	0.11	Head: lowered
-0.85	Head: rest on surface	21	0.09	Start: lateral
-0.72	Head: level	22	0.08	Start: stand
0.71	Ears: back	23	-0.08	Head: rest on surface
-0.34	Start: lateral	24	-0.04	Other: lip licking
-0.34	Orient: tester	25	0.02	End: sit
0.18	Tail: on surface	26	0.01	Eyes: sleepy/lidded
-0.11	Start: sit	27	-0.01	Tail: on surface

Table G4. Ordering of palpation behaviours in the Anaesthesia, Anaesthesia/Surgery and Control treatments by canonical 2 SCC and CS coefficients. SCC = Pooled within-class standardised canonical coefficients, CS= pooled within canonical structure correlations.

SCC	Behaviour	*Order*	CS	Behaviour
-41.54	End: lateral	1	0.6	Vocal: whine
31.07	Start: lateral	2	-0.27	Head: rest on surface
19.19	Position change: no	3	0.26	Head: high
-15.73	Start: Stand	4	-0.26	Start: sit
-12.32	Tail: low	5	-0.22	Orient: stare ahead
12.25	Eye position: watch	6	-0.21	End: lateral
11.35	Head: level	7	-0.2	Ears: neutral
-11.04	Orient: tester	8	-0.18	Eyes: stare ahead
10.42	Eyes: stare ahead	9	0.18	End: sternal
-10.02	End: sternal	10	0.18	Start: sternal
-9.84	Tail: on surface	11	0.17	Other: lip licking
-9.38	End: sit	12	-0.14	Position change: yes
8.67	Position change: yes	13	-0.14	Head: lowered
-6.69	End: stand	14	-0.12	Start: lateral
5.61	Other: lip licking	15	-0.11	Orient: tester
-5.43	Orient: stare ahead	16	-0.08	Tail: on surface
4.93	Vocal: whine	17	-0.07	Tail: low
4.82	Tail: slow wag	18	-0.06	Tail: slow wag
3.42	Head: lowered	19	0.05	Position change: no
-3.16	Ears: neutral	20	-0.05	Head: level
2.56	Head: rest on surface	21	-0.05	Ears: back
2.26	Ears: back	22	0.04	Start: Stand
-1.1	Start: sternal	23	-0.03	End: stand
0.96	Head: high	24	0.03	Other: arched back
-0.33	Start: sit	25	0.02	Eye position: watch
0.32	Eye: sleepy/lidded	26	0.02	Eye: sleepy/lidded
0.03	Other: arched back	27	-0.01	End: sit

Table G5. Ordering of palpation behaviours in the Anaesthesia/Analgesia, Anaesthesia/Surgery/Analgesia and Control treatments by canonical 1 SCC and CS coefficients. SCC = Pooled within-class standardised canonical coefficients, CS= pooled within canonical structure correlations.

SCC	Behaviour	*Order*	CS	Behaviour
205.98	End: stand	1	-0.36	Eyes: stare ahead
-160.9	Position change: no	2	-0.35	Vocal: whine
141.2	End: sternal	3	0.28	Eye position: watch
-115.4	Position change: yes	4	0.28	Tail: slow wag
106.29	End: lateral	5	0.28	Head: high
99.37	End: sit	6	0.24	Ears: back
-65.69	Start: lateral	7	-0.23	Tail: low
-50.87	Start: sternal	8	-0.23	Eyes: sleepy/lidded
-39.14	Start: sit	9	0.21	Start: sit
-31.75	Start: stand	10	0.21	Other: lip licking
-29.7	Tail: low	11	-0.19	Head: rest on surface
28.09	Head: rest on surface	12	-0.18	Position change: no
25.49	Eye position: watch	13	-0.17	Head: level
-22.97	Vocal: whine	14	0.15	Other: arched back
-18.45	Ears: back	15	-0.12	End: lateral
17.7	Head: level	16	0.12	End: sit
17.16	Tail: on surface	17	-0.12	Ears: neutral
-15.57	Tail: slow wag	18	-0.12	Orient: stare ahead
-15.49	Head: high	19	-0.09	End: sternal
14.51	Other: lip licking	20	-0.08	Start: lateral
-11.09	Ears: neutral	21	-0.08	Start: sternal
10.57	Orient: stare ahead	22	0.06	Position change: yes
8.55	Other: arched back	23	-0.06	Start: stand
6.42	Orientation: tester	24	0.05	Tail: on surface
-5.72	Head: lowered	25	-0.03	End: stand
2.76	Eyes: sleepy/lidded	26	-0.01	Orientation: tester
-2.75	Eyes: stare ahead	27	-0.01	Head: lowered

Table G6. Ordering of palpation behaviours in the Analgesia/Anaesthesia, Analgesia/Anaesthesia/Surgery and Control treatments by canonical 1 SCC and CS coefficients. SCC = Pooled within-class standardised canonical coefficients, CS= pooled within canonical structure correlations.

