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Behaviours and experiences as indicators for
the result in a behavioural test for dogs

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Sammanfattning/Abstract:

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Nyckelord/Keyword:

Behavioural test, C-BARQ, *Canis familiaris*, Early experiences, Temperament, Working dogs

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Abstract

In 2005 Swedish Armed Forces (SAF) started a breeding program of military working dogs. The dogs leave SAF's kennel at an age of 8 weeks and live with puppy raisers. To evaluate the suitability of dogs for military work the dogs conduct a behavioural test at an age of 15-18 months. An "Index value" is extracted from this behavioural test. The puppy raisers answered a modified version of Canine Behavioral Assessment and Research Questionnaire (C-BARQ) when the dogs were approximately 12 months old. Answered questionnaires and results from the behavioural test were obtained for 59 dogs. Dogs that had passed the behavioural test had tendency for higher scores for "Trainability" ($p = 0.078$) and "If lived with other animals" ($p = 0.066$). Failing dogs had significantly higher score for "Stranger Directed Fear" ($p = 0.006$), "Non-Social Fear" ($p = 0.005$), "Dog Directed Fear" ($p = 0.021$), "Hours of daily activation" ($p = 0.001$), "Mounting objects" ($p = 0.012$), and a tendency for higher risk of "Urinating when home alone" ($p = 0.058$). In a regressions between the "Index value" and the values of the questions from C-BARQ, the "Index value" was negatively correlated to "Stranger Directed Fear" ($p = 0.002$), "Non-social Fear" ($p = 0.003$), and "Dog Directed Fear" ($p = 0.006$). The "Index value" was positively correlated to "Trainability" ($p = 0.013$), "Hours left home alone" ($p = 0.043$), "Hyperactive" ($p = 0.018$), "Chases shadows/light spots" ($p = 0.043$), and a positive tendency for "Chewing on inappropriate objects" ($p = 0.075$). From a PCA at the categories in C-BARQ, 3 components were extracted. All three components had a correlation to the "Index value". The results show that the use of C-BARQ can indicate whether the dog will pass the behavioural test or not.

Keywords: Behavioural test, C-BARQ, *Canis familiaris*, Early experiences, Temperament, Working dogs

1. Introduction

Behavioural tests are used for numerous of animals and applications. One of the most common fields is personality research (Svarberg, 2003). It is also used in research such as, response to stress; for example, Janczak et al. (2007) found that offspring to stressed hens had other behaviours than the offspring to non-stressed parents. Janczak et al. (2007) found that the offspring to stressed hens had a longer duration in tonic immobility and ate less in a competitive ability test where one chicken from both groups competed for food resources. Behavioural tests are also used to assess heritability of behaviours, for example in behaviours related to production traits in sheeps (Dodd et al., 2012), behavioural disorders, for example crib-biting in horses (Nagy et al., 2010), and effects of early experiences, for example, regrouping in piglets (Hayne and Gonyou, 2003). Behavioural tests are also used in the field of learning abilities, for example, learning performances in horses with different temperaments (Lansade and Simon, 2010).

In dogs (*Canis familiaris*) behavioural tests are used for, for example, selection for breeding (Wilsson and Sundgren, 1997), prediction of working suitability (Slabbert and Odendaal, 1999), prediction of likelihood of a dog being adopted from a shelter (Ledge and Baxter, 1997), identification of behavioural problems (Netto and Planta, 1997), and welfare, such as poor housing and harsh training (Beerda et al., 1997). The Swedish Armed Forces train dogs to be military working dogs. By using a

standardised behavioural test they select the dogs they find suitable for this purpose (Wilsson and Sinn, 2012).

In 2005 the Swedish Armed Forces Dog Instruction Centre, SAFDIC, started a breeding program of German Shepherd Dogs in Sollefteå (Wilsson and Sinn, 2012). Every year the SAFDIC is expected to deliver at least 50 dogs with the right temperament (defined here as: behaviour that differs between individuals, but within an individual that is relatively consistently displayed when tested under similar situation (Svartberg, 2007)), to make the decision of whether the dog should be trained to become a military dog or a breeding dog (Wilsson and Sinn, 2012). The dogs that are bred at the kennel of the SAFDIC are raised by volunteers (hereafter referred to as *puppy raisers*) from the age of eight weeks until they do a standardised behaviour test (Wilsson and Sundgren, 1997; Wilsson and Sinn, 2012), at an age of 15 to 18 month. During the time of the stay at the puppy raisers there are three available meetings for the puppy raisers with consultants (which are working for the SAFDIC) to get information from the SAFDIC. If a dog passes the behavioural test, it will either be trained by the Swedish Armed Forces for 8-10 months or become a part of the breeding program. The behavioural tests are conducted at five different places; spread across Sweden, with the same test leader at all the test to reduce bias from different test leaders. The behavioural test is divided into 12 sub-tests, which are all conducted during the same day. All sub-tests combined takes about 40 minutes for every dog. The purpose of the behavioural test is to evaluate the dogs' temperament and suitability to become military working dogs or used as breeding animals. Since the start of the selective breeding program about 25 % of all born German Shepherds are used in the Swedish Armed Forces in some way. About 50% of all tested dogs are eliminated due to unsuitable temperament, and almost 25 % are eliminated due to medical issues (most common; problems with joints, hips and elbows). Still, dogs with physiological problems are scored in the behavioural test, in order to get more information about the heritability of test responses and also to evaluate the parental breeding dogs. The differences in the results of the behavioural test could be due to, for example, personality, genes and early experiences of the dogs.

It is generally known that experiences during early age (infantile) are more important in terms of their effects later on in life (adulthood) than experiences occurring in later life stages (Serpell and Jagoe, 1995). In dogs, the development could be divided into four different development stages: (1) Neonatal period, 0-13 days of age; (2) Transition period, 13-20 days; (3) Socialisation period, 3-12 weeks; and (4) Juvenile period, week 12 through puberty (Scott, 1962). A fifth period could be added to these periods, a prenatal period, since also events occurring *in utero* affects the behaviour of an adult individual (Joffe, 1969 cited in Serpell and Jagoe, 1995).

The foetuses can be affected by their mother during the prenatal period (Scott and Fuller, 1965 p 84-116). A research group found that in guinea pigs, female offspring to mothers which had had an unstable social environment during pregnancy, had higher testosterone level in the blood and showed more masculine behaviours than female offspring which mothers had had a stable social environment (Kaiser et al., 2003). The foetuses are also affected by their littermates. In mice and rats, for example, a female foetus developed between two male littermates has a higher concentration of testosterone in the blood than a female foetus developed between two female littermates (vom Saal and Bronson, 1980; Meisel and Ward, 2012).

When an animal is born, depending on species, they are either precocial or altricial. A young that is precocial is relatively mobile when born or hatched, whilst an altricial young is unable to move on their own soon after birth or hatching (Ploger and Yasukawa, 2002, p. 188). In altricial species, the dog for example, the newborn has a large neural immaturity which develops fast during the dogs early lifetime (Gazzano et al., 2008). Therefore there is a reason to believe that experiences during this time have an effect on the behaviour later in life, for example response to stress. Gazzano et al. (2008) found that in different dog breeds, the frequency of handling during the first 8 weeks of life affected the behaviour of the puppies. An altricial young is highly dependent on the care from their parents and thereby have a high social interaction with their mother, through maternal care (Ploger and Yasukawa, 2002, p. 188). The early rearing from the mother can exert changes which are maintained also in adulthood. For example, individual difference were found in stress response in offspring to high respectively low licking/grooming and arched-back nursing (LG-ABN) rat mothers (Caldij et al., 1998). These differences occur due to differences in DNA methylation (Weaver et al., 2004). Weaver et al. (2004) also found that the methylation occurred postnatal. By cross-fostering offspring born by low-LG-ABN mothers but reared by a high-LG-ABN mothers Weaver et al. (2004) found that the offspring behaved as offspring born and reared by high-LG-ABN mothers. However, rats which were reared by low-LG-ABN mothers can be reversed. By getting a social enriched post-weaning environment through group housing with conspecifics the corticosterone response to stress decreases and behavioural indications of anxiety reduces (Francis et al., 2002). Bredy et al. (2003) found indications in cognition differences if rats reared by a low-LG-ABN and then held in large groups. Rats that were not held in a large group showed a poorer score in the Morris water maze (a round pool filled with water where the task is to find the platform which is hidden 1 cm beneath the surface) than the individuals than were held in large groups. This means that during the neonatal period the individual is susceptible for changes. But the behavioural responses to these changes are not fixed and can be reversed.

