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Title: Fear vs. frustration – possible factors behind canine separation related behaviour

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Abstract

The signs of separation related problems (SRP) may vary according to the inner state that triggers them – for example we found earlier that dogs with owner-reported SRP were characterized with a predominance of whining during a short isolation from the owner, meanwhile barking occurred independently of the owner-reported SRP status. Based on the theory that the owner represents a resource for the dog we hypothesise that there is an association between the permissive and inconsistent behaviour of the owner and the reduced frustration threshold in the dog, which consequently will show specific signs of SRP. In our study, personality traits of the owner and the dog were measured with a questionnaire, while the separation behaviour was observed with an outdoor test. We found that dogs that rather barked than whined in the separation test had more likely a lenient owner. Dogs with owner-reported SRP whined less frequently than non-SRP dogs if they had lenient owners. The connection between the owner's permissiveness and the type of emitted vocalisation supports the theory that the owner's attitude towards the dog can be associated with the dogs' frustration-related SRP signs as they tend to respond with similar behaviours that occur in other frustrating situations.

Keywords: dog, frustration, personality, separation, vocalisation

1. Introduction

Based on attachment theory, being separated from a parent causes a moderate level of distress in children (Bowlby, 1958; Ainsworth, 1969). Dogs also show similar behaviours as human infants in the absence of their owner (Topál et al., 1998). A low level of stress in the absence of a parent is adaptive for the offspring (Bowlby, 1958), however in the case of companion dogs, the signs that occur during the absence of the owner are often considered undesirable. Henceforth, the complex (and excessive) behavioural and physiological response to separation in some dogs is considered as a behavioural problem and it is often called separation anxiety (Simpson, 2000; Flannigan and Dodman, 2001; Appleby and Pluijmakers, 2004) or separation related disorder (Gaultier et al., 2005). However, the term ‘disorder’ may not be proper, since it refers to an abnormal behaviour and implies that a clinical assessment has been made – which in turn may not always be the case due to the high prevalence of the problem and the commonly used technique of questionnaire-based surveys related to this topic. Based on this, for the present study we opted for a less specific term such as ‘separation-related problem’ (SRP) as it refers to the nature of owner-reported characteristics of left alone dogs’ behaviour. The SRP in dogs is characterised by various stress related signs that only appear in the absence of the owner. The investigation of this behavioural problem is crucial, not just because of its frequent occurrence within the companion dog population, but because this condition has an adverse effect not only on the welfare of dogs, but it can also become stressful for the people living in the affected dog’s environment (Voith et al., 1992, Simpson, 2000).

The signs of SRP can be quite diverse. Expressions of general distress such as salivation or inactivity, or more specific behaviours like the destruction of objects or intensive vocalisation are among the most commonly reported events (Overall, 2001; see for a review Ogata, 2016).

Not only the signs of SRP are various, but also the main causes behind it. SRP can have a genetic predisposition (Vermeire et al., 2009), but it can also appear with aging or after a traumatic experience (Appleby and Pluijmakers, 2004). Moreover, there are various articles about the risk factors of SRP seeking the possible effects of the basic characteristics of the dog, for instance, the gender, reproductive status, and age at acquisition.

The appearance and the relative strength of SRP-signs may vary according to the exact inner state that triggers the given dog’s response in the absence of the owner (Lund & Jørgensen, 1999; Sherman and Mills, 2008). According to the literature there are several inner states that may appear during the separation episode, such as anxiety, fear or frustration; where the severity of the behavioural and physiological correlates can escalate from being mild (in case of anxiety) to severe (typically in case of fear) (Lund & Jørgensen, 1999, Appleby and Pluijmakers, 2003; Shermann and Mills, 2008). Although the different inner states may cause very similar signs, there may be differences in their intensity or their ratio during the separation.

To understand the complex causation of SRP, one should consider the possible factors that may trigger discomfort in the dog upon the departure and absence of its owner. Among the likely candidates, fear of being alone is a well-known stress elicitor in social species in which individuals have strong social bonds and intricate dependence relationships with one another (Bowlby, 1958). Attachment between the dog and its owner is one of the well-studied interspecific social ties, where separation from the owner generates insecurity and fear (Topál et al., 1998, Konok et al., 2011). Another possible factor that causes stress when dogs are separated from their owner is frustration (Lund and Jørgensen, 1999). Frustration appears if a needed resource is unreachable or when the reward of an action that was previously reinforced ceases. In the case of mammals, usually the mother provides the resources to the offspring and during separation the cessation of resources causes fear as emotional reaction and frustration (Papini, 2003; Jakovcevic, 2013). According to some authors, frustration has similar signs of distress to those elicited by fear (Jakovcevic et al., 2013). Based on the analysis of video-

recordings of 20 dogs with SRP, Lund and Jørgensen (1999) constructed a model that described dogs' behaviour during isolation in terms of frustration that in turn may cause arousal and/or fear. They assumed that dogs' whining during separation might be caused by fear, while frustration probably provokes barking. However, in the aforementioned study, the authors did not assess the dogs' frustration tendencies, therefore the possible connection between the signs of SRP and frustration remained uninvestigated.

The vocal responses of dogs to separation offers a promising opportunity for disentangling the different inner state related factors behind SRP. The various types of vocalisations during separation are acoustically diverse enough (e.g. Cohen and Fox, 1976; Pongrácz et al., 2005) and mutually exclusive. There is ample evidence showing that dogs vocalise differently in markedly different contexts; and in turn, these vocalisations convey reliable information to the receivers about the dogs' apparent inner state (Molnár et al., 2010; Pongrácz et al., 2011). In a recent study, we found that experimentally isolated dogs have shown characteristically different patterns of vocalisations (Pongrácz et al. 2017). We studied the type and frequency of whines and barks during the absence of the owner in a 3-minute long outdoor situation. It was found that owner reported SRP of the dog (based on the validated questionnaire of Konok et al. (2011) was predominantly associated with the onset and frequency of whines, meanwhile the occurrence of barks did not show an SRP-dependent pattern in the surveyed population. Dogs that had owner-reported SRP, started to whine sooner; and more SRP-dogs whined than non-SRP dogs did. Barking was common both in the dogs with and without SRP, so it seems that in the case of separation, barking is easily provoked even in dogs without SRP. Putting together our previous and Lund and Jørgensen's (1999) results, we hypothesise that when dogs are left alone they generally experience a low (normal) level of frustration because of the inaccessible resource (the owner). However, others experience also fear and/or more intensive frustration, which can be related to particular traits of personality and/or based on their previous experience. Although human listeners attributed high levels of fear/desperation to the barks of left alone dogs (e.g. Molnár et al., 2010; Pongrácz et al., 2011; Pongrácz, 2017), these earlier playback studies were not coupled with behavioural or physiological data related to the actual inner states of the vocalising dogs. Based on our previous results (Pongrácz et al., 2017) there is no correlation between whining and barking in a short outdoor separation context, which suggests that in the case when dogs are separated from their owners these two types of vocalisations might be associated with different inner states.