SCC	Behaviour	*Order*	CS	Behaviour
1.13	Slow motion position change	*1*	0.7	Slow motion position change
-0.67	Stretching	*2*	0.29	Draws legs up
0.63	Draws legs up	*3*	0.23	Lip licking
-0.52	Panting	*4*	0.21	Ataxia
-0.34	Torso weight shift	*5*	0.12	Normal speed cage circling
-0.23	Ataxia	*6*	-0.12	Normal speed position change
-0.21	Head lifts	*7*	0.11	Thoracic limb weight shift
-0.21	Normal speed position change	*8*	0.11	Grooming
0.19	Hang stand	*9*	0.08	Torso weight shift
-0.17	Whine	*10*	0.07	Cage sniffing
0.17	Bark	*11*	-0.07	Bark
0.16	Normal speed cage circling	*12*	0.06	Head lifts
0.10	Lip licking	*13*	0.05	Whine
0.09	Thoracic limb weight shift	*14*	-0.05	Stretching
0.03	Cage sniffing	*15*	-0.05	Panting
0.00	Grooming	*16*	-0.05	Hang stand

Table G7. Canonical 1 ordering of both SCC and CS coefficients for hourly behaviours in the surgery groups. SCC= Pooled within-class standardised canonical coefficients, CS= Pooled within canonical structure correlations.

SCC	Behaviour	*Order*	CS	Behaviour
1.10	Normal speed cage circle	*1*	-0.37	Grooming
-0.88	Normal speed position change	*2*	-0.33	Normal speed position change
-0.72	Grooming	*3*	0.27	Stretching
0.71	Lip licking	*4*	-0.27	Cage sniffing
0.57	Torso weight shifts	*5*	0.25	Whine
-0.52	Thoracic limb weight shifts	*6*	0.22	Hang stand
0.44	Stretching	*7*	-0.20	Head lifts
0.42	Whine	*8*	0.18	Thoracic limb weight shifts
-0.42	Slow motion position change	*9*	0.17	Draws legs up
-0.28	Head lifts	*10*	0.17	Panting
0.25	Hang stand	*11*	0.12	Normal speed cage circle
0.23	Bark	*12*	0.08	Ataxia
0.15	Ataxia	*13*	0.07	Bark
-0.13	Cage sniffing	*14*	-0.05	Torso weight shifts
0.06	Draws legs up	*15*	0.04	Lip licking
0.00	Panting	*16*	0.01	Slow motion position change

Table G8. Canonical 2 ordering of hourly behaviours by both SCC and CS coefficients for development of Control group differentiation. SCC= Pooled within-class standardised canonical coefficients, CS= Pooled within canonical structure correlations.

SCC	Behaviour	*Order*	CS	Behaviour
-3.79	End: stand	*1*	0.39	Vocal: whine
-2.10	Start: sit	*2*	0.18	Start: lateral
1.82	Position change: yes	*3*	0.15	End: lateral
-1.81	Orientation: stare ahead	*4*	-0.13	Start: sit
1.69	Head: lowered	*5*	0.09	Head: rest on surface
1.61	Head: high	*6*	-0.09	Other: arched back
1.55	Position change: no	*7*	-0.09	End: stand
-1.48	Start: sternal	*8*	-0.08	Tail: slow wag
-1.40	End: sternal	*9*	-0.07	Head: lowered
-1.32	Eye position: watch	*10*	-0.06	Ears: neutral
1.14	Vocal: whine	*11*	-0.06	Position change: yes
-1.07	Start: stand	*12*	0.05	Position change: no
-0.91	Ears: back	*13*	-0.05	Head: level
-0.87	Start: lateral	*14*	-0.05	Orientation: stare ahead
-0.81	End: sit	*15*	0.04	Tail: on surface
0.77	Other: lip licking	*16*	-0.04	Orientation: tester
-0.76	Orientation: tester	*17*	-0.03	End: sit
-0.60	Other: arched back	*18*	-0.03	Ears: back
0.58	Eyes: stare ahead	*19*	-0.03	Start: stand
0.57	Head: level	*20*	-0.03	Eye position: watch
0.49	Head: rest on surface	*21*	0.02	End: sternal
0.42	Tail: slow wag	*22*	-0.02	Tail: low
-0.25	End: lateral	*23*	0.01	Other: lip licking
0.19	Tail: on surface	*24*	0.00	Head: high
-0.18	Tail: low	*25*	0.00	Start: sternal
0.01	Ears: neutral	*26*	0.00	Eyes: stare ahead