During the transitional period physiological transformation occurs. In dogs the eyes and ear canals are opening and the puppy starts to react to its environment such as reacting to sudden and loud sounds, they also start to move, crawl as well as standing (Serpell and Jagoe, 1995). The effect of early experiences during this period of the puppy's life is not different compared to the effect during the neonatal period (Scott and Fuller, 1965).

The socialisation period, in dogs, is sometimes also called the "critical period" due to that during this period the puppy has the easiest to form social relationships and attachment (Scott, 1962). In wolves during natural conditions, the socialisation period is the time when the puppies form attachment to their littermates, parents and the other wolves in the pack (Serpell and Jagoe, 1995). In dogs, on the other hand, which are growing up close to humans, the puppies are forming attachments for non-conspecifics, humans or other animals in their environment. Fox (1969) found that dogs reared by a cat and had kittens as littermates preserved positive social behaviour towards cats than dogs reared by a dog (cited in Serpell and Jagoe, 1995). Freedman et al. (1961) found that the socialisation period could be approximated to an age of 2.5 to 9-13 weeks of age. They found this by isolating the litter and their mother from human interactions. Then by interacting with different litters at different time and see

during which week of living they form the strongest attachment they concluded the approximate age for the socialisation period.

During juvenile (commonly referred to as adolescence) period the individual can be sensitive to stress. For example, Kaiser et al., (2007) studied guinea pigs that had been in an unstable social environment during the time of puberty and the effect of it on cortisol suppression and social behaviour when the guinea pigs were at four months of age. Pair-housed males had a higher level of courtship and sexual behaviour than males which had been housed in a colony. However, the pair-housed males showed a much higher level of agonistic behaviour towards an unfamiliar male and a shorter time to start fighting with an unfamiliar male. They also found that a pair-housed male had a lower basal level of cortisol concentration in the blood and had a higher level of cortisol in the blood when isolated in a novel cage. Kaiser et al. (2007) concluded that social stress during the time of puberty has a negative effect on social behaviour and the HPA activity later in life.

When reading about personality, you will automatically come across the terms temperament and coping styles (Horváth et al., 2007). Some researchers use temperament instead of personality because personality in animals is associated with anthropomorphism (Gosling, 2001). When talking about coping it is almost exclusively in the field of stress response in individuals. There are definitions related to both stressors that can be removed and those that cannot. However, the most common definitions are associated with stressors that cannot be removed (Wechsler, 1995). The definitions of coping in animals often contain reduction of fitness if the stressor is not removed (Wechsler, 1995). The biggest differences between coping research in humans and animals is the emotion-focused coping, even though the animals feel the adversity of the stimuli, to this day it is hard to access animals emotions (e.g. Bateson, 1991; Maestriperi et al., 1992). This is the reason why coping research in animals more often includes stress than emotions.

The big five model is a commonly used model of personality in humans (Digman, 1990). This model has, with some success, also been applied on non-human species. Gosling and John (1999) wrote in their review article that they have found 12 non-human species with the same groups of personality as humans. One of these 12 species is the domestic dog (*Canis familiaris*). The research of personality in dogs is an interesting part of this field because dogs are found in great numbers in the human society. Dogs are held for companionship (as pets), but also for working purposes; for example hunting, herding and in the military. To know which dog that is suitable for which type of work it is important to have knowledge about the dogs' personality. According to Svartberg and Forkman (2002) the dog is also of interest for personality researchers due to their evolutionary history. There are studies done on the wild ancestor of the dog, the wolf (*Canis lupus*), that indicates that the cubs are more or less bold or shy (Fox, 1972). During domestication there were different selective pressures on the dog, than the selective pressure of the wolf, which resulted in a large variety in morphology and behaviours (Svartberg and Forkman, 2002). So if the personalities do not differ between wolf and dog this is an indication of that these traits are evolutionary stable. Svartberg and Forkman (2002) make a statement that the personality traits in the dog and wolf are almost the same, which confirms the hypothesis of evolutionary stable traits. This strengthens the research of personality in the dogs. Another issue of personality is that the behavioural responses can be

predicted. This knowledge about future behaviour can be useful in different situations. For example when selecting dogs that are suitable for a special kind of work. By being able to find the signs this predicts failure or success for a kind of work, before the dog is trained or early on in the training, money and time can be saved. Also by knowing the typical behaviour of the dog, individual specific training could be useful to make the success rate for working dogs to increase.

The different reactions between subjects in a behavioural test could also be due to genetical differences between dogs. In a study by Saetre et al. (2006) they found that some of the results from the Dog Mentality Assessment, a behaviour test not unlike the behavioural test used by the Swedish Armed Forces, could be explained by inheritance in German Shepherd Dogs. They also found some indications of genetic explanations of the differences between the breeds. van der Waaij et al. (2008) found that there were genetical differences within the German Shepherd Dogs after analysing the behaviour test conducted by the Swedish Dog Training Centre. This means that there are genetical differences in the breed and that these differences affect the behaviour of the dogs.

Even though a potential military working dog passes the behavioural test, this does not mean that the dog actually necessarily becomes a working dog. After passing the test the dog is put into training to become a working dog. During training some dogs can still fail to become a military dog. About 25 % of the dogs that starts the training fail due to mental issues. This means that there are some aspects of the behavioural test that does not make it 100 % sure that if the dog passes it will become a working dog. Batt et al. (2010) studied success of military working dogs, they had two definitions of success, either the dog (1) succeed to graduate from the training program or (2) the dog was still working as a guide dog one year after the graduation. They found that there was a significant difference between the number of graduating dogs and dogs working one year after graduation, with less dogs working than graduating. In their study they handed out a questionnaire for the puppy raisers to answer to get feedback from the puppy raisers. They found that, together with other factors, the use of the questionnaire was associated with the rate of working success. This finding suggests that by using a questionnaire the success in military training can be predicted.

One way to examine behaviour in dogs is to use the Canine Behavioural Assessment and Research Questionnaire, more commonly known as C-BARQ (Hsu and Serpell, 2003). The C-BARQ is a questionnaire which the dog's owner/caretaker answers. There are seven sections in the questionnaire with questions about; Training and Obedience; Aggression; Fear and Anxiety; Separation-related behaviour; Excitability; Attachment and Attention-seeking; and Miscellaneous (Hsu and Serpell, 2003). When developing the questionnaire, Hsu and Serpell (2003) did a factor analysis on the questionnaires collected from 2054 dogs (more than 100 breeds represented). They got 11 components which accounted for 57 % of the common variance. The components identified were given the following names: Stranger-Directed Aggression; Owner-Directed Aggression; Stranger-Directed Fear; Non-social Fear; Dog-Directed fear and aggression; Separation-Related Behaviour; Attachment and Attention-Seeking behaviour; Trainability; Chasing; Excitability; and Pain Sensitivity (Appendix A). The 11 components consisted all together of 68 questions. Later on two additional components were added: Dog Rivalry; and Energy Level (Duffy et al.,

2008). The version of C-BARQ used in this present study had 81 questions divided into the 14 categories and 24 questions in the miscellaneous section (see Appendix A). According to van der Berg et al. (2010) C-BARQ can be a good way to estimate whether a dog's personality makes the dog suitable for training, working (e.g. military, service) and/or breeding programs. The dog's results from a behavioural test will probably be correlated to its personality and behaviour but also with early experiences in the dog's life. Early experiences in dog do affect the behaviour of the adult dog (Serpell and Jagoe, 1995). This indicates that if the dog has been experience something specific this will affect the performance in the behavioural test. These experiences are also covered by C-BARQ and by adding some questions about experiences this will be even more covered.

