The relationship between owner to dog parenting styles and problem behaviour in domestic dogs *(Canis familiaris)*

Validation of the dog-directed PSDQ and the relationship with fear, aggression and separation-anxiety

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Abstract

Parenting styles are known to influence the behavioural development of children and possibly similar relationships exist in the owner to dog relationship, potentially opening ways to new strategies to prevent unwanted behaviour in dogs. In humans, the two dimensions parental responsiveness and parental demandingness are assumed to underlie four different parenting styles, *i.e.* authoritative, authoritarian, permissive and uninvolved/neglectful. This study investigated whether or not parenting styles are present in owner-dog relationships and if the Parenting Style and Dimensions Questionnaire (PSDQ) adapted for use with dogs instead of children is a valid measuring tool. Logical associations amongst PSDQ questions (items) and associations between PDSQ outcomes and the owners' behaviour in standardized experiments were assumed to indicate construct validity. Also investigated were the relationships between parenting styles and dog problem behaviour as assessed with the Canine Behavioural Assessment and Research Questionnaire, focussing on aggression, fear and separation anxiety. Principal components analyses of the five-point scale PDSQ answers related to the parenting of dogs showed associations in line with expectations, supporting that parenting styles manifest in the owner to dog relationship. Behaviour tests showed that permissive owners scored high on responsiveness, as they used more verbal praises when learning a new behaviour or preventing unwanted behaviour, gave more treats as praise when learning the dog new behaviour and uttered more physical praises and paid more attention to the dog during spontaneous interactions in a break. The authoritarian owners scored low on this dimension, showing relatively few verbal praises when preventing unwanted behaviour, few physical praises during spontaneous interactions in a break and little use of treats when learning the dog new behaviour. When owner and dog greeted a stranger, authoritarian owners gave relatively few verbal instructions to their dogs. Authoritative parenting showed high demandingness, with relatively many verbal instructions and controlled their dog more by using the leash when greeting a stranger compared with owners who scored higher on the other parenting styles. Together the results support the validity of the dog-directed PSDQ for assessing parenting styles in dog owners. Direct relationships were found between the dog owner authoritarian parenting style and non-social fear ($p<0.05$) and pain sensitivity ($p<0.10$) in his/her dog. Reversed relationships ($p<0.05$) existed between the authoritative parenting style and owner-directed aggression and pain sensitivity, and a trend for a direct relationship was found between the permissive parenting style and stranger-directed fear ($p<0.10$). These findings are more or less in line with what is known about parenting styles and (problem) behaviour of children, meaning that the guidance of dog owners into an appropriate style of parenting dogs could be an effective means to improve the owner-dog relationship and behaviour of the dog, and thus the latter's well-being.

Keywords: parenting style, problem behaviour, responsiveness, demandingness, domestic dog

1. Introduction

Problem behaviour in dogs is a major reason for their relinquishment to animal shelters, with aggression being the most serious problem behaviour with the worst consequences on the long term, *i.e*. euthanasia. Aggression in dogs is common and the occurrence of dog bite incidents in the Netherlands is around 8.3 per 1000 people annually (Cornelissen & Hopster, 2010). Aggressive behaviour in dogs has been associated with owner attitude and behaviour, for example as expressed in parenting styles, though scientifically little is known about this yet. It is unknown, for example, if different parenting styles exist in the owner-dog relationships and it seems worthwhile to investigate this because of the association between parenting styles and problem behaviour in children. Basically, there are two parenting style dimensions, namely parental responsiveness and parental demandingness, which underlie the four parenting styles authoritative (high level of both responsiveness and demandingness), authoritarian (low level of responsiveness, high in demandingness), permissive (high level of responsiveness, low in demandingness) and uninvolved/neglectful (both low level of responsiveness and demandingness, see figure 1).

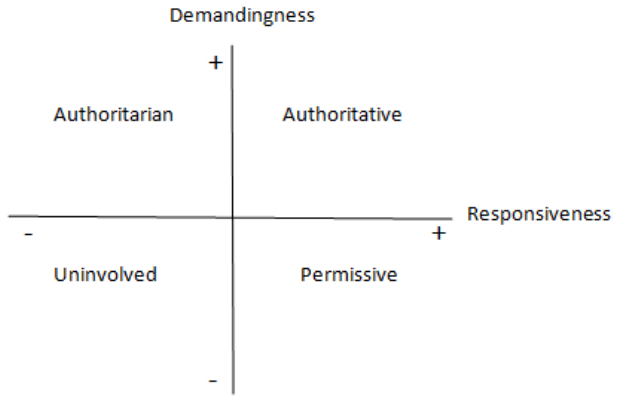

Figure 1. *The parenting styles in relation to the underlying parenting dimensions. The authoritarian style corresponds with high demandingness, low responsiveness, the authoritative style with high demandingness, high responsiveness, the permissive style with low demandingness, high responsiveness and the uninvolved style with low demandingness, low responsiveness.*

Responsiveness, also referred to as parental support, divides in the two components nurturance or warmth and clarity of communication. Nurturance refers to the parental affectionate qualities and caretaking and is expressed by warmth and involvement. Clarity of communication is about "the extent to which the parent uses reason to obtain compliance and uses open rather than manipulative techniques of control" (Baumrind, 1967). Demandingness is composed of parental control and maturity demands. Parental control refers to acts that are intended to shape the child's goal-oriented activity and may be seen as a measure of restrictiveness and disciplining, whereas maturity demands are about asking the child to perform to its ability and giving the child the opportunity to make its own decisions (training to independence). There are associations between parenting styles and problem behaviour in children and, for example, the authoritarian parenting style of mothers with mothers using over-reactive discipline are related to children's aggressive and externalizing behaviour (O'Leary *et al.*, 1999). In O'Leary's study 117 families participated and the correlations ($p<0.05$) that were found varied among boys and girls, and over time, between coefficients of 0.29

and 0.61. The correlations found stayed significant over time, indicating a stable relationship between aggressive behaviour and the authoritarian parenting style, although the causation remains unclear. Not only aggressive behaviour, but also anxiety is associated with the authoritarian parenting style, especially authoritarian fathering. A Pearson bivariate correlation of 0.17 ($p \leq 0.01$) was found in a study where 203 participants (aged 18-25 years old) were questioned about the perceived parenting style of their parents and their anxiety (Soysa & Weiss, 2014). A third dimension, psychological control, is ignored in most studies, but may be important. For example, as evident from a Chinese study with 100 boys and 115 girls (divided over nine classes of two preschools) that investigated the influence of psychological control and physical coercion on relational and physical aggression (Nelson *et al.,* 2006). The study used peer reports to access the children's aggression and interviewed all the children individually with questions like "who starts fights with other children" and "who likes to mess up other children's things" for assessing physical aggression and "who tells some other kids not to be friends with someone" for assessing relational aggression. To determine the parenting style of both parents, a spouse-report questionnaire was used. They found a significant positive association between combined (both maternal and paternal) psychological control and a girl's relational and physical aggression, with linear function slopes (β) of 0.64 and 0.55 ($p<0.01$), respectively. For boys, findings were less evident, but there was a relationship between combined physical coercion and a boy's relational and physical aggression, with a β of 0.39 ($p<0.07$) and 0.41 ($p<0.01$), respectively. Rathert *et al.* (2011) found similar results with a sample size of 69 children between age 9 and 12. They interviewed the children and parents separately and teachers filled in a questionnaire about the children's behaviour at school, revealing an association between parental psychological control and proactive aggression. Problem behaviour in children may result from a combination of parenting style dimensions rather than one dimension alone, with differential effects on different types of problem behaviour. One such type are externalized problem behaviours, which are disinhibited behaviours directed to others, like anger, aggression and frustration. Internalized behaviours are directed to oneself, like withdrawal, fearfulness, inhibition and anxiety. Aunola and Nurmi (2005) investigated the impacts of the parenting style dimensions affection, behavioural control and psychological control and parenting styles (*i.e.* combinations of the dimensions) on children's internal and external problem behaviour. The study was part of the Jyväskylä Entrance into Primary School (JEPS) study, a large ongoing research project in Finland that tracks children's development from kindergarten to primary school (n=196). The children were interviewed six times over a four year period (1999-2002) and their problem behaviour was measured using the Johns Hopkins Depression Scale and the Strengths and Difficulties Questionnaire, which were read to the children. The parents filled in a questionnaire to define their parenting styles, which was the Block's Child Rearing Practice Report. Surprisingly, the study found that high levels of maternal psychological control combined with high affection predicted increases of children's internal and external problem behaviour over time (figure 2). The explanation provided by the authors is that this type of parental style based on both supportive and guilt-inducing child-rearing, can manipulate the psychological world of the child and give inconsistent messages of maternal approval. The result would be an increase of the child's dependence and eventually different kind of problem behaviour. Additionally, Aunola and Nurmi (2005) found that a neglectful parenting style, with low affection and low psychological control, predicts external problem behaviour. Note that the summary score for internalizing and externalizing problem behaviours in this study consists of only nine yes/no

questions, five focusing on depressive symptoms for internalizing problem behaviour and four focusing on antisocial symptoms for externalizing problem behaviour. The mean scores were 1.22 and 0.89 respectively, and the increase when both maternal affection and psychological control was high was less than 0.6 and 0.8 respectively (see figure 2). The small increase could be a result of some individual extremes, but the study does not comment on individual cases.

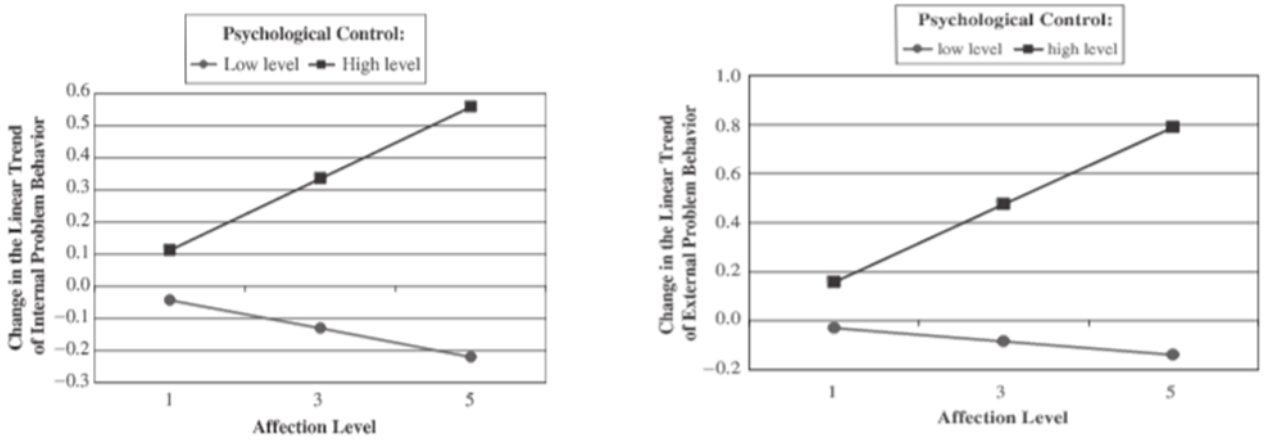

Figure 2. *From Aunola and Nurmi (2005). Change in linear trend of internal (left graph) and external (right graph) problem behaviour at different levels of maternal affection and psychological control. The range for internalizing problem behaviour is 0 to 5, the range for externalizing problem behaviour is 0 to 4, with an average of 1.22 and 0.89, respectively. When mothers show low levels of psychological control, the level of affection had no effect on problem behaviour (small decrease is not significant), but when mothers show high level of psychological control, the higher the level of affection, the greater the increase of problem behaviour in children over time (estimate=0.25, p<0.05 for internal problem behaviour, estimate=0.31, p<0.05 for external problem behaviour).*

Physical aggression was found to be correlated with an authoritarian parenting style of both the mother and father, with fractions of explained variance (R^2) of 0.24 and 0.27, respectively ($p<0.05$), in a study where in 159 eight-year-old children aggression was assessed with the Direct and Indirect Aggression Scale (Pascual-Sagastizabal *et al.,* 2014). Parental styles of both mothers and fathers were determined using the Parenting Styles and Dimensions Questionnaire. In addition, saliva samples were taken to measure androgen levels and the aforementioned correlations were found only when child salivary testosterone was relatively high, that is in being one standard deviation above the mean. Correlations were non-significant when testosterone was mediate or low (mean or one standard deviation below the mean). Thus, testosterone seems to interact with parenting styles and together they can predict more precisely the chance of showing aggressive behaviour in a child, although again the causality remains to be established (Pascual-Sagastizabal *et al.,* 2014).

Given that there is a relationship between parenting styles and (problem) behaviour in children, it is interesting to know if parenting styles exist in owner-dog relationships and explain, in part, the occurrence of problem behaviour in dogs. Problem behaviour in dogs is of importance as it is a main reason for owners to relinquish their dog to animal shelters. The most common reason to relinquish a dog are changes in life-style and housing (*e.g.* moving, landowner not allowing a pet), together explaining 34% of the dogs brought to an animal shelter, followed by problem behaviour of the dog

(Salman *et al.,* 1998). Twenty-nine % of the dogs in shelters were relinquished because of their problem behaviour, with 38% of these showing undue aggression. The figures may be underestimations as a significant number of people give reasons of housing condition or lifestyle rather than problem behaviour, being afraid that the dog may be euthanized for its behaviour (Segurson *et al.*, 2005). A range of behaviours other than aggression may cause owners to abandon their dog. In a large study in Pensylvania, 711 dog owners filled in a questionnaire at a veterinary clinic and this revealed how 42% of the dog owners think their dog shows some kind of problem behaviour (Voith *et al.,* 1992). These included behaviours like excessive barking, fearfulness, marking behaviour, disobedience and separation anxiety. In the present study on owner to dog parenting styles and problem behaviour in dogs we focus on different types of aggressive behaviour and fear, specifically stranger-directed, owner-directed and dog-directed aggression together with stranger-directed fear, dog-directed fear, non-social fear, pain sensitivity and separation anxiety.