There is evidence that the presence of SRP might have an association with other behavioural phenotypes of the dog. Dogs with SRP showed negative cognitive bias (Mendl et al., 2009; 2010); SRP often co-occurs with storm or noise-phobia (Overall et al., 2001); and it is connected to food-related aggression (McGreevy, 2008). Although the exact causation behind the interconnected behavioural signs is largely unknown due to the correlative manner of the previously mentioned studies, it is still possible to investigate the possible connection between particular inner states and signs of SRP. We hypothesise that dogs with a low threshold against frustration will show specific SRP signs and it affects the vocal behaviour during the separation. We predict that dogs that may be easily frustrated will mostly bark in the absence of their owner. We also hypothesize that owners' permissiveness and the dogs' demanding behaviour are associated with the dogs' proneness to be frustrated, consequently making a connection between the owners' and dogs' personality traits and the SRP-related vocal behaviour.

Unpredictable housing was often used to induce a depression-like, general negative state in laboratory animals (Mineur et al., 2006; Nollet et al., 2013). According to our prediction, if the owner usually behaves in a permissive/inconsistent manner in other situations (that are independent from separation - e.g. playing, feeding, forbidding of undesirable behaviours), then this may result with signs of SRP. This attitude could cause a lowered threshold to frustration in the dog because it makes the consequence of its actions unpredictable. In the same way, dogs

that can force their preferences on the owner by showing persistently demanding behaviours in other situations, may develop frustration-related SRP signs more often, because, in the case of being left alone by the owner, the otherwise successful demanding behaviours will not yield the preferred outcome (i.e. the owner's return).

In this paper, we studied the possible association between the owner's permissive and the dog's demanding behaviour, with the dog's vocal responses, during a short separation episode. For describing the personality traits regarding the permissiveness of the owner and the demanding behaviour of the dog, we constructed a questionnaire. Finally, to assess the separation-related behaviours of the dogs, we set up a 3-minute outdoor separation situation to describe the behaviour and vocalisations of the dog during the absence of the owner.

2. Materials and Methods

2.1 Questionnaire

The online questionnaire contained 58 questions (see: Supplementary Material). Eleven questions were taken from a questionnaire of Bálint et al., 2017. In the first section, we requested general demographic information about the owner and the dog; the existence and signs of SRP and other behavioural problems. The next section of the questionnaire contained questions about such situations where a dog might show persistent behaviour. In the case of these, owners had to indicate the frequency and intensity of the dog's corresponding behaviours. Frequency was measured on a Likert-scale where 1=never and 5=all the time. The intensity of a particular behaviour was indicated by a list of inclining responses, such as: (the dog) 1= sits and stares; 2= whines; 3= barks; 4= jumps up. The questionnaire also included questions about the owner's permissiveness in the case of the dog's persistent/demanding behaviours. For these items, owners could rate the frequency of these particular situations on a scale from 1 to 5. The questionnaire was distributed online via social media, altogether N=180 questionnaires were completed by Hungarian dog owners.

2.2 Behaviour test

2.2.1 Subjects and experimental groups

We tested N=44 adult companion dogs (older than 1 year, mean age: 6 years). Four subjects were excluded from the analysis because of technical problems with the video recording during their tests. For further analysis we used the video footages of 40 dogs (sex ratio: N=23 male and N=17 female; breed status: N=24 purebred and N=16 mixed breed). The owners who marked in the questionnaire that they would willingly participate in the test with their dogs were invited to the experiment. The owners were informed about the aim of the study, the procedure, and the possibility that they could stop the test if they felt their dog showed a high level of stress. The Animal Welfare Committee of the Eötvös Loránd University reviewed and accepted the experimental procedure (Ref. no.: PEI/001/1056-4/2015). An equal number of dogs (N₁=N₂=20) were chosen with and without signs of SRP, based on a particular question from the questionnaire: "Does your dog have separation anxiety or separation related behavioural problems?". It was shown in previous studies that owners can reliably recognize whether their dog has separation anxiety or not (Konok et al., 2011).

2.2.2. Procedure

We set up an outdoor separation situation that lasted for 3 minutes (Figure 1) The behaviour tests were performed at Eötvös Loránd University, Budapest on a flat, open area. The owner tied the dog to a tree with a 1.5 m long leash and after saying "good bye" in their usual way,

he/she walked away, leaving the dog behind. After a 45 m long walk the owner disappeared behind a building. The time was measured by the owner with a timer that was started when the owner left the dog. After 3 minutes elapsed the owner reappeared and returned to the dog. The owner greeted and released the dog from the leash. Special attention was given so that any stress caused by the separation would be alleviated by administering ample petting and playful interactions between the dog and owner after their reunion. During the whole test, two experimenters handled the recording devices without interacting with the dog. Tests were recorded by a video camera (Panasonic HDC-SD10) and by a shotgun microphone (Seinheiser ME-66), both standing on tripods. The dog's name, the moment when the owner disappeared, and the moment when the owner reappeared from behind the building, were verbally added to the recording by the experimenters.

2.2.3 Behaviour coding

The test was divided into two parts during the behaviour coding. (1) The owner leaves the dog and walks away (i.e. the owner is still visible) (2) The owner disappeared behind the building. We coded the following behaviours:

Whine:

- 0: The dog does not whine
- 1: The dog seldom whines (less than 30% of the time)
- 2: The dog frequently whines (between 30-50% of the time)
- 3: The dog whines most of the time (more than 50% of the time)

Bark:

- 0: The dog does not bark
- 1: The dog seldom barks (less than 50% of the time)
- 2: The dog barks most of the time (more than 50% of the time)

Move:

- 0: The dog stands, may change its position sometimes, but the leash is not taut
- 1: The dog moves some (less than 30% of the time)
- 2: The dog moves a lot (more than 30% of the time)
- 3: The dog moves most of the time (more than 50% of the time), the leash is taut most of the time.

2.2.4. Data analysis

For testing the reliability of the coding procedure, an independent coder analysed 10 randomly chosen videos. The results of the Pearson correlation showed that our coding procedure is reliable (whining: $r=0.778$; $p=0.008$; barking: $r=1.0$; $p<0.001$; moving: $r=0.706$; $p=0.002$).

Because of the unequal proportion of the groups resulting from the whine, bark and move scores, we merged some of the groups before the analysis. First we merged the two phases of

the test. We always kept the higher behaviour score from the two phases (E.g.: If a dog received whining score 2 in the first phase but 3 in the second, we kept score 3 during the further analysis). After the merging we had the following sample sizes:

whine	0 (N=11)	1 (N=16)	2+3 (N=14)
bark	0 (N=26)	1+2 (N=14)	
move	0+1 (N=21)	2+3 (N=19)	

2.3. Statistical analysis

All the analyses were done with IBM SPSS Statistics 23.0.0.0. Regarding the questionnaire, we performed two separate Principal Component Analyses (PCA) on the items describing the behaviour of the owner and the dog (See Supplementary material) based on correlations between variables with Varimax Rotation. The number of PCA components was chosen using the break point of the Scree Plot (see Cattell, 1965). For further simplification of the components we applied a backward elimination approach, excluding step-by-step those parameters that had low loading (less than 0.5) or contributed to more than one component with similar absolute loading. Cronbach's alpha was calculated to assess the internal consistency of the final extracted factors and for testing the repeatability of the measurement (DeVellis, 1991). One PCA incorporated all the answers to the questions about the owner's permissiveness, and the other PCA involved the intensity scores of the situations when the dog shows persistent behaviour, and additionally with the questions about the dog's problematic behaviours (Table 1). The factor scores of the resulting components (traits) were used as dependent variables in the subsequent Generalized Linear Models (GLM). We used the following independent variables: whine, bark and move scores, SRP (SRP/non-SRP) sex (male/female), reproductive status (intact/neutered-spayed), and breed (purebred/mixed). In the model we analysed the main effects of the independent variables and their 2-way interactions as well. We performed backwards model selection and Tukey post hoc tests for the between group comparisons.

