Separation Anxiety in Pet Dogs Behaviour Patterns and Time Course of Activity

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Introduction

Separation anxiety in dogs is characterized by excessive barking, howling and/or behaviour sometimes accompanied by urination and defecation, when the dog is at home alone (Borchelt and Voith, 1982; McBride et al., 1995). Dogs exhibiting separation problems are often strongly attached to the owner (Borchelt and Voith, 1982; Voith, 1985, McBride, 1995), and are less likely to remain alone voluntarily in a room (McBride, 1995). Separation-related problems are associated with first-time ownership (Serpell and Jagoe, 1995), and dogs adopted from an animal shelter, which often become strongly attached to the new owners, are more likely to exhibit separation problems (Borchelt 1983, McBride et al. 1995). Furthermore, early experience such as too early separation from its mother or premature weaning may predispose the dog for development of separation anxiety (McElroy, 1989). Obedience training, however, seems to have a positive effect on separation problems (Borchelt and Voith, 1982; Clark and Boyer, 1993, Serpell and Jagoe, 1995) by influencing the relationship between dog and owner.

Breed and gender both seem to influence separation behaviour (Lund, 1995). Especially, hounds, sporting and herding dogs, bred for high activity, frequently cause problems by barking or whining, while the owner is away (Niego et al., 1990).

The aim of the present study was to examine the behaviour of dogs with separation problems when at home alone and to describe the temporal distribution of separation behaviour.

Animals, materials and methods

Recorded cases of separation anxiety

The analysis was based on video-recordings of 20 dogs with separation problems. The dogs were between 10 months and 9 years old and predominantly males (4/5). The video tapes were analyzed for the following types of behaviour:

1. Appetitive behaviour including searching and sniffing at different objects (exploration) and nosing at or around the door.
2. Locomotor behaviour including scratching, digging, chewing and tearing objects apart.
3. Eremotic elements of predator's behaviour including stiff legged jumping, grabbing and head shaking.
4. Displacement activities including yawning, licking and vacuum chewing.
5. Urination and defecation.
6. Vocalization including barking, whining and howling.
7. General activity - see below.
The four hour period covered by each recording was divided into 5 min intervals, and the behaviour was recorded as bouts of activity in question. Body postures and motor activity were divided into 4 categories: 1) lying, 2) sitting, 3) standing and 4) walking, and the frequency of transitions between these patterns was used as a measure of general activity. Furthermore, the proportion of the total number of intervals the dogs were awake and active was calculated.

Statistical analysis

For all statistical analysis the software package Statistical Analysis Systems version 6.04 (SAS Institute Inc., 1989) was used. Correspondence analysis was performed in order to find associations between the different types of separation behaviour. Additionally, Pearson correlation coefficients between the different types of behaviour were calculated. The temporal cross correlations between the different types of behaviour were corrected for differences in the level of activity between the individual dogs. The trend in the time course of activity was found using a linear regression model on the log, square or square root transformed data (mean activity of all dogs as a function of time). Finally, analysis for autocorrelation was performed in order to reveal possible tendencies for periodic activity in the individual dogs.

Results

Behaviour patterns

All dogs exhibited some form of appetitive behaviour (APP), 19 dogs performed displacement activities (DIS), 19 were whining (WHI), 18 performed destructive behaviour (DES), 17 were barking (BAR), 14 were howling (HOW) and 9 displayed elements of predatory behaviour (PRE). We observed no cases of eliminative behaviour. Of the 18 dogs displaying destructive behaviour, 15 were also barking, 12 were also howling, and only 3 dogs did neither bark nor howl. All of the 14 howling dogs were also barking, but 3 of the 17 barking dogs were not howling.

A simple correspondence analysis was performed to see how the different measures of activity and forms of separation behaviour were associated within the 20 dogs. The association between the columns (behaviour) and rows (dogs) in full 8 dimensions was measured by the total chi-square statistic of 1450.52. Of the total chi-square and inertia 78% was explained by the first and the second dimension.

Fig. 1 shows a two-dimensional plot of the different forms of behaviour. Short distance between behaviours indicates a high degree of association. Vocalization (BAR, HOW and WHI) below and displacement activities (DIS) and predatory behaviour (PRE) above the centroid all make large contributions to both the inertia of dimension 1 and dimension 2. Whining (WHI) and howling (HOW) are closely associated. Both are relatively distant to barking (BAR). The association between appetitive (APP), destructive (DES) and predatory behaviour is relatively close, but they are distant to displacement activities and vocalization. The time awake and active (AWA) and general activity (ACT) are closely associated.