In theory the same four parenting styles in humans could be distinguished in owner to dog relationships, based on the two parenting dimensions, *i.e.* responsiveness and demandingness. The dimension psychological control is disregarded in this study, since the concept of parenting styles in dog-rearing is still at an early stage. Although these specific dimensions are poorly studied in the context of dog-rearing, it is known that different owner behaviour and characteristics influence unwanted behaviour in dogs, like training methods, gender, age and level of affection. Since human-directed aggression is the main reason for owners to euthanize their dogs, Casey *et al.* (2014) studied the risk factors of this type of aggression and those related to 'dog parenting' are of interest here. Questionnaires (n=3897) were used asking information about the owners' age and gender, their experience of owning the dog and the dogs' age, sex, breed and neutered status, the training methods used and if the dog showed undesirable behaviour like aggression. A relationship was found between aggressive behaviour and the attendance of obedience training and the training methods used. There was an increased risk of aggression to family members of 1.7 times when dogs participated at obedience classes for at least four times. However, the causality of this relationship is unknown; it could indicate that obedience classes trigger aggressive behaviour, or that owners with aggressive dogs are more likely to go to these classes. On the other hand, the attendance at puppy classes was associated with decreased risk of aggression to unfamiliar people (of 1.5 times). One explanation is that these dogs had more social contact with unfamiliar people in their socialisation period, which is important for the development of their behaviour to strangers (as stated by Casey *et al.,* 2014). Trainings methods can be categorized in positive and negative reinforcement (encouraging wanted behaviour), and positive and negative punishment (discouraging unwanted behaviour). Positive reinforcement includes verbal praising, rewarding with food treats, clicker training, stroking or petting and playing as a reward when the dog shows desirable behaviour. Negative reinforcement includes withdrawal of negative stimuli following desirable behaviour, for example letting the dog walk off leash when it behaves correctly. Positive punishment includes verbal punishment (*e.g.* shouting), physical corrections, electric/bark activated collars and nonverbal sound distractions as a punishment of unwanted behaviour. Finally, negative punishment includes withdrawal of attention, food rewards or a favourite toy when the dog shows unwanted behaviour. In Casey's study the association between aggression and trainings methods, as assessed by the owner, was high. Dogs of owners that used positive punishment or negative reinforcement had a 2.9 and 2.2 times higher risk of aggression to family members and strangers, respectively, compared to owners using positive

reinforcement or negative punishment (Casey *et al.,* 2014). Although the causality of this relationship is unknown, the results correspond with those from other studies, for example as found in a questionnaire survey of Blackwell *et al.* (2008) (n=197). In this study the training methods varied from only positive reinforcement (16% of the owners), to a combination of positive and negative reinforcement (12%), a combination of positive reinforcement and positive punishment (32%), or a combination of all of the training methods (40%). Owners who used only positive reinforcement had the lowest mean scores for all types of problem behaviour that were tested in this study (aggression, fear and attention seeking). When focussing on aggression, owners using a combination of positive reinforcement and positive punishment had dogs with the highest aggression score (figure 3, derived from Blackwell *et al.,* 2008). When the training methods were divided in only two categories, whether or not the owners used any positive punishment method, the relationship was even stronger (figure 3). Hsu and Sun (2010) also found positive correlations between physical punishment and aggressive behaviour in dogs (n=852, $p \leq 0.053$). Dogs of owners that used physical punishment showed higher levels of aggression directed at strangers, owners and dogs. Owners (n=140) of dogs that already showed some kind of problem behaviour were asked by survey about prior efforts before seeking professional help (Herron *et al.,* 2009). Strategies tried by dog owners differed from aversive direct confrontation (*e.g.* hitting the dog, kicking it, dominance down, shock collars, leash corrections), aversive indirect confrontation (*e.g.* yelling, using spray bottle, verbal punishment), non-aversive reward-based training (*e.g.* clicker training, food rewards, playing, petting) and neutral interventions (*e.g.* avoid exposure to stimuli that trigger aggression, medicines to decrease anxiety). Aversive interventions, whether direct or indirect, resulted most often in aggression, contrary to reward-based training and this suggests that most aggressive behaviour of domestic dogs is not a result of dominance or the owner being not dominant enough, but rather a result of fear and anxiety (Herron *et al.,* 2009). However, most dogs had received different training methods before the owners sought help and, therefore, it is hard to determine causal relations. It could be that owners who had severe aggressive dogs did more often go for the positive punishment treatment. Nevertheless, such studies suggest that owners can influence problem behaviour by the way they treat their dogs. This could indicate that not only training methods, but parenting styles in general have an influence on aggressive behaviour too.

More in general, dog owner characteristics matter and, for example, gender and age of the owner can influence problem behaviour in dogs. A study in Germany where 206 dog owners were questioned in a veterinary clinic investigated the owner characteristics of two different groups. Owners had visited the veterinary because their dog was injured by another dog or because their dog had caused injuries to others (Roll & Unshelm, 1997). Not only training methods used by the owner but also dog characteristics (breed, age, gender and background) and owner characteristics discriminated the groups of victims and aggressors. Aggressive dogs were mainly owned by males between the age of 30 and 39 which commonly did not have a strong emotional relationship with their dog. These people mostly used physical correction to achieve obedience. Besides, when their dog fought, they tended to be rather passive and just shouted at their dog after the fight or showed no reaction at all. On the other hand, dogs that were victims of a fight were mostly owned by women and kept for companionship, indicating a stronger emotional relationship and higher level of responsiveness (Roll & Unshelm, 1997). The authors did not clarify the causality of the relationships found.

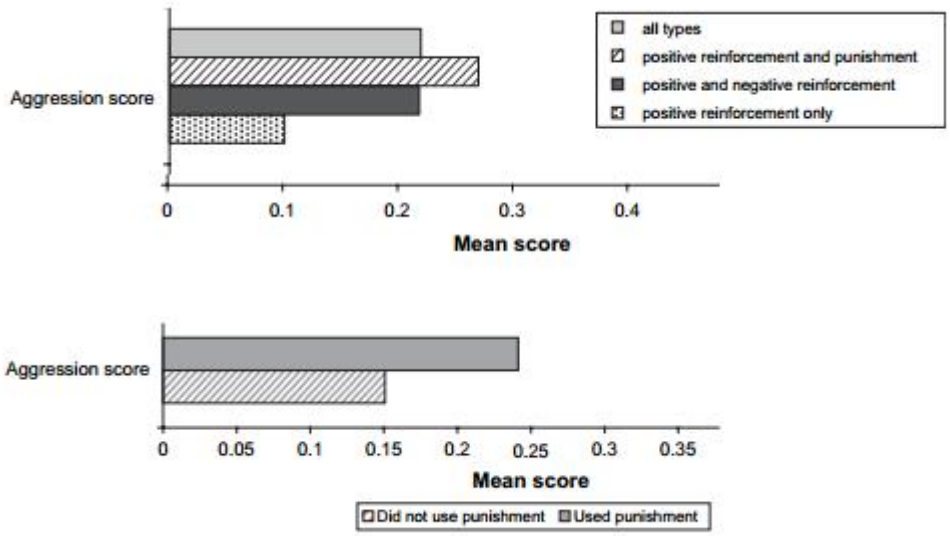

***Figure 3**. From Blackwell et al. (2008). Mean aggression score of dogs with different training types. In the upper graph the mean aggression score of dogs when owners used positive reinforcement and punishment (striped bar), positive and negative reinforcement (black bar), only positive reinforcement (dotted bar) or when they used all training types (grey bar). There is a significant difference between the trainings methods and the mean score (Kruskal-Wallis X^2=10.884 with df=3 and p<0.05). In the bottom graph the mean aggression score of dogs with owners that did use positive punishment and of dogs with owners that did not. The mean aggression score is significantly higher when owners did used punishment (Mann-Withney U z=-2.719, p<0.01).*

The causality of relationships between owner characteristics and dog problem behaviour as found in several studies is often obscure. A good example is a study of Jagoe and Serpell (1996) on the relationships between owner characteristics and the prevalence of canine behaviour problems. They used questionnaires among 737 dog owners and outcomes included, firstly, a reversed relationship between obedience training and competitive aggression and separation anxiety, secondly, a direct relationship between sleeping close to the owner and competitive aggression and separation anxiety and, thirdly, a direct relationship between first-time ownership and dominance aggression, separation anxiety and fear of loud noises (Jagoe & Serpell, 1996). Causality was not studied and it remains unknown if, for example, separation anxiety was a result of sleeping close to the owner (the dog never learned to be far away from the owner) or a cause (because of the behaviour when separated from the owner, the owner let the dog sleep close to him/her). Nevertheless, the study does indicate that human-dog relationships and owner characteristics are associated with dog behaviour.

The present study investigates whether parenting styles are present in dog-rearing and if so, whether there is a relationship between parenting styles and problem behaviour in dogs. The definitions of the parenting styles according to Baumrind (1966) are used as a starting point. Thus, authoritarian owners are believed to shape and control the dog's behaviour, highly value obedience, and prefer punitive or forceful control techniques in order to improve the dog's behaviour. Authoritative owners steer the dog's behaviour in a rational way, encouraging the dog to be dog and giving it both responsibility and freedom. Permissive owners attempt to be non-punitive and acceptant towards the desires and behaviour of the dog and avoiding the exercise of control. Uninvolved owners are

neither responsive nor controlling, they minimize their parenting effort and time and may respond with hostility or may not respond at all to the needs and behaviour of the dog (following the theoretical framework by Baumrind, 2013). Our assumption that parenting styles in dog owners influence the problem behaviours of dogs is based on the associations between parenting styles (mainly authoritarian) and problem behaviour in children. Besides, associations exist between training methods and aggressive behaviour in dogs and parenting styles likely influence the training method used. The first hypothesis to be tested is that there is a direct relationship between authoritarian parenting style and the different types of aggression and fear. The second hypothesis assumes a direct relationship between the permissive parenting style and different types of fear and aggression, which is based on the study of Baumrind (1966) in which children of permissive owners developed anxiety about their own competences, as well as aggressive behaviour because of the non-interference of the parent. Before we can test these hypotheses, we first must know if parenting styles are present in dog-rearing and we start with validating a parenting style questionnaire, for example by comparing self-reports to owner-dog interactions in behavioural tests.

2. Materials and Methods

2.1. Participants and questionnaires

To investigate if dog owners can be divided by the way they raise their dog, *i.e*. their parenting style, two questionnaires were developed and advertised in the Netherlands via social media and other Internet resources. The questionnaires were both in part extracted from the Parenting Style and Dimensions Questionnaire (PSDQ; Robinson *et al.,* 1995), originally developed for parents and their children, and adapted for dog owners. Also included were questions about attitudes on pets following the Lexington Attachment to Pets Scale (LAPS; Johnson *et al.,* 1992). The two questionnaires differed in the conversion of the original PSDQ and the largest questionnaire consisted of 62 short five point scale questions translated from the 62 item PSDQ (see *appendix 2*), while the smaller questionnaire contained only 42 short five point scale questions of the PSDQ. General information was collected also, like the owner's gender and age, and dog's neutered status and breed. The 62-item questionnaire was completed by 534 voluntary dog owners (485 women, 44 men, 5 unknown), the 42-item questionnaire by 538 dog owners (496 women, 38 men, 4 unknown). Since these PSDQ questionnaires were converted to dog owners for the first time, we checked the construct validity for example by comparing the outcomes of the questionnaires with owner to dog interactions in an experimental setting. Thirty-two dog owners, of which 21 filled in the 42-item questionnaire and 11 the 62-item questionnaire, were invited to visit Wageningen University and Research Centre with their dogs to take part in behaviour tests. Additionally, 28 out of these 32 participants filled in a second questionnaire, which contained part of the Canine Behavioural Assessment and Research Questionnaire (C-BARQ) about dog problem behaviour, specifically fear (24 items on a 5-point scale), aggression (29 items) and separation anxiety (14 items, Hsu & Serpell, 2003). This allowed us to attest the relationship between parenting style and problem behaviour in dogs.

2.2. Behaviour tests

Thirty-two dog owners participated in behaviour tests at Carus research facility in Wageningen, the Netherland. In different experimental settings dog owners were observed for their interacting with

their dogs and observations were compared to self-reported parenting styles as assessed with the questionnaires. All the behaviour tests were recorded on video and analysed afterwards using Observer XT10.5.

Based on the two dimensions that define a parenting style, namely responsiveness and demandingness, five tests were designed to assess these and behaviours were recorded following a same ethogram (see *appendix 1*). This ethogram consisted of both owner behaviours and dog behaviours like locomotion, stress signals, arousal signals and attention of the dog. Owner behaviours that were scored included given reprimands, praises and commands and attention of the owner. Dog owners who arrived at Wageningen University were welcomed by one of the experimenters and shown the test room. A second experimenter then walked into the test room after which it was observed how the dog greeted this stranger (*i.e.* the second experimenter, n=30). We mainly focused on aspects of control and maturity demands, like if the dog was allowed to greet the stranger, remained with all paws on the ground (*i.e.* no jumping up to the stranger), performed a sit or lay down without guidance (indicating that the dog showed learned behaviour on how to greet a stranger), and whether or not the owner gave a command. In the second test, owners (n=31) got three minutes to make the dog score goals, using a Jolly "Push-n-Play" ball of 15cm (for dogs measuring 30cm or under at the withers) or 25cm (for dogs measuring over 30cm at the withers) and a goal (68x45x51cm). The owner was asked to make the dog score as many times as possible and was allowed to help and reward the dog. The level of warmth was measured during the test, and whether or not owners used clarity of communication like if they supported their dog when teaching it a new behaviour. Furthermore of interest was if they gave commands and tried to learn the behaviour step by step, rewarding successes along the way or only focused on and rewarded the final target behaviour. The next test focused on how owners prevented unwanted behaviour in their dogs. In this test, the owner walked with the dog (n=28) on leash back and forth past a coffee table (20cm high) with on it a treat. Owners were instructed that the dog was not allowed to eat the treat and it was observed whether or not the owner pulled the leash or commanded the dog. Other ways used by the owner to prevent unwanted behaviour was noted and these included blocking the dog by standing between the treat and the dog or shortening the leash. The level of warmth was measured, simply by observing whether or not the owner rewarded the dog when it did not eat the treat. The test was repeated with a ball next to the table instead of the treat on it and these two trials were also repeated after a break. Somewhere in the middle of the session there was a five minute 'break' when the owner and dog could do whatever they wanted (n=31) whilst remaining in the test room. There were toys available for the dog and something to read for the owner. In this test we observed the level of responsiveness (mainly warmth and involvement) by looking at how much of the time the owner interacted with the dog, and whether or not the dog received toys and praises (verbal, physical). The level of demandingness was observed by measuring the number of reprimands and instructions. Finally, a self-control test was performed for assessing the level of demandingness (n=32). In children too much behavioural control results in low self-control and poor skills to resolve conflicts, while insufficient behavioural control results in low impulsive control, and the self-control test was conducted to check if this applies to dogs. The experimenter placed a treat in front of the dog at one meter distance, which the dog was not allowed to eat. The owner made the dog sit and told the dog once that it had to stay, after which the time that dog stayed seated was recorded with a maximum of two minutes. Assumingly, the staying time mirrored the level of self-control and

behavioural control. The test was done twice, and the second time the owner was allowed to support the dog to stay. All the tests were done in a random order, except the greeting stranger test, which was always first, and the break test, which was always in the middle. Figure 4 shows the set-up of the tests in the test room.

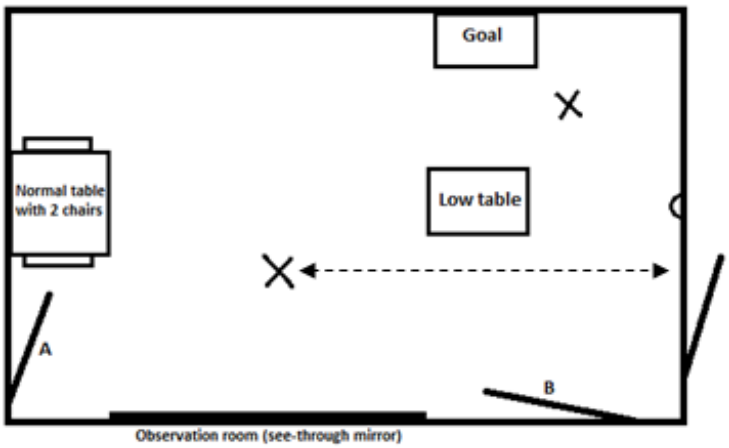

Figure 4. *Schematic view of the test room. The normal table (with two chairs) was always present in the room, in the goal scoring test the ball and in the break test toys and magazines were placed on this table. The low table and goal were placed when the related test started and directly removed after the test. The dotted arrow represents the route the owner and dog had to take in the treat on table test (they walked from the door to the taped X and back). The other X represents the place the dog had to sit during the self-control test. The ring on the right side of the wall is the place the three meter leash was secured.*

2.3. Statistical analysis

To establish associations between questionnaire items, a principle component analysis (PCA, Jolliffe, 1986) was conducted for both questionnaires following procedures described by Van Reenen *et al.* (2004). Underlying correlation matrices in sets of items, here questions, are represented by principal components as linear combinations of item scores. Principal components identify items that co-vary in the same or opposite direction and could possibly represent a parenting style or dimension. The relative importance of a component is indicated by the percentage of variation in the data set that it explains. The questions with loadings (w_1) higher than |0.4| were considered related, possibly representing a parenting style. Parenting style scores were calculated by summing the questions that loaded significantly on a same PCA dimensions and expressing the score as a percentage of the maximum.