3. Results

3.1 Principal Component Analysis

The PCA on the questions about the dog's behaviour resulted in four traits which explained 51.8 % of the total variance. After the reliability analyses, we only kept three traits as the fourth did not turn out to be reliable (Cronbach's Alpha: 0.820; 0.682; 0.601; 0.332). Based on the items belonging to the components (traits), we arbitrarily labelled the traits with fitting names for further reference during the following analyses. The first trait ('Obedient dog') contains six items: (for the correspondent questions of the variables see Table 2) all relate to obedience and discipline. The second trait ('Begging dog') contains four items which relate to food begging behaviours. The third trait ('Resistant dog') contains five items which relate to persistent and stubborn behaviours of the dog.

We performed a separate PCA on the questions regarding the owner's behaviour (Table 2 and 4). It resulted in two reliable factors (Cronbach's Alpha: 0.753; 0.726). The first trait ('Strict owner') contains five items (one with negative loading). The second trait ('Lenient owner') also contains four items. These components explained 55.5% of the total variance.

3.2 Results of the Generalized Linear Models

3.2.1 Traits regarding the dogs' behaviour

In the case of the 'obedient dog' trait, we found only one significant effect, purebred dogs gained higher scores than mixed breeds ($F_{1, 32}=7.748$; $p=0.009$) (See Tables 3 and 4).

In the case of the ‘begging dog’ trait, we found significant interactions between SRP-status and whine scores ($F_{2, 26}=8.327$; $p=0.002$), sex and whine scores ($F_{2, 26}=5.66$; $p=0.009$) and between move and whine scores ($F_{2, 26}=12.508$; $p<0.001$). According to the post hoc tests, dogs that move less and do not whine had higher ‘begging dog’ scores, as did females that did not whine. Lastly, dogs that had owner-reported SRP but did not whine, had the highest scores in the case of the ‘begging dog’ trait.

In the case of the ‘resistant dog’ trait, we found two main effects, female dogs ($F_{1, 32}=11.512$; $p=0.002$) and dogs with SRP ($F_{1, 32}=5.168$; $p=0.03$) (Figure 2) had higher scores than males and dogs without owner-reported SRP did, respectively.

3.2.1 Traits regarding the owners’ behaviour

In the case of the ‘strict owner’ trait, we only found one significant main effect, owners of male dogs had higher scores than owners of female dogs ($F_{1, 23}=5.507$; $p=0.025$) (See Tables 3 and 4). In the case of the ‘lenient owner’ trait, we found several significant interactions between the amount of emitted whines and barks ($F_{2,24}=5.952$; $p=0.008$) (Figure 3); between the sex and bark score ($F_{1, 24}=6.36$; $p=0.019$); sex and move scores ($F_{1, 24}=4.73$; $p=0.04$); sex and SRP status ($F_{1, 24}=5.037$; $p=0.034$); SRP status and whine scores ($F_{2, 24}=8.453$; $p=0.002$) (Figure 4), and lastly between SRP status and the breed ($F_{1, 24}=11.183$; $p=0.003$). Dogs that barked frequently, but did not whine, got the highest scores in case of ‘lenient owner’ trait. Also male dogs with frequent barking got lower score than the females had. Female dogs that moved only a little during the test had high score in this trait. Dogs with owner-reported SRP that whined infrequently had lenient owners based on our questionnaire. Dogs without SRP that whined had a lenient owner as well. Mixed breeds with owner-reported SRP had the least score and purebred dogs without SRP had the highest. Finally, males without SRP had the least score.

4. Discussion

In a study where we combined a short separation experiment with a questionnaire, our goal was to investigate whether behavioural traits of the owner (covering different aspects of permissiveness) and the dog (mainly covering different aspects of demanding behaviour) would show associations with the owner-reported SRP status of the dog and its behaviour during a short session of isolation. Our main hypothesis was that particular signs of SRP would show associations with the dogs’ tendency to become frustrated. In agreement with our predictions, particular aspects of the permissiveness of the owner (mainly manifested in the ‘leniency’ trait) during their everyday interactions with the dog, had a strong connection with both the SRP status and the vocal behaviour of the dog. Based on our questionnaire, lenient (i.e. permissive) owners have such dogs that mostly bark (but do not whine) during separation – these dogs will likely be viewed by lenient owners as SRP-dogs. However, we also found that some dogs that whined abundantly during the test were considered as non-SRP dogs by the lenient owners.

A likely interpretation of these results would be that the leniency of the owner may coincide mostly with dogs that become easily frustrated in the absence of the owner, and this is manifested mostly through barking – which behaviour is subsequently interpreted as SRP by these owners. Although Konok et al. (2011) found that owners were able to reliably assess the SRP status of their dog in the case of our study, in the case of at least a subgroup of our human participants (lenient owners) this ability might be different. Lenient owners may not notice fear-related SRP, where the main form of vocalisation is whining – according to our previous results (Pongrácz et al., 2017) and earlier assumptions (Lund and Jorgensen, 1999). Compared to leniency, the other aspect of owners’ permissiveness (the ‘strict owner’) had a less complex association with the SRP status and behaviour of dogs. This relationship was also affected by the sex of the dog: male, non-SRP dogs that frequently barked had strict owners, meanwhile

female dogs that barked frequently had non-strict owners. These results altogether suggest that ‘strictness’ and ‘leniency’ are not merely the non-overlapping counterparts of permissiveness. In our study, owners were mostly strict with their male dogs and less strict with females – meanwhile this seems to be rather independent of whether they were lenient or not. In other words, a lenient owner can be either strict or not – which is exactly the kind of unpredictability that is more likely to trigger frustration in the dog.

The behavioural traits of the dog’s food demanding and tendency to resist showed effects of the frustration/ SRP-related factors – and these results supported our predictions. Dogs that scored high on the ‘begging dog’ trait did not whine frequently during the separation test, even if they were considered as SRP-dogs by their owners. We can interpret this as those owners who let their dogs become overtly food demanding, may possibly trigger the development of easily frustrated dogs that show SRP signs which are atypical of fear (i.e. these dogs did not whine). Furthermore, the result showing that SRP-dogs scored high on the resistance dimension is in good agreement with our prediction, because it can be interpreted as those dogs that usually resist against the owner’s will, may become frustrated easily and show signs that can be interpreted as SRP.

