Who pulls the leash?

The influences of parenting styles, training methods and (mis)behaviours of the dog on leash tension

By Plug, V.E.

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The influences of parenting styles, training methods and (mis)behaviours of the dog on leash tension

*Plug, V.E.*

*Date: 15th March 2020*

*Supervisor:*

* *Dr. Beerda – Wageningen University*

*Behavioural ecology group (BHE)*

*Wageningen University and Research*

*BHE-80336*

*Wageningen*



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## Abstract

Leash pulling in dogs is seen as a problem by many dog owners, which can have consequences for the welfare of the dog as dog ownership dissatisfaction can lead to abandonment. The underlying causes of leash pulling are unclear and likely the owner-dog relationship is of influence. This relationship includes training methods and dog-directed parenting styles. In this research it was investigated how these two factors (training methods, dog-directed parenting styles) associated with leash pulling and other problem behaviours. Leash tension may result from the dog pulling the leash and / or the owner wanting to control the dog, and the difference was investigated. An online questionnaire was used to assess dog-directed parenting styles and training methods of 233 dog owner and of these 41 owners filled out a second questionnaire that included the Canine Behavioural Assessment and Research Questionnaire to determine their dog’s problem behaviours. Subsequently, 38 owners participated in a behaviour test in which owners walked their dog through 4 parkours of different difficulty with either distractions or not. The leash tension was measured every second on a scale from 0-4. Linear mixed model analyses showed that the parkours with distractions resulted in significantly higher leash tensions than those without and that the more difficult parkour with distractions resulted in the highest leash tensions. The authoritative (authoritative intrinsic value-oriented) parenting style related inversely with leash tension, and training methods based on negative reinforcement related directly to leash tension. Furthermore, high leash tension related directly to owner-directed aggression and tended to do so with excitability. These findings show that dog-directed parenting styles and training methods associate with leash tension when owners walk their dog through test parkours. This supports the idea that the owner-dog relationship shows in the way owners walk with their leashed dog, with effects of both owners (e.g. his/her parenting style or training method) and dog (e.g. its aggression and excitability). Good communication between the owner and dog seems to be achieved mainly by an authoritative kind of parenting. This research provides insight in the underlying mechanism of leash tension when owners walk their dog, which can be helpful to improve the owner dog relationship and ultimately the welfare of the dog.

Keywords: Dog, parenting styles, training methods, problem behaviour, leash tension

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## **1. Introduction**

The relationship between dogs and their owners is strong but complicated (Robinson, 2013). Dogs (*Canis familiaris*) have a history of living with humans for more than fourteen thousand years, fulfilling different roles, from companionship to working dog (Coren, 1994). Nowadays, dogs are mainly kept for their companionship and owners even consider their dog as a part of their family. This humanizing of dogs shows in that women use “motherese” or baby-talk when interacting with the dog (Prato‐Previde et al., 2006). Additionally, they “hold and cuddle them seeking and maintaining physical contact” (Prato-Previde et al., 2014). The dog-owner relationship is bidirectional in affect and resembles a relationship similar of that between a parent and child. This shows in attachment behaviours that are measured with the Ainsworth strange test (Ainsworth et al., 1970). The test with children models different situations where the mother is either present alone, together with a stranger, not present but the stranger is, or the child is alone. The behaviour of the child is then recorded during different episodes. The scores of the different behaviours result into three main attachment styles namely, secure attachment, insecure avoidant and insecure ambivalent/resistant (McLeod et al., 2008). The Ainsworth strange test has been used worldwide and was also adopted for the use with dogs (Topál et al., 1998). The dogs’ behaviours in the Ainsworth strange allowed to describe the human-dog relationship in a 3-dimensional factor space of anxiety, acceptance and attachment. A cluster analysis discriminated 5 substantial different classes of dogs, and dogs could be categorized along the secure-insecure attached dimensions of Ainsworth’s original test. The results showed that dogs react similar to the test as infants, which supports the existence of an infant-like attachment bond between dogs and their owners (Prato-Previde et al., 2003; Topál et al., 1998). This close relation implies that an owner’s way of dealing with their dog will affect the latter’s behaviour and well-being.

Given that owners could be considered to parent their dog, it should be possible to categorize the ways in which owners do so. In human social sciences, the way in which parents raise their child is known as parenting styles. Studies since the 1970’s have identified relatively stable patterns in parenting behaviour and goals of the parents for their child (Baumrind, 1971)**.** The impact of the parenting styles is that it has an effect on the development and well-being of the children. These parenting styles exist in the owner-dog relationship also (Herwijnenen et al., 2018), which gives an opening to improve the behaviour and welfare of the dog. Demandingness and responsiveness are the two dimensions that underlie four different parenting styles (Fig 1., for a discussion see Hughes et al., 2005). Demandingness refers to the monitoring of the child and the practice of confrontive control. Monitoring provides structure, predictability and order, where confrontive control teaches a child to behave in a proper way by discouraging disruptive behaviour and enforcing rules in a goal-oriented and reasonable way (Baumrind, 1991). Responsiveness represents emotional warmth and supportive actions, reflecting the degree to which a parent responds to the child’s needs and wishes (Baumrind, 1991). Authoritative parents are characterised by their flexibility, adapting their parenting to the child’s needs/interests (Önder et al., 2009). This form of parenting is seen as the higher quality of parenting due to its reflection of both demandingness and responsiveness (Baumrind, 1989). Authoritarian parenting includes a high level of demandingness towards the child but low responsiveness. Authoritarian parents are neither warm nor responsive to their children, but their expectations of the child are high, as is the control they exert on them. Rules are set without explaining the reasoning behind them and of the failure to abide the rules is punished (Baumrind, 1991; Johnson, 2006). These punishments are either physical or verbally, the focus of authoritarian parenting lies on eliminating negative behaviour (Önder et al., 2009). The third style is permissive parenting which involves low demandingness but high responsiveness (Baumrind, 2013; Yazdani et al., 2016). They have minimal expectations for their children or dog and exhibit a high tolerance for their misbehaviours. This results in freedom and low levels of guidance and discipline (Yazdani et al., 2016)**.** The last parenting style is neglectful or uninvolved parenting, which is about low demandingness and low responsiveness (Karavasilis et al., 2003). In this case, barely anything is expected from the child and little effort is put into the emotional needs of the child (Baumrind, 1989; Yazdani et al., 2016).

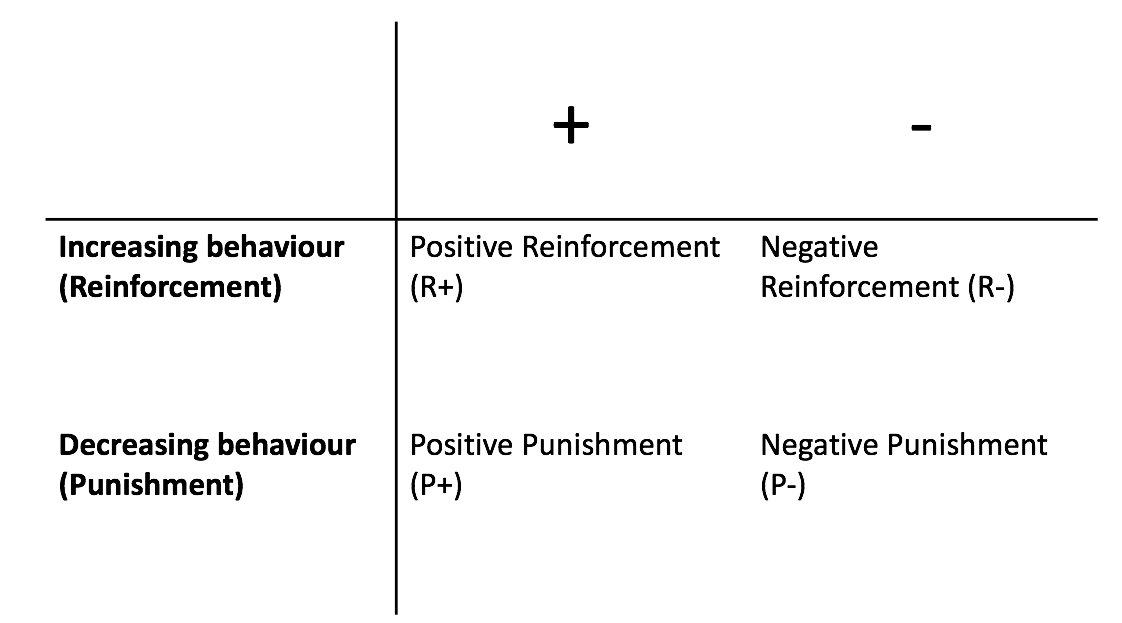
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**Figure 1: The parenting style in relation to the underlying parenting dimensions**. The authoritarian style corresponds with high demandingness, low responsiveness, the authoritative style with high demandingness, high responsiveness, the permissive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

Research on dog-directed parenting styles by van Herwijnen et al. (2018) detected the original parenting styles authoritarian and authoritative (training oriented and intrinsic value oriented), using an adapted version of the Parenting Style and Dimension Questionnaire (PSDQ; Robinson *et al.,* 1995). The authoritarian parenting style separated into authoritarian-verbal correction and authoritarian physical correction but was combined into the authoritarian correction orientated parenting style. The authoritative-intrinsic value-oriented style indicated high responsiveness, while being oriented on the needs and emotions of the animal. Owners which score high for this style valued the needs and emotions of their dog. The authoritative-training oriented style mostly resembles the human authoritative parenting style. It captures variations in both demandingness and responsiveness. This style is mostly oriented on training and teaching the dog how to behave. No results for permissive or uninvolved parenting styles were found, which the researcher attributed to the study population of devoted dog owners (Herwijnen et al., 2018).

Besides the parenting styles, also the training methods contribute to the dog-owner relationship. Different training techniques exist to modify the behaviour of a dog through different learning processes (Fernandes et al., 2017). The most commonly used method is operant conditioning where the probability of occurrence of a given behaviour is increased or decreased by setting its consequences (Skinner, 1938). Dogs learn to perform specific behaviour to avoid unpleasant stimuli and/or achieve pleasant stimuli. It would be interesting to know how different forms of operant conditioning/training methods are related to the different forms of parenting styles. Operant conditioning is divided in four different quadrants which can be categorized as reward-based methods or aversive-based methods. This former category consists of positive reinforcement (+R), where a behaviour results in a pleasant stimulus and the probability of its occurrence increases. The latter encompasses negative reinforcement (-R), where a behaviour removes an unpleasant stimulus and the probability of its occurrence increases, positive punishment (+P), where a behaviour results in an unpleasant stimulus and the probability of its occurrence decreases and negative punishment (-P), where a behaviour removes a pleasant stimulus and the probability of its occurrence decreases (Fernandes et al., 2017) (Fig. 2).



**Figure 2:** Different forms of operant conditioning. With + indicating a pleasant stimulus and – indicating a negative stimulus.

Typically, rewards are in the form of vocal praise, stroking, food, interactive play and social contract. Punishers can be in the form of vocal (raising voice/screaming) and physical reprimands or inflicted pain of discomfort trough tools. The use of aversive-based training methods may be encouraged by the view that dogs, like wolves, are pack animals who have a linear hierarchy with the dominant leader on top (Landsberg et al., 2003). However, it is questioned for their potential negative effects on dog welfare (Fernandes et al., 2017).

Parenting style and training method in part define the owner-dog relationship, likely influencing the dog’s behaviour and welfare. Most dogs receive at least a rudimentary training. For instance, dogs are trained to defecate in an appropriate place, to walk, to heel and to obey a range of commands (Hiby et al., 2004). Poor education of the dog can play a major role in the misbehaviour of a dog (Borchelt, 1983). Dogs that are not trained properly or raised in the right way could experience problem behaviours which can impair their welfare(Hiby et al., 2004). Haverbeke et al. (2008) did a study with military dogs which were paired with handlers. These handlers used either aversive-based methods (pulling on the leash and hanging on the collar) or reward-based stimuli (stroking and patting) during training. During performance of obedience and protection work, the dogs exhibited a significantly lower body posture after aversive stimuli then after reward-based stimuli. The dogs who experienced aversive stimuli seemed more stressed (Haverbeke et al., 2008). Cooper et al. (2004) preformed an experiment with companion dogs which were trained with aversive-based or reward-based methods. These dogs were allocated to three groups of which the first group was trained by a certified chock collar trainer (with or without shock collar) and by a reward-based professional trainer. The dogs which were trained with a shock collar showed significant more time stress-related behaviours in comparison with the dogs trained with reward-based methods (Cooper et al., 2014). Deldalle et al. (2014) studied dogs who were trained by their owners, however at two different training schools. One school used the R+ methods (reward-based) and the other school the R- (aversive-based). They found that dogs trained with the R- method showed more stress related behaviour. Also gazing to the owners, which could be a measurement for owner-dog attachment (Dölen et al., 2013; Nagasawa et al., 2015), happened less often than dogs trained with R+ (Deldalle et al., 2014). When studying dog-owner pairs in standard situations, dogs were less interactive during play and contacted and interacted less with the experimenter during a relaxed social test when these were from owners who said to use more physical punishment for basic training education and obedience training (Rooney et al., 2011). These negative effects of aversive-based methods do not only show during the actual training, but persist in daily life. Schilder et al. (2004) did a study with guard dogs which were trained with shock collars (aversive based, +P), these dogs showed direct reactions after the shock in the form of lowering body posture, barks and squeals, redirection aggression and tongue flicking, suggesting stress, fear and pain. Dogs trained with shock collars also showed more stress-related behaviour outside the training situation than dogs who had not received shocks. Similar outcomes came from a survey (Schilder et al., 2004).