The owner behaviours recorded during the behaviour tests were expressed as events in rate per minute and states in percentage of the observation time and next investigated for associations using PCA. Component scores derived from the PCA were calculated from an individual's score for the different items, using loadings as weighing factors. These component scores, like those representing 'warmth' or 'control', as well as single owner behaviours were used for further analyses. Pearson correlations (r) were calculated between parenting style scores (percentages) and the different owner behaviours. The assumptions on data distribution for a Pearson correlation coefficient were checked by making Q-Q plots to evaluate normality. Readout parameters of the treat on table test were analysed with restricted maximum likelihood (REML) by use of a linear mixed model (LMM). REML assumes data to have a normal distribution, but LMM takes the actual distribution into

account and implements REML-type analyses. The statistical models included a random component to account for the repeated measures as every dog did the test four times, two times with a treat and two times with a ball. The following statistical model was used:

$$Y_{xpq} = \mu + TRIAL_x + OBJECT_p + (TRIAL_x \bullet OBJECT_p) + DOG_q + e_{xpq}$$

where Y_{xpq} is a behaviour score for dog q (n = 28) during trial x (1, 2) with object p (ball, treat). Dog made up the random component of the statistical model as to account for the repeated measures on the same experimental unit.

For further analyses on associations sums of the 4 different tests were used. Finally, Pearson correlations (r) were calculated between the problem behaviour factor scores derived from the C-BARQ, expressed as percentages of the maximum, and the parenting style percentages.

3. Results

3.1. Parenting style questionnaires

In the first of three study phases it was investigated whether or not dog owners use parenting styles in dog-rearing. Two questionnaires were used, with the complete PSDQ questionnaire (62 items) as the most important one. A PCA was conducted for both questionnaires, to check which questions correlated to each other and possibly reflect a parenting style or dimension. The questions with loadings higher than |0.4| were considered significant and components were checked especially for if these represented one of the three parenting styles, authoritative, authoritarian or permissive.

For the 62-item questionnaire (n=534), the first component of the PCA contained 18 questions that originally represented the authoritative parenting style, explaining 13.9% of the variation in the dataset. It also contained three questions that originally represented the authoritarian parenting style, but with reversed (negative) loadings, and additionally the two questions “I tell my dog what to do” (which originally represented the authoritarian parenting style) and “I lure my dog with reward to solicit certain behaviour, even when it is misbehaving at that moment” (of the permissive parenting style). The second component contained eight questions of the authoritarian parenting style and two of the permissive style with a reversed scale score, with 8.9% of the variation explained. The third component contained six questions of the permissive parenting style (6.9% variance explained) and three questions of the authoritative parenting style, with two that originally represented the dimension warmth and involvement and one that represented democratic participation. In table 1 the questions corresponding to each parenting style and their loadings are shown, no components were found that could be linked to the uninvolved parenting style.

Table 1*. Dog owners reported on how they parented their dogs by filling out the (adapted) Parenting Style and Dimensions Questionnaire (PSDQ), commonly used for assessing child parenting styles. Sixty-two Item scores expressed on a 5-points scale were analysed for associations using a Principal Components Analysis (n=534). Questions corresponding with parenting styles to dogs and their loadings are presented and the third column indicates the parenting style where the questions originally correspond to, according to PSDQ by Robinson et al. (1995). AUTV=authoritative, AUTN=authoritarian, PERM=permissive.*

	Question	Official PS	Loading
Authoritative parenting style			
Q148	I have good times together with my dog.	AUTV	0.46
Q158	I encourage my dog to ‘be dog’ even when it results in a dirty or wet dog.	AUTV	0.47
Q163	I lure my dog with reward to solicit certain behavior, even when it is misbehaving at that moment.	PERM	0.45

Q173	I show respect for my dog' s needs by encouraging my dog to 'be dog'.	AUTV	0.59
Q193	I take into account my dog's preferences in making plans.	AUTV	0.52
Q208	I practice behavior step by step with my dog, so I am sure he understands what I ask of him.	AUTV	0.57
Q218	I channel my dog's misbehavior into a more acceptable activity.	AUTV	0.53
Q501	I encourage my dog to show how it feels by its body language, I see growling as a signal of my dog's emotion for example.	AUTV	0.40
Q506	I guide my dog by punishment more than by tapping into its natural needs.	AUTN	-0.45
Q521	I give praise when my dog is good.	AUTV	0.48
Q526	I use a corrective slap when my dog misbehaves.	AUTN	-0.41
Q531	I joke and play with my dog.	AUTV	0.52
Q566	I am easy going and relaxed with my dog.	AUTV	0.47
Q576	I practice certain behavior with my dog before asking this behavior in a more difficult situation.	AUTV	0.55
Q586	I show patience with my dog.	AUTV	0.57
Q601	I am responsive to my dog's feelings or needs.	AUTV	0.64
Q621	I think about why rules should be obeyed by my dog.	AUTV	0.52
Q631	I tell my dog 'good dog' when he tries to follow guidance, even if he does not succeed.	AUTV	0.43
Q641	I help my dog to understand the impact of its behavior by offering him choices in situations.	AUTV	0.44
Q651	I take my dog's desires into account before asking him to do something.	AUTV	0.53
Q656	I can explode in anger towards my dog when he does something he knows I don't want him to do.	AUTN	-0.43
Q696	I tell my dog what to do.	AUTN	0.46
Q706	I think about why my dog does something when it misbehaves.	AUTV	0.57
Authoritarian parenting style			
Q133	I use a poke of my finger, or short kick to snap my dog out of it when it misbehaves.	AUTN	0.45
Q138	I use short pulls on the leash or pull back when my dog pulls.	AUTN	0.49
Q153	When two dogs are fighting, I discipline first and think about why it happened later.	AUTN	0.40
Q178	I set strict well-established rules for my dog.	PERM[1]	-0.56
Q183	I let my dog know how I feel about its good and bad behavior.	AUTV	0.55
Q198	When I ask my dog to do something, he should do so, because I said so and I am its boss.	AUTN	0.62
Q213	I demand that my dog does things.	AUTN	0.55
Q536	I do not set consequences even when my dog acts contrary to my wishes.	PERM	-0.52
Q581	I raise my voice to make my dog improve.	AUTN	0.42
Q591	I grab my dog when he/she is being disobedient.	AUTN	0.45
Q681	I use physical punishment as a way to improve my dogs behavior.	AUTN	0.52
Q686	I carry out discipline after my dog misbehaves.	PERM[1]	-0.45
Permissive parenting style			
Q516	I find it difficult to discipline my dog	PERM	0.41
Q541	I show sympathy when my dog is hurt or frustrated.	AUTV	0.45
Q551	I spoil my dog.	PERM	0.44
Q556	I give comfort when my dog is upset.	AUTV	0.48
Q596	I threaten with punishments towards my dog and do not actually do them.	PERM	0.43
Q606	I allow my dog to give input on decisions for instance with regard to the route we follow on walks.	AUTV	0.49
Q646	I am afraid that disciplining my dog for misbehavior will cause him to like me less.	PERM	0.44
Q666	I threaten my dog with punishment more often than actually giving it.	PERM	0.45
Q701	I give into my dog when he causes a commotion about something or doesn't do something I want it to.	PERM	0.55

[1]These questions had a reversed scale score in the original PSDQ

A same PCA on the items of the 42-item questionnaire (n=538) produced a main component that contained eight of the 16 questions that originally represented the authoritarian parenting style, with a percentage of variation explained of 12.3%, and one question that originally represented the authoritative parenting style (warmth and involvement dimension) with a reversed loading. See *appendix 3* for the questions (in Dutch) corresponding to each parenting style and their PCA loadings. The second most important component contained seven of the 14 questions of the authoritative parenting style and explained 10.9% of the variation. It also contained two questions that originally represented the authoritarian parenting style and two that represented the permissive parenting style. A third component contained seven of the 12 questions of the permissive parenting style and one of the authoritative parenting style ("I take my dog's desires into account before asking him to do something"), explaining 8.4% of the variation.

3.2. Validation of the dog directed PSDQ

The second phase of the study involved further validation of the PSDQ questionnaire for measuring parenting styles in dog owners by comparing questionnaire based scores to scores for owner-dog interactions in experimental settings. In both questionnaires owners (n=534 and 538) were asked to participate in the dog behaviour tests. In order to make the two groups of owners comparable, parenting style scores were based on the questions with loadings higher than |0.4| in the PCA of the 62-item questionnaire, which were used also in the 42-item questionnaire. These questions are shown in table 2 and original items scores on a 5-point scale were used to calculate parenting style percentages of the maximum possible score (see *appendix 3* for the original Dutch questions of both questionnaires). The participants (n=32) of the behaviour tests had average (± standard deviation, SD) parenting style scores for being authoritarian, authoritative and permissive of, respectively, 46.1±13.0%, 74.4±8.1% and 42.5±14.6%. They had an average of 76.6±14.5% for the total LAPS score, which indicates the level of emotional attachment of the owner to the dog. Positive Pearson correlations were found between the LAPS score and scores for being authoritative (r=0.41, n=32, p=0.05) and permissive (r=0.37, p=0.05), and a negative correlation with scores for being authoritarian (r=-0.35, p=0.05). Parenting style scores were compared with the results of the behaviour tests by calculating Pearson correlation coefficients (see *appendix 5*).

Table 2. *Questions that are used to calculate the parenting style percentages of the participants (n=32). All these questions have a loading > |0.4| resulted from the PCA and correspond in both questionnaires (for original Dutch questions of each questionnaire, see Appendix 3).The first column shows the parenting style, AUTV=authoritative, AUTN=authoritarian, PERM=permissive. The table also shows the question number in the 62-item, the 42-item and the original PSDQ.*

PS	Q 62-item	Q 42-item	Question
AUTV	506[1]	189[1]	2. I guide my dog by punishment more than by tapping into its natural needs.
	521	229	5. I give praise when my dog is good.
	526[1]	139	6. I use a corrective slap when my dog misbehaves.
	531	154	7. I joke and play with my dog.
	566	254	14. I am easy going and relaxed with my dog.
	586	199	18. I show patience with my dog.
	601	274	21. I am responsive to my dog's feelings or needs.
	651	289	31. I take my dog's desires into account before asking him to do something.

	656[1]	204[1]	32. I can explode in anger towards my dog when he does something he knows I don't want him to do.
	148	184	46 I have good times together with my dog.
	163[2]	134[2]	49. I lure my dog with reward to solicit certain behavior, even when it is misbehaving at that moment.
	193	129	55. I take into account my dog's preferences in making plans.
	218	159	60. I channel my dog's misbehavior into a more acceptable activity.
AUTN	536	114[1]	8. I do not set consequences even when my dog acts contrary to my wishes.
	581	214	17. I raise my voice to make my dog improve.
	591	279	19. I grab my dog when he/she is being disobedient
	681	244	37. I use physical punishment as a way to improve my dogs behavior.
	686	109[1]	38. I carry out discipline after my dog misbehaves.
	178	169	52. I set strict well-established rules for my dog.
	183	94	53. I let my dog know how I feel about its good and bad behavior.
	198	149	56. When I ask my dog to do something, he should do so, because I said so and I am its boss.
	213	179	59. I demand that my dog does things.
PERM	516	194	4. I find it difficult to discipline my dog.
	541	144	9. I show sympathy when my dog is hurt or frustrated.
	551	174	11. I spoil my dog.
	556	104	12. I give comfort when my dog is upset.
	646	119	30. I am afraid that disciplining my dog for misbehavior will cause him to like me less.
	666	224	34. I threaten my dog with punishment more often than actually giving it.

[1]Questions with a reversed scale score

[2]Question is not used in further analyses, not the same translation in the two questionnaires, one correlates with permissive, other with authoritative parenting style (see Appendix 3)

For each behaviour test (except the self-control test) a PCA was done to detect correlated owner behaviours. For every test, two main components were identified that included behaviours with loadings higher than |0.4|, and that could be linked to one of the parenting style dimensions. Next, Pearson correlation coefficients were calculated between the behaviour test component scores and the parenting style percentages. Correlations were also calculated with some isolated owner behaviours, to check if single behaviours were related to parenting styles rather than owner behaviour patterns.

3.2.1. Greeting stranger test

The dogs' responses to the unfamiliar experimenter were measured as well as how the owner acted during this meet. The dataset consisted of 30 records (2 records were lost because of recording failures), with one per owner-dog dyad. The mean (±SD) scores and occurrence of the 17 owner behaviours that were observed are presented in *appendix 4*. Seven of the 17 behaviours did not occur during this test, *i.e.* gesture and physical reprimands, gesture and treat praises, body position control by moving and by blocking and finally giving toys. A PCA with the remaining owner behaviours (n=30 with 10 input parameters) resulted in two meaningful components consisting of behaviours linked to behavioural control and behaviours linked to warmth (and involvement). The behavioural control component, explaining 36% variation, consisted of the percentage of time the leash was tight (w_1=0.90), body position control using leash (w_1=0.84), verbal reprimand (w_1=0.57), reprimand using leash pull (w_1=0.55), gesture command/instruct (w_1=0.48) and verbal command (w_1=0.47). The component representing warmth explained 17.8% of the variation and consisted of the behaviours physical praise (w_1=0.59), verbal command (w_1=0.57), gesture command (w_1=-0.65) and verbal reprimand (w_1=-0.64). High positive component scores for behavioural control and

warmth represented strong tendencies in the named dimensions, with negative component scores indicating the opposite.

Correlations between parenting styles and owner behaviours, as well as PCA component scores for control and warmth are presented in table 3. Negative correlations were found between the authoritarian parenting style with verbal instructions (r=-0.67, n=30, p<0.01) and with warmth (r=-0.37, p=0.05), and to a minor degree with body position control by leash (r=-0.35, p=0.07) and behavioural control (r=-0.32, p=0.10). Positive correlations where found between authoritative parenting with behavioural control (r=0.66, p<0.01), body position control by leash (r=0.62, p<0.01), the percentage of the time the leash was tight (r=0.61, p<0.01) and with verbal instructions (r=0.48, p<0.01). No correlations were found between any of the owner behaviours and the permissive parenting style. Finally, positive correlations were found between the LAPS score and the warmth dimension (r=0.62, p<0.01), verbal instructions (r=0.57, p<0.01) and a trend with body position control by leash (r=0.34, p=0.10).

Table 3. *Seventeen owner behaviours (see appendix 4) of owners who participated with their dog in the greeting stranger test (n=30) were observed and the ten that occurred during the test were used for a PCA that resulted in two component scores groups, indicating 'control' and 'warmth'. The four most observed owner behaviours as well as the two component scores groups were used to calculate the Pearson correlation coefficients between owner behaviour and parenting style percentages. The correlations with values higher than |0.36| are considered significant (with a two-tailed p of 0.05).* R^2*, the percentage of variation that is explained by the linear model, is also shown (only when significance is higher than p=0.10).*

	AUTN	**AUTV**	**PERM**	**LAPS**
Sc1: control	-0.32 (R^2=0.10)	0.66 (R^2=0.44)	0.07	0.22
Sc2: warmth	-0.37 (R^2=0.13)	0.09	0.28	0.62 (R^2=0.39)
Reprimand leash pull	0.14	0.31	-0.21	-0.09
Instruct verbal	-0.67 (R^2=0.44)	0.48 (R^2=0.23)	0.10	0.57 (R^2=0.33)
Body position control - leash	-0.35 (R^2=0.12)	0.62 (R^2=0.38)	0.18	0.34 (R^2=0.12)
Tight leash	-0.21	0.61 (R^2=0.38)	0.13	0.35

n=30, two-tailed p=0.05, critical value=0.36

3.2.2. Goal scoring test

The strategies owners used to learn the dog a new behaviour, in this case scoring with a ball in a goal, were observed by means of 12 owner behaviours (see *appendix 4* for the means±SD expressed in rates per minute or percentage of the observation time). Two of those behaviours, gesture and physical reprimands, were not observed during this test and excluded from the PCA. The dataset consisted of 31 records, one per owner-dog dyad, one participant skipped the test because she was blind. The PCA of the goal scoring test resulted in two groups with percentages of variation explained of 17.9% and 16.9%, but what dimensions the components represented remains somewhat speculative. The first component contained the behaviours verbal instruction (w_1=0.73), percentage of time owner was standing straight (w_1=0.70) and bending (w_1=0.58), gesture instruction (w_1=0.44) and the percentage of time owner was kneeling (w_1=-0.84). This component could represent a dimension of being dominant over the dog or low involvement, since the main behaviours are verbal instructions and the owner standing straight or bending over the dog, which could indicate distance or dominance, rather than kneeling down to the dog to communicate on the same level. However, no significant correlations were found between the parenting styles and this behaviour pattern, so it may have represented something different and unrelated to parenting style, like the age of the

owner influencing whether or not he/she decides to kneel down. The second component consisted of the behaviours gesture instruction (w_1=0.61), percentage of time the owner was kneeling (w_1=0.46), instruct by demonstrating (w_1=-0.71), percentage of time owner was bending (w_1=-0.60) and physical instruction (w_1=-0.53). This group of behaviours may mirror clarity of communication, which will be further explained later. A negative correlation was found between the authoritarian parenting style and this second component score group (r=-0.50, n=31, p<0.01), and a tendency towards a positive correlation with the permissive parenting style (r=0.35, p=0.07). No correlation was found with the authoritative parenting style, but there was a positive correlation between the LAPS and this second component (r=0.49, p<0.01). Furthermore, positive correlations exited between the permissive parenting style and verbal praises (r=0.41, p=0.05) and praises using treats (r=0.50, p<0.01), and a negative correlation between this style and instruct via demonstration (r=-0.37, p=0.05). There were negative correlations between the authoritative parenting style and physical instructions (r=-0.40, p=0.05) and instruct via tricks (r=-0.36, p=0.05). For the authoritarian parenting style a negative correlation was found with praise using treat (r=-0.42, p=0.05), and positive correlations with physical instructions (r=0.49, p<0.01) and the percentage of time the owner was bending over the dog (r=0.38, p=0.05). Summarized, the permissive parenting style correlated with behaviours concerning warmth (verbal praise and praise using treat), which corresponds with the results of the treat on table test and during the break (see next sections). As expected, the authoritative parenting style correlated negatively with 'cold ways' of instructing your dog (physical instruction, or forcing the dog, instruction using 'manipulative' tricks and bending over the dog) and the authoritarian parenting style correlated positively with these behaviours (physical instruction, bending over the dog), as well as negatively with behaviours concerning warmth (praise with a treat).