Several authors reported earlier that dogs which participated in obedience training, show less problematic behaviours (Clark and Boyer, 1993; Jagoe and Serpell, 1996 – but see Voith et al., 1992 for the opposite). From our aspect it is especially important that Clark and Boyer (1993) found that dogs which participated in an obedience training course showed less signs of SRP than the control group. In our study the only effect found in the case of the ‘obedient dog’ trait was that purebred dogs received higher scores from this aspect – but ‘obedient dog’ scores did not have any association neither with the owner-reported SRP status nor with the behaviour in the separation test. An explanation for this result could be that in our case the ‘obedient dog’ trait was comprised mainly of such items that are less tightly connected to formal training of dogs (e.g. responding to calling, or learning rules), therefore this trait could not measure the effect in dogs that were routinely trained to perform more complex tasks. Another explanation could be that owners had learned the importance of consistency (vs. leniency) while visiting obedience classes with their dogs. What we found (purebreds scored higher on ‘obedient dog’) could be explained by the difference of where the majority of mixed breed and purebred dogs are obtained from. On one hand, many mixed breed dogs are adopted from shelters (Flannigan and Dodman, 2001; New et al., 2000; Takeuchi et al. 2001; van der Borg et al., 1991). There are several papers reporting that dogs that were acquired from shelters more often develop behaviour problems that may also involve low scores on general obedience. On the other hand, purebred dogs are taken to obedience training more often (Turcsán et al., 2017).

We found a few instances where the sex of the dog had associations with the traits describing the owners’ permissiveness. One of these effects showed that the owners of male dogs were stricter than the owners of female dogs. The owner’s attitude towards their dog may be influenced by the personality differences between the two sexes. For example, according to the opinion of the owners’, male dogs are bolder than females (Turcsán et al., 2017; Starling, 2013, Kubinyi et al., 2009). Moreover, male dogs more often develop behaviour problems (e.g. aggression) and they are less social with their conspecifics than female dogs are (Borchelt, 1983; Turcsán et al., 2017). These differences may cause owners of male dogs to be stricter from the beginning of their relationship in order to prevent future problems.

Dogs with high scores on the ‘resistant dog’ trait had a higher chance of also having SRP. Based on the owners’ opinion, on the level of individual items belonging to this trait, these dogs react more negatively or even in a threatening way, when being punished or disciplined and show

high stimulus reactivity. There are several studies that found connection between aggression and SRP (Borchelt, 1982). Bamberger and Houpt (2006) analysed the comorbidity between behavioural problems and they found that SRP and dominance-related aggression are associated (Bamberger and Houpt, 2006). Stimulus reactivity and SRP (McGreevy et al., 2008), just like stimulus reactivity and aggression (Wright and Nesselrote, 1987), were also found to having a connection with each other. Summarizing the previously listed results with our findings, we can conclude that the 'resistant dog' trait showed a convincing construct validity, even if the trait itself incorporated two questions about situations when the dog is left alone, because these items contributed with relatively low loadings.

It seems that there is a proportion of dogs that, according to the opinion of their permissive ('lenient') owners have SRP; however, they did not produce the fear-related signs such as whining in the absence of the owner. We should consider that from our questionnaire, we cannot assess precisely which particular signs of SRP were considered by the owner when he/she answered the questions about the dog's SRP-status. This possibility strengthens the hypothesis that SRP is such a complex phenomenon, where multiple factors can trigger various signs (e.g. Sherman and Mills, 2008). Consequently, there might be a proportion of dogs with owner-reported SRP that mostly react not with fear, based on the characteristic lack of whining, but with frustration to the absence of the owner.

There was a proportion of dogs that did not whine, but they barked during the outdoor separation test, and these had lenient owners as well. These dogs may react to the departure of the owner with frustration related behaviours such as barking, in order to change the owner's current intention (of leaving them) towards taking them away from the unpleasant situation (not leaving or not leaving them behind). We did not find direct association between the owner-reported SRP and barking in the outdoor separation test – this result is consistent with our previous results (Pongrácz et al., 2017). Here we found that dogs of 'lenient' owners mostly barked instead of whining when they were isolated from their owners – this is a good indication that owners' permissive/inconsistent behaviour may be associated with having a frustration-prone dog that easily reacts with barking in the case of unpleasant situations. Barking is one of the most conspicuous signs of SRP and the most disturbing for the neighbourhood as well (Pongrácz et al., 2016). Conversely, whining is a short-range vocalisation (Faragó et al., 2014) that is nearly inaudible even in the next room to the dog. It may explain why barking is probably an over-represented sign given by owners as compared to whining when assessing SRP. Whining is a vocalisation related to negative inner states (including fear) and it appears not just in other canid species in similar contexts (Cohen & Fox, 1976; Tembrock, 1976, Palestirini et al., 2010), but it is connected to distress in human babies as well (Green et al., 2011; Johnson et al., 1975). On the other hand, being isolated from group members elicits barking only in dogs (unlike wolves, foxes and coyotes) (Cohen & Fox, 1976, Federsen-Petersen, 2000). According to our current hypothesis, barks of the left alone dog may be considered as a frustration-driven protest in order to terminate the unpleasant situation. However, we should also consider the possibility that at least in case of some dogs fear may induce barking either in contexts of separation (i.e. Pongrácz et al., 2005; Pongrácz, 2017) or threat (Vas et al., 2005; Bálint et al., 2016).

We must also consider that permissiveness/inconsistency of the owner influences how they assess the problematic behaviours of their dog – similar to earlier results on the association between owners' personality/attitude traits and the way they assessed their dogs' personality (O'Farrell, 1987; Turcsán et al., 2012). It is possible that there is a proportion of dogs, that although their owner did not recognise or did not assess it as a real problem, the dog truly has SRP because they clearly show intensive vocal behaviour during the absence of the owner. The

findings of Jagoe and Serpell (1996) support this possible explanation as they found more frequent behaviour problems in the case of first time owners' dogs, who in turn assessed their dogs as being more disobedient than experienced owners. They assumed that on one hand it may be the result of the wrong choice of breed or individual dog, but they also argue that it may be caused by different insight of the owners because of their lack of experience regarding 'normal' dog behaviour (Jagoe and Serpell, 1996).

The 'begging dog' trait showed largely similar associations with the whining behaviour and SRP status to the effects we found in the case of the 'lenient owner' trait. We can assume that food demanding and the strong need for the owner's presence may have common roots (McGreevy, 2008). Based on the individual questions belonging to this trait, these dogs often beg for food or they even steal it if they have the chance. If the food is inaccessible, they may develop frustration sooner/more intensively than dogs that show less pronounced food begging behaviour. McGreevy also found that there is a connection between food-related aggression and SRP; and dogs that get food less than half an hour after the owner arrived home, also developed SRP more often (McGreevy, 2008). Their results and our results support the hypothesis that both food demanding behaviour of dogs and the permissiveness of the owner can be associated with low tolerance against frustration in dogs.