Likewise to training methods, dog-directed parenting styles are expected to affect dog behaviour and welfare as these parenting styles are known to affect child behaviour and well-being. A study with 308 families showed the association of parenting dimensions and academic achievements of children (Pinquart, 2016). The authoritative parenting style resulted in better academic performance of the children compared to the authoritarian, permissive and uninvolved parenting style (Pinquart, 2016). Also, parenting styles associated with child obesity (Frontini et al. 2016). The study a sample of 223 children included 125 children of a healthy weight and 98 who were obese. The parenting styles of the mothers was measured using a parenting style and dimensions questionnaire. Mothers who had children with obesity used a more permissive parenting style in comparison with the mothers who had children with a healthy weight. Surprisingly, not only with a permissive parenting style children tended to be obese, this relation was also found with an authoritarian style (Frontini et al., 2016). Of particular interest is that associations were found between the parenting styles and problem behaviour in kids. The authoritarian parenting style of mothers related to children’s aggressive and externalizing behaviour (O’Leary et al., 1999). In O’Leary’s study, 117 families participated and the correlations between parenting style and problem behaviour, which varied between boys and girls, stayed significant over time, indicating a stable relationship between aggressive behaviour and the authoritarian parenting style. Next to aggressive behaviour, also anxiety is associated with the authoritarian parenting style, specifically when practiced by fathers (O’Leary et al., 1999). Given that there is a relationship between parenting style and (problem) behaviour in children, it is interesting to investigate if parenting styles in owner-dog relationships can explain, if only in part, the occurrence of problem behaviour in dogs.

Leash pulling by dogs is annoying to dog owners and many experiences it as an unwanted behaviour. Excessive leash pulling can be dangerous for both the dog and the owner, especially if the dog is large (Shabelansky et al., 2016). Strain on the leash can range from a little tuck to excessive pulling from both parties. The resulting pressure on the neck of the dog can damage the larynx or trachea, which can impair the welfare of the dog (Pauli et al., 2006). A survey conducted by Blackwell et al., (2008) showed that 69% of the 192 dog owners who filled in a questionnaire had a dog that pulled on the leash. Although dogs habituate to wearing a neck or head collar and a harness after 20 minutes (Grainger et al., 2016; Haug et al., 2002), the consequent restraint does affect the gait and behaviour of the dog. Peham et al. (2013) placed pressure strips underneath three different harnesses in eight guide dogs. They found specific pressure distribution throughout the dog’s body; in all the three harness types the highest pressure was found in the right sternal region. Pressure mat measurements revealed that the forelimb weight shifted away from the leash in dogs, which were lighter then twelve kilos (Keebaugh et al., 2015)**.** Additionally, leash-related gait asymmetry was found in a study group of 66 dogs of various breeds and sizes (Fahie et al., 2018). The dogs were walked and trotted at their own pace on a pressure sensing walkway system. The side at which the owner held the leash influenced the gait symmetry of the dog. Besides the effects on gait, leashing also changes the behaviour of the dog. Dogs held on a leash during their walks showed less sniffing behaviour towards other dogs (Řezáč et al., 2011).They recorded 1,870 dogs and owners during their walk in the park and found less dog-dog interaction with dogs that were leashed. More importantly, dog’s that were held on a leash displayed twice as often threats toward other dogs, for instance barking, growling, snarling or baring teeth (Řezáč et al., 2011). This aggressive behaviour can cause serious harm to other dogs, who may react aggressively and start a fight, or they become afraid. Thus, leash pulling annoys owners and can impair the welfare of the dog. The underlying mechanism of leash pulling is unfortunately not clear, which complicates the formulation of counter measures. Hampl (2013) explained that in dyadic walks, guidance/leadership is not always equally distributed between partners, in this case between the owner and dog. Most of the time the one partner leads the walk. Ideally the owner determines in which direction they walk, or when to stop and what to do next. Sometimes the guidance will alternate within the dyad. During leash walks conflicts about guidance can occur. The dyadic partners can act in-between the length of the leash, which can be seen as an instrument of communication. When an individual does not want to walk in a certain direction, or want to correct certain behaviour, the leash will be strained (Hampl, 2013). Studies mentioned above already indicate that some dogs held on a leash show more signs of aggression or fear. These problem behaviours could cause leash pulling in dogs. However, the owner-dog relation which is influenced by the parenting styles and training methods, could also be the underlying reason of a higher leash pressure.

It is relevant to investigate the relationship between leash pulling and the owner-dog relationship (read dog-directed parenting styles and training methods) or dog (mis)behaviour. This could clarify if it is mainly the dog owner or dog that strains the leash. Leash tension may be measured like they do with horse riding with the use of a rein sensor (Dumbell et al., 2019), which is attached to a horse’s bit. Results with 24 dogs showed that there was more tension on the leash during a walk of more difficult parkour than an easy parkour. The easy parkour existed out of a simple trajectory with some small distractions in the form of food, whilst the complicated walk was a zigzag trajectory with more distractions, including toys (Herwijnen et al., 2019). Here, I investigate if leash pulling is associated with different forms of parenting style and training techniques, or with dog characteristics in the meaning of problem behaviour. The results provide insight in who initiates especially leash pulling, the owner or his/her dog, and identifies risk factors of problem behaviours like fear and aggression.

## **2. Materials and methods**

This study used a survey to assess dog-directed parenting styles of dog owners and their preferred training methods (positive reinforcement, negative reinforcement and positive punishment, but not the rarely used negative punishment). The different parenting styles and training methods were related to problem behaviour in the dogs as reported by their owners. The last aspect of this study involved behaviour tests to record leash tension when owners walked their dog though parkours of varying difficulty. The main focus of this study was to determine if a strained leash is many associated with the ways the owner interacts with the dog (parenting styles and training methods) or if it results from the dog, for example as it in general tends to show problem behaviour.

### 2.1 Questionnaires

A questionnaire was developed to determine which form of parenting styles dog owners used. The basis was the Parenting Practices Questionnaire (Robinson et al., 1995),however it was made applicable to dog owners and supplemented with the Lexington Attachment to pet Scale (LAPS; Johnson et al., 1992). The questionnaire consisted of seventeen questions (5-point scale) as this was found to be enough to determine the parenting style of the dog owners (Dijk, 2019)(*see* *appendix 1.)*. The questions were linked to the four original parenting styles, three dog-directed parentings styles and the two dimensions. Besides these seventeen questions, general information was collected on the dog and its owner (owner’s gender and age, dog’s sex, age and weight; *see appendix 2.).* Questions about training methods were asked to determine which form of operant conditioning (positive reinforcement, negative reinforcement or positive punishment) an owner used mostly. The online survey started with two general questions to determine if the dog had had any sort of training and by what training methods. This was followed by five questions in which certain situations were described in which the dog had to perform a certain task, such that owners could report their ways of training (*i.e.* Which training methods do you use if you try to let your dog to sit?). The owner was allowed to check a maximum of five out of twelve answers, which represented different training methods *(see appendix 4.).* The owner was asked to only check the boxes which were most applicable in the described situations. This questionnaire was completed by 233 voluntary dog owners (198 women, 35 men). The participants were recruited via social media and by asking around the neighbourhood. All the participants were the main owners of the dog.

From the entries to the questionnaire, 38 dog owners were selected to visit Wageningen University and Research centre to take part in a behaviour test. Additionally, 36 out of these 38 participants filled in a second questionnaire, which contained part of the Canine Behavioural Assessment and Research Questionnaire (C-BARQ) about dog problem behaviour. Two additional owners also filled in this questionnaire but didn’t participate with the behavioural test. The questionnaire consisted of questions about aggression (26), excitement (21), fear (18), fear of abandonment (7), attention seeking behaviour (13), trainability (7) and chasing behaviour (4) (Hsu et al., 2003). These results, in combination with the results of the first questionnaire, were used to determine the associations between problem behaviour in relation to parenting styles and training methods.

### 2.2 Protocol and Subjects

The test for collecting the data on leash pressure was performed at Carus building of Wageningen University and Research. This location is equipped for doing behavioural tests with dogs. A leash tension test was conducted outside, in front of the Carus building. In total 38 owners participated (*see appendix* 3.)**.** Information about the procedure of the test was provided before the start of the experiments and the owners were asked to fill in a form for consent to being filmed and the use of this video material for either educational and/or research purposes. The last matter that was addressed before the beginning of the experiment was that the owner was responsible for their dog throughout the tests, meaning that they were allowed to stop the test at any moment and / or see to their dog’s maintenance (*e.g.* providing water, food etc).

### 2.3 Experimental approach

A screenshot of a cell phone

Description automatically generatedTo assess leash tensions during dog walks, an experiment was conducted consisting of owners walking their dogs though 4 different parkours: two control parkours (no distractions) and two test parkours (with distractions). Parkours were easy to walk, consisting out of a rectangle of 10x5 meters (30 meters in total), or more difficult to navigate, with turns of different dimensions (total of 30 meters) (Fig. 3). Five distractions were placed on fixed locations for the easy parkour with distractions (three foods and two toys). Seven distraction were placed on fixed locations for the difficult parkour with distractions (three toys, three foods and one dummy dog). The participants walked each parkour twice (2x4 parkours per participants). The order of which the parkours were walked was assigned randomly, using the random sorter program of Excel. The experiment was filmed out of 2 corners using a GoPro situated on a tripod. One GoPro was located in the corner of the starting position, this camera was handled manually.

**Figure 3**:The four parkours of the leash pressure test**.** The top figures indicate the easy parkour (top right) and the control of the easy parkour (top left). The bottom figures indicate the difficult parkour (bottom right) and the control of the difficult parkour (bottom left). The S/F stands for start/finish, the food bowls represent food distractions, the balls repressed toy distraction and the dog represents a dummy dog.

The recording was started when the owner began the parkour and ended when they finished. The other camera was located at the other side of the parkour, filming during the whole test.

The distractions, both for the easy walk and the complicated walk, were 0.8 or 1.2 metersremoved from the parkour, depending on the size of the dog. With dogs that were small or medium sized (0 to 25.9 kg) the distractions were placed 0.8 meters removed from the walking outline of the parkour (n=19). For large and giant dogs (26 > kg) the distractions were 1.2 meters removed from the walking lines (n=19). Distances made it difficult for the dog to reach them, whilst being clearly noticeable. The owners were asked, before the experiment, on which side they normally held their dog on the leash. Owners who held their dog on their left side walked the parkour counterclockwise, ensuring that the dog was in the inner circle of the parkour and the owner did not end up between the dog and the distractions. If the owner had no preference for a side, then the parkour was walked counterclockwise. The same direction will be maintained throughout the test. The owners were instructed to guide their dogs through the course without the dog touching the distractions, and the owners were told to be free to use any method they saw suitable to establish this. The experimenter walked the parkour one time to show the owner which directions he/she should go. The owner used their own leash and collar/harness, since the dog was used to this way of handling.

A dog jumping in the air

Description automatically generated The video recordings were analysed for the strain on the leash at the times that owners walked their dog through the different parkours. The strain on the leash was ranked between 0 (no strain) to 4 (highest amount of strain) (Fig. 4), following an ethogram (*see appendix 6).* The pressure was ranked every second, beginning from the moment the owner past the starting point and ending after they reached the finish. A leash tension parameter of 0 and 1 was not seen as overly meaningful and only if the parameter was a 2 or higher it was noted down who initiated the increase in tension (owner or dog).