3.2.3. Treat on table test

Owners walked their dog passed a table with on it a food treat or next to it a ball that dogs were supposed to ignore. Sixteen behaviours shown by the owner (n=28, 4 records were excluded from the analyses, see *appendix 4* for the means±SD) were measured in 4 trials, with 2 repeats per object, resulting in 112 records that were analysed with PCA. The PCA output resulted in two significant components, including one that corresponded with a 'cold way' of controlling your dog and explained 19.9% of the variation. This first component grouped the percentage the leash was tight (w_1=0.82), the behaviours body position control using the leash (w_1=0.73), verbal instruction (w_1=0.64), verbal reprimand (w_1=0.52), reprimand using leash pull (w_1=0.43) and physical praise (w_1=-0.42). The second component explained 12.8% of the variation and corresponded with praising the dog (responsiveness dimension), grouping the behaviours verbal praise (w_1=0.72), physical praise (w_1=0.61) and gesture praise (w_1=0.44). Owner-dog dyads performed the test four times, two times with a treat on the table and two times with a ball next to the table, and a REML was done to tested for the effects of object (treat, ball) and trials (1 to 4, both fixed factors), excluding 2-way interactions. The use of a treat or ball had no effect on any of the behaviours that were measured. Trial number did have an effect on verbal reprimand (Wald test statistic W=12.3, p=0.006), praise with a treat (W=9.4, p=0.024) and the percentage the leash was tight (W=24.9, p<0.001). The effects of trial number are presented in detail in *appendix 6* (see here for the complete results of the REML). Briefly, the predicted means±se for verbal reprimand, praise with a treat and the percentage the leash was tight were 3.25±0.59 rate per minute (rpm), 1.29±0.27 rpm and 73.13±3.29 % of

observation time, respectively. Predicted means for trials 1 to 4 for verbal reprimands were 3.89, 4.43, 3.00 and 1.70, respectively. For the percentage the leash was tight these decreased from 33.46, 32.19, 23.76 to 18.09, and for praise with a treat increased from 0.98, 1.21, 1.36 to 1.63.

Next, the summed scores of each participant (*i.e.* across four trials) were used for calculating Pearson correlation coefficients. We found negative correlations between the authoritarian parenting style and the number of verbal praises (r=-0.40, n=28, p=0.05) and physical praises (r=-0.38, p=0.05). Furthermore, there were positive correlations found between the permissive parenting style and the component scores of the warmth dimension (praises; r=0.40, p=0.05) and the verbal praises alone (r=0.45, p=0.05). Near significant correlations were found between the authoritative parenting style and verbal praises (r=0.34, p=0.10), and a negative correlation between the LAPS score and verbal reprimands (r=-0.36, p=0.07). The most significant finding seems the verbal praises being related significantly to all parenting styles (p=0.05, for authoritative parenting style p=0.10), and these results are shown in figure 5.

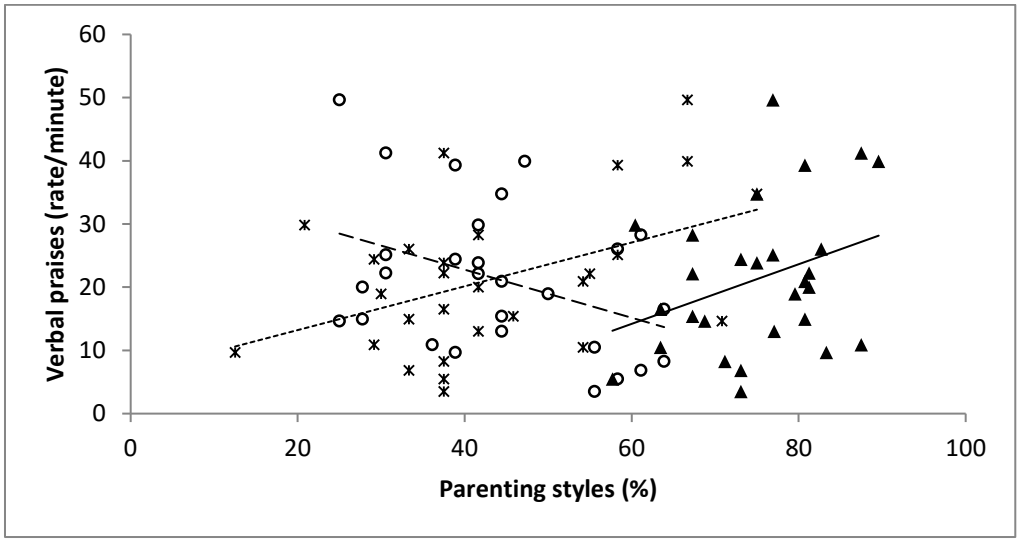

Figure 5. *Dog owners (n=28) with different parenting styles, measured with the dog-directed PSDQ, who praised their dog verbally during the treat on table test. On the y axis the rate per minute of verbal praises and on the x axis the parenting style percentage. The open dots and striped line represent the authoritarian parenting style, the closed triangles and the continuous line represent authoritative parenting style and the asterisks and the dotted line represent the permissive parenting style. There is a positive linear relationship between verbal praises and the authoritative (r=0.335, R^2=0.112, p=0.10) and permissive parenting style (r=0.447, R^2=0.200, p=0.05), and a negative linear relationship between verbal praises and the authoritarian parenting style (r=-0.395, R^2=0.156, p=0.05).*

3.2.4. Break test

The mutual attention and behaviour of the owner and dog were observed during the five minute break (n=31, one record was excluded from the analyses). Of the 17 owner behaviours that were observed (for means±SD see *appendix 4*), two did not took place during the test and the remaining 15 were analysed by means of PCA. The main component resulted from the PCA grouped behaviours corresponding to the involvement of the owner, so whether or not the owner paid attention to the dog, either reinforcing behaviour or punishing it. These 'involvement behaviours' were verbal reprimand (w_1=0.74), gesture, physical and verbal instruction (w_1 of 0.80, 0.68 and 0.67 respectively), praise with treat (w_1=0.66), gesture praise (w_1=0.58), verbal positive and verbal negative attention

(w_1 of 0.60 and 0.49 respectively), giving toys (w_1=0.47) and giving no attention (w_1=-0.62), explaining 29.6% of the variation. The second most important component consisted of behaviours with a positive or negative meaning, so whether the dog got positive or negative attention (warmth dimension). This 'warmth' dimension consisted of the behaviours physical positive attention (w_1=0.76), physical and verbal praise (w_1 of 0.70 and 0.62, respectively), giving no attention (w_1=-0.71), verbal negative attention (w_1=-0.65), gesture praise (w_1=-0.58) and verbal reprimand (w_1=-0.49), with a percentage of variation explained of 21.6%. As in the greeting stranger test, we found a strong positive correlation between the LAPS score and the warmth component (r=0.53, n=31, p<0.01), as well as with the physical praises (r=0.38, p=0.05) and physical positive attention (r=0.40, p=0.05). A negative correlation existed between the authoritarian parenting style and the number of physical praises (r=-0.45, p=0.05), as in the treat on table test. Subsequently, there were positive correlations between the permissive parenting style and the warmth component (r=0.45, p=0.05), verbal praises (r=0.38, p=0.05), physical praises (r=0.37, p=0.05) and physical positive attention (r=0.51, p<0.01), which is similar to the results of the treat on table and goal scoring test. There was a negative correlation between the permissive parenting style and giving no attention to the dog (r=-0.61, p<0.01).

3.2.5. Self-control test

The staying time in dogs (n=32) was measured in seconds, with a maximum of 120s. The mean scores for the latency without help of the owner was 55.36±45.98 and for the latency with help was 87.48±45.48. Pearson correlation coefficients between the latency of the self-control test and the parenting style percentages did not show any significant associations (two-tailed p>0.05). The strongest correlation found was between the authoritative parenting style and the latency without help (r=0.34, n=32, p=0.07).

3.3. Relationship between parenting style and problem behaviour

Finally, the third phase addresses if there was a relationship between parenting styles and problem behaviour in dogs. For this, Pearson correlation coefficients were calculated between each parenting style and each factor of the C-BARQ. The mean scores (±SD) for the problem behaviours are listed in table 4. With a two-tailed significance threshold, a positive correlation was found between the authoritarian parenting style and non-social fear (r=0.39, n=28, p<0.05), a negative correlation between the authoritative parenting style and owner-directed aggression (r=-0.39, p<0.05) and a negative correlation between the authoritative parenting style and pain sensitivity, meaning fear for being groomed, bathed, claw clipped or for the veterinarian (r=-0.39, p<0.05). Trends (p<0.10) existed in that there was a positive correlation between the authoritarian parenting style and pain sensitivity (r=0.35, p=0.07) and a positive correlation between the permissive parenting style and stranger-directed fear (r=0.34, p=0.10, see *appendix 7* for all the Pearson correlations). The positive and negative correlations are shown in figure 6.

Table 4. *Mean scores, SD and variances of the factors of the C-BARQ (n=28). Factor scores are calculated as percentages of the maximum possible score of the 5-point scale items corresponding each factor. The occurrence of the problem behaviour is also listed, as well as the number of five point scale questions per factor.*

Factor	1	2	3	4	5a	5b	5_{totaal}	6	7	11
Occurrence	19	8	13	23	20	21	24	16	28	19
Nr of questions	10	8	4	6	11	11	22	8	6	4
Mean	9.82	2.68	14.29	18.97	15.51	20.30	17.88	8.04	46.58	20.39
±SD	11.42	6.41	20.75	14.34	20.63	26.38	20.43	10.47	14.11	19.19
variance	130.52	41.03	430.72	205.55	425.57	695.74	417.57	109.54	199.09	368.23

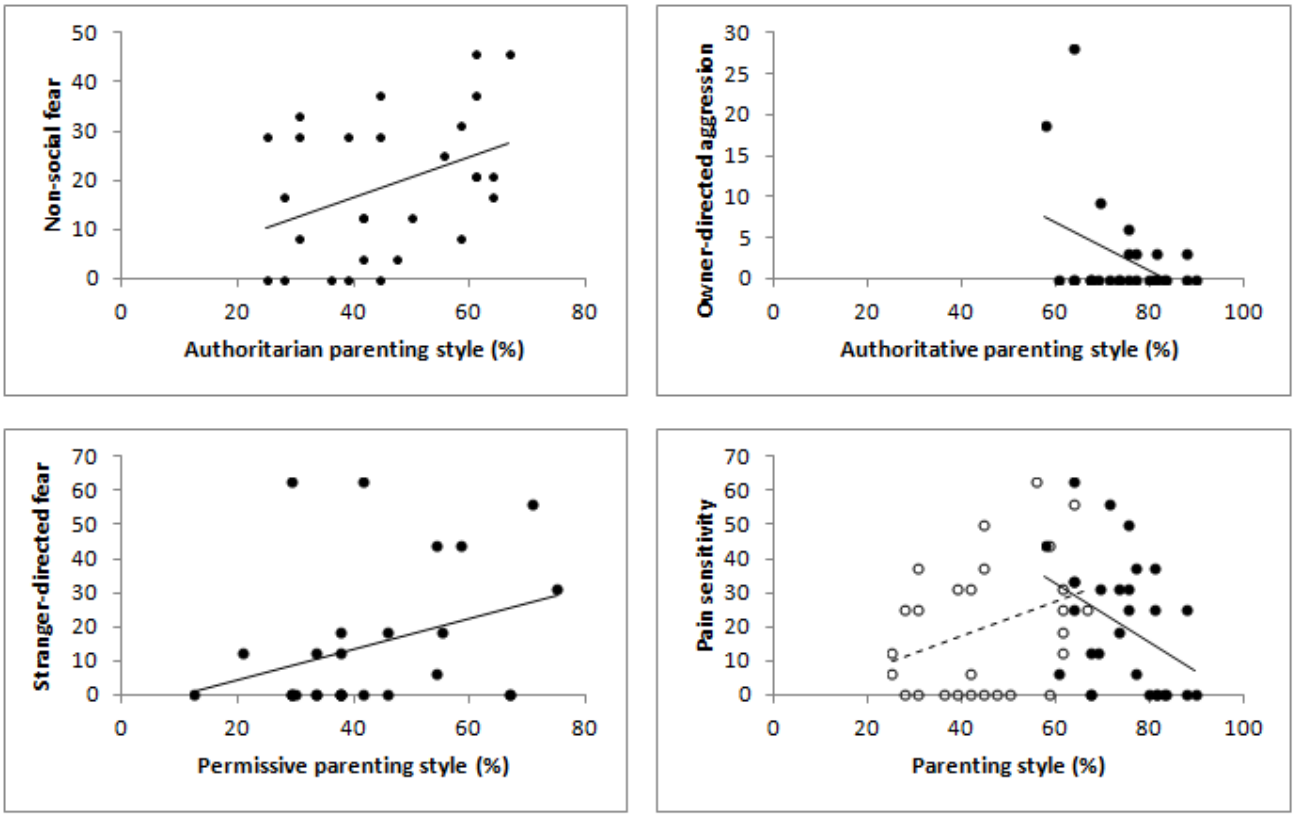

Figure 6. *Significant Pearson correlations between parenting styles of owners (n=28) and problem behaviour in dogs, measured with the C-BARQ that owners filled in. In the upper left graph the direct relationship between factor 4, non-social fear, and the authoritarian parenting style, in the upper right graph the reversed relationship between factor 2, owner-directed aggression, and the authoritative parenting style, in the lower left graph the direct relationship between factor 3, stranger-directed fear, and the permissive parenting style, and in the lower right graph the relationship between factor 11, pain sensitivity, and the authoritarian (open dots and striped line) and authoritative (closed dots and solid line) parenting style.*

4. Discussion

The main aim of this study was to validate the Parenting Style and Dimensions Questionnaire (PSDQ, Robinson *et al.,* 1995) for assessing parenting styles in the owner to dog relationship, for example by comparing the owner parenting styles with the way they interacted with their dogs in behaviour tests. Considerable evidence was found to assume that parenting styles are present in dog-rearing and that these can be measured using the dog-directed PSDQ. Most of the significant correlations

that were found support the validity of the dog-directed PSDQ, confirming construct validity. Interestingly, the authoritarian parenting style had mainly negative correlations with warmth, which is expected, but barely positive correlations with controlling behaviours. The authoritative parenting style correlated positively with behaviours of the control dimension, but only in the greeting stranger test and no significant correlations ($p<0.05$) were found with warmth in any of the behaviour tests. The permissive parenting style was mainly correlated with behaviours of the warmth dimension, but no meaningful negative correlations with controlling behaviours were found. Two hypotheses could explain these findings. It could be that the observed behaviours are a combination of the two dimensions rather than one dimension alone, thus not corresponding with the demandingness dimension or responsiveness dimension, but rather with 'warmth-controlling' techniques and 'cold-controlling' techniques, which in this case shift the original dimension axes (see figure 7, left panel). The other explanation is that the dog-directed PSDQ is not measuring parenting styles, but rather dimensions (responsiveness and demandingness). In this case, the authoritarian parenting percentages correspond negatively with the responsiveness dimension, while the permissive parenting percentages correspond positively with this dimension. The authoritative parenting style percentages correspond with the demandingness dimension, according to this study (see figure 7, right panel). The different parenting styles are addressed in more detail next, with the aim to first summarize and interpret the large number of findings before integrating these with facts from earlier scientific studies.