Across dogs appetitive behaviour was significantly correlated with all other forms of behaviour. Especially, appetitive behaviour was highly correlated with general level of activity (corr=0.77) and destructive behaviour (corr=0.78). Furthermore, a significant correlation was found between predatory and destructive behaviour (corr=0.51). The different forms of vocalization were highly correlated (corr=0.88-0.96). The correlations between destructive behaviour (DES) and vocalization (BAR, WHI and HOW) were moderate (corr=0.31-0.46), but none less significant for DES and HOW.
In dogs displaying less than 75 transitions/hour, the frequency of predatory behaviour increased by increasing activity (Fig. 2). In dogs displaying 75 - 125 transitions/hour the frequency of predatory behaviour was relatively constant. Above this level of activity, however, the frequency of predatory behaviour decreased. The frequency of destructive behaviour increased by increasing activity up to a level of 125 transitions/hour, but then tended to decrease. The frequency of vocalization was relatively low in dogs showing less than 100 transitions/hour. Above this level of activity the frequency of barking steeply increased, whereas the frequency of howling and whining (which closely followed each other) seemed to have a more linear relationship to the level of activity.

Temporal distribution of behaviour

The temporal correlations between appetitive, predatory, and destructive behaviour were moderate (corr=0.33-0.39). The correlations between predatory behaviour and vocalization (corr=0.06-0.15) and between barking and whining (corr=0.19) were low, but the correlation between barking and howling (corr=0.37) was moderate. The correlations between 1) whining and howling (corr=0.62), 2) appetitive behaviour and general activity (corr=0.62), and 3) destructive behaviour and general activity (corr=0.53), however, were relatively high. All the correlations - except the correlation between predatory behaviour and barking - were significant.

Predatory behaviour was displayed in 36 of the total number of 5-min intervals in the 20 dogs, but 31 of these also included appetitive behaviour, which only was exhibited in 158 of the 6 intervals. Destructive behaviour was shown in 35 of the 36 intervals including predatory behaviour, although the former behaviour only occurred in 147 of the 913 intervals.

For all forms of behaviour the trends in time course of activity were best described (R-squares) by exponential functions (declining) as compared to linear, square and square root functions (Table 1, see Fig. 4a+b).

Table 1 shows the results of an auto correlation analysis including the time series of general activity, appetitive + predatory + destructive behaviour and vocalization. Most dogs showed a peak in auto correlation indicating some tendency for periodic distribution of behaviour, and the mean periods in the time course of activity were 27.0, 26.2 and 22.4 min for the 3 forms of behaviour respectively. However, the peak correlations greatly varied between the dogs.

Table 1
Models for the trend in the time course of behaviour: explanatory value (R-square) for linear, exponential, square and square root functions.

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Linear</th>
<th>EXP</th>
<th>Square</th>
<th>Sq-root</th>
</tr>
</thead>
<tbody>
<tr>
<td>APP+PRE+DES</td>
<td>0.522</td>
<td>0.815</td>
<td>0.665</td>
<td>0.352</td>
</tr>
<tr>
<td>VOC</td>
<td>0.461</td>
<td>0.560</td>
<td>0.555</td>
<td>0.320</td>
</tr>
<tr>
<td>ACT</td>
<td>0.507</td>
<td>0.760</td>
<td>0.629</td>
<td>0.361</td>
</tr>
</tbody>
</table>

Table 2
Results of the analysis of auto correlation in general activity (ACT), appetitive (APP) + predatory (PRE) + destructive behaviour (DES) and vocalization (VOC). The table shows the
number of dogs displaying a tendency for cyclic activity (N), the mean period in the time course of activity and the peak in auto correlation.

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>N</th>
<th>Period (min)</th>
<th>Peak into auto correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>15</td>
<td>27.0</td>
<td>Min 0.06  Max 0.46</td>
</tr>
<tr>
<td>APP+PRE+DES</td>
<td>17</td>
<td>26.2</td>
<td>Min 0.01  Max 0.49</td>
</tr>
<tr>
<td>VOC</td>
<td>17</td>
<td>22.4</td>
<td>Min 0.04  Max 0.46</td>
</tr>
</tbody>
</table>

Discussion

Separation behaviour

The present study suggests that behaviour related to separation anxiety may be divided into 1) appetitive behaviour, 2) predatory behaviour, 3) destructive behaviour and 4) vocalization. Eliminatory behaviour reported by other authors (Borchelt and Voith, 1982; McBride et al., 1995) was not found.

In a questionnaire study by McBride et al. (1995) including 44 dogs with separation problems, 84% were destructive, 41% barked or howled and 18% eliminated. Of those showing vocalization or destructive behaviour, only 27% displayed both. In our study both forms of behaviour were displayed in 80% of the dogs. However, in the study by McBride et al. (1995) some forms of behaviour may have been displayed by the dog without being recognized by the owner.

The correspondence analysis indicated 1) a relatively strong association between appetitive, predatory and destructive behaviour and 2) strong association between howling and whimpering - both less strongly associated to barking. The relations between appetitive and destructive behaviour and between the different forms of vocalization were largely confirmed by the correlation analysis.