**Figure 4:** Visual representation of the pressure on the leash ranked from 0 to 4. With 0 the leash is hanging loose and 4 with maximum tension, where either the dog is out of balance or the owner.

2.4 Statistical analysis

The scores for each parenting style were calculated by averaging answers, which were expressed on a 5-point scale (n=233). A score of 0 for a certain parenting style indicated that the owner didn’t perform any sorts of this style, whereas a score of 5 indicated the owner had a maximum score for this style. The questions associated with training methods were calculated into a percentage of the maximum score for each of the training methods (positive reinforcement, negative reinforcement, positive punishment) (n=233). Meaning that owners which scored 0% for a certain method didn’t practice this type of training, whereas 100% indicated that the owner only uses this method. To test if there were any associations between training methods and parenting styles the spearman rank correlations was used, since the data was not normally distributed (also not after a Logarithmic transformation. The test was two-tailed, and significance levels were set at p <0.05. Normality of data was evaluated by Q-Q plots and the Shapiro-Wilk test. Significant correlation coefficients below 0.35 were indicated as weak correlations, significant correlation coefficients between 0.36 and 0.67 were indicated as moderate correlations and significant correlations coefficients between 0.68 and 1.0 were seen as strong or high correlations (Taylor, 1990).

The problem behaviours were divided in eleven C-BARQ factors (*see appendix 5).* The Scores for each problem behaviour was calculated by means of calculating the percentages of the maximum possible score of the 5-point scale items corresponding to each C-BARQ factor (0% showed no form of this problem behaviour, score of 100% was maximum score for this problem behaviour) (n=38). Associations between training methods and the different factors of the problem behaviours were calculated using the Spearman’s rank correlation test. Associations between parenting styles and the different factors of the problem behaviours were calculated using either the Pearson’s correlations test or the Spearman’s rank correlation test depending on their normality. Associations between authoritative parenting and factor 7, 8, 9, and 10 (attachment/attention seeking behaviour, trainability, chasing, excitability) were calculated using the Pearson’s correlations test. The Pearson’s correlations test was also used to test for associations between demandingness and C-BARQ factors 7, 8, 9 and 10. Associations between the permissive parenting style and factor 7 were calculated with a Pearson’s correlations test (α<0.05) after a Log10(x) transformation. The rest of the correlations were calculated using a Spearman’s rank correlations.

Leash tensions were expressed as means for each participant (n=38) and parkour resulting in a total of 304 records. The mean leas tensions scores on a scale of 0 to 4 were analysed with a linear mixed model (LMM) by the use of restricted maximum likelihood (REML). REML assumes data to have a normal distribution, but LMM takes the actual distribution into account and implements the REML-type analysis. The statistical model included a random component to account for the repeated measures on same dogs and the following statistical model was used:

Yxpqr = μ + roundx \* parkour p \* distractionq + dogr + *e*

Where Yxpqr is the leash tension for dog r, during round x (first or second time), walking parkour p (easy or difficult) with distractions q (present or not present). Association between parenting styles and leash pressure were calculated using only the data collected for round 1 (n=38). Leas tension scores, both overall means on those for different parkours, were correlated with demandingness (raw scores and log transformed) using Pearson’s. A similar approach was used to tests associations with the permissive parenting style. Associations between leash tension and training methods were tested with Spearman’s rank.

Association between leash tensions and problem behaviour tested using only the data collected for round 1 (n=38). A Pearson’s correlations test was used for the normally distributed data of the difficult parkour and C-BARQ factors 7, 8, 9 and 10. Other relationships between leash tension and problem behaviours were done using the Spearman’s rank correlation test.

The strain on the leash was scored as being caused (mainly) by the owner (O) or the dog (D) and this this was expressed as a ratio ([O-D]/[O+D]), per record of owner and parkour. A score of 1 indicated that the owner initiated all events and -1 that the dog did. Ratios were analysed by REML as described, where here Yxpqr is the ratio between the owner and dog. The original amount of initiations of pressure on the leash caused by the owner and dog were used to investigated for associations with training methods or parenting styles, using Pearson’s correlations. Data was log10 transformed where appropriate and when the assumptions of normality were not met a Spearman’s rank correlation was used. All data was processed using the program R studio. Untransformed data was used in the graphs. Results were interpreted as significant when the p-value was < 0.05 or as a trend when between 0.05 and 0.1.

## **3. Results**

### 3.1 Parenting styles and training methods

In the first of the three study phases it was investigated whether parenting styles and training methods were related. The data was obtained by the questionnaire, and 17 questions on a 5-point scale were expressed as sores for the four original parenting styles (authoritative, authoritarian, permissive and uninvolved), the three dog-directed parenting styles (authoritative-intrinsic value orientated and authoritative -training oriented style, authoritarian-correction oriented) and the two dimensions (demandingness and responsiveness). To determine the training methods of the owner, 5 questions on a 5-point scale were used to determine which form of operant conditioning (positive reinforcement, negative reinforcement and positive punishment) they used. The mean scores (± SE) of the parenting styles and training methods, investigated using the questionnaire, are listed in Tables 1 and 2**.**

***Table 1:*** *Mean score, SE and variance of the parenting styles and their dimensions (n=230). Scores are calculated as the maximum of the possible score. (AUTV stands for Authoritative, AUTN stands for authoritarian, UNINV stand for uninvolved, AUTVI stands for authoritative-intrinsic value orientated, AUTVT stand for authoritative -training oriented style and AUTNC stand for authoritarian-correction oriented).*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **AUTV** | **AUTN** | **PERM** | **UNINV** | **AUTVI** | **AUTVT** | **AUTNC** | **Responsiveness** | **Demandingness** |
| **mean** | 1.92 | 0.45 | 1.81 | 1.17 | 2.26 | 3.18 | 1.09 | 68.55 | 56.14 |
| **± St. error** | 0.07 | 0.06 | 0.07 | 0.08 | 0.07 | 0.06 | 0.06 | 1.42 | 1.05 |
| **variance** | 0.88 | 0.43 | 0.73 | 1.09 | 0.73 | 0.73 | 0.59 | 325.7 | 91.84 |

**Table 2:** Mean score, SE and variance for the different forms of operant conditioning (n=230). Scores are calculated as a percentage of the maximum, possible score of the 5-point scale items corresponding each training method**.**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Positive reinforcement** | **Negative Reinforcement** | **Positive punishment** |
| **mean** | 92.84 | 3.92 | 3.24 |
| **± St. error** | 0.67 | 0.44 | 0.45 |
| **variance** | 96.7 | 43.92 | 44.04 |

Eighteen significant correlations were found between the different parenting styles and the different training methods (Table 3). Positive reinforcement seemed to relate directly with responsiveness mainly. Positive reinforcement had several weak positive correlations, including one with the authoritative parenting style (r= 0.25, R2 = 0.062, p =0.0001), with the permissive parenting style (r=0.14, R2=0.02, p<0.05), with the authoritative-intrinsic value orientated (r=0.26, R2=0.068, p<0.0001), with the authoritative -training oriented style (r=0.27, R2= 0.073, p<0.0001) and lastly with the dimension of responsiveness (r= 0.3 R2= 0.09, p<0.001). Two weak negative correlations were found for positive reinforcement. The first one is with authoritarian parenting style (r=-0.21, R2= 0.044, p<0.01) and the other with authoritarian-correction oriented style (r= -0.22, R2= 0.048, p<0.001). Negative reinforcement associated more or less oppositely as described for positive reinforcement, though there was no association with authoritarian parenting. It showed weak negative correlations with the authoritative parenting style (r=-0.17, R2=0.029, p=0.01), permissive parenting style (r=-0.14, R2= 0.02, p<0.05), authoritative-intrinsic value orientated style (r=-0.19, R2=0.036, p<0.01), authoritative -training oriented style (r=-0.16, R2=0.026, p=0.01) and with responsiveness (r=-0.17, R2=0.029, p=0.01). Positive punishment associated with parenting styles a bit like negative reinforcement, though somewhat more strongly, and especially oppositely to positive reinforcement. There were weak negative correlations with authoritative parenting style (r=-0.24, R2=0.058, p<0.001), with authoritative-intrinsic value orientated style (r=-0.22, R2=0.048, p<0.001), and with responsiveness (r=-0.3, R2=0.09, p<0.0001). Positive punishment also showed a moderate negative correlation with authoritative -training oriented style (r=-0.41, R2=0.17, p<0.0001). Also, a negative trend was found between positive punishments and permissive parenting (r=-0.11, R2=0.012, p=0.1). Two weak positive correlations were found between positive punishment and authoritarian parenting style (r=0.26, R2=0.068, p<0.0001) and authoritarian-training oriented style (r=0.27, R2=0.073, p<0.0001).

**Table 3:** Spearman rank correlation coefficients with their p-value (two-tailed) between training methods and the parenting styles (n=230). Bold data indicates a significant correlation, cursive data indicates a trend. (AUTV stands for Authoritative, AUTN stands for authoritarian, UNINV stand for uninvolved, AUTVI stands for authoritative-intrinsic value orientated, AUTVT stand for authoritative -training oriented style and AUTNC stand for authoritarian-correction oriented).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Positive Reinforcement** | | **Negative Reinforcement** | | **Positive Punishment** | |
|  | Correlation coefficient | | Correlation coefficient | | Correlation coefficient | |
| **AUTV** | 0.25 | \*\*\* | -0.17 | \* | -0.24 | \*\*\* |
| **AUTN** | -0.21 | \*\* | 0.047 |  | 0.26 | \*\*\*\* |
| **PERM** | 0.14 | \* | -0.14 | \* | *-0.11* |  |
| **UNINV** | 0.044 |  | -0.033 |  | -0.086 |  |
| **AUTVI** | 0.26 | \*\*\*\* | -0.19 | \*\* | -0.22 | \*\*\* |
| **AUTVT** | 0.27 | \*\*\*\* | -0.16 | \* | -0.41 | \*\*\*\* |
| **AUTNC** | -0.22 | \*\*\* | 0.077 |  | 0.27 | \*\*\*\* |
| **Responsiveness** | 0.30 | \*\*\*\* | -0.17 | \* | -0.3 | \*\*\*\* |
| **Demandingness** | 0.014 |  | 0.01 |  | -0.025 |  |

n= 230, two-tailed, \*P<0.05, \*\*P<0.01, \*\*\*P<0.001, \*\*\*\*P<0.0001

### 3.2 Problem behaviour in relation to parenting styles and training methods

The second phase of this study addressed how problem behaviour associated with parenting styles and training methods. The mean C-BARQ scores and variance (+SE) for the problem behaviours are listed in Table 4, with values in percentages of the maximum. Thirty-three of the 41 owners that filled in the second questionnaire concerning problem behaviours reported that their dog preformed some sorts of unwanted behaviour, though this was not necessarily perceived as problematic. Nine owners addressed that their dogs were over excited, and four of them saw this as a problem behaviour. Six owners indicated that their dog showed some form of aggression, and four of them considered this as a problem. Two owners had a dog that was fearful, but none of these owners saw this as a problem behaviour. Four owners indicated that their dog showed unwanted behaviour in the form of chasing, two of them saw this as problem behaviour. One owner had a dog that showed signs of pain sensitivity, however, didn’t addressed this as a problem. Two owners filled in that their dog showed excessive leash pulling, without this being a problem.Other kinds of unwanted behaviours were obsessions or eating from the street.