Even though the use of questionnaires can be very useful to obtain information it has to be used with caution. Questions have to be asked clearly and simply and be easy to answer (Bush et al., 1995; Kelly, 2000). Inappropriate use of questionnaires can make common beliefs or biases to become facts (Rooney and Bradshaw, 2004; Rooney et al., 2004).

The aim of this study is to see if the results from the standardised behaviour test can be connected to a modified version of C-BARQ, i.e. early experiences and personality. The first hypothesis is that there will be indications for success in the behavioural test by the use of C-BARQ. The second hypothesis is that some of the additional questions, concerning early experiences, will be indicators of success in the behavioural test. This will be done by investigating the correlations between the questions and the "Index value" from the behavioural test.

2. Material and methods

This study was a part of Pernilla Foyer's ongoing PhD project, a collaboration between the Swedish Armed Forces Dog Instruction Centre, Linköping University and the Swedish National Defence College.

3.1 Subjects

Questionnaires and test results from the behavioural test were collected from 59 dogs of the breed German Shepherd Dog. The potential N-value was calculated to 95 dogs, this had been the N-value if all puppy raisers of every dog from all litters had answered the questionnaire. However, since not all puppy raisers showed up at the last meeting, and not all consultants handed the questionnaires to the puppy raisers the actual N-value became lower than expected. The dogs were a part of the breeding program at the Swedish Armed Force Dog Instruction Centre, SAFDIC, and potentially military working or breeding dogs. The criteria for the dogs included in this study were that: (1) the puppy raiser had one last meeting with the consultants; and (2) the dog was to be tested before the end of February, 2013, to make sure that the results from the behavioural test were collected before the statistical analysis were made. Of these 59 dogs, 31 were males and 28 were females. The dogs represented 15 different litters, which had a size ranged from 2 to 10 dogs. The dogs were born between 28th of January 2011 and 18th of September 2011.

Information about re-homing (if the dog had moved from one puppy raiser to another) was collected from the Swedish Armed Forces' data base. If the dog had been re-

homed once or more times they got a score of 1 for re-homed and if the dog had not been re-homed it scored a 0.

3.2 C-BARQ

In this study a somewhat modified version of C-BARQ (Canine Behavioural Assessment and Research Questionnaire) was used to find how the dogs have behaved during their time with the puppy raisers. C-BARQ was developed by researchers at the Centre for the Interaction of Animals and Society of the University of Pennsylvania and Svartberg translated the questionnaire into Swedish and used in his own studies (e.g. Svartberg, 2005). Some questions were added to the questionnaire to get more information about experiences that the dogs have acquired during their stay with the puppy raisers (see Appendix A).

The used version of C-BARQ consists of 122 questions. The majority of the questions have a score of either a 5-point scale (0-4) or a frequency scale (never, seldom, sometimes, usually and always). The last additional 13 questions (110-122) were answered by writing the answer. By using the C-BARQ scoring method (see Appendix B), developed by Hsu and Serpell (2003) and later revised by Svartberg (2005), 81 of the total 122 questions were divided into 14 categories. In the original C-BARQ, 46 questions ended up in the miscellaneous questions and the additional 17 question added were questions about experiences during the first year of life. Because some of the additional questions (110-122) had written answers they needed to be categorised to be able to fit the statistical calculations (see Appendix C). The question about what the dogs eat were excluded due to that the dogs had been eating the same kind of food. The question about other animals in the family and if there are any other dogs in the household were pooled to living with other animals. The question concerning if and what the puppy raisers had trained with their dog were pooled into if the dogs had trained or not.

The modified C-BARQ was filled in by the puppy raisers at the last meeting with the consultants, which carried out when the dogs had reached the approximate age of 12 month. Some questionnaires were received via e-mail. The dogs were between 293 and 621 days old (427.5 ± 7.8 days) when the questionnaire were answered.

The puppy raisers were encouraged to contact me if something vital happened to the dog during the time from conducting the questionnaire until the time of the T-test. However, none of the puppy raisers did contact me. This tells me that either, (1) nothing vital happened to any of the dogs; or (2) if something happened this was not reported.

When the puppy raisers answered the questionnaire they were asked to answer all the questions, and only leave blank if they had never observed the dog in the described situation. Blank answers within the miscellaneous or early experiences sections were treated as a missing value. If the blank answer/answers were within one of the 14 categories and this resulted in more than 20 % of the questions within that category missing the whole category was treated as a missing value. If the missing answer/answers however resulted in less than or equal to 20 % of the questions within the category missing, the mean of the remaining questions was used, this resulted in different N-values between the categories and questions.

3.3 Standardised behavioural test

The sub-tests and the behavioural variables are described in detail in Wilsson and Sinn (2012) (also see Appendix D and for scoring Appendix E). The dogs were between 374 and 635 days old (498.0 ± 4.1 days) when they were tested.

Every dog gets an “Index value” from the behavioural test. The “Index value” range from -100 to 100. The “Index value” is calculated through adding the “Partial index” value for all sub-tests, subtract with the number of sub-tests and then multiply with 10 to get rid of the decimals. The “Partial index” (calculated by a SAF employee) is calculated by looking at historical scoring of dogs whose working status is known (working or not working). Almost all of the sub-tests have a scoring 1-5. The “Partial index” is calculated using following equation:

$$I_x = O_x/E_x$$

Where O_x is the observed number of dogs, which are working, in sub-test x. E_x is the expected number of dogs, which are working, in sub-test x. For example, 100 dogs has been tested for sub-test x. Sub-test x has a scoring 1-5. In the test 20 dogs received a 5, 20 dogs a 4 and so on (frequency f). If the test did not tell us anything about the working quality of the dog, half of the tested dogs would pass, which give us 10 dogs per score (expected E). However, this is not the case; there will be an observed value (O) which differs from 10 dogs per score. The “Partial index” is now calculated by divide the observed (O) passed dogs with the expected (E) passed dogs. The “Partial index” value is proportional to how good or bad it is to be given a particular score. The reason that the test of a dog is compared with already tested dogs, is that the risk of passing a dog that will fail the training are minimised. A dog which gets an “Index value” of 0 has a 50 % change of being a successful military working dog. The higher the total “Index value” the greater the chance for the dog to become a successful working dog, related to all dogs that have been tested until present day.

3.4 Data analysis

Data were analysed by using SPSS 21.0 for Windows (SPSS, Inc.). To find differences, for the categories and other questions from C-BARQ, between dogs that passed the behavioural test and dogs that failed the behavioural test, between the sexes, and between re-homed and not re-homed dogs an Independent sample t-test was performed. To find correlations between the “Index value” and the categories and questions from C-BARQ, Pearson correlations were done. A PCA was done on the categories from C-BARQ, and Pearson correlations for the components and the “Index value”. Also Pearson correlations were done between the “Index value” and the categories with high/low loadings in the components due to low N-value (34) in the PCA. “Dog Rivalry” was not included in the PCA due to that the category is excluded for dogs with no answers for the questions and therefore the category is a missing value. There are only 18 dogs with “Dog Rivalry” and due to missing values at other categories only 14 dogs were included in the PCA if “Dog Rivalry” would be included. So by exclude “Dog Rivalry” the N-value becomes 34 which still is not that high proportion of the total N-value (59 dogs). But to higher the number some of the most interesting categories had to be excluded. This is why PCA only included 13 of the 14 categories and. To find connections between the categories from C-BARQ and the sub-tests in the behavioural test, Pearson correlations were done. The significant

threshold is set to $p = 0.05$, if the p -value is between 0.1 and 0.05 the differences are treated as a tendency.