Appetitive behaviour sometimes led to predatory behaviour, which tended to occur in sequences. The dog might jump at an object, take it into the mouth, shake it and then throw it up in the air to jump at it again. Between these sequences some dogs would chew the object or try to tear it apart (destructive behaviour). In some dogs appetitive behaviour directly led to chewing and tearing or intense scratching directed at an object or digging near the front door.

Fear is present in many situations in which exploration is involved, and Wood-Gush and Vestergaard (1991) suggest that when fear and a tendency for exploration are in equilibrium, play is inhibited. In dogs elements of predatory behaviour are often included in normal play sequences, and separation problems seem to involve fear (see below) as well as a tendency for exploration. This might indicate that predatory behaviour found in the present study was play. However, the temporal association with destructive behaviour, which may correspond to the normal consummatory behaviour after prey killing, suggests that at least in some dogs predatory behaviour (leading to destructive behaviour) was disinhibited - not play.

Some dogs responded to external stimuli by a relatively low pitched form of barking. Often they continued to bark for a long time after the stimuli had disappeared. However, the barking gradually changed into a high pitched form, which might reflect a high level of arousal caused by the stimulus rather than a response to the stimulus itself.

In wolves howling is used in long distance communication - for example, when an individual has been separated from the pack. Furthermore, allomimetic howling is probably used to strengthen the coherence within the pack. Therefore, howling is a natural response in pet dogs experiencing the discomfort of being left alone.
Relationship between frustration and separation behaviour

According to Borchelt and Voith (1982) separation problems are caused by fear of being left alone related to the attachment to the owner. In our study, we found some indirect indications that fear was involved. In addition to the excessive barking some dogs responded to external stimuli by more or less 'resetting' the time course of activity (see below). This response may be explained by arousal and fear. Furthermore, all dogs except 1 in our study were whining.

The relationships between the different factors influencing separation behaviour are suggested in Fig. 3. Because of the attachment to the owner, all dogs left at home alone may experience some level of frustration arousing the dog. A normal 'fearless' dog will not give any problems. However, for some dogs the level of frustration will exceed a certain threshold eliciting separation behaviour. Frustration may cause disinhibition of certain behaviour patterns (e.g. displacement activities, predatory behaviour and destructive behaviour) and will arouse the dog influencing the level of activity as well as vocalization. The actual level of arousal is influenced by breed and gender (Niego et al., 1990; Lund, 1995) as well as individual characteristics and prior experience influencing the attachment to the owner (Borchelt and Voith, 1982; Clark and Boyer, 1993; McBride, 1995; Serpell and Jagoe, 1995). Furthermore, the frustration may lead to fear (see Duncan and Wood-Gush, 1972) reflected in the level of whining and howling.

Proposed model for the time course of activity

According to Borchelt and Voith (1982) separation behaviour reaches a peak intensity shortly after the owner leaves and usually ceases after a period of time, although some times barking and howling may be relatively constant throughout the day. In some cases damage caused by digging and chewing indicates several hours of work by the dog.

The present study confirmed the early peak intensity in separation behaviour reported by Borchelt and Voith (1982). We found that the time trend in the pattern of activity was best described as an exponential decrease. In most dogs the time course of activity also seemed to include a cyclic pattern with a period of 20-30 min. Interestingly, in an investigation of night time activity in domestic dogs Adams & Johnson (1993) found a period of 25 min. This suggests that the cyclic pattern in the present study was related to the diurnal rhythm.

We suggest that the basic time course of activity in dogs with separation problems may be described by a combination of two components (Fig. 4a): 1) a cyclic component, which be controlled by internal factors, and 2) a gradual decrease related to a general decentral starting just after the owner has left the dog. If the dog is rearoused by external stimuli, however, the time course may be 'reset' (Fig. 4b), and if the dog is extremely sensitive to external stimuli, or it is constantly aroused above the threshold for eliciting separation behaviour, the basic pattern may be blurred.

Conclusion

We suggest that separation problems is not caused by disobedience or boredom, but by frustration related to the dependency of the owner resulting in 1) arousal reflected in the level of barking, 2) fear reflected in the level of whining and howling, and 3) disinhibition of appetitive, predatory behaviour and destructive behaviour.

The time course of activity may be divided in two components: 1) a long term exponential decrease influenced by external factors arousing the dog and 2) a cyclic component having a period of 20-30 min related to the diurnal rhythm,
Acknowledgements
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References
Fig. 1. Two-dimensional plot of behaviour. AWA = awake and active; ACT = general activity; APP = appetitive behaviour; PRE = predatory behaviour; DES = destructive behaviour; DIS = displacement activities; BAR = barking; HOW = howling; WHI = whining.
Fig. 2. Relation between the frequency of separation behaviour and the level of general activity (transitions/hour) in the 20 dogs.
Fig. 1. Relationship between factors influencing separation behaviour.
Fig. 4. Proposed model for the time course of separation behaviour: a) basic pattern composed of two components - cyclic fluctuations and a general exponential decline, b) the effect of rearousal of the dog by external stimuli.