***Table 4:*** *Mean scores, SE and variance of the factors of the C-BARQ (n=38****).*** *Factor scores are calculated as percentage of the maximum possible score of the 5-point scale items corresponding each factor. The number of five-point scale questions per factor is also listed. (Factor 1 = stranger-directed aggression, 2 = owner-directed aggression, 3 = stranger-directed fear, 4 = non-social fear, 5a = dog-directed fear, 5b = dog-directed aggression, 6 = separation anxiety, 7 = attachment/attention seeking behaviour, 8 = trainability, 9 = chasing behaviour, 10 = excitability, 11 = pain sensitivity).*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Factor** | **1** | **2** | **3** | **4** | **5a** | **5b** | **6** | **7** | **8** | **9** | **10** | **11** |
| **Nr of Questions** | 10 | 5 | 4 | 6 | 8 | 4 | 7 | 13 | 7 | 4 | 6 | 4 |
| **Mean** | 12.59 | 1.70 | 12.02 | 17.07 | 20.50 | 20.89 | 5.86 | 32.84 | 71.11 | 47.49 | 39.64 | 16.08 |
| **± St. error** | 2.19 | 0.68 | 2.65 | 2.58 | 2.90 | 3.19 | 1.68 | 2.18 | 1.92 | 4.70 | 3.47 | 2.68 |
| **variance** | 182.33 | 17.35 | 267.20 | 252.52 | 318.49 | 386.50 | 107.59 | 181.38 | 139.63 | 841.16 | 456.62 | 272.65 |

#### 3.2.1 Problem behaviour and parenting style

Twelve significant correlations and sixteen trends were found between the parenting styles and problem behaviours (Table 5). Findings were in line with expectations with favourable associations between authoritative parenting and (mis)behaviours and unfavourable for the others. The uninvolved parenting styles had a weak positive correlation with stranger directed aggression (r=0.35, R2= 0.12, p=0.04). The authoritarian style had a weak positive correlation with non-social fear (r=0.34, R2= 0.12, p=0.04). Additionally, a moderate positive correlation was found for the uninvolved parenting style and attachment/attention seeking behaviour (r=0.48, R2= 0.23, p=0.004). Also, several trends were found between the four parenting styles and problem behaviours. The authoritative parenting style showed a negative trend for attachment/attention seeking behaviour (r=-0.29, R2=0.08, p=0.09). Looking at the permissive parenting style, two trends were found, first a negative trend for trainability (r=-0.27, R2=0.07, p=0.1) and a positive trend for excitability (r=0.32, R2=0.1, p=0.06). The uninvolved parenting style showed three positive trends. A first with stranger directed fear (r=0.25, R2=0.06, p=0.1), a second with non-social fear (r=0.28, R2=0.08, p=0.09) and a third with excitability (r=0.26, R2=0.07, p=0.1).

Six significant correlations were found for the three dog-directed parenting styles. A moderate negative correlation was found between the authoritative-intrinsic value orientated style and owner directed aggression (r=-0.42, R2= 0.18, p=0.01). The authoritative -training oriented style showed a moderate positive correlation with stranger directed fear (r=0.54, R2=0.3, p=0.0006), a moderate positive correlation with dog directed aggression (r=0.36, R2=0.13, p=0.03), a moderate positive correlation with chasing related behaviour (r=0.4, R2=0.16, p=0.02) and a moderate correlation with pain sensitivity (r=0.42, R2=0.18, p=0.01). The last moderate positive correlation was found between the authoritarian-training oriented style and dog directed aggression (r=0.4, R2= 0.16, p=0.02). Additionally, seven trends were found between the three dog-directed parenting styles and problem behaviours. Authoritative-intrinsic value orientated style showed a negative trend dog directed aggression (r=-0.25, R2=0.07, p=0.1) and with attachment/attention seeking behaviour (r=-0.26, R2=0.07, p=0.1). Authoritative -training oriented style showed three positive trends with stranger directed aggression (r=0.27, R2=-0.07, p=0.1), with owner directed aggression (r=0.32, R2=0.1, p=0.06), with separation related behaviour (r=0.29, R2=0.08, p=0.09) and with excitability (r=0.26, R2=0.07, p=0.1). The authoritarian-training oriented style showed one positive trend with attachment/attention seeking behaviour (r=0.27, R2=0.07, p=0.1).

The two dimensions, responsiveness and demandingness also showed three significant correlations and three trends with problem behaviours. Responsiveness showed one weak positive correlation with dog directed aggression (r=0.33, R2=0.11, p=0.05). A positive trend was found between responsiveness and owner directed aggression (r=0.27, R2=0.07, p=0.1) as well as between responsiveness and pain sensitivity (r=0.26, R2=0.07, p=0.1). Demandingness had a weak positive correlation with non-social fear (r= 0.34, R2=0.12, p=0.04) and a moderate positive correlation with dog directed aggression (r=0.37, R2= 0.14, p=0.03). Additionally, one trend was found between demandingness and stranger directed fear (r=0.29, R2=0.08, p=0.08).

***Table 5:*** *Correlations coefficients with their p-value between the different parenting style (original and dog-directed) and their two dimensions (n=36). The Pearson correlations test is used with normal distributed data or with a Log10 transformation if necessary. For data which was not normally distributed the spearman correlation test was used. Bold data indicates a significant correlation, cursive data indicated a trend. Factor 1 stands for stranger-directed aggression, 2 stands for owner-directed aggression, 3 stands for stranger-directed fear, 4 stands for non-social fear, 5a stands for dog-directed fear, 5b stands for dog-directed aggression, 6 stands for separation anxiety, 7 stands for attachment/attention seeking behaviour, 8 stands for trainability, 9 stands for chasing behaviour, 10 stands for excitability, 11 stands for pain sensitivity.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **AUTV** | | **AUTN** | | **PERM** | | **UNINV** | | **AUTVI** | | **AUVT** | | **AUTNC** | | **Responsiveness** | | **Demandingness** | |
|  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  |
| **Factor 1** | -0.13 |  | -0.007 |  | 0.23 |  | 0.35 | \* | -0.16 |  | 0.27 |  | 0.048 |  | -0.19 |  | 0.067 |  |
| **Factor 2** | -0.16 |  | 0.063 |  | -0.12 |  | 0.028 |  | -0.42 | \*\* | 0.32 |  | 0.0037 |  | 0.27 |  | 0.092 |  |
| **Factor 3** | 0.11 |  | 0.083 |  | 0.2 |  | 0.25 |  | -0.083 |  | 0.54 | \*\*\* | -0.081 |  | 0.013 |  | 0.29 |  |
| **Factor 4** | 0.094 |  | 0.34 | \* | -0.088 |  | 0.28 |  | 0.0046 |  | 0.21 |  | 0.21 |  | 0.005 |  | 0.34 | \* |
| **Factor 5a** | -0.2 |  | 0.13 |  | 0.039 |  | 0.22 |  | -0.25 |  | 0.36 | \* | 0.4 | \* | 0.33 | \* | 0.37 | \* |
| **Factor 5b** | 0.06 |  | 0.079 |  | -0.033 |  | 0.0046 |  | 0.037 |  | 0.15 |  | 0.016 |  | 0.013 |  | 0.13 |  |
| **Factor 6** | 0.23 |  | -0.024 |  | 0.054 |  | 0.15 |  | 0.077 |  | 0.29 |  | -0.17 |  | 0.18 |  | -0.016 |  |
| **Factor 7** | -0.29 |  | 0.15 |  | 0.22 |  | 0.48 | \*\* | -0.26 |  | 0.15 |  | 0.27 |  | -0.2 |  | 0.19 |  |
| **Factor 8** | -0.24 |  | 0.25 |  | -0.27 |  | -0.12 |  | -0.18 |  | -0.23 |  | 0.19 |  | -0.078 |  | 0.14 |  |
| **Factor 9** | 0.18 |  | 0.082 |  | -0.005 |  | 0.15 |  | 0.065 |  | 0.4 | \* | 0.2 |  | 00023 |  | 0.23 |  |
| **Factor 10** | -0.17 |  | 0.17 |  | 0.32 |  | 0.26 |  | -0.2 |  | 0.26 |  | 0.07 |  | -0.16 |  | 0.21 |  |
| **Facto 11** | -0.005 |  | 0.013 |  | 0.1 |  | 0.12 |  | -0.17 |  | 0.42 | \* | 0.11 |  | 0.26 |  | 0.23 |  |

n= 230, two-tailed, \*P<0.05, \*\*P<0.01

#### 3.2.1 Problem behaviour and training methods

Correlations were calculated between problem behaviour and training methods, but none were significant. Two trends were found, being a positive trend between negative reinforcement and owner directed aggression (r=0.27, R2=0.07, p=0.1) and a positive trend between positive punishments and non-social fear (r=0.27, R2=0.07, p=0.1) (see *appendix 7*).

### 3.3 Leash pressure

The third phase of this study investigated which factors underly leash tension when owners walk their leashed dog. The data of 38 participants were used to perform a REML (*see appendix 8)* on the effects of round (first, second), parkour complexity (easy, difficult), distractions (present, absent), including interactions between these. The analysis showed that there was a significant higher (p <0.001) leash pressure the first time the participants walked the parkour (of 1.02 ± 0.054; predicted mean ± se) in comparison with the second one (0.70 ± 0.054). This effect was dependent on the presence of distraction (2-way interaction Wald test statistic, W=12.16, p<0.001; see Fig. 5A), with the stronger round effects with distractions. The overall predicted means for leash tension were 1.22 ± 0.054 with distractions and 0.50 ± 0.054 without (W=180.84, p<0.001) with the stronger difference in round one (see Fig. 5A**)**. Another two-way interaction was found between the parkour and distractions (W=5.67, p=0.017; see Fig. 5B). The two parkours without distraction didn’t show any significant differences with each other, but with distractions the difficult parkours caused more leash tension (1.33 ± 0.076) than the easy one (1.11 ± 0.076).

**B**

**A**

**Figure 5:** Differences between leash pressure. The bars represent the predicted mean ± 2 standard error. (A) There is a significant higher leash pressure for the first time the participants walked the parkour and the parkours with distractions showed a significant higher leash pressure in general (p<0.001). (B) The parkours with distractions showed a significant higher leash pressure than the parkours without, also the difficult parkour with distractions had a significant higher leash pressure than the other parkours (p=0.017). Differing lower case letters note a significant difference.

#### 3.3.1 Leash tension in relation to parenting styles and training methods

Correlations were calculated between the parenting styles and the mean leash tensions for each parkour (*see appendix 9a).* The authoritative parenting style had a moderate negative correlations with the leash tension in the easy parkour with distractions (r=-0.37, R2=0.13, p<0.05), a weak negative correlation with the difficult parkour with distractions (r=-0.32, R2=0.1, p=0.05) and a weak negative correlation with the overall leash pressure calculated as average from al the parkours (r=-0.32, R2=0.1, p=0.05). Weak negative correlations were also found between the authoritative-intrinsic value-oriented style and the easy parkour with distractions (r=-0.33, R2=0.11, p=0.04) and difficult parkour with distractions (r=-0.33, R2=0.11, p<0.05). Besides that, a negative trend was found for the overall leash pressure (r=-0.3, R2=0.09, p=0.07). The permissive parenting style tended to relate negatively with leash tension in the difficult parkour without distractions (r=-0.27, R2=0.07, p=0.1). Responsiveness correlated moderately and negatively with leash tension in the easy parkour with distractions (r=-0.42, R2=0.18, p=0.009). Furthermore, it had a weak negative correlation with the overall leash pressure (r=-0.32, R2=0.1, p=0.05). One last negative trend was found between responsiveness and the leash tension in the difficult parkour with distractions (r=-0.27, R2=0.07, p=0.1).

For training methods, three positive correlations were found (*see appendix 9b)*. Negative reinforcement had a weak positive correlation with leash tension in the easy parkour with distractions (r=0.35, R2=0.12, p<0.05). Negative reinforcement had a moderate positive correlation with tension in the difficult parkour with distractions (r=0.46, R2=0.21, p<0.01) and it had weak positive correlation with overall leash pressure (r=0.35, R2=0.12, p<0.05). One negative trend was found between positive reinforcement and leash tension in the easy parkour with distractions (r=-0.28, R2=0.08, p=0.09).

#### 3.3.2 Leash pressure and problem behaviour

Several correlations were found between the leash pressure in the different parkours and the different problem behaviours (*see appendix 10).* Owner directed aggression showed a moderate positive correlation with the leash pressure of the difficult parkour with distractions (r=0.38, R2=0.14, p<0.05) and with the overall leash pressure of all parkours combined (r=0.41, R2=0.17, p<0.05). It also showed a trend with the two parkours without distractions (r=0.27, R2=0.07, p=0.1) and with the easy parkour with distractions (r=0.31, R2=0.1, p=0.06). A weak negative correlation was found between trainability and the leash pressure of the easy parkour with distractions (r=-0.32, R2=0.1, p=0.05). Additionally, a moderate negative correlation was found between pain sensitivity and the leash pressure in the difficult parkour without distractions (r=-0.37, R2=0.14, p<0.05). The difficult parkour without distractions showed two negative trends: one with the stranger directed fear (r= -0.28, R2= 0.08, p=0.1) and one with the dog directed aggression. Excitability also showed two positive trends. One with the difficult parkour with distractions (r=0.26, R2=0.07, p=0.1) and one with the overall leash pressure (r=0.28, R2=0.08, p=0.1).

#### 3.3.3 Initiation of pressure on the leash

The difference between the amount of initiations of pressure on the leash was analysed by calculating the ratio between the owner and the dog. REML analyses revealed how ratios decreased from -0.2 ± 0.08 in parkours without distractions to -0.45 ± 0.08 in parkours with (W=10.62, p=0.001), demonstrating how dogs responded to the distractions. There was an underlying 2-way interaction involved (W=10.62, p=0.001; see Fig. 6), showing how the effect of distraction was most pronounced for the easy parkours.