3. Results

Of the potential 95 dogs that could have been included, questionnaires from 59 dogs were returned. This makes the answer rate for the questionnaire 62 %.

Of the 59 dogs included in this study 44 % (26 dogs; 15 males and 11 females) passed the behavioural tests.

There were no significant differences between the number of passed dogs and which litter the dog came from, number of littermates, the sex of the dog, if the dog were rehomed or not and the age of the dog when tested. Therefore further analyses are done with pooled data.

Dogs that passed the behavioural test showed a tendency for a higher score in “Trainability” ($p = 0.078$) and “If they had lived with other animals (dogs, cats, rabbits, horses, birds)” ($p = 0.066$) (Table 1). If the dog, however, failed the behavioural test they showed a significant higher score for “Stranger Directed Fear” ($p = 0.006$), “Non-Social Fear” ($p = 0.005$), and “Dog Directed Fear” ($p = 0.021$). The failing dogs also had a significantly higher number for “Average hours being activated per day” ($p = 0.001$) and “Mounted (sexually) objects” ($p = 0.012$). There were also a tendency for higher score for “Urinating when dog was left home alone” ($p = 0.058$) (Table 1.).

Table 1. The means for the significant differences between the dogs that passed and failed the behavioural test for the categories from C-BARQ.

	Passed dogs			Failed dogs		
	N	Mean	\pm SE	N	Mean	\pm SE
Trainability	25	2.88	0.07	34	2.70	0.07
Lived with animals	25	0.76	0.09	34	0.53	0.09
Stranger Directed Fear	24	0.05	0.04	34	0.36	0.10
Non-Social Fear	25	0.30	0.07	34	0.69	0.11
Dog Directed Fear	18	0.38	0.14	25	0.99	0.21
Hours activated	24	2.32	0.21	33	3.44	0.23
Mounting objects	25	0.04	0.04	34	0.41	0.13
Urinating when left home alone	24	0.00	0.00	34	0.53	0.09

The “Index value” was significant negatively correlated with “Stranger Directed Fear” ($R = -0.40$, $N = 58$, $p = 0.002$), “Non-Social Fear” ($R = -0.39$, $N = 59$, $p = 0.003$), and “Dog Directed Fear” ($R = -0.41$, $N = 43$, $p = 0.006$) (see Fig. 1.) and significant positively correlated with “Trainability” ($R = 0.32$, $N = 59$, $p = 0.013$), “Hyperactive, restless, has trouble settling down” ($R = 0.31$, $N = 59$, $p = 0.018$), “Chases/follows shadows, light spots, etc.” ($R = 0.27$, $N = 58$, $p = 0.043$), and “Average of hours left home alone per day” ($R = 0.27$, $N = 57$, $p = 0.043$). There was also a tendency that “Index value” was positively correlated with “Chews at inappropriate objects” ($R = 0.23$, $N = 59$, $p = 0.075$) (Fig. 2.).

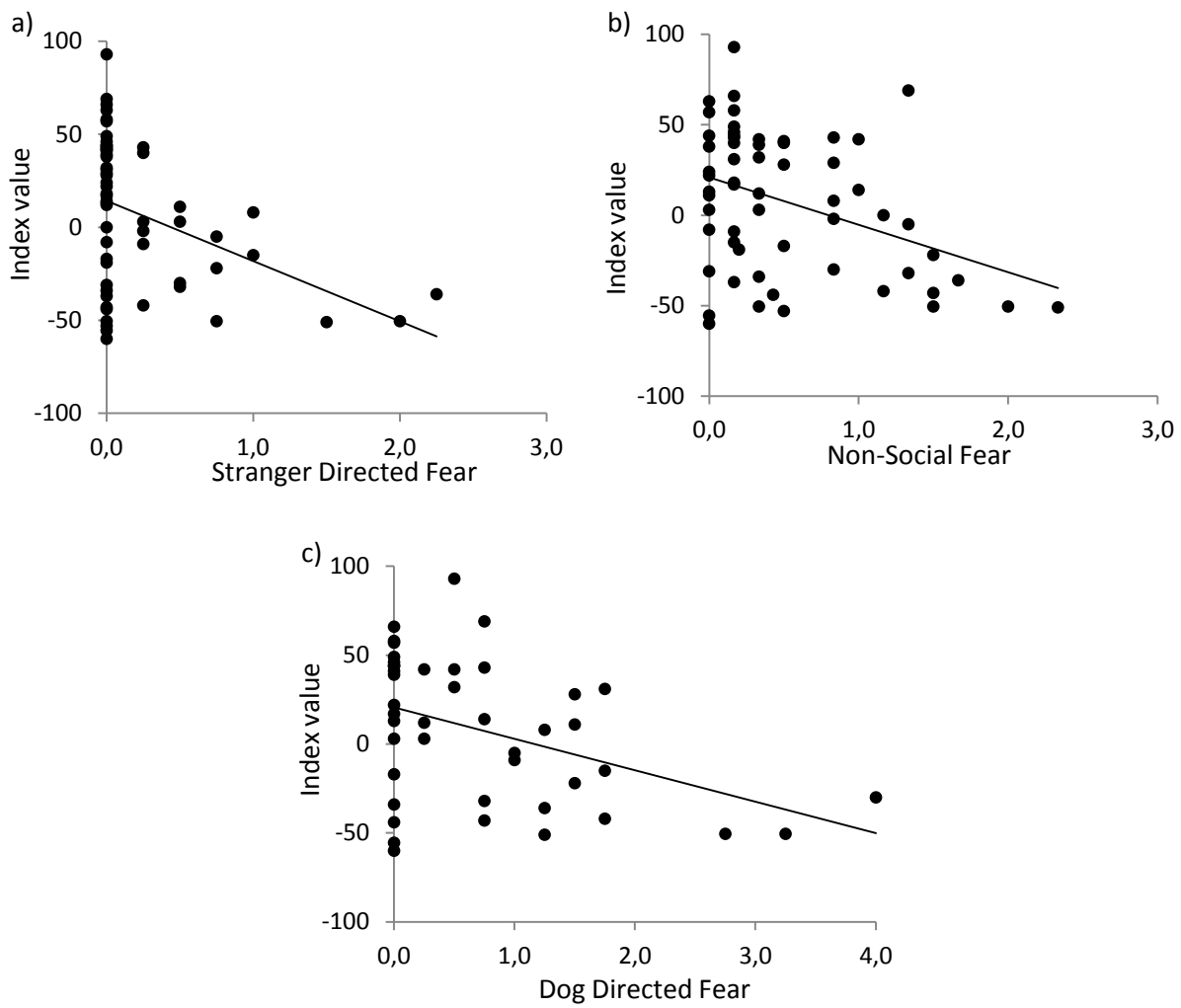


Fig. 1. Scatter-plots showing the negative correlations between the “Index value” and (a) “Stranger Directed Fear” ($R = -0.40$, $N = 58$, $p = 0.002$), (b) “Non-Social Fear” ($R = -0.39$, $N = 59$, $p = 0.003$), (c) “Dog Directed Fear” ($R = -0.41$, $N = 43$, $p = 0.006$).