Table G9. Canonical 1 ordering of both SCC and CS coefficients for palpation behaviours in the surgery groups. SCC= Pooled within-class standardised canonical coefficients, CS= Pooled within canonical structure correlations.

SCC	Behaviour	*Order*	CS	Behaviour
-3.59	End: stand	*1*	-0.29	Tail: low
2.65	Start: stand	*2*	-0.28	Eyes: stare ahead
2.53	Start: lateral	*3*	0.25	Eye position: watch
-2.41	End: lateral	*4*	0.25	Head: high
-2.14	End: sternal	*5*	-0.22	End: stand
1.64	Start: sit	*6*	0.19	End: sit
-1.66	End: sit	*7*	0.18	Tail: on surface
1.53	Start: sternal	*8*	0.17	Tail: slow wag
1.42	Head: lowered	*9*	-0.16	Head: rest on surface
1.12	Head: high	*10*	-0.16	Start: stand
1.07	Tail: on surface	*11*	0.14	Ears: back
0.96	Ears: neutral	*12*	0.13	Other: lip licking
-0.87	Eyes: stare ahead	*13*	-0.13	Vocal: whine
-0.69	Eye position: watch	*14*	0.12	Start: sit
-0.64	Orientation: tester	*15*	-0.10	Head: level
0.54	Tail: slow wag	*16*	0.09	End: sternal
0.48	Ears: back	*17*	-0.08	Position change: no
-0.47	Head: rest on surface	*18*	0.07	Other: arched back
0.45	Head: level	*19*	-0.07	Orientation: stare ahead
0.45	Position change: yes	*20*	0.06	Start: sternal
-0.44	Orientation: stare ahead	*21*	-0.03	Ears: neutral
0.28	Other: arched back	*22*	-0.03	Head: lowered
0.27	Other: lip licking	*23*	-0.02	Position change: yes
-0.22	Position change: no	*24*	-0.02	End: lateral
-0.06	Tail: low	*25*	0.01	Start: lateral
0.02	Vocal: whine	*26*	0.01	Orientation: tester

Table G10. Canonical 2 ordering of both SCC and CS coefficients for palpation behaviours in the surgery groups. SCC= Pooled within-class standardised canonical coefficients, CS= Pooled within canonical structure correlations.

Appendix H

Combination Graphs: (Figures H1-H8)
Behaviours and Plasma Cortisol Concentrations

(Hourly Behaviours/SURGERY Treatments)

Slow Motion Position Change. For the Control group there was virtually no activity of this behaviour, and there was no change in plasma cortisol concentration. The Anaesthesia/Surgery group showed an initial rise in plasma cortisol concentration followed by a fall. In contrast to the plasma cortisol pattern, bitches in this group showed a sharp and sustained fall in this behavioural activity. The presurgical analgesic group (Analgesia/Anaesthesia/Surgery) showed greater change in plasma cortisol concentration and corresponding higher levels of this behaviour at all points in time than the postsurgical analgesic group (Anaesthesia/Surgery/Analgesia). However, neither group showed a correlation between the change in plasma cortisol concentration and the frequency of this behaviour. The lower cortisol values and the lower frequencies of this behaviour in the postsurgical analgesia group may reflect the sedative effect of the butorphanol (Figure H1).