A screenshot of a cell phone

Description automatically generated

**Figure 6:** Boxplots of the ratio between the amount of initiations of pressure between the owner and the dog for each of the parkours (n=233). A score of 1 indicates that the owner initiated all the pressure and a score of minus one indicates that the dog initiated all the pressure. For the parkour with distraction, the dog pulled significantly more on the leash than the owner.

##### 3.3.4.1 initiation of pressure on the leash in relation to parenting styles and training methods

The amount of initiations of putting pressure on the leash expressed if owners or dogs triggered the leash tension were associated with parenting styles and training methods. The mean scores (± SE) of the number of times of tugging the leash by the owner or pulling of the dog is listed in Table 6**.**

**Table 6:** Mean score and SE for the amount of initiations of putting pressure on the leash either by owner or dog(n=38).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **Owner** | | **Dog** | |
|  |  | Mean | St. Error | Mean | St. Error |
| **No distractions** | **Easy** | 1.55 | 0.42 | 2.10 | 0.60 |
| **Difficult** | 1.13 | 0.42 | 1.79 | 0.51 |
| **Distraction** | **Easy** | 2.23 | 0.51 | 10.5 | 1.73 |
| **Difficult** | 5.13 | 0.72 | 10.26 | 1.12 |
| **Average** |  | 2.51 | 0.90 | 6.16 | 2.44 |
|  |  |  |  |  |  |

Nine significant correlations were found (Table 7). When looking at the parenting styles, authoritative parenting style had a weak negative correlation with the amount of initiation of pressure by the owner for the easy parkour with distractions (r=-0.34, R2 = 0.12, p<0.05). Also, a negative trend was found for the average amount of initiation by the owner (r=-0.3, R2= 0.09, p=0.07). The permissive parenting style had a moderate negative correlation with the amount of initiations by the owner for the difficult parkour without distractions (r=-0.42, R2= 0.18, p<0.01). The permissive parenting style had also a weak positive correlation with the amount of initiations of pressure on the leash caused by the dog taken as average over all the parkour (r=0.34, R2= 0.12, p<0.05) and a positive trend with the amount of initiations of pressure on the leash caused by the dog for the difficult parkour with distractions (r=0.3, R2=0.09, p=0.06). The uninvolved parenting style only showed several negative trends with the amount of initiations of pressure on the leash caused by the owner, this was for the easy parkour without distractions (r=-0.29, R2= 0.08, p=0.08), for the difficult parkour without distractions (r=-0.3, R2=0.09, p=0.07), and for the average amount of initiations taken for all the parkours combined (r=-0.28, R2=0.08, p=0.1). Correlations were found for the dog-directed parenting styles. Starting with the authoritative-intrinsic value-oriented style which has a moderate negative correlation with the amount of initiations of pressure on the leash caused by the owner and the easy parkour with distractions (r=-0.41, R2=0.17, p=0.01). Further, three trends were found with the authoritative-intrinsic value-oriented style, one positive trend with the amount of initiations of pressure on the leash caused by the dog for the easy parkour without distractions (r=0.28, R2=0.08, p=0.09), a negative trend with amount of initiations of pressure on the leash caused by the owner on the difficult parkour with distractions and the same negative trend for the amount of initiations of the owner taken as average from all the parkour (r=-0.31, R2=0.1, p=0.06). The Authoritative -training oriented style had two weak positive correlations, the amount of initiations caused by the dog for the easy parkour with distractions (r=0.33, R2= 0.11, p=0.05) and a moderate positive correlation with the difficult parkour with distractions (r=0.39, R2= 0.15, p=0.01). The authoritarian-training oriented style showed no correlations or trends with any of the initiations. Looking at the two dimensions, responsiveness had moderate negative correlations with the initiations caused by the dog in the easy parkour with distractions (r=-0.38, R2= 0.14, p<0.05) and a weak positive correlation with the amount of initiations caused by the dog for the difficult parkour without distractions (r=-0.34, R2= 0.12, p<0.05). Demandingness had one positive trend with the amount of initiations caused by the dog for the easy parkour with distractions (r=0.28, R2= 0.08, p=0.09).

Of the training methods, only negative reinforcement had significant correlations. Negative reinforcement had a weak positive correlation with the amount of initiations of the dog for the easy parkour with distractions (r=0.33, R2=0.11, p=0.04). Negative reinforcement had a moderate positive correlation with the amount of initiations of the dog for the difficult parkour with distractions (r=0.37, R2=0.14, p=0.02). Lastly negative reinforcement showed a moderate positive correlation with the average amount of initiations taken for all the parkours combined of the dog (r=0.39, R2=0.15, p=0.02). Also, one positive trend was found between negative reinforcement and the amount of initiations of the owner for the difficult parkour with distractions (r=0.26, R2=0.07, p=0.1) **(***see appendix 11).*

**Table 7:** Correlations coefficients with their p-value between the average amount of initiations of leash pressure by the owner and dog for each of the parkours and the parenting styles (the four original and the three dog-directed) and their two dimensions (n=38**).** The Pearson correlation test is used, with the normal distributed data or with a log10 transformation if necessary. For data which was not normally distributed the Spearman correlation test was used. The “1” stands for the parkour without distraction and “2” stands for parkour with distraction, “A” is the easy parkour and “B” is the difficult parkour. (AUTV stands for Authoritative, AUTN stands for authoritarian, UNINV stand for uninvolved, AUTVI stands for authoritative-intrinsic value orientated, AUTVT stand for authoritative -training oriented style and AUTNC stand for authoritarian-correction oriented)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **AUTV** | | **AUTN** | | **PERM** | | **UNINV** | | **AUTVI** | | **AUTVT** | | **AUTNC** | | **Responsiveness** | | **Demandingness** | | |
|  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  |
| **1A. Owner** | -0.24 |  | -0.009 |  | -0.16 |  | -0.29 |  | -0.11 |  | *-0.28* |  | 0.13 |  | -0.21 |  | -0.1 |  |
| **1A. Dog** | 0.24 |  | -0.23 |  | 0.11 |  | 0.13 |  | *0.28* |  | *0.29* |  | -0.096 |  | 0.18 |  | 0.0084 |  |
| **1B. Owner** | -0.34 | \* | -0.15 |  | -0.21 |  | -0.074 |  | -0.41 | \*\* | 0.032 |  | -0.037 |  | -0.38 | \* | 0.023 |  |
| **1B. Dog** | -0.1 |  | -0.034 |  | 0.012 |  | 0.23 |  | -0.07 |  | 0.33 | \* | -0.047 |  | -0.043 |  | *0.28* |  |
| **2A. Owner** | -0.16 |  | 0.086 |  | -0.42 | \*\* | *-0.3* |  | *-0.31* |  | -0.23 |  | 0.13 |  | -0.34 | \* | -0.01 |  |
| **2A. Dog** | -0.05 |  | -0.012 |  | 0.0003 |  | 0.063 |  | 0.038 |  | 0.097 |  | 0.013 |  | 0.003 |  | -0.063 |  |
| **2B. Owner** | *-0.19* |  | -0.17 |  | -0.01 |  | -0.18 |  | -0.23 |  | -0.15 |  | -0.13 |  | -0.16 |  | -0.14 |  |
| **2B. Dog** | 0.022 |  | -0.15 |  | *0.3* |  | 0.1 |  | *0.014* |  | *0.29* |  | -0.037 |  | 0.06 |  | *0.16* |  |
| **Average Owner** | *-0.3* |  | -0.19 |  | -0.14 |  | *-0.28* |  | *-0.31* |  | -0.18 |  | -0.02 |  | -0.33 | \* | -0.12 |  |
| **Average Dog** | 0.053 |  | -0.11 |  | 0.34 | \* | 0.19 |  | 0.055 |  | 0.39 | \* | -0.082 |  | 0.11 |  | 0.16 |  |

n= 38, two-tailed, \*P<0.05, \*\*P<0.01

## **4. Discussion**

A good owner-dog relationship improves a dog’s quality of life. In this, not only training methods are important, but also that the owner’s dog-directed parenting style. In children, authoritative parenting works out best whereas other parenting styles, such as authoritarian or uninvolved, associate with problematic behaviour. Dog-owners practice parenting styles towards their dogs (Herwijnen et al., 2018), meaning this could equally be the case in dogs. Problem behaviour in dogs can be facilitated furthermore by risky training methods, specifically those based on positive punishment. One of the behaviours in dogs that owners dislike is leash pulling. Many owners have a strained leash when walking their dog. This leash tension can have consequences for the behaviour and welfare of the dog and constitutes serious issue. Leash tension can be caused mainly by the behaviour of the dog or its owner. Assumingly, the former would show as a relationship between leash pulling and dog characteristics, like its misbehaviour in daily life, and the latter as a relationship with owner characteristics, like parenting style and training method. This is what I wanted to find out and this study investigated whether the dog-directed parenting style and training method of dog owners were associated with leas tension when owners walked their dog through different parkours in a controlled experiment. In the study population of 38 owner dog dyads, the dog-directed parenting styles and training methods correlated with leash tension in the expected directions, with the weaker leash strain for owners that were relatively authoritative and did not use positive punishment. Owner-directed aggression and excitability related directly with leash tension, pointing out the role of dogs in leash pulling. The number of times that owners strained the leash as compared to the dog pulling it, was somewhat balanced for the two parkours without distractions, but the dogs caused leash tension more often when distractions (toys, treats and dummy dog) were present. Clearly, leash tension is the result of actions by both the owner and his/her dog. A dog’s (mis)behaviour will be influenced by its owner’s parenting style and way of training, meaning this seems the obvious route to remedy undue leash pulling, by promoting authoritative parenting and reward-based training methods.

### 4.1 The relationship between parenting styles and training methods

Parenting styles and training methods are ways to interact with a dog, and in a way, determine the owner-dog relation. Dog-owners filled out online surveys, which allowed me to assess their dog-directed parenting styles and training methods (positive reinforcement, negative reinforcement, positive punishment). Authoritative owners are seen as warm and supportive, providing affection and support (Önder et al., 2009), which combines logically with reward based training methods. In humans, this authoritative style is marked by patterns of consistency and non-punitive discipline (Karavasilis et al., 2003) and likely authoritative dog owners encourage good behaviour in their dog through communication, induction and encouragement. This fits with the training method of positive reinforcement, were certain behaviours are stimulated by praise and rewards (Fernandes et al., 2017). The findings of this research were in line with this. Here positive reinforcement was positively correlated with the authoritative parenting styles. Authoritarian owners are more focused on results then on the emotional well-being of the dependent and this is compatible with the use of positive punishment (Baumrind, 1991; Johnson, 2006). If the dog doesn’t meet the (high) standard of the owner it is likely to be punished as a way to eliminate unwanted behaviour (Önder et al., 2009). Punishment can be either verbally or physically (Fernandes et al., 2017). This explains the positive relations found for authoritarian parenting and positive punishment. Both authoritative and authoritarian owners have expectations of their dog (high demandingness), however they use different methods to put demands on their dog. Permissive parents have less expectations (low demandingness) of their dog but show a high level of emotional warmth (Baumrind, 1991). Parental responsiveness is high, and parents respond to their child needs and wishes but don’t ask to much in return. Findings showed that permissive parenting was associated with positive reinforcement. However, permissively parented dogs experience more freedom and it is unlikely that positive reinforcement is applied consistently a training method but rather as a general way of handling the dog. Uninvolved owners are known for their neglectful way of parenting. In order to train your dog there must be an involvement (Baumrind, 1989; Yazdani et al., 2016). This explains that no associations were found with any of the training methods. Alternatively, the present study population included too little variation in this style to pick up on existing relationships (for a discussion see van Herwijnen et al., 2018).

### 4.2 Problem behaviour in relation to parenting style and training methods

Parenting styles and training methods influence the dog-owner relation, and in this way influence the (mis)behaviour of the dog, as is seen in children (O’Leary et al. 1999). For instance, authoritarian parenting is associated with different types of aggression (e.g. O’Leary et al. 1999; Blackwell et al., 2008; Hsu and Sun, 2010). This is mainly because authoritarian owners score high on the dimension of demandingness, which is associated with disciplinary practises and actions such as verbal scolding and physical punishment which are thought to lead to aggressive tendencies and antisocial behaviour in children (MacKenzie et al., 2012). O’Leary et al. (1999) studied associations between parenting styles and problem behaviours. In total, 117 families participated, and findings showed that the behaviours stayed significant over time and indicating a stable relationship between aggression and authoritarian parenting. Next to aggressive behaviour, also anxiety is associated with the authoritarian parenting style. Rooney et al. (2016) found that search dogs of handlers who believed in improving the dog’s behaviour by punishment, which is associated with authoritarian parenting, tended to have less confident dogs, assuming less confident dogs are prone to be more fearful and anxious. This is in line with the relation found between non-social fear and authoritarian parenting. Further relations between authoritarian parenting and other problem behaviours were not overly strong, possibly in part due to limited variation. Owners had very low scores for the authoritarian style, and most owners fell into the authoritative parenting style categories. Attempts to recruit more authoritarian owners were unsuccessful.