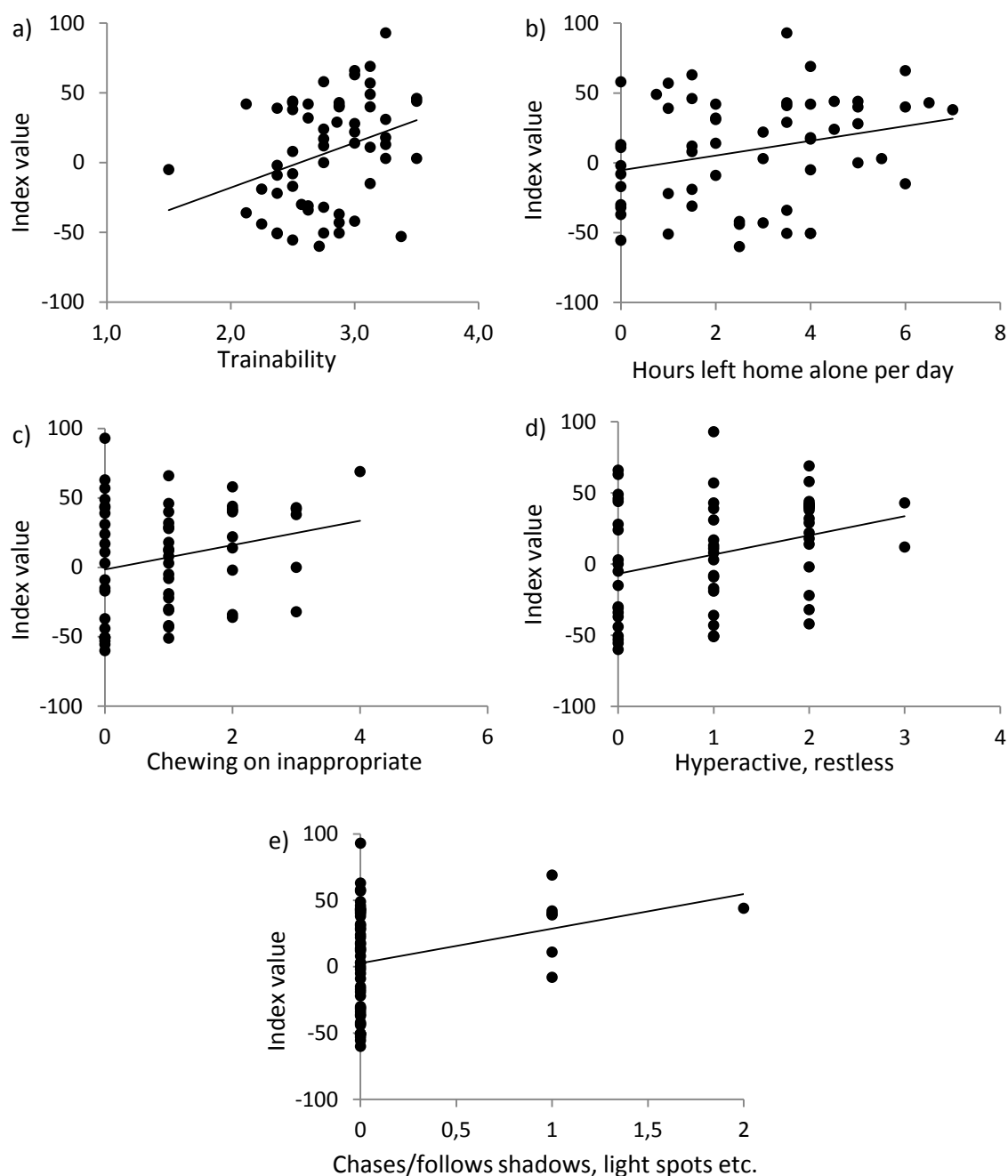


Fig. 2. Scatter-plots showing the positive correlations between the “Index value” and (a) the category “Trainability” ($R = 0.032$, $N = 59$, $p = 0.013$), (b) “How many hours the dog is left home alone per day on average” ($R = 0.27$, $N = 57$, $p = 0.043$), (c) “Chewing on inappropriate objects” ($R = 0.23$, $N = 59$, $p = 0.075$), (d) “Hyperactive, restless, has trouble settling down” ($R = 0.31$, $N = 59$, $p = 0.018$), (e) “Chases/follows shadows, light spots, etc.” ($R = 0.027$, $N = 58$, $p = 0.043$).

From the PCA, 5 components with eigenvalues greater than 1 were identified. However, there is a clear decrease in the slope in the scree plot for the PCA after the third component only the three first components are used in further analysis. Together the three components (Table 2) accounted for 57.2 % of the variance.

Table 2. The 13 categories included in the PCA and their loadings within the three first components.

	PC1	PC2	PC3
Stranger Directed Aggression	0.64	-0.04	-0.13
Owner Directed Aggression	0.38	0.66	-0.42
Dog Directed Aggression	0.75	-0.14	0.15
Stranger Directed Fear	0.65	-0.48	-0.19
Non-social Fear	0.70	0.03	0.13
Dog Directed Fear	0.64	-0.55	0.06
Separation Related Fear	0.56	0.07	0.45
Attachment and Attention Seeking	0.31	0.18	0.62
Trainability	-0.57	-0.21	0.18
Chase	0.61	0.10	0.06
Excitability	0.29	0.56	0.29
Touch Sensitivity	0.49	0.48	-0.58
Energy level	-0.21	0.71	0.33

The components were then used in correlation to the “Index value” to see if the “Index value” could be explained by the components. There were no significant results, but tendencies for PC2 and PC3 to be correlated to the “Index value” (Table 3). However, since some questionnaires had missing values for some of the categories and a PCA only includes subjects with answers on every category included in the PCA the N-value was lower than half of the dog included in the study (N = 34) a correlation with the highest/lowest loaded numbers in PC1 was done (Table 2) to see if there were any significant correlations with the “Index value”. There were significant correlations between the “Index value” and the categories “Stranger Directed Fear”, “Non-social Fear”, “Dog Directed Fear” and “Trainability” (Table 4).

Table 3. Pearson correlation between the “Index value” and the three first components in the PCA at the categories from C-BARQ. (*) means that there are a tendencies for differences.

		PC1	PC2	PC3
Index	Pearson	-0.28	0.32 (*)	0.34 (*)
value	Sig. (2-tailed)	0.11	0.07	0.05
	N	34	34	34

Table 4. Pearson correlation between the “Index value” and the categories with highest respectively lowest loadings in the first component from the PCA at the categories from the C-BARQ. * means that there are significant differences.

	Index value		
	Pearson	Sig (2-tailed)	N
Stranger Directed Aggression	-0.07	0.59	59
Dog Directed Aggression	-0.09	0.56	45
Stranger Directed Fear	-0.40*	<0.01	45
Non-Social Fear	-0.39*	<0.01	59
Dog Directed Fear	-0.41*	<0.01	43
Separation Related Fear	0.02	0.87	57
Trainability	0.32*	0.01	59
Chase	-0.09	0.51	52

The Pearson correlations between the categories and the sub-test resulted in a lot of correlations (Appendix E). The most interesting and some of the strongest correlations were between “Affability”, where the dog was led through a group of people, and “Stranger Directed Aggression” (R = -0.39, N = 59, p < 0.01). Between Affability and “Stranger Directed Fear” (R = - 0.31, N = 58, p = 0.02). Between “Acoustic Startle”, where a pair of metal buckets was dropped on the floor 2 meters from the dog, and “Non-Social Fear” (the reaction during the test R = -0.39, N = 56, p < 0.01, the abreaction R = -0.32, N = 59, p = 0.02 and the follow-up R = -0.32, N = 55, p = 0.02). Between “Visual Startle”, where an overall is pulled into the air shaping an X, and “Non-Social Fear” (the reaction during the test R = -0.29, N = 55, p =0.03, the abreaction R = -0.35, N = 55, p = 0.01, and the follow-up R = -0.39, N = 55, p < 0.01). Between “Search”, where a tennis ball is under a wooden pallet, (the reaction during the test and the intensity) and “Non-Social Fear” (R = 0.39, N = 54, p < 0.01). And between “Gun fire fear”, where a blank shots are fired, and “Non-Social Fear” (R = -0.50, N = 52, p < 0.01).