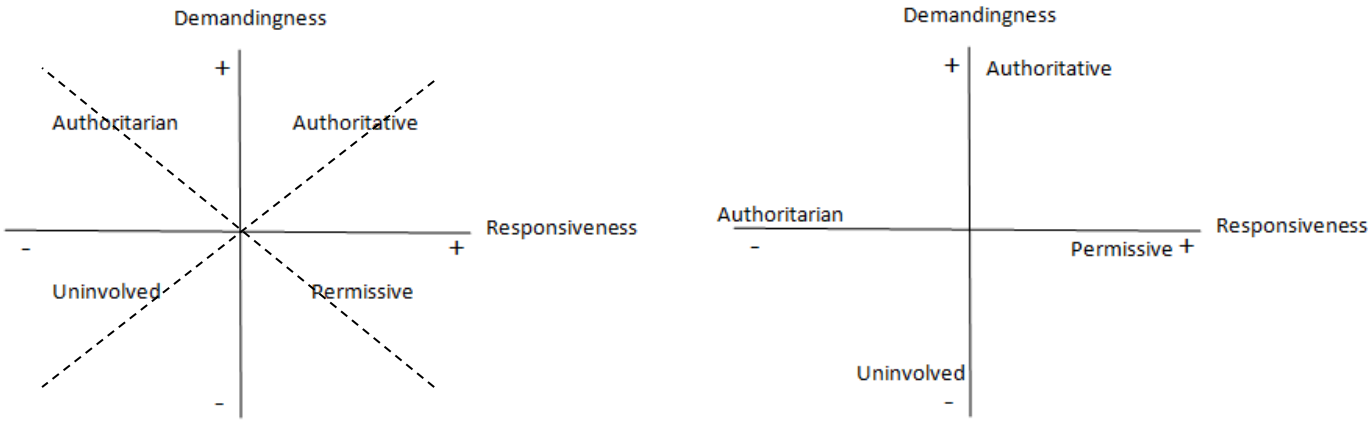

***Figure 7**. Two possible hypotheses about the four parenting styles and their dimensions according to the results of this study. On the left the hypothesis when the behaviour tests measured parenting styles rather than dimensions, the dotted lines represent the new dimensions in this case. On the right the hypothesis when the behaviour tests did measure demandingness and responsiveness, but the dog-directed PSDQ did not measured parenting styles, but rather dimensions.*

4.1. Authoritarian parenting

The authoritarian parenting style is characterized by high levels of demandingness in combination with low levels of responsiveness, resulting in punitive, forceful measures when the dog's behaviour does not satisfy the expectations of the owner (following the theoretical framework by Baumrind, 1966). In the behaviour tests of greeting a stranger, ignoring the treat or ball on the table and spontaneous interactions during a break, the owners' behaviours in part represented a dimension of

responsiveness (warmth). Scores for assumed warmth, at least when based on behaviour during the greeting of a stranger and break, had a strong positive correlation with the Lexington Attachment to Pets Scale (LAPS) scores, which supports our assumption. Owners that score high on the LAPS are emotionally attached to their pet and it makes sense that they show more warmth and involvement by petting their dog and using less reprimands (Johnson *et al.,* 1992). The greeting stranger test scores for warmth had a reversed relationship with scores for the authoritarian parenting style, validating the latter's assessment since this style encompasses high behavioural control and low responsiveness. Other findings provide further support. Negative correlations were found between authoritarian parenting style with praise with using a treat in the test where owners learned dogs to score a goal, physical praises during the break and verbal and physical praises in the ignore treat (or ball) on table test. The scores for authoritarian parenting correlated negatively with a second dimension that, with the help of Principal Components Analyses (PCA), was extracted from the results on the goal scoring test. The PCA grouped gesture instruction (w_1=0.61), percentage of time the owner was kneeling down to the dog (w_1=0.46), instruct by demonstrating (w_1=-0.71), percentage of time the owner was bending over the dog (w_1=-0.60) and physical instruction (w_1=-0.53), and this seems to represent clarity of communication as part of the responsiveness dimension. When teaching a dog new behaviour, in this case pushing a ball in a goal, gesturing like pointing at the object may be one of the most helpful and clear communication strategies. Verbal instructions may not be useful when the dog knows little about what to do and pointing seems like the best teaching strategy. It may also help to kneel down to facilitate communication with the dog and comfort it during learning rather than bending over the dog which could signal dominance and threat. Physical instructions, which included forcing the dog in a certain position or touch an object, may be inappropriate communicating by being too forceful and possibly stressful to the dog. Demonstrating how to score by rolling the ball in the goal was reversely related to behaviours like gesturing and may not have been an effective way of communicating in the given context. Together the group of behaviours seem to reflect clarity of communication, which is part of the responsiveness dimension and expected to be positively related with the authoritative and permissive parenting style, and negatively related with the authoritarian parenting style. The negative correlation with the authoritarian parenting style was found, and a positive correlation existed with the permissive parenting style, as well as with the LAPS score. This is further evidence for correspondence between authoritarian parenting scores obtained by PSDQ and the way dog owners acted towards their dogs in experimental settings, indicating construct validity. These findings correspond partly with results of other studies about authoritarian parenting in parent to child relationships. For example, those from a study where 97 Chinese mothers filled in the 91-item Child Rearing Practices Report about parenting styles and the 36-item Parenting Stress Index-Short Form about parent-child dysfunctional interaction (Xu *et al.,* 2005). One of the findings was a positive association between mother-child dysfunctional interaction, which represents the quality of interactions in the sense that children do not meet the mothers' expectations, and the authoritarian parenting style. Thus authoritarian parents are more often dissatisfied with their children's competences resulting in less responsiveness. Other results that validate the dog-directed PSDQ are the trends ($p<0.10$) for reversed relationship between the authoritarian parenting style and the PCA derived dimension of control during the meeting of the stranger, as well as the single control behaviours body position control using leash and, significantly ($p<0.01$), verbal instruction. The same behaviours and PCA

component scores were correlated positively with the authoritative parenting style, indicating authoritarian and authoritative worked as opposites. Both authoritarian and authoritative owners are expected to show high behavioural control, but differ in the way they accomplish this and in being responsive. Behaviours like verbal instruction may be more positive, warm ways of controlling the dog and that would explain why the authoritative parenting style correlates positive and the authoritarian parenting style negative. Alternatively, the dogs of the authoritarian parenting owners knew better how to behave when a stranger approaches (showing less misbehaviour), so that these owners had little reason to correct or control their dog. This could mean that owners who used, for example, physical corrections in the past to improve the dog's behaviour had greater impact on the dog and better results. In order to briefly check this, the dog's behaviour was evaluated, but neither positive nor negative correlations were found between the authoritarian parenting style and jumping up to the stranger, excitement behaviour or calm behaviour (data not presented). In a study of Rooney and Cowan (2011) similar results were found when 53 owner-dog dyads were visited at home (in an enclosed room). Owners who used physical punishment or punishment-based training, measured with the Reported Training Methods (RTM) interview, had dogs who were less likely to contact and interact with the experimenter (*i.e.* a stranger) in a relaxed social behaviour test. The explanation the authors give is that punishment based training, indicators for authoritarian parenting, can result in more anxious and fearful dogs, hence it may be less confident to approach a stranger (Rooney & Cowan, 2011). Thus, the results of this study combined with findings of other studies support the theoretical framework described by Baumrind (1966) that authoritarian dog owners show low levels of responsiveness, similar to authoritarian parents in parent-child relationships.

4.2. Authoritative parenting

Authoritative dog owners are expected to show high levels of both demandingness and responsiveness, resulting in open rather than manipulative communication and control (Baumrind, 1966). The authoritative parenting style indeed correlated positively with control, but only with behaviours from the greeting stranger test, namely giving verbal instructions ($r=0.48$, $p<0.01$), body position control using the leash ($r=0.62$, $p<0.01$), the percentage of time the leash was tight ($r=0.61$, $p<0.01$) and with integrated scores for six 'control' behaviours that were grouped by PCA ($r=0.66$, $p<0.01$, containing the percentage of time the leash was tight, body position control using the leash, verbal reprimand, reprimand using leash pull, gesture command and verbal command/instruction). Verbal instructions are believed to be an open or positive way of controlling one's dog when greeting a stranger, and a positive correlation existed between this behaviour and authoritative parenting style, as well as with the LAPS score. In the goal scoring test, authoritative owners used relatively few physical instruction and instructions based on tricks, which seem negative ways of controlling a dog. Physical instructions consisted of pushing or forcing the dog into a certain position, like grabbing the dog's paws and push the ball with it. Instructions using a trick included putting a treat under the ball so that when the dog tried to grab the treat it pushed it and these may represent manipulative techniques for controlling a dog (*i.e.* lack of clarity in communication, Baumrind, 1967). These correlations support the idea that authoritative dog owners use open rather than manipulative communication and control. Less significant relationships ($p<0.10$) were found between authoritative parenting with verbal praises, in both the goal scoring test and treat on the table test. These trends

do support that owners who show high levels of authoritative parenting, show relatively higher levels of warmth and responsiveness than owners who show lower levels of authoritative parenting, and therefore give (verbal) praise when their dog is behaving correctly. The direct relationship between the authoritative parenting style percentages and the LAPS score confirms this further. Little research is done about authoritative parenting in owner-dog relationships, but in child-rearing it is known that the authoritative parenting style is positively associated with secure adult attachment (Doinita & Maria, 2015). Secure attachment occurs when the parent is responsive to the child's needs, providing parental warmth and openness as well as setting limits and clear rules, resulting in children who develop more confidence and are able to better regulate their own emotions. The study (n=74) used two questionnaires, the Adult Attachment Questionnaire containing four statements on a seven point scale specific to four types of attachment (secure, fearful, preoccupied and avoidant attachment) and the 18-item Parental Styles Questionnaire, with six items on a five point scale for each parenting style (authoritative, authoritarian and permissive). Although the attachment questionnaire contained only four statements, a direct relationship was found between the authoritative parenting style and secure attachment (Spearman's rank correlation coefficient $r=0.329$, $p=0.004$). Authoritative parenting is linked with secure attachment and therefore these parents, or owners, show behaviour of both responsiveness and demandingness, supporting our findings.

4.3. Permissive parenting

Permissive dog owners attempt to raise their dog in a non-punitive affective way and use reason and manipulation to channel the dog's behaviour (Baumrind, 1966), showing low levels of demandingness and high levels of responsiveness (especially nurturance). The positive correlation between the LAPS and this parenting style showed that permissive owners are more attached to their dog and probably show this attachment by nurturing and care taking. Direct relationships existed between the permissive style and the PCA warmth component derived from the spontaneous owner-dog interactions during the break and the treat (or ball) on table test, which supports the notion that permissive parents show high levels of nurturance. Further support comes from the relationships with single behaviours, and permissive owners showed higher levels of verbal praises, during the break and in the test of treat on table and goal scoring, used more treats as praise in the goal scoring test, and showed more physical praises, like petting, during the break. During the break, permissive owners gave their dog more positive physical attention, which also correlated positively with the LAPS score, indicating that positive physical attention like playing with the dog or petting it represents responsiveness. Interestingly, the permissive parenting style was correlated mainly with behaviours linked to warmth (verbal, physical and treat praises), but there were no meaningful negative correlations with behaviours linked to control. There was a negative correlation found between permissive parenting and instruction by demonstrating the dog what to do in the goal scoring test. The cause of this correlation remains unknown, but this behaviour is also positively associated with the LAPS score, thus indicating some aspect of attachment. In the study of Doinita & Maria (2015) mentioned earlier, permissive parenting is positively associated with fearful/anxious attachment ($r=0.22$, $p=0.05$). Permissive parents with fearful attachment are inconsistent and need constant approval of others, and raise children with a chronic fear of rejection and high level of anxiety. Permissive parents show their fearful attachment by providing constant nurturance and

warmth, combined with low expectations regarding their children's competences and high tolerance of misbehaviour to avoid exert power and control. Although no (negative) associations were found with control, permissive owners showed significantly more nurturance and warmth than authoritarian and authoritative owners in our study. Thus, the findings of this study as well as what is found in earlier studies support the hypothesis that parenting styles are present in owner-dog relationships. In table 5 the significant relationships between the results of the behaviour tests and the authoritarian, authoritative and permissive parenting style are summarized.

Table 5. *Of 32 dog owners who participated in the behaviour tests and filled in the dog-directed PSDQ, Pearson correlation coefficients were calculated between the parenting style percentages and owner behaviours in the greeting stranger, goal scoring, toy/treat on table and break test. The correlations with a significance of at least p=0.05 are listed here. Note that + means a positive correlation and - a negative correlation.*

Authoritarian	**Authoritative**	**Permissive**
- PCA warmth in greeting stranger test (r=-0.37)	+ PCA control in greeting stranger test (r=0.66)	+ PCA warmth in break (r=0.45) and treat on table test (r=0.40)
- physical praises in break (r=-0.45) and treat on table test (r=-0.38)	+ verbal instruction in greeting stranger test (r=0.48)	+ verbal praises in break (r=0.38), treat on table test (r=0.45) and goal scoring test (r=0.41)
- verbal praises in treat on table test (r=-0.40)	+ body position control using leash in greeting stranger test (r=0.62)	+ physical praises in break (r=0.37)
- PCA clarity of communication in goal scoring test (r=-0.50)	+ tight leash in greeting stranger test (r=0.61)	+ praises using treat in goal scoring test (r=0.50)
- praise using treat in goal scoring test (r=-0.42)	- physical instruction in goal scoring test (r=-0.40)	+ giving positive physical attention in break (r=0.51)
+ bending over dog in goal scoring test (r=0.38)	- instruction using a trick in goal scoring test (r=-0.36)	- giving no attention in break (r=-0.61)
- verbal instruction in greeting stranger test (r=-0.67)		- instruction by demonstration in goal scoring test (r=-0.37)
+ physical instruction in goal scoring test (r=0.49)		

4.4. Self-control

In children it is suggested that too much behavioural control by parents during a child's development results in low self-control and poor skills to resolve conflicts, while insufficient behavioural control results in low impulsive control development (Kuppens *et al.,* 2009; Aunola & Nurmi, 2005). To test if this is the same in dogs, the staying time in dogs was measured after it was told to stay by the owner, while there was a treat at one meter distance of the dog. The means scores were 55 seconds without support of the owner and 87 seconds with support of the owner. The dogs' levels of self-control were not correlated to the scores for any of the owners' parenting styles. The highest correlation (r=0.34, p=0.07) found was between the authoritative parenting style and the latency to stay without the owners trying to make the dogs to remain seated. Correlations between the authoritarian (r=-0.09) and permissive (r=-0.13) parenting style and these same latencies without help were negative, but far from significant (p>0.47). These results provide some minor indications that too high or too low behavioural control does result in a lower self-control of the dog, as is seen in children (Kuppens *et al*., 2009; Aunola & Nurmi, 2005). The present results would be more credible if the precise behaviour of the owner is taken into account, to directly associate the rate of behavioural control

with the dog's self-control. In humans it is known that self-control can be depleted and Miller *et al.* (2010) discovered something similar in dogs. First they showed that dogs who had to perform a self-control task (sit and stay, n=12) for 10 minutes, had a decreased persistence on an unsolvable task, *i.e.* a toy from which it was impossible to retrieve food (while they had previously been able to extract food from the same toy). The mean duration the dogs of the control group persisted on the task was 141.2s, while the mean duration of the dogs who had performed the self-control task was 48.2s. Second, they showed that the self-control of dogs depends on comparable biological processes known to influence human self-control processes, specifically blood glucose. The same test was done (n=20) but now half of both groups (self-control and control) got a glucose drink, while the other half got a sugar-free drink. The dogs from the self-control group who received the sugar-free drink performed significantly less than the dogs of the control group ($p<0.001$), while the persistence of the dogs from the self-control group who received the glucose drink did not differ from the control group ($p=0.66$). Thus, self-control of dogs and humans in part relies on energy availability and is comparably regulated (Miller *et al.,* 2010). In boys with attention-deficit/hyperactivity disorder (ADHD) a reversed relationships existed between hyperactivity and self-control, as well as with visuospatial working memory (Patros *et al.,* 2017) and since low self-control is likely to be positively related to hyperactivity and destructive behaviour in dogs, it is interesting to know if owners can have an influence on this behaviour.