5. Conclusion

Our results are the first attempt to test the model developed by Lund and Jørgensen (1999) in a hypothesis-driven empirical study untangling the possible association between particular signs of SRP and the emotional states of the dog. As we predicted, the owner's permissiveness might lower the threshold of frustration in the dog and this was manifested mainly as barking during the absence of the owner. Konok et al. (2015) found that dogs that had an owner with avoidant attachment style, developed SRP most often. Dogs that experience ignored needs, and dogs not provided with a secure base, may develop SRP because of owner access insecurity (Konok et al., 2015). Dogs that experience higher levels of unpredictability in their permissive/inconsequent owners' behaviour, may react with frustration to a separation episode, showing signs that are different from fear-induced separation anxiety.

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Dog – food begging	How frequent are these behaviours regarding your dog?
DSF_begsfood_table DSF_excitedoutside	If there is food on the table, does your dog beg for it? Does your dog get excited when he/she is left confined alone in another room/house? (while you are still around, just not with your dog)
DSF_begsfood_O DSF_begstreat	Is your dog begging for food while you are eating? Is your dog begging for treats/food if it knows the place where these are kept?
Owner’s permissive behaviour	How typical are the following features regarding your behaviour with your dog?
O_will	I can enforce my will on my dog
O_givein	It happens that I yield to my dog
O_consist	I am consistent with my dog
O_permiss	I am permissive with my dog
O_dogwins	My dog can impose its will on me
O_firm	I am strong minded with my dog
O_notfirm	I am weak with my dog
O_playeasy	If my dog wants something from me for no apparent reason, I start a play session with it
O_forbidseasy	I can easily stop unwanted activities of my dog (e.g. by verbal inhibition)
Dog’s problematic behaviour	How typical are the following features of your dog?
D_disobey	Does not, or almost never obeys to commands
D_easycall_dog	The dog can be called back even if there are other dogs in its vicinity
D_stealfood	The dog has a skill to seek out and steal food from anywhere, sometimes even from the hands of people
D_protest_dislike	The dog responds by barking or growling to situations/events it does not appreciate or opposes
D_counterattack	The dog responds threateningly/shows intimidating behaviour when being punished or disciplined
D_stressed_alone	The dog is highly stressed when left alone, continuously barks or shows destructive behaviour
D_easycall_animal	The dog can be called back even if there are other dogs, animals (e.g.: pigeon, cat) in its vicinity
D_learnsrules	Once the dog understands that something is forbidden, it is easy to prevent the same thing on a subsequent occasion
D_scattermind	Sometimes the dog’s attention is so distracted that it impairs its obedience
D_barkseasy	The dog often barks in unusual or novel situations. In these cases, it is almost impossible to calm it

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Table 1: The short names of the variables and the corresponding questions from the questionnaire

Question	Variables	1. Obedient dog	2. Begging dog	3. Resistant dog
The dog can be called back even if there are other dogs in its vicinity	D_easycall_dog	0.869	0.038	-0.023
The dog can be called back even if there are other dogs, animals (e.g.: pigeon, cat) in its vicinity	D_easycall_animal	0.831	0.011	-0.080
Sometimes the dog's attention is so distracted that it impairs its obedience	D_scattermind	-0.701	0.141	0.022
The dog can be called back even if there are other humans in its vicinity	D_easycall_hum	0.689	-0.139	-0.281
If the dog once understands that something is forbidden, it is easy to prevent the same thing on a subsequent occasion	D_learnrules	0.600	-0.099	-0.047
Doesn't or almost never obeys to commands	D_disobey	-0.544	0.111	0.145
If there is food on the table, does your dog beg for it?	DSL_begsfoodtable	-0.005	0.771	0.034
Is your dog begging for food while you are eating?	DSL_begsfood_O	-0.102	0.703	0.075
The dog has a skill to seek out and steal food from anywhere, sometimes even from the hands of people	D_stealfood	-0.243	0.698	-0.056
Is your dog begging for treats/food if he/she knows the place where these are kept?	DSL_begstreat	-0.016	0.631	0.063
The dog responds by barking or growling to situations/events it does not appreciate or opposes	D_protest_dislike	-0.192	0.013	0.721
The dog often barks in unusual or novel situations. In these cases, it is almost impossible to calm it	D_barkseasy	-0.252	-0.034	0.661
The dog is highly frustrated when left alone, continuously barks or shows destructive behavior	D_stressed_alone	0.032	-0.017	0.567
Does your dog get excited when he/she is left confined alone in another room/house? (while you are still around, just not with your dog)	DSL_excitedoutside	-0.099	0.262	0.552
The dog responds threateningly/shows intimidating behavior if being punished or disciplined	D_counterattack	-0.004	0.001	0.540
	Cronbach's Alpha	0.820	0.682	0.601
	Variables	1. Strict owner	2. Lenient owner	
I can enforce my will on my dog	O_will	0.795	0.008	
I am strong minded with my dog	O_firm	0.779	-0.272	
I am consistent with my dog	O_consist	0.685	-0.300	
I am weak with my dog	O_notfirm	-0.638	0.284	
I can easily stop unwanted activities of my dog (e.g. by verbal inhibition)	O_forbidseasy	0.559	-0.058	
I am permissive with my dog	O_permis	-0.246	0.787	
It happens that I yield to my dog	O_givein	-0.173	0.773	
My dog can impose its will on me	O_dogwins	-0.334	0.743	
If my dog wants something from me for no apparent reason,	O_playseasy	0.002	0.594	
I start a play session with it				
	Cronbach's Alpha	0.753	0.726	

Table 2. Combined table of the particular questions from the questionnaire and the results of the PCA analysis. The top row shows the labels we arbitrarily assigned to the particular principal component based on the characteristics of the items (questions) that belong to them (first column from the left). Loadings highlighted with bold typesetting show those items that were clustered to a particular principal component.

Obedient dog			
Variable	df	F	p
Whine	2,32	1.884	0.175
Bark	1,32	0.97	0.332
Move	1,32	2.348	0.135
Sex	1,32	2.583	0.118
SRP	1,32	0.321	0.575
Breed	1,32	7.748	0.009
Begging dog			
Variable	df	F	p
Whine	2,26	10.307	0.001
Bark	1,26	0.367	0.55
Move	1,26	14.892	0.001
Sex	1,26	15.419	0.001
SRP	1,26	18.933	0
Breed	1,26	2.452	0.129
SRP*whine	2,26	8.327	0.002
Sex*Whine	2,26	5.66	0.009
Whine*Move	2,26	12.508	0
Resistant dog			
Variable	df	F	p
Whine	2,32	0.838	0.442
Bark	1,32	2.695	0.11
Move	1,32	0.11	0.742
Sex	1,32	11.512	0.002
SRP	1,32	5.168	0.03
Breed	1,32	0,19	0.666
Strict owner			
Variable	df	F	p
Whine	2,32	0.603	0.553
Bark	1,32	2.688	0.111
Move	1,32	0.358	0.554
Sex	1,32	5.507	0.025
SRP	1,32	2.341	0.136
Breed	1,32	1.403	0.245
Lenient owner			
Variable	df	F	p
Whine	2,24	1.176	0.326
Bark	1,24	0.179	0.676
Move	1,24	10.014	0.004
Sex	1,24	2.494	0.127
SRP	1,24	0.066	0.799