There are a correlation between the frequency of attending to the meetings and the “Index value” that the dog received from the behavioural test (see Table 4.). There are fewer participants at the later meetings. This might mean that the puppy raisers that have answered the questionnaire are more concerned about the success of the dog and therefore attend to all three meetings.

Table 5. A summary of all the dogs that have been tested (675 dogs). The number of meetings with the consultants in the column to the left, the corresponding mean “Index value” in the middle column and the number of dogs which puppy raisers had attended to one, two or three meetings.

Meetings with consultants	Index value	Number of dogs
1	-8.9	289
2	12.2	198
3	24.1	188

4. Discussion

The “Index value” was positive correlated to “Trainability”, “Hours left home alone per day”, “Chasing/fallows shadows, spot lights, etc.”, “Hyper active, restless, has

problems settling down” and “Chewing on inappropriate objects”. The “Index value” was negatively to “Stranger Directed Fear”, “Non-Social Fear” and “Dog Directed Fear”. Three components were extracted from the categories, PC1 had a negative correlation to the “Index value”, whilst there was a positive tendency for a correlation between the “Index value” and PC2 and between “Index value” and PC3. The sub-test “Affability” was negatively correlated to the categories “Stranger Directed Aggression” and “Stranger Directed Fear”. The category “Non-Social Fear” was negatively related with the sub-tests “Acoustic Startle”, “Visual Startle” and “Gun Fire”. There was a positive correlation between the sub-test “Search” and the category “Trainability”.

The response to a survey can vary considerably, from as low as 9.4 – 31.4 % for Internet surveys (Deutskens et al., 2004) to as high as 97 % for questionnaires answered by puppy raisers (Serpell and Hsu, 2001). In this study the response to the questionnaire was 59 of 95 potential dogs which results in a response of 62 %. This means that the response rate in this study is of decent rate. The percentage of dogs passing the behavioural test (44 %) is higher in this study than the percentage of passing dog of all dogs that have been tested since year 2005 when the breeding program started (27 %). The reason for that there are more dogs that have passed in this study than the total percentage of all tested dogs, might be due to that the questionnaires were answered at the last meeting with the consultants. SAFDIC has statistics at the participation at the meetings with the consultants. This statistics tells us that if the puppy raisers have been participating to more meeting than the dog of that puppy raiser gets a higher “Index value” in the behavioural test. However, there are no statistics on if the participation is decreasing with the meetings, if there are fewer participants at the last meeting than at the first meeting. But if this was the case than this might be the reason to why the percentage of passed dogs is higher in this study than the average percentage.

The results show that the category Trainability has a positive correlation to both success in the behavioural test and the “Index value”, this is in accordance with the literature. Kutsumi et al. (2013) conducted a study of dogs which had different experiences of training. They had four groups; (1) “Puppy class” where the dogs had 1 hour of training per week in 6 weeks and the dogs were 10-18 weeks old; (2) “Puppy party” where the dogs had 1 hour of training and the dogs were between 10 and 18 weeks old; (3) “Adult class” where the dogs had 1 hour of training per week in 6 weeks and the dogs were 5-24 months old; and (4) “No class” in which dogs with no training were included. They did a behavioural test when the dogs were 6-36 months old and connected the results to C-BARQ. They found that dogs in the first group (Puppy class) had a lower frequency of behavioural disorders. They also found that a dog that got a high score at Trainability in C-BARQ had a higher recall on commands given by the owner. By having these results in mind and the results from this present study we might say that if the dog has a high score at Trainability the chance for the dog of succeed in the behavioural test is higher than for the dogs with a low score. However, Seksel et al. (1999) found in their study that the behaviours between puppies exposed to different kind of training or socialisation did not differ. They had five groups: (1) Socialisation and Training with 1 hour puppy class each week over 4 weeks and got food rewards; (2) Training, where the dogs were trained 10 minutes per week over 4 weeks and got food rewards; (3) Socialisation where the dogs were socialised for 1 hour per week over 4 weeks and got food rewards; (4) Feeding

were the dogs only got food reward without training and socialisation; and (5) Control were the dogs stayed at a veterinary hospital for 15 minutes per week over 4 weeks without training, socialisation or food reward. By comparing these two studies it seems like the matter of when the dogs are trained have a bigger impact than what the dogs had been trained in. This might be the reason why the question about what the puppy raisers had trained with their dog did not give any significant results.

In my version of the C-BARQ I added some additional questions. One of them was “Have you trained something with your dog? If yes, what?”. This question could have been done at a different way, because the puppy raisers might not have written everything they have trained with their dog. So instead of the way it is answered now, written, there should have been check boxes, than the reliability of that question would have been higher. Because as the question is right now the absence of a kind of training does not mean that the puppy raiser has not been training the dog in that kind of training. Still if the results from Seksel et al. (1999) are reliable the different training does not affect the behaviour of the dog. To see if the absence of training affects the “Index value” from the behavioural test the question was treated as “Yes, I have trained the dog” or “No, I have not trained the dog”. However, since only three dogs had the answer ‘No, I have not trained the dog’ the result from the pooling of the question does not say anything.

The “Stranger Directed Fear”, “Non-social Fear” and “Dog Directed Fear” have a negative impact on the success in the behavioural test. The question is if these fear related behaviours might be the same. The three categories are strongly correlated to each other. However, as seen in the analysis of correlations between the categories and the sub-tests there are differences in which sub-test the category is correlated to indicated that the three categories might not be totally correlated to each other. Perhaps the number of dogs included in this study is too low to be able to show the differences between the categories. During the development of C-BARQ the research group state that the categories are not correlated to each other. This might be possible to find if the N-value is high enough. In the study by Hsu and Serpell (2003) collected 1851 dogs while in this study there are 59 dogs included and this might not be enough to find the differences between the categories.

The correlations between the correlations and the sub-tests were not big of surprise. If a dog has high scores for the categories “Stranger Directed Aggression” and “Stranger Directed Fear” the dog would get a low score for the sub-test where the dog is led through a group of people. A low score at the “Affability” sub-test means that the dog withdraws or does not seek contact with the people in the group. The category “Non-Social Fear” was correlated to the fear response in the sub-test “Gun Fire”, to the “Visual Startle” and “Acoustic Startle”. This is not either a surprise when the category “Non-Social Fear” contains questions about sudden noises and potential frightening objects. So a dog with high score at “Non-Social Fear” should have low score for the correlated sub-tests. There was also a correlation between the category “Trainability” and the sub-test “Search”. This correlation might be harder to explain. However, the SAFDIC put big emphases in the intensity of the searching in the “Search” sub-test, they also put a big emphasis in the obedience and trainability of the dog. These two might be correlated when the SAFDIC breed for better trainability.

The Pearson correlation between the components in the PCA and the “Index value” resulted in significant correlations for PC2 and PC3 and not for PC1. But recall that

the N-value in the PCA (N = 34) was lower than half the total dogs included (N = 59). Therefore a correlation between the highest/lowest loadings for PC1 and the “Index value” was performed to find a correlation this way. The first component (PC1), describes dogs which are aggressive and insecure. The second component (PC2), describes dogs that have a high level of energy. Finally, the third component (PC3), describes dogs that have a high attachment level. This might mean that the Swedish Armed Forces want to have dogs which are confident, non-aggressive, have a high energy level and are easy to handle when inspecting. The first component “Aggression and Insecurity” was negatively correlated to the “Index value” this result is in accordance to the earlier studies (Wilsson and Sinn, 2012; Wilsson and Sundgren, 1997), the SAFDIC does not want to have aggressive and insecure dogs. The second and the third component had a positive correlation to the “Index value”. These results are also in accordance to previous studies. Wilsson and Sundgren (1997) found in their study a component which explained “Affability” and this component have similarities with the third component in this study explaining “Attachment”. In the study by Wilsson and Sinn (2012) they found a component (Engagement), from doing a PCA, which included the behaviour “Liveliness”. This component had a positive correlation with the probability of success in the training of the military dogs. The behaviour “Liveliness” is not that different to the second component in this study (High level of energy). This means that the components extracted from the categories in C-BARQ are reliable as indicators to the success in the behavioural test.