4.5. Parenting styles and problem behaviour

Six of the 28 dog owners that participated in our study went to a specialist for some kind of problem behaviour of the dog, four because of aggressive behaviour (out of fear, to other dogs or while walking on the leash) and two because of other problem behaviour than fear or aggression. Based on the findings by, for example, O'leary *et al.* (1999), Blackwell *et al.* (2008) and Hsu and Sun (2010), a direct relationship was expected between the authoritarian parenting style and different types of aggression. Direct relationships were found between authoritarian parenting style and problem behaviour, but only for non-social fear and pain sensitivity as reported by the owners in the Canine Behavioural Assessment and Research Questionnaire (C-BARQ, Hsu & Serpell, 2003). A review of Rooney *et al.* (2016) describes how search dogs of handlers who believed in improving the dog's behaviour by using punishment tended to have less confident dogs. This matches with the direct relationship with non-social fear found in this study, assuming less confident dogs are prone to be more fearful and anxious. The dogs that participated in the behaviour tests showed no aggression during the tests, neither to owners nor strangers, which confirmed what the owners told about the behaviour of their dog. It makes sense that owners of aggressive dogs feel uncomfortable about participating in behaviour tests like these as they may feel ashamed of the behaviour of their dog. Fearful and/or anxious behaviour was at times observed during the tests, which could indicate that such behaviour is experienced by the owner as more acceptable. Tendencies towards fear and anxiety in the dogs may be stimulated by permissive parenting. Permissive owners are believed to show high levels of responsiveness and low levels of demandingness. Owners or parents of this kind try to avoid the exercise of control and rather use reason and manipulation instead of overt force to make the dog or child behave, which could result in fearful behaviour or aggression (Baumrind, 1966). Direct relationships between permissive parenting with different types of fear and/or aggression were therefore expected. There was a direct relationship between the permissive

parenting style and the dogs' stranger-directed fear in daily life as reported by the owners in the C-BARQ. No correlations were found with other fear-related factors of the C-BARQ, being non-social fear, dog-directed fear and pain sensitivity, nor with the aggression-related factors stranger-directed, owner-directed and dog-directed. This could be due to the unequal division of the parenting styles among the owners, as most owners scored high on the authoritative parenting style and low on the authoritarian and permissive parenting style. This means that variation in parenting was limited, which seems to have applied especially to the types of parenting that are likely to have the strongest impact on problem behaviour. Extremes in parenting authoritarian or permissive, let alone uninvolved, were not present in our study population. Reversed relationships were found between the authoritative parenting style and owner-directed aggression and pain sensitivity. Most dogs did not show any owner-directed aggression, but the ones who did (8 of 28) had owners that scored slightly lower on the authoritative parenting style. Concerning the reversed relationship with pain sensitivity, authoritative owners may be more likely to train their dog to accept being brushed or nail clipped, while the typical permissive owner may have troubles with following this through and rather avoid interventions that dogs dislike. The authoritarian owner may punish the dog for unwanted fearful behaviour during such interventions instead of calming and reassuring the dog, hence the direct relationship found between pain sensitivity and this parenting style. Authoritative owners show high levels of responsiveness and control and will 'work on' fearful behaviour rather than avoid or punish it. According to the framework of Baumrind (1966), an authoritative parenting style should result in the least problem behaviour, which corresponds with our findings. Furthermore, Blackwell *et al.* (2008) found similar results, their research showed that dogs of owners (n=197) who used only positive reinforcement, indicators for an authoritative parenting style, had the lowest mean scores for aggression, fear and attention seeking in dogs, as assessed by the owner. In conclusion, the relationships found in this study are similar to findings of other studies and support the hypothesis that parenting styles and problem behaviour are related to each other.

Our dog-directed PSDQ was based on a questionnaire of Robinson *et al.* (1995), which in turn was based on the study of Baumrind (1966). The questions of the dog-directed PSDQ may therefore be somewhat outdated and it is suggested to reformulate some of the questions. It contains for example questions like "I do not set consequences *even* when my dog acts contrary to my wishes", which are not very appealing to fill in with "always/completely true" as the way it is formulated makes owners may feel soft. Furthermore, the authoritarian parenting style only asks questions about corrections (e.g. corrective slaps, short pulls on the leash, shoving your dog), while for the authoritative parenting style the questions are mainly "I have good times together with my dog", "I am easy going with my dog", "I allow my dog to give input on decisions". Near nothing is asked about how they would correct their dog if it misbehaves. The questions seem skewed and it is uncertain if the PSDQ really measures parenting styles and not simply the underlying dimensions. The uninvolved parenting style is not questioned in the original PSDQ, although according to Baumrind (2013) the reversed scale score of the authoritative parenting style could be used. Since the participants in this study scored all relatively high on the authoritative parenting style, the uninvolved style was not investigated in this study. It is hard to find uninvolved owners that are willing to fill in a questionnaire and other recruiting techniques should be used to reach this specific group. Further research could look at temporal behaviour patterns of owner-dog interactions during the behaviour tests instead of

evaluating only the ethogram based scores. For example, how many times an owner gives a command does not reveal much if the dog's behaviour is not taken into account, like if it listened the first time and how long did it took before it performed the asked behaviour. Besides, not only whether or not a command is given, but also the way how is important, being voiced with high pitch or low pitch, loud or soft.

This study showed that parenting styles do exist in owner to dog relationships and they are associated with at least some problem behaviour in dogs. In a twelve months study in 1998 in the United States, on average 14,042 animals were brought to an animal shelter (twelve shelters were selected for the study), of which 55% was euthanized (Salman *et al.,* 1998). Of the 3,772 people that were interviewed, 3,676 dogs were relinquished, apart from 1,409 cats. Aggression towards people and animals, other behaviour issues, dog characteristics, human lifestyle and human preparation-expectation were among the top ten of reasons for pet relinquishment. One thousand twenty-three (28%) of the relinquished dogs were aged between 5 months and 3 years, which suggests a mismatch between owner and dog with the pet not meeting the expectations of the owner. Better matching between owner and dog, for example based on an owner's parenting style and the dog's personality traits, could increase the satisfaction of owners and thus the dogs' welfare, decreasing the number of dogs relinquished to animal shelters.

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Appendix 1. Ethogram for the analyses of the behaviour tests

Table 1.1*. Ethogram that is used to analyse the videos of the four behaviour tests greeting stranger, goal scoring, treat on table and break test.*

Class	Behaviour	Description	Abbr.	Test**
1. Events dog	active approach	taking at least one step (replacing one leg) in the direction of the person	a	1
	active avoidance	taking at least one step away from the person	v	1
	passive avoidance	Looking away/moving head away from person (without direct active avoidance)	x	1
	tongue flicking & licking mouth	briefly shows tip of the tongue straight ahead towards the nose, possibly even up to the nose (over the nose), or with the tongue on the upper lip to one of the corners of the mouth.	t	1, 3
	shaking	fast sideward (shaking) movements with the whole body or with the head only	s	1, 3
	paw lifting	lifting one of the front paws from the ground (the wrist is bend up at an angle of 45 degrees)	p	1, 3
	yawning	an involuntary intake of breath through a wide open mouth	o	1, 3
	sniffing	sniffing the stimulus (person/object) with the nose, nose is close to the stimulus or in the air pointed at the stimulus (nose in direction of stimulus)	r	1, 3
	grooming	dog is scratching, licking, grooming its own body	u	1, 3
	playing bow	dog falls on its front legs and the hind legs are kept high as a characteristic form of challenging to play	q	1, 3
	playing	dog shows play behaviour with toys, with or without the owner, when lasting for more than 5s, score again	e	1, 3
	jumping up / standing up	Jumping movements towards person	j	1, 3
	licking person	dog licks person	l	1, 3
	barking	dog barks to person	b	1, 3
	growling	dog makes low buzzing sound	g	1, 3
	whining	dog produces a sustained, high-pitched plaintive sound (as in pain, fear or complaint)	h	1, 3
	success	dog succeeds the test (depending on the test), for example finds the treat within time, does not touch the treat/object or scores with a ball	w	2, 4
	fail	dog fails the test, for example does not find the treat within time or touches/eats the object/treat when not allowed	f	2
2. Events owner	Reprimand – verbal	using voice or verbal signal to reprimand/punish the dog for its behaviour (“uh”, “no”, “foei”, etc.)	V	all
	Reprimand – gestures	using a hand signal (like pointing a finger to the dog, without touching the dog) to reprimand/punish the dog for its behaviour	G	all
	Reprimand – physical	using a physical touch (slap, poking, etc.) to reprimand/punish the dog for its behaviour	P	all
	Reprimand – leash pulling	using a short pull on the leash to reprimand/punish the dog for its behaviour	L	1, 2
	Praise – verbal	using voice or verbal signal to reward the dog for its behaviour	S	all
	Praise – gestures	using gestures (like clapping or raising hands) to reward the dog for its behaviour	H	all
	Praise – physical	using physical touch (like petting) to reward the dog	A	all
	Praise – treats	using treats to reward the dog	T	all
	Command/Instruct dog – verbal	giving a verbal command or instruction (voice, hand or physical signal) to the dog on how to behave /to request a position like sit or lay down	C	all
	Command/Instruct	using (hand) gestures to instruct the dog on how to behave/to	X	all

	dog – gestures	request a position like sit or lay down. Can also be pointing to a stimulus or touching it.		
	Command/Instruct dog – physical	using physical signs to instruct the dog on how to behave/to request a position like sit or lay down, can also be forcing the dog into a certain position or to touch an object	F	all
	Command/Instruct – demonstration	owner shows the dog what to do by pushing the ball in the goal, or moving the goal to the ball (so that the dog always scores) – only applicable in goal scoring test	D	4
	Command/Instruct – trick	owner 'tricks' the dog into success, for example by putting a treat under the ball so that the dog pushes the ball (to get the treat) – only applicable in goal scoring test	I	4
	Body position control – leash	keeping dog away from object/person by shortening the leash	E	1, 2
	Body position control – move	keeping dog away from object by taking steps away from the object/person	M	1, 2
	Body position control - block	keeping dog away from the object/person by placing body of owner in pathway of dog	B	1, 2
	Giving toys	owner gives the dog one or more toys to play with (during break)	O	3
3. State tail wagging dog	Tail wagging on	dog wags/moves its tail (sideward movements of the tail)	y	1, 3
	Tail wagging off*	dog does not wag/move its tail	n	
	Tail wagging out of sight	the tail is not visible	.	
4. State tail position dog	Tail position high	upright position of the tail	c	1, 3
	Tail position low	position of the tail is lower than in "neutral"	d	
	Tail position neutral*	natural position of the tail according to the breed standards (www.fci.be)	i	
	Tail position out of sight	tail is not visible in the video recording	,	
5. State locomotion dog	Sitting	hind quarters on the ground and forelegs supporting the body	z	1, 2, 3
	Standing*	dog taking a standing position with all four paws on the ground with legs upright and extended supporting the body (it may move two steps)	k	
	Laying down	dog lays down in ventral or lateral position	-	
	Moving /walking	walking at least one step with all four paws (can also be jumping with at least two paws off the floor)	m	
6. state attention of dog	attention to stimulus	dog moves head towards the stimulus (treat/ball/stranger) and looks at the stimulus	8	all
	attention to owner	dog moves head towards the head of the owner and looks at the owner	9	
	attention to other*	dog looks at something else than the owner or stimulus	7	
7. State of the leash	loose leash*	there is no tension on the leash (or it is not clear, default)	J	1, 2
	tight leash	there is tension on the leash	Q	
8. State locomotion owner	standing*	owner stands with legs upright and with a straight back, possibly with walking	U	4
	kneeling	owner kneels to the ground, with knees fully bend, possibly rest one or both knees on the ground	W	
	bending	owner stands with straight legs (at least not bend more than 45 degrees) and only bend down/lean over by bending his/her back	0	
9. State attention of owner (only applicable for break test)	passive attention	owner pays attention to dog only by looking at it	2	3
	active positive attention – verbal	owner pays positive attention to the dog by talking to it, with or without looking at it	3	
	active positive attention – physical	owner pays positive attention to the dog by physical interaction. like petting the dog or playing with it, with or without toys, possibly with talking and/or looking at it	4	

active negative attention – verbal	owner pays negative attention to the dog verbally (talking to it), for example by reprimand the dog verbally (e.g. yelling)	5
active negative attention – physical	owner pays negative attention to the dog by physical interaction, like physical reprimand	6
no attention*	owner is doing something for him/herself, paying no attention to the dog	1

* initial state event (default)

** where test 1. Greeting stranger, 2. Treat on table, 3. Break, 4. Goal scoring

Appendix 2. Dog-directed PSDQ questionnaire

Table 2.1*. Dog directed-PSDQ questions (translated by Ineke van Herweijnen, PhD, unpublished data). The numbers before the questions correspond with the numbers of the original PSDQ listed in Robinson et al. (1995). In the second column the parenting styles and in the third the column the dimensions where the questions correspond with.*