Normal Speed Position Change. *The Control group showed high frequency of this behaviour; however, there was little change in behavioural frequency over time, and there was little change in plasma cortisol concentration over time in this group. Within the Anaesthesia/Surgery group the pattern of frequency for this behaviour was similar to the change in plasma cortisol concentration*[1]. For the Analgesia/Anaesthesia/Surgery group, little change in frequency of this behaviour was seen, while at the same time the change in plasma cortisol concentration fell significantly. Between the second and third hour after extubation, when the change in plasma cortisol concentration fell for the Anaesthesia/Surgery/Analgesia group, so did the frequency of this behaviour; however, the same trend was not seen between the third and fourth hour, i.e., subsequent falls in change in plasma cortisol concentration for this group were not associated with frequency of behavioural changes. Low levels of activity for both slow motion position

[1] Observations printed in italics might suggest possible interaction between behaviour and plasma cortisol concentrations.

change and normal speed position change in the Anaesthesia/Surgery/Analgesia group likely reflect the sedation property of butorphanol. The low activity of position changes and low plasma cortisol concentrations in this group suggest that the Anaesthesia/Surgery/Analgesia treatment is associated with the least pain-induced distress among the surgery groups (Figure H1).

Torso Weight Shifts. *The plasma cortisol concentration remained unchanged in the Control group, and so did the frequency of this behaviour.* For both the Anaesthesia/Surgery and the Analgesia/Anaesthesia/Surgery groups, as the change in plasma cortisol concentration fell the frequency of this behaviour remained relatively unchanged. However, this was not true for the Anaesthesia/Surgery/Analgesia group. *For the Anaesthesia/Surgery/Analgesia group, as the plasma cortisol concentration fell over time, so did the behavioural frequency* (Figure H1).

Thoracic Limb Weight Shift. *A stable low cortisol concentration in the Control group was associated with both the infrequent and stable behavoural frequency.* All the surgery groups showed higher behavioural frequency and higher change in plasma cortisol concentration than the Controls; however, none of the surgery groups showed a correlation between the pattern of change in plasma cortisol concentration and behavioural frequency. Within the surgery groups, the pattern of highest behavioural frequency was associated with the pattern of lowest change in plasma cortisol concentration (Anaesthesia/Surgery/Analgesia bitches) (Figure H1).

Draws Legs Up. *The plasma cortisol concentration did not change in the Control group, nor did the frequency of behaviour, which was consistently <1.* The highest levels of change in plasma cortisol concentration and behaviour were seen within the Anaesthesia/Surgery group; however, the patterns for change in plasma cortisol concentration and behaviour frequency were not similar. The frequency of behaviour remained high while the change in plasma cortisol concentration declined in this Anaesthesia/Surgery group. *Both the pre- and postsurgical analgesia groups showed a decline in frequency of this behaviour as the plasma cortisol concentration declined* (Figure H2).

Stretching. There did not appear to be any correlation between the change in plasma cortisol concentration and frequency of behaviour patterns (Figure H2).

Normal Speed Cage Circle. *The plasma cortisol change was similar to that of behavioural frequency within both the Control group and the Analgesia/Anaesthesia/Surgery group: no change and decline, respectively* (Figure H2).

Head Lifts. In the Control group this behaviour had consistently high frequency and was consistently associated with low change in plasma cortisol concentration, but in all other groups high plasma cortisol concentration was seen with high frequencies of this behaviour. *Within the Anaesthesia/Surgery/Analgesia group, as the change in plasma cortisol concentration declined, so did the frequency of this behaviour.*

Lip Licking. *Neither the plasma cortisol concentration nor the frequency of this behaviour changed in the Control group.* Frequency of this behaviour was consistently highest in the Anaesthesia/Surgery group. *In the Anaesthesia/Surgery group the patterns of change in behavioural frequency and plasma cortisol concentration were similar* (Figure H2).

Whining. In the Control group where there was little change in plasma cortisol concentration, this behaviour was rare. *For both the Anaesthesia/Surgery and the Analgesia/Analgesia/Surgery groups the pattern of change in plasma cortisol concentration was similar to the pattern of behavioural frequency:* as the plasma cortisol concentration declined, so did the frequency of whining (Figure H3).

Cage Sniffing. *In the Control group the plasma cortisol concentration was relatively constant and so was the frequency of this behaviour.* There appeared to be no association between the change in plasma cortisol concentration and this behaviour among any of the surgery groups, even though frequencies were lower than in Controls (Figure H3).

Grooming. *In the Anaesthesia/Surgery group the frequency pattern for this behaviour was similar to the change in plasma cortisol concentration.*

In this group, as the plasma cortisol concentration declined, so did the behaviour frequency after hour two(Figure H3).