The opposite end of the authoritarian parenting styles is the permissive style and neither of these styles has been linked to positive outcomes. Presumably because both minimise opportunities for children to learn to cope with stress (Bornstein et al., 2007). Permissive parentsavoid exerting control and rather use manipulation instead of force to make the child behave (Baumrind, 1966). This can result in dogs acting over-excited, as found with this study. They may act more excited when there is no punishment when they overreact and step out of line. Permissive owners will exhibit a high tolerance for misbehaviour, such as excitement, resulting in low levels of discipline for the dog (Yazdani et al., 2016).

Owners that have no to little interest in their dog practice uninvolved parenting. Uninvolved owners are expected to have minimal expectations of their dog and show little effort in supporting them emotionally or meeting their needs, i.e. when extrapolating findings from humans (Baumrind, 1989; Yazdani et al., 2016). Children who have parents with an uninvolved parenting style often lack social competences, be overly independent, have difficulty determining right behaviour from wrong and they are prone to experience school problems (Terry, 2004). In dogs this translates to several (mis)behaviours, like stranger directed aggression, stranger directed fear and non-social fear, which I found with this research. Dogs that were parented by the uninvolved style show furthermore attention/attachment seeking behaviour. Children that are parented by uninvolved parents tended to look for acceptance in other places (Mounts, 2002). For instance, a study tested drug use by people raised by different parenting styles. The findings showed that people who had uninvolved parents had more friends who used drugs and were more likely to use drugs themselves (Mounts, 2002). Mounts (2002) explains this by assuming that these children act rebellious to gain attention from their caregivers, but in return find a group where they can relate with and in this way gain attention in other places.

The authoritative parenting style is seen as the most optimal style. Dogs show less (mis)behaviours and there is a stronger owner-dog relation, which is in line with the finding that these dogs show less attention/attachment seeking behaviour. Authoritative parents are warm and responsive and provide affection and support (Önder et al., 2009)**.** The early work of Baumrind (1971) showed the positive effect of authoritative parenting. Data was collected on the behaviours of preschool children and their parents through interviews, home visits and structured observations. Findings showed that these children were self-reliant, self-controlled, buoyant, loving, demanding and understanding. These children were in no need to look for extra attention or develop (mis)behaviours. Explaining the behaviour of dogs, which showed reversed associations with aggression when having authoritative owners. The present findings on the dog-directed authoritative-training oriented style were not in line with the findings of Baumrind. Here, direct relations were found with several (mis)behaviours, like fear and aggression. It was expected that these dogs would experience less of these behaviours, since this dog-directed parenting style corresponds most with the original authoritative parenting style that is associated with less anger and fear related behaviour in children (Baumrind, 1966). Most of our owners scored high for this parenting style (a mean 3.18 ± 0.06 on a scale of 0 to 4) and 33 out of the 41 owners that filled in the questionnaire indicated that their dog had some form of unwanted behaviour. Eight of these 41 dogs had been rehomed or were out of a shelter and particularly the owners of these dogs reported dog directed aggression or attachment seeking behaviour as well as high scores for the authoritative-training oriented style. Dogs that originate from shelters show more aggression and fear related behaviour (Wells et al., 2000) and new owners may respond to this by adopting an authoritative-training oriented style.

Parenting styles and training methods have an impact on the dog-owner relation and especially aversive-based methods are known to induce (mis)behaviours in dogs. Like positive punishment which uses methods as physical punishment or verbal scolding, which is associated with higher aggression scores and avoidance scores (Hiby et al., 2004). Here a survey was conducted were 364 dog owners were examined for the effects of different training methods and the dog’s (mis)behaviour. Results showed that punishment was associated with an increase of problematic behaviours (Hiby et al., 2004). This expression of misbehaviours can be an indication of compromised welfare, because such behaviours can be the result of a state of anxiety and may lead to relinquishment or abandonment. Dog’s show for instance fearful behaviour after receiving physical punishment (Haverbeke et al., 2008; Roll et al., 1997).Also, negative reinforcement, which is seen as an aversive-based method was associated with more stress related behaviours (Deldalle et al., 2014). A study compared positive and negative reinforcement and what impact this had on the behavioural wellbeing of the dog (Deldalle et al., 2014). The results showed that dogs trained with negative reinforcement had lower body postures, showed more signals of stress and were also less involved with their owner. They showed less gazing behaviour and the present results suggest that such could facilitate owner directed aggression.

### 4.3 Leash tension

Leash pulling has a negative impact on the physical and emotional well-being of the dog (Keebaugh et al., 2015; Pauli et al., 2006; Peham et al., 2013) and annoys owners, making it relevant to understand what causes it. In the present study owners walked their leashed dog twice through 4 different parkours of different complexity. Leash tension was highest when parkours included distractions (toys, food treats and dummy dog). The authoritative parenting styles related inversely with leash tension, with similar findings for the authoritative-intrinsic value-oriented style. The beneficial effects of the authoritative form of parenting has been established earlier in children. The study by Chan et al. (2011) interviewed British 15-year olds which revealed that authoritative parenting promoted self-esteem and subjective well-being. Self-reports of 414 children and their mothers revealed a positive association between authoritative parenting and a secure attachment between the child and its mother (Chan et al., 2011)**.** Dogs that have a secure attachment to their owner are more observative and play closure attention to their owner instead of paying attention to the distractions provided (Auer et al., 2011; Heszle, 2012; Topál et al., 2005). Thus, authoritative parented dogs could be relatively self-confident and less likely to leash pull due to reacting strongly, fearfully or aggressive to the distractions. This reduction of leash tension for authoritative owners seems to be caused by the dimension responsiveness which also related inversely with leash tension. Providing parental warmth and emotional support to your dog seems to decrease leash pulling. As explained above, aversive based training methods have a negative effect on the well-being of the dog. Here negative reinforcement showed an increase in leash pressure, presumably caused by the higher tendency to be more aggressive and show more stress related behaviour (Haverbeke et al., 2008), which can result in a higher strain on the leash.

Behavioural changes occur when dogs are leashed. Řezáč et al., (2011) recorded 1,870 dog owner walks and found less dog-dog interaction when dogs were leashed. More importantly, leashed dogs also displayed twice as often threats towards other dogs, for instance barking, growling, snarling or baring teeth (Řezáč et al., 2011). In my study, dog’s that showed more owner directed aggression had a significant higher leash tension. Aggressive dogs seem more likely to leash pull and the same has been found to be true for excitable dogs (Bennett et al., 2007). Here it was tested if problematic behaviour of dogs was associated with demographic variables, involvement in dog training activities and other dog-human interactions. They found that leash pulling was a factor that indicated a higher level of excitement. The direct relation between excitability and leash tension was a trend in the present study.

The communication between the dog and the owner are key when walking the dog. As could be seen from this study were dogs payed close attention to the owner when walking parkours without distractions. Dogs being attentive to owners is important, especially during walks, because in this way signals can be interchanged to facilitate working together without conflict (Kotrschal, 2012). During these walks without distractions there was minimum tension, also no significant differences were found between the amount that the owners put strain on the leash or dogs. For the parkours with distractions, the leash tension was relatively high (1.22±0.054 versus 0.5±0.054; predicted mean ± SE), mainly due to the dog. Dog’s usually explore their surroundings, especially objects which are novel and of interest to them. They will make efforts to explore such items of interests (Topál et al., 2004).

Good communication fulfils the criteria for a cooperative task, which Naderi et al. (2001) defined to include congruence, synchrony and spatial coordination. To avoid problems or conflicts, both the owner and dog need to cooperate (Naderi et al., 2001). Findings showed that authoritative (intrinsic value-oriented) parenting related inversely with the number of times the owner strained the leash. Such authoritative owners are less likely to pull on the leash to correct or dominate the dog, which would be more associated with the authoritarian style (Önder et al., 2009) though this was not confirmed here. As indicated, considering that the participants were all very motivated and dedicated owners, the population might not have been varied enough to find significant results for the authoritarian style. The permissive parenting style related inversely with how often owners tugged the leash (in the difficult parkour without distractions). But it related directly with the number of times that the dogs pulled the leash. So permissive owners, pulled less on the leash whereas their dog tended to pull more. Dogs raised with the permissive parenting style may have low levels of discipline (Yazdani et al., 2016), being more prone to pull the leash because there are no consequences. Authoritative and permissive parenting is known for their high levels of responsiveness, which here is also associated with less tugs on the leash by the owner. Apparently, owners who are more responsive exert less control by pulling on the leash. Uninvolved parenting had similar associations and likely such owners don’t care and put little effort in correcting the behaviour of the dog. Use of negative reinforcement as a training method related directly to leash pulling by the dog. This form of aversive-based training methods could cause higher arousal in dogs (Haverbeke et al., 2008) or, reversely, constitute a way by which owners deal with excitable dogs.

## **5. Conclusion**

To conclude, this study found relations between parenting styles and training methods. As was expected, the autorotative, authoritative-intrinsic value-oriented and the authoritative-training oriented parenting styles linked to positive reinforcement, whereas the authoritarian and the authoritarian correction-oriented styles linked to positive punishment. The uninvolved parenting style showed no association with any of the training methods, indicating that a form of involvement should be present when having a preferred form of training. Some forms of parenting and training method were associated with problem behaviours. Mainly the authoritarian, the authoritarian correction-oriented styles and the uninvolved parenting style had direct relations with aggression and fear, oppositely to the authoritative and authoritative-intrinsic value-oriented parenting styles. The main focus of this research was on the underlying mechanism of leash tension. As expected, it was related inversely with the authoritative and authoritative-intrinsic value-oriented parenting styles. Owners that practiced these parenting styles had less tension on the leash. No direct relationships were found with the authoritarian and the authoritarian correction-oriented styles. In part, as few owners performed these styles, resulting in minimal variation. For the training methods, negative reinforcement related directly with an increased leash tension. This supports the notion that aversive-based training methods impact on the welfare of the dog, and in this case increases leash tension. Owners complain about leash pulling, but owners also contributed significantly to leash tension and only when dogs faced distractions, they were the main instigator. Interestingly, owners tended to pull less on the leash when they had an authoritative, authoritative-intrinsic value-oriented, authoritative -training oriented and permissive parenting style. Consequently, the parenting dimension responsiveness was related inversely with the leash tugging by the owner. Responsiveness seems to be important mainly for the owner not pulling on the leash, presumably since responsive owners take the dog’s emotionally well-being into account. Leash pulling by the dogs related directly with the authoritative -training oriented style mainly.

This study indicates that leash tension is influenced by the owner-dog relationship, including parenting styles and training methods. Further research into leash tension and the relation with parenting styles and training methods might benefit domestic dogs around the world. More accurate leash tension measuring devices should be used, and the parkours could be walked indoor such that distractions other than the ones intended have no effect. If the underlying mechanism why many owners experiencing a high leash tension is clear, this can be helpful to improve the owner dog relationship and ultimately the welfare of dogs.

## **References**

Ainsworth, M. D., & Bell, S. M. (1970). Attachment, exploration, and separation: illustrated by the behavior of one-year-olds in a strange situation. *Child Development*.

Auer, M., Wedl, M., Range, F., Virányi, Z., Belényi, B., & Kotrschal, K. (2011). Leash walking as a model for cooperation between humans and wolves: the effects of personality and intensity of contact. *Journal of Veterinary Behavior: Clinical Applications and Research*, *1*(6), 100–101.

Baumrind, D. (1989). *Rearing competent children. InW. Damon (Ed.), Childdevelopment today andtomorrow (pp. 349–378)*. San Francisco: Jossey-Bass.

Baumrind, Diana. (1966). Effects of authoritative parental control on child behavior. *Child Development*, 887–907.

Baumrind, Diana. (1971). Current patterns of parental authority. *Developmental Psychology*, *4*(1p2), 1.

Baumrind, Diana. (1991). The influence of parenting style on adolescent competence and substance use. *The Journal of Early Adolescence*, *11*(1), 56–95.