Question	PS	Dimension
1. I encourage my dog to show how it feels by its body language, I see growling as a signal of my dog's emotion for example.	AUTV	warmth & involvement (warmth & support)
2. I guide my dog by punishment more than by tapping into its natural needs.	AUTN	corporal punishment/ physical coercion
3. I know the names of my dog's play mates.	AUTV	warmth & involvement
4. I find it difficult to discipline my dog.	PERM	self confidence (Indulgent)
5. I give praise when my dog is good.	AUTV	warmth & involvement (warmth & support)
6. I use a corrective slap when my dog misbehaves.	AUTN	corporal punishment/ physical coercion
7. I joke and play with my dog.	AUTV	good natured/easy going
8. I do not set consequences even when my dog acts contrary to my wishes..	PERM	ignoring misbehaviour
9. I show sympathy when my dog is hurt or frustrated.	AUTV	warmth & involvement
10. I punish by taking away toys from my dog.	AUTN	non-reasoning/punitive
11. I spoil my dog.	PERM	lack of follow through (indulgent)
12. I give comfort when my dog is upset.	AUTV	warmth & involvement (warmth & support)
13. I yell or shout when my dog misbehaves.	AUTN	verbal hostility
14. I am easy going and relaxed with my dog.	AUTV	good natured/easy going
15. I allow my dog to greet someone else, regardless of that person's love of dogs.	PERM	ignoring misbehaviour
16. I practice certain behaviour with my dog before asking this behaviour in a more difficult situation.	AUTV	reasoning/induction
17. I raise my voice to make my dog improve.	AUTN	directiveness (verbal hostility)
18. I show patience with my dog.	AUTV	good natured/easy going
19. I grab my dog when he/she is being disobedient.	AUTN	corporal punishment/ physical coercion
20. I threaten with punishments towards my dog and do not actually do them.	PERM	lack of follow through (indulgent)
21. I am responsive to my dog's feelings or needs.	AUTV	warmth & involvement (warmth & support)
22. I allow my dog to give input on decisions for instance with regard to the route we follow on walks.	AUTV	democratic participation (autonomy granting)
23. I struggle with my dog.	AUTN	verbal hostility
24. I appear confident about training skills towards my dog.	PERM[1]	self confidence
25. I think about why rules should be obeyed by my dog.	AUTV	reasoning/induction (regulation)
26. I appear to be more concerned with own feelings than with my dog's feelings.	AUTN	non-reasoning/punitive
27. I tell my dog 'good dog' when he tries to follow guidance, even if he does not succeed.	AUTV	warmth & involvement
28. I punish by giving my dog 'time out' and walking away if he misbehaves, even if he finds the situation he is in uncomforting.	AUTN	non-reasoning/punitive
29. I help my dog to understand the impact of its behaviour by offering him choices in situations.	AUTV	reasoning/induction (regulation)
30. I am afraid that disciplining my dog for misbehaviour will cause	PERM	self confidence

him to like me less.		
31. I take my dog's desires into account before asking him to do something.	AUTV	democratic participation (autonomy granting)
32. I can explode in anger towards my dog when he does something he knows I don't want him to do.	AUTN	verbal hostility
33. I am aware of problems or concerns about my dog that neighbours (may) have.	AUTV	warmth & involvement
34. I threaten my dog with punishment more often than actually giving it.	PERM	lack of follow through (indulgent)
35. I express affection by rubbing my dog under its chin.	AUTV	warmth & involvement
36. I ignore my dog's misbehaviour such as chasing game, barking at other people or peeing against stores in a shopping area.	PERM	ignoring misbehaviour
37. I use physical punishment as a way to improve my dogs behaviour.	AUTN	corporal punishment/ physical coercion
38. I carry out discipline after my dog misbehaves.	PERM[1]	lack of follow through
39. I feel bad towards my dog when making a mistake in guiding it..	AUTV	warmth & involvement
40. I tell my dog what to do.	AUTN	directiveness
41. I give into my dog when he causes a commotion about something or doesn't do something I want it to.	PERM	lack of follow through (indulgent)
42. I think about why my dog does something when it misbehaves.	AUTV	reasoning/induction
43. I use a poke of my finger, or short kick to snap my dog out of it when it misbehaves.	AUTN	corporal punishment/ physical coercion
44. I use short pulls on the leash or pull back when my dog pulls.	AUTN	verbal hostility
45. I allow my dog to jump up on people, as long as it is friendly.	PERM	ignoring misbehaviour
46 I have good times together with my dog.	AUTV	warmth & involvement (warmth & support)
47. When two dogs are fighting, I discipline first and think about why it happened later.	AUTN	non-reasoning/punitive
48. I encourage my dog to 'be dog' even when it results in a dirty or wet dog.	AUTV	democratic participation (autonomy granting)
49. I lure my dog with reward to solicit certain behaviour, even when it is misbehaving at that moment.	PERM	lack of follow through
50. I scold or criticize when my dog's behaviour doesn't meet my expectations.	AUTN	directiveness (verbal hostility)
51. I show respect for my dog' s needs by encouraging my dog to 'be dog'.	AUTV	good natured/ easy going (autonomy granting)
52. I set strict well-established rules for my dog.	PERM[1]	self confidence
53. I let my dog know how I feel about its good and bad behaviour.	AUTV	reasoning/induction (regulation)
54. I use threats as punishment without feeling need for justification towards my dog.	AUTN	non-reasoning/punitive
55. I take into account my dog's preferences in making plans.	AUTV	democratic participation (autonomy granting)
56. When I ask my dog to do something, he should do so, because I said so and I am its boss.	AUTN	non-reasoning/punitive
57. I appear unsure on how to solve my dog's misbehaviour.	PERM	self confidence
58. I practice behaviour step by step with my dog, so I am sure he understands what I ask of him.	AUTV	reasoning/induction (regulation)
59. I demand that my dog does things.	AUTN	directiveness
60. I channel my dog's misbehaviour into a more acceptable activity.	AUTV	democratic participation
61. I shove my dog when he is disobedient.	AUTN	corporal punishment/ physical coercion
62. I use more or higher value reward (food or toy) when I believe my dog should really do something in a situation.	AUTV	reasoning/induction (Regulation)

[1]Questions with a reversed scale score for that parenting style

Appendix 3. PCA results of the two dog-directed PSDQ questionnaires

Table 3.1. *Dutch questions corresponding with parenting styles to dogs and their loadings (questions of the 62-item questionnaire). In the third column the parenting style where the questions originally correspond with, according to Robinson et al. (1995), AUTV=authoritative, AUTN=authoritarian, PERM=permissive.*

	Question	Official PS	Loading
Authoritative parenting style			
Q148	Ik heb het leuk met mijn hond.	AUTV	0.4554
Q158	Ik moedig mijn hond aan 'hond' te zijn, ook als het leidt tot een vieze of natte hond.	AUTV	0.4733
Q163	Ik lok gewenst gedrag uit bij mijn hond met voer of spel, ook als hij zich op dat moment misdraagt.	PERM	0.4516
Q173	Ik toon respect voor de behoeften van mijn hond door hem aan te moedigen 'hond' te zijn.	AUTV	0.5884
Q193	Ik houd voorkeuren van mijn hond in gedachten als ik plannen maak.	AUTV	0.5230
Q208	Ik oefen gedrag stap voor stap met mijn hond, zodat ik zeker weet dat hij begrijpt wat ik van hem vraag.	AUTV	0.5742
Q218	Ik buig ongewenst gedrag van mijn hond om naar meer gewenst gedrag.	AUTV	0.5266
Q501	Ik moedig mijn hond aan zijn gemoedstoestand te tonen, zo mag hij grommen bij ongemak.	AUTV	0.4005
Q506	Ik stuur mijn hond meer op basis van straf dan door gebruik te maken van zijn natuurlijke behoeften.	AUTN	-0.4480
Q521	Ik prijs mijn hond als hij iets goed doet.	AUTV	0.4786
Q526	Ik gebruik een corrigerende tik als mijn hond zich misdraagt.	AUTN	-0.4146
Q531	Ik speel en heb plezier met mijn hond.	AUTV	0.5202
Q566	Ik ben makkelijk en ontspannen in de omgang met mijn hond.	AUTV	0.4667
Q576	Ik oefen bepaald gedrag met mijn hond, voordat ik dat gedrag vraag in een voor de hond moeilijke situatie.	AUTV	0.5467
Q586	Ik toon geduld met mijn hond.	AUTV	0.5712
Q601	Ik houd rekening met de gevoelens en behoeften van mijn hond.	AUTV	0.6404
Q621	Ik denk na over regels die ik mijn hond opleg.	AUTV	0.5214
Q631	Ik vertel mijn hond dat hij braaf is als hij probeert mijn sturing op te volgen, zelfs als hij daarin niet slaagt.	AUTV	0.4332
Q641	Ik help mijn hond inzien wat het gevolg is van zijn gedrag, door hem keuzes te geven in situaties.	AUTV	0.4428
Q651	Ik houd de wensen van mijn hond in gedachten voordat ik hem vraag iets te doen.	AUTV	0.5346
Q656	Ik kan in woede uitbarsten richting mijn hond als hij iets doet waarvan hij weet dat ik dat niet wil.	AUTN	-0.4275
Q696	Ik geef aan mijn hond aan, wat ik van hem verwacht.	AUTN	0.4591
Q706	Ik denk na over waarom mijn hond iets doet als hij zich misdraagt.	AUTV	0.5662
Authoritarian parenting style			
Q133	Ik prik met mijn vinger, of geef een kort schopje als mijn hond zich misdraagt. Zo haal ik hem uit het gedrag.	AUTN	0.4466
Q138	Ik gebruik korte rukjes aan de lijn, of trek terug, als mijn hond aan de lijn trekt.	AUTN	0.4894
Q153	Als twee honden vechten, corrigeer ik eerst, om daarna na te denken over waarom het gebeurde.	AUTN	0.4011
Q178	Ik bepaal duidelijke, strenge regels voor mijn hond.	PERM[1]	-0.5632
Q183	Ik laat mijn hond weten hoe ik denk over goed en slecht gedrag van hem.	AUTV	0.5481
Q198	Als ik mijn hond iets vraag, moet hij dat doen, omdat ik het zeg en ik de baas ben.	AUTN	0.6235
Q213	Ik eis dat mijn hond dingen doet.	AUTN	0.5549
Q536	Ik geef consequenties (gevolgen) aan het gedrag van mijn hond als deze iets tegen mijn zin doet.	PERM[1]	-0.5227

Q581	Ik verhef mijn stem als mijn hond zijn gedrag moet verbeteren.	AUTN	0.4154
Q591	Ik pak mijn hond beet als hij ongehoorzaam is.	AUTN	0.4468
Q681	Ik gebruik fysieke (lichamelijke) correcties (bijvoorbeeld een tik of een slipketting) als een manier om het gedrag van mijn hond te verbeteren.	AUTN	0.5219
Q686	Ik zorg voor consequenties (een leermoment) als mijn hond ongewenst gedrag toont.	PERM[1]	-0.4479
Permissive parenting style			
Q516	Ik vind het moeilijk om mijn hond te corrigeren.	PERM	0.4095
Q541	Ik toon medeleven als mijn hond pijn heeft of gefrustreerd is.	AUTV	0.4540
Q551	Ik verwen mijn hond.	PERM	0.4361
Q556	Ik troost mijn hond als hij overstuur is.	AUTV	0.4789
Q596	Ik dreig met straf richting mijn hond, maar voer het niet daadwerkelijk uit.	PERM	0.4344
Q606	Ik sta toe dat mijn hond mijn besluiten beïnvloedt, bijvoorbeeld wat betreft de route tijdens de wandeling.	AUTV	0.4941
Q646	Ik ben bang dat het corrigeren van mijn hond bij ongewenst gedrag ertoe leidt dat hij me minder leuk vindt.	PERM	0.4435
Q666	Ik dreig vaker naar mijn hond dan dat ik echt een correctie geef.	PERM	0.4481
Q701	Ik ben toegeeflijk richting mijn hond als hij scène maakt (blaft, uitvalt), of iets niet doet wat ik wil.	PERM	0.5547

[1]These questions had a reversed scale score in the original PSDQ

Table 3.2. *Dutch questions corresponding with parenting styles to dogs and their loadings (questions of the 42-item questionnaire). In the third column the parenting style where the questions originally correspond with, according to Robinson et al. (1995).*

	Question	**Official PS**	**Loading**
Authoritarian parenting style			
Q139	Ik gebruik een corrigerende tik wanneer mijn hond niet doet wat ik wil	AUTN	0.5521
Q144	Wanneer ik zie dat mijn hond zich slecht voelt, maak ik dat hij/zij zich beter voelt	AUTV	-0.4355
Q149	Wanneer mijn hond iets moet doen, is dat omdat ik dat zeg en de baas ben	AUTN	0.5271
Q179	Ik eis dat mijn hond naar mij luistert	AUTN	0.5155
Q189	Ik corrigeer mijn hond vaak zonder erbij na te denken	AUTN	0.4395
Q239	Ik dreig als manier om te corrigeren	AUTN	0.5012
Q244	Ik gebruik een fysieke correctie wanneer mijn hond niet doet wat ik wil	AUTN	0.6534
Q279	Ik pak mijn hond beet wanneer hij/zij niet naar mij luistert	AUTN	0.5658
Q284	Ik trek / duw mijn hond als hij/zij niet naar mij luistert	AUTN	0.5964
Authoritative parenting style			
Q94	Ik laat mijn hond merken wat gewenst en ongewenst gedrag is	AUTV	0.5371
Q124	Ik corrigeer mijn hond wanneer zijn/haar gedrag niet aan mijn verwachtingen voldoet	AUTN	0.4724
Q154	Ik speel samen met mijn hond	AUTV	0.4792
Q169	Ik heb bepaalde regels waaraan mijn hond zich moet houden	PERM[1]	-0.5486
Q184	Ik probeer leuke momenten met mijn hond te hebben	AUTV	0.5577
Q199	Ik ben geduldig met mijn hond	AUTV	0.4507
Q209	Ik gebruik lichamelijk contact zoals knuffelen en aaien om de liefde voor mijn hond te uiten	AUTV	0.4892
Q214	Ik corrigeer mijn hond om te zorgen dat zijn/haar gedrag betert	AUTN	0.5620
Q249	Ik weet met welke honden mijn hond graag speelt en met welke niet	AUTV	0.4037
Q254	Ik ga ontspannen om met mijn hond	AUTV	0.4950
Q264	Ik kom zelfverzekerd over in de opvoeding van mijn hond	PERM[1]	-0.5593

Permissive parenting style			
Q114	Wanneer mijn hond iets niet wil doen wat ik vraag, dan laat ik het daarbij	PERM	0.4794
Q119	Ik ben bang dat mijn hond mij niet meer aardig zal vinden als ik hem/haar corrigeer	PERM	0.5059
Q134	Ik probeer mijn hond met beloningen "om te kopen", zodat hij/zij doet wat ik wil	PERM	0.4387
Q174	Ik verwen mijn hond	PERM	0.4020
Q194	Ik vind het moeilijk om mijn hond te corrigeren	PERM	0.5627
Q219	Ik vind het moeilijk om het gedrag van mijn hond te veranderen	PERM	0.4984
Q224	Ik dreig vaker met straf dan daadwerkelijk te straffen	PERM	0.4613
Q289	Ik houd rekening met mijn hond (zoals het liever niet nat willen worden) voordat ik hem/haar iets laat doen	AUTV	0.4617

[1]These questions had a reversed scale score in the original PSDQ

Table 3.3. *Original Dutch questions of the 62-item questionnaire and the corresponding question in the 42-item questionnaire that are used to calculate the parenting style percentages of the participants.*

PS	Q 62-item	Question in 62-item	Q 42-item	Question in 42-item
AUTV	506[1]	Ik stuur mijn hond meer op basis van straf dan door gebruik te maken van zijn natuurlijke behoeften.	189[1]	Ik corrigeer mijn hond vaak zonder erbij na te denken
	521	Ik prijs mijn hond als hij iets goed doet.	229	Ik prijs mijn hond wanneer hij/zij braaf is
	526[1]	Ik gebruik een corrigerende tik als mijn hond zich misdraagt.	139[1]	Ik gebruik een corrigerende tik wanneer mijn hond niet doet wat ik wil
	531	Ik speel en heb plezier met mijn hond.	154	Ik speel samen met mijn hond
	566	Ik ben makkelijk en ontspannen in de omgang met mijn hond.	254	Ik ga ontspannen om met mijn hond
	586	Ik toon geduld met mijn hond.	199	Ik ben geduldig met mijn hond
	601	Ik houd rekening met de gevoelens en behoeften van mijn hond.	274	Ik sta open voor de gevoelens en behoeften van mijn hond
	651	Ik houd de wensen van mijn hond in gedachten voordat ik hem vraag iets te doen.	289	Ik houd rekening met mijn hond (zoals het liever niet nat willen worden) voordat ik hem/haar iets laat doen
	656[1]	Ik kan in woede uitbarsten richting mijn hond als hij iets doet waarvan hij weet dat ik dat niet wil.	204[1]	Ik barst in woede uit naar mijn hond
	148	Ik heb het leuk met mijn hond.	184	Ik probeer leuke momenten met mijn hond te hebben
	163[2]	Ik lok gewenst gedrag uit bij mijn hond met voer of spel, ook als hij zich op dat moment misdraagt.	134[2]	Ik probeer mijn hond met beloningen "om te kopen", zodat hij/zij doet wat ik wil
	193	Ik houd voorkeuren van mijn hond in gedachten als ik plannen maak.	129	Ik houd rekening met mijn hond wanneer ik plannen maak
	218	Ik buig ongewenst gedrag van mijn hond om naar meer gewenst gedrag.	159	Ik probeer ongewenst gedrag van mijn hond om te zetten in gewenst gedrag
AUTN	536	Ik geef consequenties (gevolgen) aan het gedrag van mijn hond als deze iets tegen mijn zin doet.	114[1]	Wanneer mijn hond iets niet wil doen wat ik vraag, dan laat ik het daarbij
	581	Ik verhef mijn stem als mijn hond zijn gedrag moet verbeteren.	214	Ik corrigeer mijn hond om te zorgen dat zijn/haar gedrag betert
	591	Ik pak mijn hond beet als hij ongehoorzaam is.	279	Ik pak mijn hond beet wanneer hij/zij niet naar mij luistert
	681	Ik gebruik fysieke (lichamelijke) correcties (bijvoorbeeld een tik of een slipketting) als een manier om het gedrag van mijn hond te verbeteren.	244	Ik gebruik een fysieke correctie wanneer mijn hond niet doet wat ik wil