Yawning. *The Control group showed a pattern of behavioural frequency similar to the pattern of plasma cortisol concentration: virtually unchanged over time* (Figure H3).

Panting. Only the Analgesia/Anaesthesia/Surgery group showed notable (high) frequency of this behaviour, and the frequency pattern was not related with the change in plasma cortisol concentration (Figure H4).

Door Pawing. Only the Anaesthesia/Surgery/Analgesia group showed any activity of this behaviour, and frequency increased obviously during the first three hourly intervals, during which plasma cortisol concentrations fell. In the fourth hour period this behaviour disappeared almost completely (Figure H4).

Barking. Only the Analgesia/Anaesthesia/Surgery group showed activity of this behaviour during each of the hourly intervals. For this group there was less behavioural activity with lower change in plasma cortisol concentration; however, there appeared to be no apparent association between patterns (Figure H4).

Ataxia. Ataxia was not seen in the Control group. *In the surgery groups higher plasma cortisol concentration were most often associated with higher frequencies of this behaviour.* It is likely that the ataxia itself contributed to the higher change in plasma cortisol concentration (Figure H4).

(Hourly Behaviours/NONSURGERY Treatments)

Slow Motion Position Change. This behaviour was exceedingly rare for all of the groups (Figure H5).

Normal Speed Position Change. Frequency of this behaviour was consistently high for both the Control and the Anaesthesia groups, groups in which the change in plasma cortisol concentration was consistently low. *The pattern of behavioural frequency was similar to the change in plasma cortisol concentration pattern for the Control bitches. Within the Anaesthesia/Immediate Analgesia group the change in plasma cortisol concentration pattern and the behavioural frequency pattern showed an inverse relationship: as the one rose the other fell* (Figure H5).

Torso Weight Shift. For both the Control and the Anaesthesia groups there was little change in plasma cortisol concentration and little change in behavioural frequency (Figure H5).

Thoracic Limb Weight Shift. For both the Control and the Anaesthesia groups there was little change in plasma cortisol concentration and little change in behavioural frequency. For the Anaesthesia/Analgesia group, the change in plasma cortisol concentration generally followed an inverse relationship to the frequency of behaviour (Figure H5).

Drawing Legs Up. All groups showed a rare occurrence of this behaviour (Figure H6).

Stretching. This behaviour was seldom seen in any of the groups (Figure H6).

Normal Speed Cage Circling. *The Control group showed a rather constant pattern of both change in plasma cortisol concentration and behavioural frequency* (Figure H6).

Head Lift. *The Control group showed a rather constant pattern of both change in plasma cortisol concentration and behavioural frequency; in the Anaesthesia/Immediate Analgesia group plasma cortisol concentration fell as behavioural frequency rose and viceversa* (Figure H6).

Lip Licking. This behaviour seldom occurred in any of the groups, and there appeared to be no association between change in plasma cortisol concentration and behavioural frequency in any of the groups (Figure H6).

Whine. *Both the Anaesthesia/Analgesia and the Anaesthesia/ Immediate Analgesia groups showed similar patterns of change in plasma cortisol concentration and behavioural frequency* (Figure H7).

Cage Sniffing. *The Control group showed a pattern of change in plasma cortisol concentration that was similar to the pattern of behavioural frequency, while the Anaesthesia/Immediate Analgesia group showed an inverse relationship for these two patterns* (Figure H7).

Grooming. The frequency of behaviour was highest in both the Control and Anaesthesia groups, in which plasma cortisol concentration was lowest, but the patterns of change in plasma cortisol concentration and behavioural frequency were dissimilar. *In the Analgesia group the patterns of change in plasma cortisol concentration and behavioural frequency were similar* (Figure H7).

Yawning. This behaviour was seen (infrequently) only in the Control and Anaesthesia groups in which plasma cortisol concentration was the lowest of all groups. *Patterns of change for plasma cortisol concentration and behavioural frequency were similar in both of these groups* (Figure H7).

Panting. There appeared to be no relationship between change in plasma cortisol concentration and behavioural frequency within any of the groups (Figure H8).

Door Pawing. This behaviour rarely occurred in any of the groups (Figure H8).

Barking. There appeared to be no association between change in plasma cortisol concentration and behavioural frequency patterns for any of the groups (Figure H8).

Ataxia. There appeared to be no association between change in plasma cortisol concentration and behavioural frequency patterns for any of the groups (Figure H8).