Breed	1,24	7.198	0.013
Whine*Bark	2,24	5.952	0.008
Sex*Bark	1,24	6.36	0.019
Sex*Move	1,24	4.73	0.04
Sex*SRP	1,24	5.037	0.034
SRP*Whine	2,24	8.453	0.002
SRP* Breed	1,24	11.183	0.003

Table 3: The results of the Generalized Linear Models (results in bold type are significant)

Obedient dog			
Variable	Variable	Mean	Std.Error
Breed	-		
1		0.35	0.196
2		-0.59	0.264
Begging dog			
Variable	Variable	Mean	Std.Error
Whine	-		
0		1.12	0.279
1		-0.358	0.191
2		0.231	0.246
Whine	Sex		
0	1	-0.19	0.342
	2	2.43	0.453
1	1	-0.564	0.247
	2	-0.152	0.295
2	1	0.035	0.293
	2	0.427	0.388
Move			
0		0.928	0.243
1		-0.266	0.179
Move	Whine		
0	0	2.723	0.425
	1	-0.482	0.272
	2	0.544	0.432
1	0	-0.483	0.368
	1	-0.235	0.314
	2	-0.081	0.247
SRP			

1		0.904	0.212
2		-0.242	0.182
SRP			
Whine			
1	0	2.504	0.415
	1	-0.153	0.269
	2	0.362	0.367
2	0	-0.264	0.343
	1	-0.564	0.303
	2	0.101	0.275
Sex			
1		-0.24	0.161
2		0.902	0.244
Resistant dog			
Variable	Variable	Mean	Std.Error
Sex			
1		-0.086	0.176
2		0.915	0.244
SRP			
1		0.726	0.209
2		0.104	0.202
Strict owner			
Variable	Variable	Mean	Std.Error
Sex			
1		0.234	0.2
2		-0.553	0.277
Lenient owner			
Variable	Variable	Mean	Std.Error
Bark	Whine		
0	0	-0.402	0.211

		1	-0.336	0.158
		2	0.188	0.161
1		0	0.38	0.239
		1	-0.267	0.212
		2	-0.439	0.259
Bark	Sex			
0		1	-0.084	0.139
		2	-0.282	0.146
1		1	-0.493	0.151
		2	0.276	0.261
Move				
0			0.139	0.142
1			-0.431	0.107
Move	Sex			
0		1	-0.197	0.143
		2	0.476	0.241
1		1	-0.38	0.149
		2	-0.482	0.166
SRP	whine			
1		0	0.419	0.269
		1	-0.297	0.159
		2	-0.621	0.223
2		0	-0.44	0.222
		1	-0.305	0.184
		2	0.37	0.178
SRP	breed			
1		1	-0.212	0.152
		2	-0.121	0.217
2		1	0.437	0.139

	2	-0.687	0.194
SRP	sex		
1	1	-0.13	0.124
	2	-0.203	0.224
2	1	-0.447	0.141
	2	0.197	0.173
Breed			
1		0.112	0.112
2		-0.404	0.146

Table 4: The results of the Tukey post hoc tests (**breed**: 1: purebred 2: mixed breed; **sex**: 1: male 2: female; **SRP**: 1: SRP 2: non-SRP)