The use of C-BARQ and letting the puppy raisers answer the questionnaire can be misleading because the puppy raisers could think that the dog is better than is actually is. In the research by Seksel et al. (1999) they found that owners have a more positive attitude to their dogs than owners’ attitude to their own dogs in a control group. It is hard to reduce the bias when an owner has to answer questions which include the raising of their dog. It might though be easier to be honest in a questionnaire if it is anonymous. This is the reason that the questionnaires only contained information about which dog the questionnaire belonged to and that the puppy raisers where ensured that their secrecy was kept.

Usually, when reading literature about early experiences’ affect of behaviours in later life, you find all possible explanations. There are all kinds of literature about that early experience affect the adult behaviour. For example, mice are dependent on if they are reared by a high-LG-ABN or a low-LG-ABN mother (Bredy et al., 2003; Weaver et al., 2004), guinea pigs (Kaiser et al., 2003) and chickens (Janczak et al., 2007) are affected prenatally by their mother in a stressful environment. However, in this present study the additional questions about early experiences did not result in affecting the “Index value” of the behavioural test. This might be due to different reasons, either the questions did not cover the issues that really affect the behaviour later in life. Or it might even be that the experiences the dogs get while living with the puppy raiser does not affect their behaviour as much as their personality does. Boissy et al. (1988) showed that human handling of heifers do not affect the human-animal relationship as much as previously thought, it seemed that only prolonged interactions with humans reduced the fear. Another research group found that the learning ability in foals did not differ between foals that had been handled by humans and those that had not been handled by humans (Mal et al., 1994). Even though the majority of the literature point in the direction of that early experiences do affect the behaviours later in life not all of the findings do.

However, the early experiences that did affect the “Index value” were dogs left home alone for long time did have a higher “Index value” and dogs that were activated for a longer time per day had a lower “Index value”. In the first case with the hours left alone the reason that the dog gets a higher “Index value” might be that the dog is that secure in itself that it is able to be left home alone for longer time. A secure dog is also what the SAFDIC is looking for, a dog that can work by itself and not have to be around the owner all the time. In the second case, hour activated per day, the dogs with low “Index value” had a high score. The reason to this might be that there are some dog that are over excited and the puppy raisers have to activate the dog for that many hours to keep the dog calm. An over excited dog is not what the SAFDIC is looking for and if a dog is not suitable for military work then it should get a low “Index value”.

A question that should have been included but were thought of to late was “Do you have any earlier experiences of owning a dog?”. The interesting part of this is to see if puppy raisers which never had had a dog before have a disadvantage in getting the dog to pass the behavioural test. Or, it might even be the other way around those puppy raisers with earlier experiences has a disadvantage due to that they think that I’ve always done this with my dog.

It is still not known to which extent rearing environment contribute to the behaviour of the adult dog (Serpell and Jagoe, 1995; Willis and Besch, 1995; Appelby et al., 2002) and further examination is needed for this area.

4.1 Conclusions

In conclusion, there is a consistent negatively effect on the success in the behavioural test and the “Index value” for “Stranger Directed Fear”, “Non-Social Fear”, and “Dog Directed Fear”. And a consistent positive effect for Trainability. This means that there are some indications that the C-BARQ could be used to predict the outcome of the behavioural test. The questions about early experiences did not indicate whether the dog were to pass or to fail the behavioural test. And more research on the effect of early experiences on the dog’s adult behaviour is needed.

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6. References

Appelby, D. L., Bradshaw, J. W. S. and Casey, R. A., 2002. Relationship between aggressive and avoidance behaviour by dogs and their experience in the first six months of life. *Veterinary Record*, 150: 434-448.

- Bateson, P., 1991. Assessment of pain in animals. *Animal Behaviour*, 42: 827-839.
- Batt, L. S., Batt, M. S., Baguley, J. A. and McGreevy, P. D., 2010. Relationship between puppy management practices and reported measures of success in guide dog training. *Journal of Veterinary Behavior*, 5: 240-246.
- Beerda, B., Schilder, M. B. H., van Hoof, J. A. R. A. M. and de Vries, H. V., 1997. Manifestations of chronic and acute stress in dogs. *Applied Animal Behaviour Science*, 52: 307-319.
- van der Berg, S. M., Heuven, H. C. M., van den Berg, L., Duffy, D. L. and Serpell, J. A., 2010. Evaluation of the C-BARQ as a measure of stranger-directed aggression in three common dog breeds. *Applied Animal Behaviour Science*, 124: 136-141.
- Boissy, A. and Bouissou, M-F., 1988. Effects of early handling on heifers' subsequent reactivity to humans and to unfamiliar situations. *Applied Animal Behaviour Science*, 20: 259-273.
- Bredy, T. W., Humpartzoomian, R. A., Cain, D. P. and Meaney, M. J., 2003. Partial reversal of the effect of maternal care on cognitive function through environmental enrichment. *Neuroscience*, 118: 571-576.
- Bush, E. J., Cowen, P., Morgan Morrow, W. E., Dickey, D. A. and Zering, K. D., 1994. Evaluation of non-sampling errors in the US National Swine Survey. *Preventive Veterinary Medicine*, 1995: 155-168.
- Caldij, C., Tennenbaum, B., Sharma, S., Francis, D., Plotsky, P. M. and Meaney, M. J., 1998. Maternal care during infancy regulates the development of neural systems mediating the expression of fearfulness in the rat. *Proceeding of the National Academy of Sciences*, 95: 5335-5340.
- Carver, C. S., Scheier, M. F. and Weintraub, J. K., 1989. Assessing Coping Strategies: A Theoretically Based Approach. *Journal of Personality and Social Psychology*, 56: 267-283.
- Child, I. L., 1968. 'Personality in culture', in Borgatta, E. F. and Lambert, W. W. (eds), *Handbook of personality theory and research*. Rand McNally. Chicago. p 83.
- Deutskens, E., De Ruyter, K., Wetzels, M. and Oosterveld, P., 2004. Response rate and response quality of Internet-based surveys: an experimental study. *Marketing Letters*, 15: 21-36.
- Digman, J.M., 1990. Personality structure: Emergence of the five-factor model. *Annual Review of Psychology*, 41: 417-440.
- Dodd, C. L., Pitchford, W. S., Hocking Edwards, J. E. And Hazel, S. J., 2012. Measures of behavioural reactivity and their relationships with production traits in sheep: A review. *Applied Animal Behaviour Science*, 140: 1-15.
- Duffy, D. L., Hsu, Y. And Serpell, J. A., 2008. Breed differences in canine aggression. *Applied Animal Behaviour Science*, 114: 441-460.