Baumrind, Diana. (2013). *Authoritative parenting revisited: History and current status.*

Bennett, P. C., & Rohlf, V. I. (2007). Owner-companion dog interactions: Relationships between demographic variables, potentially problematic behaviours, training engagement and shared activities. *Applied Animal Behaviour Science*, *102*(1–2), 65–84.

Blackwell, E. J., Twells, C., Seawright, A., & Casey, R. A. (2008). The relationship between training methods and the occurrence of behavior problems, as reported by owners, in a population of domestic dogs. *Journal of Veterinary Behavior*, *3*(5), 207–217.

Borchelt, P. L. (1983). Aggressive behavior of dogs kept as companion animals: classification and influence of sex, reproductive status and breed. *Applied Animal Ethology*, *10*(1–2), 45–61.

Bornstein, L., & Bornstein, M. H. (2007). Parenting styles and child social development. *Encyclopedia on Early Childhood Development. Montreal: Centre of Excellence for Early Childhood Development and Strategic Knowledge Cluster on Early Child Development*.

Chan, T. W., & Koo, A. (2011). Parenting style and youth outcomes in the UK. *European Sociological Review*, *27*(3), 385–399.

Cooper, J. J., Cracknell, N., Hardiman, J., Wright, H., & Mills, D. (2014). The welfare consequences and efficacy of training pet dogs with remote electronic training collars in comparison to reward based training. *PloS One*, *9*(9), e102722.

Coren, S. (1994). *The intelligence of dogs: Canine consciousness and capabilities*. Free Press New York.

Deldalle, S., & Gaunet, F. (2014). Effects of 2 training methods on stress-related behaviors of the dog (Canis familiaris) and on the dog–owner relationship. *Journal of Veterinary Behavior: Clinical Applications and Research*, *9*(2), 58–65.

Dijk, M. van. (2019). *Educational intervention on parenting styles in the owner-dog relationship*.

Dölen, G., Darvishzadeh, A., Huang, K. W., & Malenka, R. C. (2013). Social reward requires coordinated activity of nucleus accumbens oxytocin and serotonin. *Nature*, *501*(7466), 179.

Dumbell, L., Lemon, C., & Williams, J. (2019). A systematic literature review to evaluate the tools and methods used to measure rein tension. *Journal of Veterinary Behavior*, *29*, 77–87.

Fahie, M., Cortez, J., Ledesma, M., & Su, Y. (2018). PRESSURE MAT ANALYSIS OF WALK AND TROT GAIT CHARACTERISTICS IN 66 NORMAL SMALL, MEDIUM, LARGE AND GIANT BREED DOGS. *Frontiers in Veterinary Science*, *5*, 256.

Fernandes, J. G., Olsson, I. A. S., & de Castro, A. C. V. (2017). Do aversive-based training methods actually compromise dog welfare?: A literature review. *Applied Animal Behaviour Science*, *196*, 1–12.

Frontini, R., Moreira, H., & Canavarro, M. C. (2016). Parenting stress and quality of life in pediatric obesity: The mediating role of parenting styles. *Journal of Child and Family Studies*, *25*(3), 1011–1023.

Grainger, J., Wills, A. P., & Montrose, V. T. (2016). The behavioral effects of walking on a collar and harness in domestic dogs (Canis familiaris). *Journal of Veterinary Behavior*, *14*, 60–64.

Hampl, C. (2013). *Cooperation behaviour in human-dog and human-wolf dyads during a walk on the leash*. na.

Haug, L. I., Beaver, B. V, & Longnecker, M. T. (2002). Comparison of dogs’ reactions to four different head collars. *Applied Animal Behaviour Science*, *79*(1), 53–61.

Haverbeke, A., Laporte, B., Depiereux, E., Giffroy, J.-M., & Diederich, C. (2008). Training methods of military dog handlers and their effects on the team’s performances. *Applied Animal Behaviour Science*, *113*(1–3), 110–122.

Heszle, M. (2012). *Cooperation in human-dog dyads during leash walks*. uniwien.

Hiby, E. F., Rooney, N. J., & Bradshaw, J. W. S. (2004). Dog training methods: their use, effectiveness and interaction with behaviour and welfare. *ANIMAL WELFARE-POTTERS BAR THEN WHEATHAMPSTEAD-*, *13*(1), 63–70.

Hsu, Y., & Serpell, J. A. (2003). Development and validation of a questionnaire for measuring behavior and temperament traits in pet dogs. *Journal of the American Veterinary Medical Association*, *223*(9), 1293–1300.

Hughes, S. O., Power, T. G., Fisher, J. O., Mueller, S., & Nicklas, T. A. (2005). Revisiting a neglected construct: parenting styles in a child-feeding context. *Appetite*, *44*(1), 83–92.

Johnson, A. K. (2006). *Physical and psychological aggression and the use of parenting styles: A comparison of African-American and Caucasian families*.

Johnson, T. P., Garrity, T. F., & Stallones, L. (1992). Psychometric evaluation of the Lexington attachment to pets scale (LAPS). *Anthrozoös*, *5*(3), 160–175.

Karavasilis, L., Doyle, A. B., & Markiewicz, D. (2003). Associations between parenting style and attachment to mother in middle childhood and adolescence. *International Journal of Behavioral Development*, *27*(2), 153–164.

Keebaugh, A. E., Redman-Bentley, D., & Griffon, D. J. (2015). Influence of leash side and handlers on pressure mat analysis of gait characteristics in small-breed dogs. *Journal of the American Veterinary Medical Association*, *246*(11), 1215–1221.

Kotrschal, K. (2012). *Wolf-Hund-Mensch: Die Geschichte einer jahrtausendealten Beziehung*. Christian Brandstätter Verlag.

Landsberg, G. M., Hunthausen, W. L., & Ackerman, L. J. (2003). *Handbook of behavior problems of the dog and cat/G. Landsberg, W. Hunthausen, L. Ackerman*. Saunders.

MacKenzie, M. J., Nicklas, E., Waldfogel, J., & Brooks‐Gunn, J. (2012). Corporal punishment and child behavioural and cognitive outcomes through 5 years of age: Evidence from a contemporary urban birth cohort study. *Infant and Child Development*, *21*(1), 3–33.

McLeod, S. A., & Bowlby, J. (2008). Mary Ainsworth. *Retrieved on September*, *18*, 204.

Naderi, S., Miklósi, Á., Dóka, A., & Csányi, V. (2001). Co-operative interactions between blind persons and their dogs. *Applied Animal Behaviour Science*, *74*(1), 59–80.

Nagasawa, M., Mitsui, S., En, S., Ohtani, N., Ohta, M., Sakuma, Y., … Kikusui, T. (2015). Oxytocin-gaze positive loop and the coevolution of human-dog bonds. *Science*, *348*(6232), 333–336.

O’Leary, S. G., Slep, A. M. S., & Reid, M. J. (1999). A longitudinal study of mothers’ overreactive discipline and toddlers’ externalizing behavior. *Journal of Abnormal Child Psychology*, *27*(5), 331–341.

Önder, A., & Gülay, H. (2009). Reliability and validity of parenting styles & dimensions questionnaire. *Procedia-Social and Behavioral Sciences*, *1*(1), 508–514.

Pauli, A. M., Bentley, E., Diehl, K. A., & Miller, P. E. (2006). Effects of the application of neck pressure by a collar or harness on intraocular pressure in dogs. *Journal of the American Animal Hospital Association*, *42*(3), 207–211.

Peham, C., Limbeck, S., Galla, K., & Bockstahler, B. (2013). Pressure distribution under three different types of harnesses used for guide dogs. *The Veterinary Journal*, *198*, e93–e98.

Pinquart, M. (2016). Associations of parenting styles and dimensions with academic achievement in children and adolescents: A meta-analysis. *Educational Psychology Review*, *28*(3), 475–493.

Prato-Previde, E., Spiezio, C., Sabatini, F., & Custance, D. M. (2003). Is the dog-human relationship an attachment bond? An observational study using Ainsworth’s strange situation. *Behaviour*, *140*(2), 225–254.

Prato‐Previde, E., Fallani, G., & Valsecchi, P. (2006). Gender differences in owners interacting with pet dogs: an observational study. *Ethology*, *112*(1), 64–73.

Previde, E. P., & Valsecchi, P. (2014). The immaterial cord: The dog–human attachment bond. In *The social dog* (pp. 165–189). Elsevier.

Řezáč, P., Viziová, P., Dobešová, M., Havlíček, Z., & Pospíšilová, D. (2011). Factors affecting dog–dog interactions on walks with their owners. *Applied Animal Behaviour Science*, *134*(3–4), 170–176.

Robinson, C. C., Mandleco, B., Olsen, S. F., & Hart, C. H. (1995). Authoritative, authoritarian, and permissive parenting practices: Development of a new measure. *Psychological Reports*, *77*(3), 819–830.

Robinson, I. (2013). *The Waltham book of human-animal interaction: Benefits and responsibilities of pet ownership*. Elsevier.

Roll, A., & Unshelm, J. (1997). Aggressive conflicts amongst dogs and factors affecting them. *Applied Animal Behaviour Science*, *52*(3–4), 229–242.

Schilder, M. B. H., & van der Borg, J. A. M. (2004). Training dogs with help of the shock collar: short and long term behavioural effects. *Applied Animal Behaviour Science*, *85*(3–4), 319–334.

Shabelansky, A., & Dowling-Guyer, S. (2016). Characteristics of excitable dog behavior based on owners’ report from a self-selected study. *Animals*, *6*(3), 22.

Skinner, B. F. (1938). The Behavior of Organisms. Appleton-Century-Crofts. *New York*.

Taylor, R. (1990). Interpretation of the correlation coefficient: a basic review. *Journal of Diagnostic Medical Sonography*, *6*(1), 35–39.

Terry, D. J. (2004). Investigating the relationship between parenting styles and delinquent behavior. *McNair Scholars Journal*, *8*(1), 11.

Topál, J., Gácsi, M., Miklósi, Á., Virányi, Z., Kubinyi, E., & Csányi, V. (2005). Attachment to humans: a comparative study on hand-reared wolves and differently socialized dog puppies. *Animal Behaviour*, *70*(6), 1367–1375.

Topál, J., Miklósi, Á., Csányi, V., & Dóka, A. (1998). Attachment behavior in dogs (Canis familiaris): a new application of Ainsworth’s (1969) Strange Situation Test. *Journal of Comparative Psychology*, *112*(3), 219.

Van Herwijnen, Ineke R, Van Der Borg, J. A. M., Naguib, M., & Beerda, B. (2018). The existence of parenting styles in the owner-dog relationship. *PloS One*, *13*(2), e0193471.

van Herwijnen, Ineke Rombout, van der Borg, J., Naguib, M., & Beerda, B. (2019). Rein sensor leash tension measurements in owner-dog dyads navigating a course with distractions. *Journal of Veterinary Behavior*.

Wells, D. L., & Hepper, P. G. (2000). Prevalence of behaviour problems reported by owners of dogs purchased from an animal rescue shelter. *Applied Animal Behaviour Science*, *69*(1), 55–65.

Yazdani, S., & Daryei, G. (2016). Parenting styles and psychosocial adjustment of gifted and normal adolescents. *Pacific Science Review B: Humanities and Social Sciences*, *2*(3), 100–105.