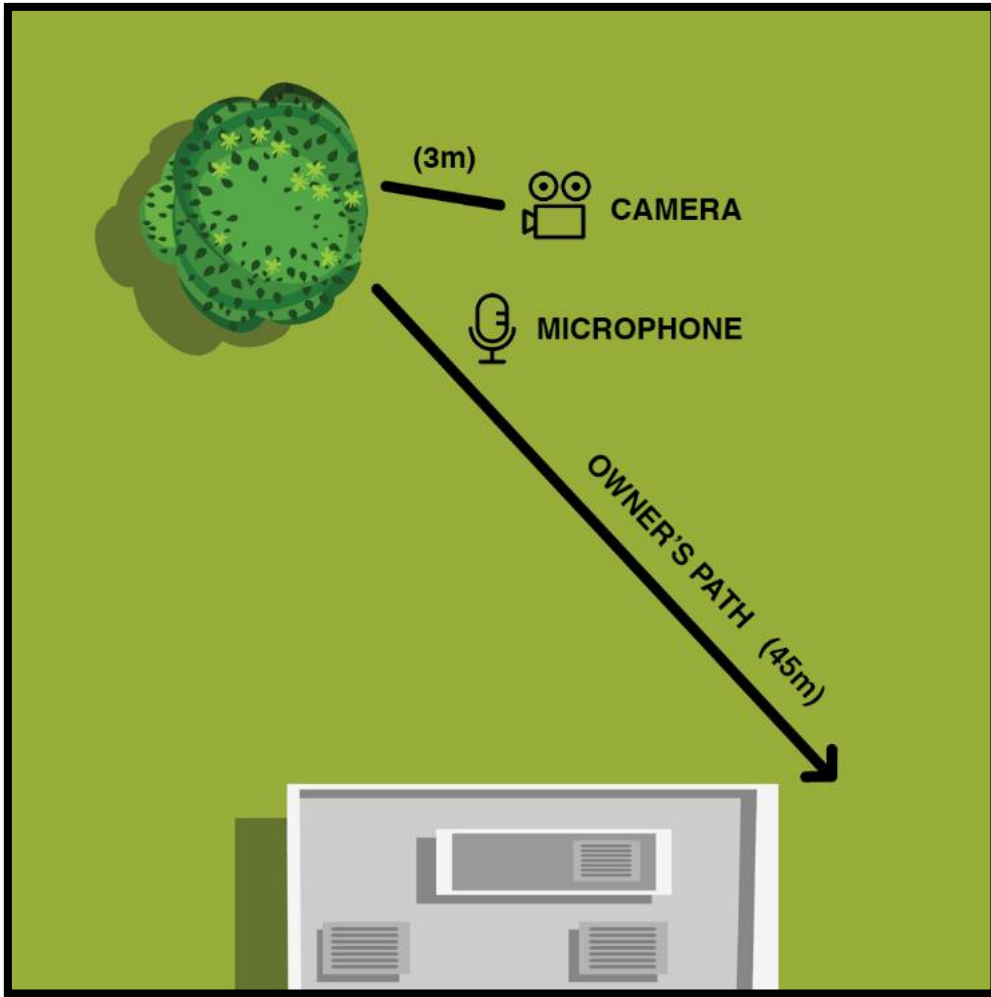


Figure 1: The schematic arrangement of the testing area

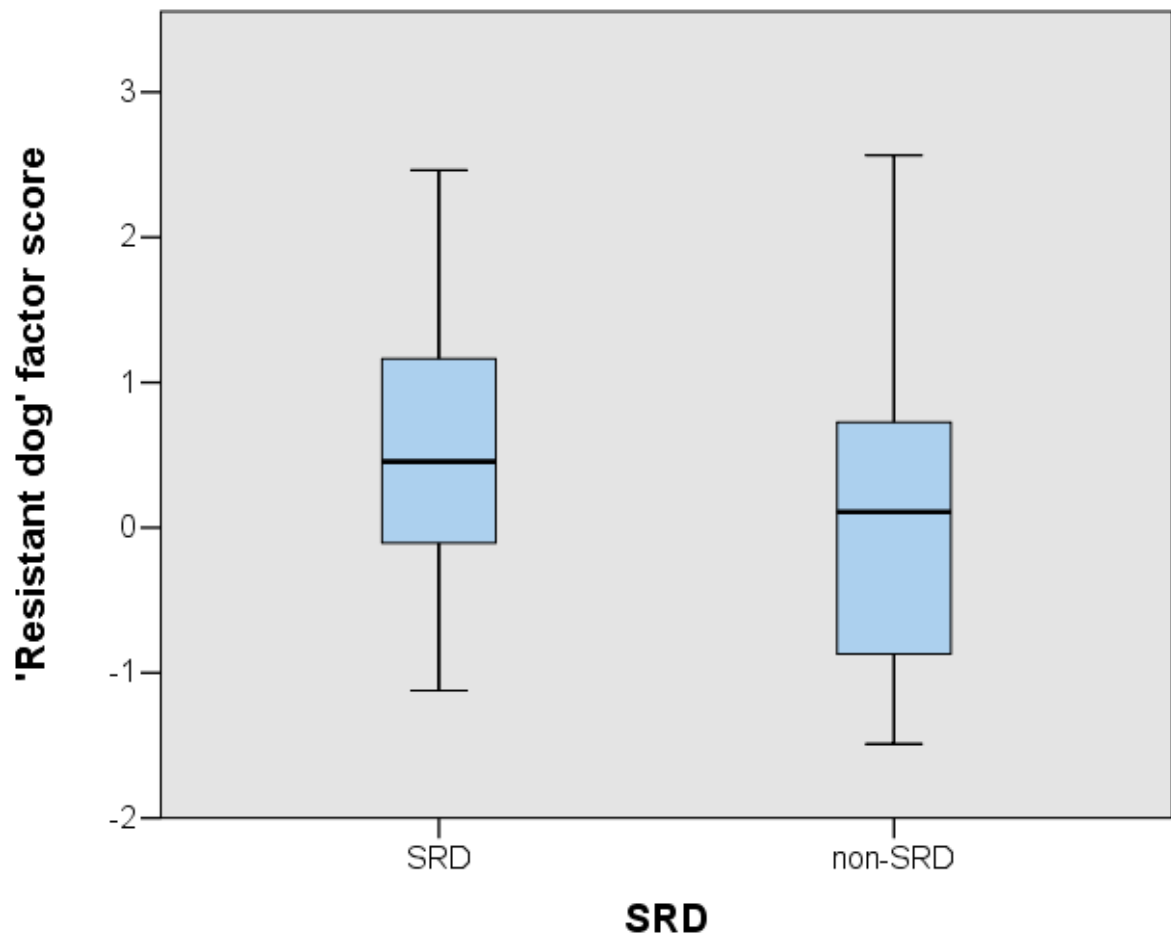


Figure 2: The relationship between Resistant dog factor and SRP-status (**SRP**: dogs with separation related problems non-SRP: dogs without separation related problems)

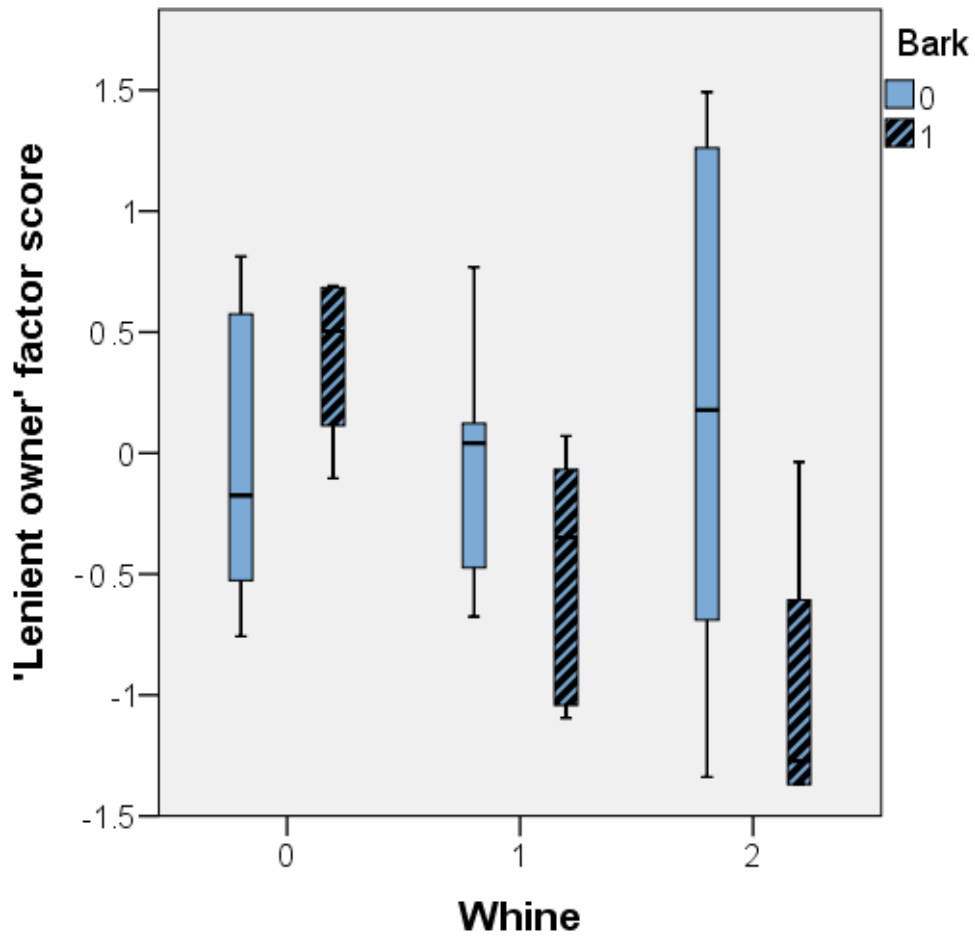


Figure 3: The relationship between lenient owner factor, whine and bark (**Whine**: the amount of whining scored from 0 to 2 **Bark**: barking scored from 0 to 1)