	686	Ik zorg voor consequenties (een leermoment) als mijn hond ongewenst gedrag toont.	109[1]	Ik corrigeer mijn hond niet wanneer hij/zij ongewenst gedrag vertoont
	178	Ik bepaal duidelijke, strenge regels voor mijn hond.	169	Ik heb bepaalde regels waaraan mijn hond zich moet houden
	183	Ik laat mijn hond weten hoe ik denk over goed en slecht gedrag van hem.	94	Ik laat mijn hond merken wat gewenst en ongewenst gedrag is
	198	Als ik mijn hond iets vraag, moet hij dat doen, omdat ik het zeg en ik de baas ben.	149	Wanneer mijn hond iets moet doen, is dat omdat ik dat zeg en de baas ben
	213	Ik eis dat mijn hond dingen doet.	179	Ik eis dat mijn hond naar mij luistert
PERM	516	Ik vind het moeilijk om mijn hond te corrigeren.	194	Ik vind het moeilijk om mijn hond te corrigeren
	541	Ik toon medeleven als mijn hond pijn heeft of gefrustreerd is.	144	Wanneer ik zie dat mijn hond zich slecht voelt, maak ik dat hij/zij zich beter voelt
	551	Ik verwen mijn hond.	174	Ik verwen mijn hond
	556	Ik troost mijn hond als hij overstuur is.	104	Ik troost mijn hond en toon begrip wanneer hij/zij een slechte dag heeft
	646	Ik ben bang dat het corrigeren van mijn hond bij ongewenst gedrag ertoe leidt dat hij me minder leuk vindt.	119	Ik ben bang dat mijn hond mij niet meer aardig zal vinden als ik hem/haar corrigeer
	666	Ik dreig vaker naar mijn hond dan dat ik echt een correctie geef.	224	Ik dreig vaker met straf dan daadwerkelijk te straffen

[1]Questions with a reversed scale score

[2]Question is not used, not the same translation in the two questionnaires, one correlates with permissive, other with authoritative parenting style

Appendix 4. Readout parameters of the behaviour tests

Table 4.1. *Readout parameters of the 17 observed owner behaviours in the greeting stranger test. The columns shows whether the behaviour was measured in rate per minute or in percentage of observational time, the occurrence per owner-dog dyad, the mean ± standard deviation and the variance.*

Behaviour	Rate per minute (R) or percentage of time (P)	Occurrence	Mean±SD	Variance
Reprimand - verbal	R	6	0.37±0.94	0.88
Reprimand - gestures	R	0	0	0
Reprimand - physical	R	0	0	0
Reprimand - leash pull	R	17	1.00±1.11	1.23
Praise - verbal	R	4	0.13±0.36	0.13
Praise - gestures	R	0	0	0
Praise - physical	R	2	0.06±0.25	0.06
Praise - treat	R	0	0	0
Instruct - verbal	R	15	0.96±1.15	1.32
Instruct - gestures	R	5	0.20±0.51	0.26
Instruct - physical	R	2	0.07±0.27	0.07
Body position control – leash	R	28	6.82±3.61	13.00
Body position control – move	R	0	0	0
Body position control – block	R	0	0	0
Give toys	R	0	0	0
Loose leash	P	30	48.52±27.75	770.06
Tight leash	P	28	51.48±27.75	770.06

N=30

Table 4.2. *Readout parameters of the 12 observed owner behaviours in the goal scoring test. The columns shows whether the behaviour was measured in rate per minute or in percentage of observational time, the occurrence per owner-dog dyad, the mean ± standard deviation and the variance.*

Behaviour	Rate per minute (R) or percentage of time (P)	Occurrence	Mean±SD	Variance
Reprimand - verbal	R	23	0.46±0.50	0.25
Reprimand - gestures	R	0	0	0
Reprimand - physical	R	0	0	0
Praise - verbal	R	31	2.91±2.02	4.08
Praise - gestures	R	3	0.03±0.09	0.01
Praise - physical	R	17	0.38±0.52	0.27
Praise - treat	R	19	1.15±1.49	2.21
Instruct - verbal	R	31	9.26±4.07	16.57
Instruct - gestures	R	30	5.83±3.56	12.68
Instruct - physical	R	10	0.28±0.54	0.30
Instruct – demonstration	R	20	1.17±1.47	2.16
Instruct –trick	R	7	0.31±0.82	0.67
Stand straight	P	31	27.59±20.81	432.94
Kneel	P	21	33.06±34.12	1164.23
Bend	P	31	39.34±24.21	586.29

N=31

Table 4.3. *Readout parameters of the 16 observed owner behaviours in the treat on table test. The columns shows whether the behaviour was measured in rate per minute or in percentage of observational time, the occurrence per owner-dog dyad, the mean ± standard deviation and the variance.*

Behaviour	Rate per minute (R) or percentage of time (P)	Occurrence (max of 112)	Mean±SD	Variance
Reprimand - verbal	R	78	3.37±4.23	17.87
Reprimand - gestures	R	6	0.16±0.80	0.63
Reprimand - physical	R	3	0.04±0.24	0.06
Reprimand – leash pull	R	36	0.89±1.49	2.22
Praise - verbal	R	103	5.33±3.78	14.30
Praise - gestures	R	3	0.06±0.44	0.19
Praise - physical	R	53	1.51±2.19	4.79
Praise - treat	R	59	1.33±1.61	2.59
Instruct - verbal	R	112	12.77±7.09	50.25
Instruct - gestures	R	65	2.81±3.76	14.15
Instruct – physical	R	15	0.22±0.62	0.38
Body position control – leash	R	72	1.78±1.74	3.02
Body position control –move	R	12	0.18±0.56	0.31
Body position control – block	R	86	1.52±1.15	1.33
Loose leash	P	112	73.47±21.96	482.35
Tight leash	P	107	26.53±21.96	482.35

N=28, with 4 repeats per dog-owner dyad

Table 4.4. *Readout parameters of the 17 observed owner behaviours in the break test. The columns shows whether the behaviour was measured in rate per minute or in percentage of observational time, the occurrence per owner-dog dyad, the mean ± standard deviation and the variance.*

Behaviour	Rate per minute (R) or percentage of time (P)	Occurrence	Mean±SD	Variance
Reprimand - verbal	R	14	0.21±0.35	0.12
Reprimand - gestures	R	0	0	0
Reprimand - physical	R	2	0.01±0.04	<0.01
Praise - verbal	R	28	1.54±1.46	2.15
Praise - gestures	R	1	0.01±0.07	<0.01
Praise - physical	R	26	1.16±1.19	1.42
Praise - treat	R	8	0.10±0.24	0.06
Instruct - verbal	R	29	2.47±2.31	5.35
Instruct - gestures	R	23	0.56±0.56	0.32
Instruct – physical	R	3	0.02±0.06	<0.01
Give toys	R	27	0.42±0.29	0.08
No attention	P	31	30.75±32.93	1084.41
Passive attention	P	31	13.24±11.37	129.28
Active positive attention – verbal	P	31	14.17±10.87	118.22
Active positive attention - physical	P	29	41.52±29.00	841.18
Active negative attention – verbal	P	4	0.32±1.12	1.26
Active negative attention – physical	P	0	0	0

N=31

Appendix 5. Pearson correlation coefficient between parenting style percentages and behaviour tests results

Table 5.1. *Pearson correlation coefficient between owner behaviour and parenting style percentages in the greeting stranger test.*

	AUTN	AUTV	PERM	LAPS
Sc1: control	-0.319 (R^2=0.102)	0.661 (R^2=0.437)	0.072	0.222
Sc2: warmth	-0.365 (R^2=0.133)	0.093	0.275	0.624 (R^2=0.389)
Reprimand leash pull	0.136	0.311	-0.209	-0.090
Instruct verbal	-0.665 (R^2=0.442)	0.479 (R^2=0.229)	0.102	0.571 (R^2=0.326)
Body position control - leash	-0.350 (R^2=0.122)	0.618 (R^2=0.382)	0.176	0.338 (R^2=0.115)
Loose leash	0.208	-0.612 (R^2=0.375)	-0.130	-0.345
Tight leash	-0.208	0.612 (R^2=0.375)	0.130	0.345

n=30, two-tailed p=0.05, critical value=0.361

Table 5.2*. Pearson correlation coefficient between owner behaviour and parenting style percentages in the goal scoring test.*

	AUTN	AUTV	PERM	LAPS
Sc1: dominant over dog	0.045	0.007	-0.093	-0.010
Sc2: clarity of communication	-0.495 (0.245)	0.190	0.352 (0.124)	0.489 (0.239)
Success rate (goals per min)	0.290	0.127	-0.009	-0.134
Reprimand verbal	-0.060	0.265	0.070	0.084
Praise verbal	-0.201	0.335 (0.112)	0.405 (0.164)	0.318 (0.101)
Praise physical	0.065	0.207	-0.032	0.018
Praise treat	-0.417 (0.174)	0.034	0.504 (0.254)	0.302
Instruct verbal	0.239	-0.055	-0.197	-0.140
Instruct gestures	-0.190	0.027	0.081	0.069
Instruct physical (forcing)	0.489 (0.239)	-0.395 (0.156)	-0.201	-0.382 (0.146)
Instruct demo	0.320 (0.102)	0.072	-0.373 (0.139)	-0.567 (0.322)
Instruct trick	0.149	-0.360 (0.129)	-0.217	-0.091
Stand straight	-0.176	0.242	-0.121	0.191
Kneel	-0.166	0.100	0.172	0.151
Bend	0.383 (0.146)	-0.349 (0.122)	-0.132	-0.374 (0.140)

n=31, two-tailed p=0.05, critical value=0.356

Table 5.3*. Pearson correlation coefficient between owner behaviour and parenting style percentages in the break test.*

	AUTN	AUTV	PERM	LAPS
Sc1: involvement	0.131	-0.022	0.309	-0.251
Sc2: warmth	-0.103	0.069	0.454 (R^2=0.206)	0.525 (R^2=0.275)
Praise verbal	0.182	0.236	0.381 (R^2=0.145)	0.169
Praise physical	-0.446 (R^2=0.199)	-0.066	0.369 (R^2=0.136)	0.379 (R^2=0.144)
No attention	0.077	-0.208	-0.608 (R^2=0.369)	-0.243
Passive attention	-0.120	-0.040	0.165	-0.054
Pos attention verbal	0.226	-0.104	0.231	-0.238
Pos attention physical	-0.125	0.125	0.509 (R^2=0.260)	0.397 (R^2=0.158)

n=31, two-tailed p=0.05, critical value=0.356

***Table 5.4**. Pearson correlation coefficient between owner behaviour (sum of the four trials) and parenting style percentages in the treat on table test.*

	AUTN	AUTV	PERM	LAPS
Sc1: control (cold)	0.105	0.115	-0.063	-0.242
Sc2: praise (warmth)	-0.285	0.110	0.402 (0.162)	0.231
Reprimand verbal	-0.019	0.233	-0.187	-0.355 (0.126)
Reprimand leash pull	0.075	0.282	-0.299	-0.129
Praise verbal	-0.395 (0.156)	0.335 (0.112)	0.447 (0.200)	0.260
Praise physical	-0.383 (0.147)	0.201	0.252	0.223
Instruct verbal	-0.161	0.277	0.063	0.134
Body position control leash	-0.013	0.237	0.035	-0.176
Body position control block	-0.015	0.069	-0.270	-0.010
Tight leash	0.063	-0.015	0.149	-0.172
Loose leash	-0.063	0.015	-0.149	0.172

n=28, two-tailed p=0.05, critical value=0.374 (one tailed p=0.05, critical value=0.317)

***Table 5.5**. Pearson correlation coefficient (r) between parenting styles and self-control test results.*

Self-control	AUTN	AUTV	PERM	LAPS
Latency without help	-0.093	0.344 (0.119)	-0.134	0.330
Latency with help	0.054	-0.109	-0.192	0.100

n=32, critical value=0.351 (one tailed critical value=0.296)

Appendix 6. REML analyses treat on table test

***Table 6.1**. Results of the linear mixed model of all the measured behaviours of the treat on table test with trial (1-4) as covariate.*

	Wald/d.f.	P-value
Reprimand verbal*	4.11	0.006
Reprimand gesture	1.19	0.313
Reprimand physical	0.34	0.794
Reprimand leash pull	1.32	0.264
Praise verbal	2.39	0.067
Praise gesture	1.01	0.386
Praise physical	1.50	0.213
Praise treat*	3.14	0.024
Instruct verbal	1.28	0.280
Instruct gesture	0.85	0.465
Instruct physical	1.09	0.351
BPC leash	0.98	0.399
BPC move	0.29	0.832
BPC block	0.46	0.710
Loose leash*	8.30	<0.001
Tight leash*	8.30	<0.001

*p-value<0.05, only these behaviours changed significantly over the tests.

***Table 6.2**. Wald statistic, p-value, standard error, predicted mean for constant and predicted means for trials of the behaviours that were significantly different over the trials.*

	Wald test	Wald/df	p	sed	predicted mean±SD	Predicted means for trials			
						1a	1b	2a	2b
Reprimand verbal	12.32	4.11	0.006	0.8302	3.254±0.5867	3.886	4.432	3.003	1.696
Praise treat	9.41	3.14	0.024	0.2174	1.293±0.2670	0.977	1.206	1.362	1.627
Loose leash	24.90	8.30	<0.001	3.554	73.13±3.291	66.54	67.81	76.24	81.91

When a REML is performed with as fixed factor only object (treat or ball), there is no significant difference found between any of the owner behaviours.

When a REML is conducted with as fixed factor only trial (1 or 2), there is a significant difference found for the behaviours reprimand verbal, praise verbal, praise physical, praise treat, loose and tight leash.

Appendix 7. Pearson correlation coefficient parenting styles and C-BARQ

Table 7.1. *Pearson correlation coefficient (r) of the different parenting styles and factors of the CBarq.*

	AUTN	AUTV	PERM
Factor 1	0.268	-0.242	0.150
Factor 2	0.267	-0.391 (R^2=0.153)	0.118
Factor 3	-0.132	-0.124	0.335 (R^2=0.113)
Factor 4	0.390 (R^2=0.152)	-0.316	0.169
Factor 5a	-0.254	0.061	0.311
Factor 5b	-0.099	-0.094	0.208
Factor 5total	-0.192	-0.030	0.288
Factor 6	0.096	-0.311	0.166
Factor 7	0.096	-0.113	-0.111
Factor 11	0.351 (R^2=0.123)	-0.386 (R^2=0.149)	0.188

n=28, p=0.05 (two-tailed), critical value = 0.374, R^2 = fraction variation explained

Table 7.2*. Pearson correlation coefficient (r) of the different parenting styles and general fear, aggression and separation anxiety*.*

	AUTN	AUTV	PERM
Aggression	0.135	-0.237	-0.081
Fear	0.187	0.225	-0.240
Separation-anxiety	0.043	-0.123	-0.109

*Aggression calculated by combining the questions of factor 1, 2 and 5a, fear by combining the questions of factor 3, 4, 5b and 11, and separation anxiety by combining the questions of factor 6 and 7.