## **Appendix 1. 17- items PSDQ**

English 17- item Parenting Style Dimensions Questionnaire (PSDQ)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item** |  | **Dimension** | **OP-PS** | **DD-PS** | **Element** |
| **1.** | I allow my dog to give input on decisions for instance with regard to the route we follow on walks | Responsiveness | AUTV | AUTVI | Warmth |
| **2.** | I give comfort when my dog is upset. | Responsiveness | AUTV | AUTVI | Warmth & Support |
| **3.** | I take my dog's desires into account before asking him to do something. | Responsiveness | AUTV |  | Warmth |
| **4.** | I use physical punishment (for instance a slap or a correction chain) as a way to improve my dogs behavior. | Demandingness | AUTN |  | Control- Physical |
| **5.** | I use a corrective slap when my dog misbehaves. | Demandingness | AUTN | AUTNC | Control- Physical |
| **6.** | I raise my voice to make my dog improve. | Demandingness | AUTN | AUTNC | Directiveness (verbal hostility) |
| **7.** | I use more or higher value reward (food or toy) when I believe my dog should really do something in a situation. | Demandingness | AUTV | AUTVT | Reasoning /induction (regulation) |
| **8.** | I practice behavior step by step with my dog, so I am sure he understands what I ask of him. | Demandingness | AUTV | AUTVT | Reasoning /induction (regulation) |
| **9.** | I present my dog with consequences for misbehavior, such as reward or attention removal. | Demandingness |  |  | Control- nonphysical |
| **10.** | I use rules and guidelines to improve my dog’s behavior, such as it is sitting before eating or lying on its bed when receiving visitors. | Demandingness |  |  | Control- nonphysical |
| **11.** | I support my dog when it is scared or spooked by an object or person. | Responsiveness |  |  | Support |
| **12.** | I help my dog understand which behaviour is appropriate in social situations that it finds difficult. | Responsiveness |  |  | Support |
| **13.** | I know what my dog is doing, even when I am doing something else in the house, such as cleaning or reading a book | Demandingness |  |  | Monitoring |
| **14.** | I prevent that my dog bothers other people or animals. | Demandingness |  |  | Monitoring |
| **15.** | I spoil my dog. | NOT | PERM |  | Lack of follow through (indulgent) |
| **16.** | I do not follow through when I threaten with punishment towards my dog. | NOT | PERM+UNINV |  | Lack of follow through (indulgent) |
| **17.** | Threatening to do so occurs more often than actually giving my dog punishment. | NOT | UNINV |  | Lack of follow through (indulgent) |

## **Appendix 2. Participants online survey**

***Figure 2a:*** *Overview of the division man/women of dog owners participating in the online questionnaire.*

***Figure 2b****: Overview of the characteristics of dogs out of the online questionnaire.*

## **Appendix 3. Participants behaviour test**

***Figure 3a:*** *Overview of the division man/women of dog owners participating in the leash pressure test.*

***Figure 3b****: Overview of the characteristics of dogs who participated in the leash pressure test.*

## **Appendix 4. Training methods questions and their possible answers**

|  |  |
| --- | --- |
| **Questions** |  |
| **1.** | Which training methods do you use if you try to learn your dog something? |
| **2.** | Which training methods do you use to get rid of undesirable behaviour? |
| **3.** | Which training methods do you use if you try to let your dog to sit? |
| **4.** | Which training methods do you use if you learn your dog to come on command? |
| **5.** | Which training methods do you use if your dog has to release an object? |

|  |  |  |
| --- | --- | --- |
| **Training methods** | **Answers to questions** |  |
| Positive reinforcement | Praise reward (pat, affection, encouragement) |  |
|  | Food reward  Friendly touch |  |
|  | Play reward |  |
|  | Clicker training |  |
|  |  |  |
| Negative reinforcement | Withdrawal of attention (time out) |  |
|  | Withholding rewards |  |
|  | Physical restrained (e.g., holding still or pushing into position) |  |
| Positive punishment | Vocal punishment (e.g. tell off)  Physical correction (yank on leash, flick ear, hit) |  |
|  | Aversive (stamp on ground, throw something on the ground) |  |

## **Appendix 5. Factors of the C-Barq questionnaire standing for different types of problem behaviour**

|  |  |
| --- | --- |
| **Factors** | **Problem behaviours** |
| **1** | Stranger-directed aggression |
| **2** | Owner-directed aggression |
| **3** | Stranger-directed fear |
| **4** | Non-social fear |
| **5a** | Dog directed fear |
| **5b** | Dog directed aggression |
| **6** | Separation anxiety |
| **7** | Attachment/attention seeking behaviour |
| **8** | Trainability\* |
| **9** | Chasing behaviour |
| **10** | Excitability |
| **11** | Pain sensitivity |

\*A low score for trainability indicates a problem

## **Appendix 6. Ethogram for the analysis of videos to determine the Leash pressure**

|  |  |  |  |
| --- | --- | --- | --- |
| **Level of pressure** | **Observation leash** | **Observation dog** | **Observation owner** |
| **0** | The leash has no tension (hangs lose) | Dog stays close, pays close attention to owner | Owner walks with leash lose in hand |
| **1** | Little tension on the leash | The dog notice something/ looks away | The owner moves the leash without intended pressure |
| **2** | Stronger tension on the leash | The dog moves to the object but doesn’t use force/The dog reacts to the pressure and moves back | The owner pulls the dog slightly back |
| **3** | Strong tension on the leash | The dog moves to the object with force/The dog fights the pressure on the leash without moving | The owner holds on to the leash with force/ The owner pulls the leash using force |
| **4** | Strongest tension on the leash | The dog moves to the object using all his force/ The dog is pulled back resulting in loss of balance/standing on his hind legs | The owner pulls back using a lot of force/ The owner loses his/her balance or is dragged forward |

## **Appendix 7. Correlation coefficients between training methods and the problem behaviours**

***Table 7:*** *Spearman rank Correlations between the training methods and the factors indication different problem behaviours (n=38).**No significant correlations were found.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Positive reinforcement** | | **Negative reinforcement** | | **Positive Punishment** | |
|  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  |
| **Factor 1** | 0.035 |  | -0.023 |  | -0.096 |  |
| **Factor 2** | -0.17 |  | 0.27 |  | 0.094 |  |
| **Factor 3** | 0.14 |  | 0.015 |  | -0.22 |  |
| **Factor 4** | -0.24 |  | 0.097 |  | 0.27 |  |
| **Factor 5a** | -0.074 |  | 0.037 |  | -0.018 |  |
| **Factor 5b** | -0.018 |  | 0.037 |  | -0.074 |  |
| **Factor 6** | 0.061 |  | -0.072 |  | 0.023 |  |
| **Factor 7** | -0.079 |  | 0.014 |  | 0.064 |  |
| **Factor 8** | 0.09 |  | 0.098 |  | -0.17 |  |
| **Factor 9** | 0.14 |  | -0.15 |  | -0.044 |  |
| **Factor 10** | -0.18 |  | 0.23 |  | 0.043 |  |
| **Facto 11** | -0.091 |  | 0.14 |  | 0.0072 |  |

n= 38, two-tailed

## **Appendix 8. REML analysis leash pressure**

***Table 8:*** *Results of the linear mixed model of the leash pressure test*

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Wald/df** | | **P-value** |
| **Round** | | 34.66 | <0.001 |
| **Route** | | 2.70 | 0.100 |
| **Distraction** | | 180.84 | <0.001 |
| **Round. Route** | | 0.96 | 0.327 |
| **Round. Distraction** | | 12.16 | <0.001 |
| **Route. Distraction** | | 5.67 | 0.017 |
| **Round. Route. Distraction** | | 0.09 | 0.766 |

## **Appendix 9. Correlation coefficients between leash pressure in relation to parenting styles and training methods.**

***Table 9a.*** *Correlation coefficients between the parenting styles and the different leash pressure for each parkour.**The Pearson correlation test was used, with normal distributed data or with a log10 transformation if necessary. For data which is not normally distributed the Spearman rank correlation test is used.*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **No Distraction** | | | | **Distraction** | | | |  | |
|  | **Easy parkour** | | **Difficult parkour** | | **Easy parkour** | | **Difficult parkour** | | **Average all parkour** | |
|  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  |
| **AUTV** | 0.056 |  | -0.083 |  | -0.37 | \* | -0.32 | \* | -0.32 | \* |
| **AUTN** | -0.12 |  | -0.094 |  | -0.03 |  | -0.14 |  | -0.093 |  |
| **PERM** | -0.045 |  | *-0.27* |  | 0.071 |  | 0.22 |  | 0.09 |  |
| **UNINV** | -0.072 |  | -0.12 |  | 0.034 |  | -0.028 |  | 0.016 |  |
| **AUTVI** | 0.048 |  | -0.027 |  | -0.33 | \* | -0.33 | \* | *-0.3* |  |
| **AUTVT** | -0.1 |  | -0.12 |  | 0.028 |  | 0.074 |  | 0.015 |  |
| **AUTNC** | -0.0033 |  | -0.0047 |  | -0.0036 |  | -0.023 |  | 0.005 |  |
| **Responsiveness** | -0.0074 |  | -0.12 |  | -0.42 | \*\* | *-0.27* |  | -0.32 | \* |
| **Demandingness** | -0.13 |  | -0.17 |  | 0.15 |  | 0.098 |  | 0.037 |  |

n= 38, two-tailed, \*P<0.05, \*\*P<0.01

***Table 9b.*** *Correlation coefficients between the training methods and the different leash pressure for each parkour****.*** *The Pearson correlation test was used, with normal distributed data or with a log10 transformation if necessary. For data which is not normally distributed the Spearman rank correlation test is used.*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **No distraction** | | | | **Distraction** | | | |  | |
|  | **Easy parkour** | | **Difficult parkour** | | **Easy parkour** | | **Difficult parkour** | | **Average all parkour** | |
|  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  |
| **Positive reinforcement** | -0.0028 |  | -0.028 |  | -0.28 |  | -0.22 |  | -0.18 |  |
| **Negative Reinforcement** | 0.02 |  | 0.018 |  | 0.35 | \* | 0.46 | \*\* | 0.35 | \* |
| **Positive Punishment** | 0.033 |  | 0.047 |  | 0.118 |  | -0.052 |  | 0.0048 |  |

n= 38, two-tailed, \*P<0.05, \*\*P<0.01

## **Appendix 10. Correlation coefficients between leash pressure and problem behaviour**

***Table 10.*** *Correlation coefficients between leash pressure for each parkour and the problem behaviours. The Pearson correlation test was used, with normal distributed data or with a log10 transformation if necessary. For data which is not normally distributed the Spearman rank correlation test is used.*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **No distraction** | | | | **Distraction** | | | |  | |
|  | **Easy parkour** | | **Difficult parkour** | | **Easy parkour** | | **Difficult parkour** | | **Average all parkour** | |
|  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  |
| **Factor 1** | -0.029 |  | -0.081 |  | 0.044 |  | -0.005 |  | -0.028 |  |
| **Factor 2** | 0.27 |  | 0.27 |  | 0.31 |  | 0.38 | \* | 0.41 | \* |
| **Factor 3** | -0.18 |  | -0.28 |  | 0.036 |  | 0.042 |  | -0.065 |  |
| **Factor 4** | 0.14 |  | 0.078 |  | 0.18 |  | 0.14 |  | 0.18 |  |
| **Factor 5a** | -0.15 |  | -0.25 |  | 0.14 |  | 0.13 |  | 0.016 |  |
| **Factor 5b** | -0.023 |  | 0.034 |  | 0.073 |  | 0.1 |  | 0.027 |  |
| **Factor 6** | 0.16 |  | 0.009 |  | 0.13 |  | 0.044 |  | 0.14 |  |
| **Factor 7** | -0.13 |  | -0.074 |  | 0.235 |  | 0.031 |  | 0.0067 |  |
| **Factor 8** | -0.32 | \* | -0.095 |  | -0.04 |  | -0.1 |  | -0.14 |  |
| **Factor 9** | 0.024 |  | -0.17 |  | 0.048 |  | 0.068 |  | -0.023 |  |
| **Factor 10** | 0.016 |  | 0.11 |  | 0.24 |  | 0.26 |  | 0.28 |  |
| **Factor 11** | -0.18 |  | -0.37 | \* | 0.095 |  | 0.13 |  | -0.055 |  |

n= 36, two-tailed, \*P<0.05

## **Appendix 11. Initiations of pulls and training methods**

***Table 11a.*** *Correlation coefficients between the training methods and the amount of initiations of pressure on the leash of the owner and the dog (n=38).**The Pearson correlation test was used, with normal distributed data or with a log10 transformation if necessary. For data which is not normally distributed the Spearman rank correlation test is used. The “1” stands for the parkour without distraction and “2” stands for parkour with distraction, A is the easy parkour and B is the difficult parkour.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Positive reinforcement** | | **Negative reinforcement** | | **Positive punishment** | |
|  | Correlation coefficient |  | Correlation coefficient |  | Correlation coefficient |  |
| **1A. Owner** | -0.08 |  | -0.0052 |  | 0.16 |  |
| **1A. Dog** | *-0.05* |  | 0.21 |  | -0.042 |  |
| **1B. Owner** | -0.096 |  | 0.12 |  | 0 |  |
| **1B. Dog** | -0.037 |  | 0.077 |  | 0.028 |  |
| **2A. Owner** | -0.06 |  | 0.13 |  | -0.034 |  |
| **2A. Dog** | -0.12 |  | 0.33 | \* | -0.07 |  |
| **2B. Owner** | -0.12 |  | *0.26* |  | -0.045 |  |
| **2B. Dog** | -0.032 |  | 0.37 | \* | -0.21 |  |
| **Average Owner** | -0.073 |  | 0.19 |  | -0.037 |  |
| **Average Dog** | -0.073 |  | 0.39 | \* | -0.16 |  |

n= 38, two-tailed, \*P<0.05