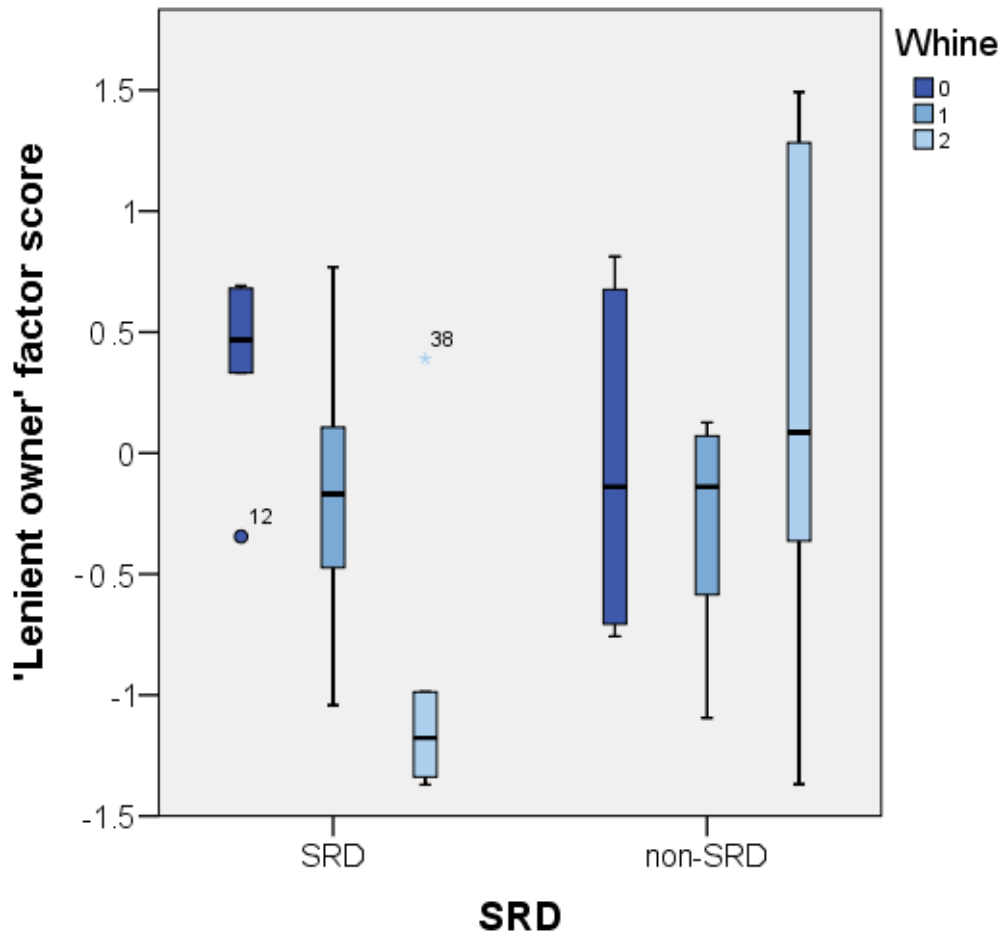


Figure 4: The relationship between lenient owner factor, SRP-status and whine (**Whine**: the amount of whining scored from 0 to 2 **SRP**: dogs with separation related problems non-SRP: dogs without separation related problems)

Supplementary Material

Questionnaire: The relationship between the owner's personality and the separation related problems in dogs. Items used in the PCA analysis.

If there is food on the table, does your dog beg for it?

1 – 2 – 3 – 4 – 5

never → always

If he/she does, what kind of behaviours does the dog show?

You can choose more than one answer

he/she sits and stares

he/she whines

he/she barks

he/she jumps up

Does your dog get excited before his/her regular feeding time?

1 – 2 – 3 – 4 – 5

never → always

If he/she does, what kind of behaviours does the dog show?

You can choose more than one answer

he/she sits and stares

he/she whines

he/she barks

he/she jumps up

Does your dog get excited when he/she is left confined alone in another room/house? (while you are still around, just not with your dog.)

1 – 2 – 3 – 4 – 5

never → always

If he/she does, what kind of behaviours does the dog show?

You can choose more than one answer

he/she sits and stares

he/she whines

he/she barks

he/she jumps

Is your dog begging for food while you are eating?

1 – 2 – 3 – 4 – 5

never → always

If he/she does, what kind of behaviours does the dog show?

You can choose more than one answer

he/she sits and stares

he/she whines

he/she barks

he/she jumps up

Does your dog bring a toy for you when he/she wants to play?

1 – 2 – 3 – 4 – 5

never → always

If he/she does, what kind of behaviours does the dog show?

You can choose more than one answer

he/she sits and stares

he/she whines

he/she barks

he/she jumps up

Is your dog begging for treats/food if he/she knows the place where these are kept?

1 – 2 – 3 – 4 – 5

never → always

If he/she does, what kind of behaviours does the dog show?

You can choose more than one answer

he/she sits and stares

he/she whines

he/she barks

he/she jumps up

Does your dog sometimes ‘want’ something from you with no apparent reason?

1 – 2 – 3 – 4 – 5

never → always

If he/she does, what kind of behaviours does the dog show?

You can choose more than one answer

he/she sits and stares

he/she whines

he/she barks

he/she jumps up

How typical are the following features regarding your behaviour with your dog?

I can enforce my will on my dog

never – rarely – sometimes – often – always

It happens, that I yield to my dog

never – rarely – sometimes – often – always

I am consistent with my dog

never – rarely – sometimes – often – always

I am permissive with my dog

never – rarely – sometimes – often – always

My dog can impose his/her will on me

never – rarely – sometimes – often – always

I am strong-minded with my dog

never – rarely – sometimes – often – always

I am inconsistent with my dog

never – rarely – sometimes – often – always

If my dog doesn't listen when I say 'No', I leave it to him/her

never – rarely – sometimes – often – always

I am weak with my dog

never – rarely – sometimes – often – always

If my dog wants something from me with no apparent reason, I respond to him/her

never – rarely – sometimes – often – always

I can easily stop unwanted activities of my dog (e.g. by verbal inhibition)

never – rarely – sometimes – often – always

How typical are the following features of your dog?

Doesn't or almost never obeys to commands

never – rarely – sometimes – often – always

The dog can be called back even if there are other dogs in its vicinity

never – rarely – sometimes – often – always

The dog has a skill to seek out and steal food from anywhere, sometimes even from the hands of people

never – rarely – sometimes – often – always

The dog seizes every opportunity to escape and run away, and after successfully getting away, it is very difficult to call him back

never – rarely – sometimes – often – always

The dog responds by barking or growling to situations/events it does not appreciate or opposes

never – rarely – sometimes – often – always

The dog responds threateningly/shows intimidating behaviour if being punished or disciplined

never – rarely – sometimes – often – always

The dog is highly frustrated when left alone, continuously barks or shows destructive behaviour

never – rarely – sometimes – often – always

The dog can be called back even if there are other dogs, animals (e.g.: pigeon, cat) in its vicinity

never – rarely – sometimes – often – always

If the dog wants to obtain something, it pursues that persistently or even aggressively

never – rarely – sometimes – often – always

The dog behaves in a dominating way

never – rarely – sometimes – often – always

If the dog once understands that something is forbidden, it is easy to prevent the same thing on a subsequent occasion

never – rarely – sometimes – often – always

Sometimes the dog's attention is so distracted that it impairs its obedience

never – rarely – sometimes – often – always

The dog often barks in unusual or novel situations. In these cases, it is almost impossible to calm it

never – rarely – sometimes – often – always

The dog can be called back even if there are other humans in its vicinity

never – rarely – sometimes – often – always