- Folkman, S., and Lazarus, R. S., 1980. An analysis of coping in a middle aged community sample. *Journal of Health and Social Behavior*, 21: 219-239.
- Fox, M. W., 1969. Behavioral effects of rearing dogs with cats during the 'critical period of socialization. *Behaviour*, 35, 273-280.
- Fox, M. W., 1972. Socio-Ecological Implications of Individual Differences in Wolf Litters: A Developmental and Evolutionary Perspective. *Behaviour*, 41: 298-313.
- Francis, D. F., Dioro, J., Plotsky, P. M. and Meaney, M. J., 2002. Environmental enrichment reverses the effects of maternal separation on stress reactivity. *Journal of Neuroscience*, 22: 7840-7843.
- Freedman, D. G., King, J. A. and Elliot, O., 1961. Critical periods in the social development of dogs. *Science*, 133: 1016-1017.
- Gazzano, A., Mariti, C., Notari, L., Sighieri, C. and McBride, E. A., 2008. Effects of early gentling and early environment on emotional development of puppies. *Applied Animal Behaviour Science*, 110: 294-304.
- Goldsmith, H. H., Buss, A. H., Plomin, R., Klevjord Rothbart, M., Thomas, A., Chess, S., Hinde, R. A. And McCall, R. B., 1987. Roundtable: What is temperament? Four approaches. *Child Development*, 58: 505-529.
- Gosling, S. D., 2001. From mice to man: What can we learn about personality from animal research? *Psychological Bulletin*, 127: 45-86.
- Gosling, S. D. and John, O. T., 1999. Personality Dimensions in Nonhuman Animals: A Cross-Species Review. *Current Directions in Psychological Science*, 8: 69-75.
- Hampson, S. E., 1988. Construction of personality. Routledge. Florence, NY, USA. p 1.
- Hayne, S. M. and Gonyou, H. W., 2003. Effects of regrouping on the individual characteristics of pigs. *Applied Animal Behaviour Science*, 82: 267-278.
- Horvárt, Z., Igyártó, B-Z, Magyar, A. and Miklósi, Á., 2007. Three different coping styles in police dogs exposed to a short-term challenge. *Hormones and Behavior*, 52: 621-630.
- Hsu, Y. and 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: 1293 – 1300.
- Janczak, A. M., Torjesen, P., Palme, R. and Bakken, M., 2007. Effects of stress in hens on the behavior of the offspring. *Applied Animal Behaviour Science*, 107: 66-77.
- Joffe, J. M., 1969. Prenatal determinants of behaviour. New York: Pergamon Press.
- Kaiser, S., Kruijver, F. P. M., Swaab, D. F. and Sachser, N., 2003. Early social stress in female guinea pigs induces a masculinization of adult behavior and corresponding

changes in brain and neuroendocrine function. *Behavioural Brain Research*, 144: 199-210.

Kaiser, S., Harderthauer, S., Sachser, N. And Hennessy, M. B., 2007. Social housing conditions around puberty determine later changes in plasma cortisol levels and behaviour. *Physiology & Behavior*, 2007: 405-411.

Kelly, P., 2000. Questionnaire design, printing and distribution. *Government Information Quarterly*, 17: 147-159.

Kutsumi, A., Nagasawa, M., Ohta, M. and Ohtani, N., 2013. Importance of puppy training for future behavior of the dog. *Journal of Veterinary Medical Science*, 75: 141-149.

Lansade, L. and Simon, F., 2010. Horses' learning performances are under the influence of several temperamental dimensions. *Applied Animal Behaviour Science*, 125: 30-37.

Ledger, R.A., Baxter, M.R., 1997. The development of a validated test to assess the temperament of dogs in a rescue shelter. In: *Proceedings of the First International Conference on Veterinary Behavioural Medicine*, Birmingham, UK, pp. 87-92.

Maestripieri, D., Schino, G., Aurelia, F. and Troisi, A., 1992. A modest proposal: displacement activities as an indicator of emotions in primates. *Animal Behaviour*, 44: 967-979.

Mal, M. E., McCall, C. A., Cummins, K. A. and Newland, M, C., 1994. Influence of preweaning handling methods on post-weaning learning ability and management of foals. *Applied Animal Behaviour Science*, 40: 187-195.

McCrae, R. R., Costa, P. T., Jr., Ostendorf, F., Angleitner, A., Hrebickova, M., Avia, M. D., Sanz, J., Sanchez-Bernardos, M. L., Kusdil, M. E., Woodfield, R., Saunders, P. R., and Smith, P. B., 2000. Nature over nurture: Temperament, personality, and life span development. *Journal of Personality and Social Psychology*, 78: 173-186.

Meisel, R. L. and Ward, I. L., 2012. Fetal female rats are masculinised by male littermates located caudally in the uterus. *Science*, 213: 239-242.

Nagy, K., Bodó, G., Bárdos, G., Bánszky, N. and Kabai, P., 2010. Differences in temperament traits between crib-biting and control horses. *Applied Animal Behaviour Science*, 122: 41-47.

Netto, W. J. and Planta, D. J. U., 1997. Behavioural testing for aggression in the domestic dog. *Applied Animal Behaviour Science*, 52: 243-263.

Pervin, L. and John, O. P., 1997. *Personality: Theory and research* (7th ed.). New York: Wiley.

Ploger, B. J. and Yasukawa, K., 2002. *Exploring Animal Behavior in Laboratory and Field: An Hypothesis-testing to the Development, Causation, Function, and Evolution of Animal Behavior*. Burlington: Academic Press.

- Rooney, N. J. and Bradshaw, J. W. S., 2004. Breed and sex differences in the behavioural attributes of specialist search dogs – a questionnaire survey of trainers and handlers. *Applied Animal Behaviour Science*, 86: 123-135.
- Rooney, N. J., Bradshaw, J. W. S. and Almey, H., 2004. Attributes of specialist search dogs – A questionnaire survey of UK dog handlers and trainers. *Journal of Forensic Science*, 49: 300-306.
- vom Saal, F. S. And Bronson, F. H., 1980. Sexual characteristics of adult female mice are correlated with their blood testosterone levels during prenatal development. *Science*, 208: 597-599.
- Scott, P.J. P., 1962. The critical periods in behavioural development. *Science*, 138: 949-958.
- Scott, J. P. and Fuller, J. L., 1965. *Genetics and the social behaviour of the dog*. Chicago: University of Chicago Press.
- Seatre, P., Strandberg, E., Sundgren, P-E., Petterson, U., Jazin, E. and Bergström, T. F., 2006. The genetic contribution to canine personality. *Genes, Brain and Behavior*, 5: 240-248.
- Seksel, K., Mazurski, E. J. and Taylor, A., 1999. Puppy socialisation programs: short and long term behavioural effects. *Applied Animal Behaviour Science*. 62: 335-349.
- Serpell, J. A. and Hsu, Y., 2001. Development and validation of a novel method for evaluating behavior and temperament in guide dogs. *Applied Animal Behaviour Science*, 72: 347-364.
- Serpell, J. and Jagoe, J. A., 1995. 'Early experience and the development of behaviour' in Serpell, J. *The domesticated dog: Its evolution, behavior, and interaction with people*. Cambridge university press. p 79-102.
- Slabbert, J. M. and Odendaal, J. S. J., 1999. Early prediction of adult police dog efficiency – a longitudinal study. *Applied Animal Behaviour Science*, 64: 269-288.
- Svartberg, K., 2003. *Personality in dogs*. Stockholm: Univ.
- Svartberg, K., 2005. A comparison of behavior in test and in everyday life: Evidence of three consistent boldness-related personality traits in dogs. *Applied Animal Behaviour Science*, 91: 103-128.
- Svartberg, K., 2007. 'Individual differences in behaviour – Dog personality'. In PJensen. P. *The behavioural biology of dogs*. CABI Publishing. Cambridge, USA.
- Svartberg, K., and Forkman, B., 2002. Personality traits in the domestic dog (*Canis familiaris*). *Applied Animal Behaviour Science*, 79: 133-155.
- van der Waaij, E. H., Wilsson, E. and Strandberg, E., 2008. Genetic analysis of results of a Swedish behavior test on German Shepherd Dogs and Labrador Retrievers. *Journal of Animal Science*, 86: 2853-2861.

Weaver, I., Cervoni, N., Champagne, F., D'Alessio, A., Sharma, S., Seckl, J., Dymov, S., Szyf, M. and Meaney, M., 2004. Epigenetic programming by maternal behaviour. *Nature Neuroscience*, 7: 847-854.

Wechsler, B., 1995. Coping and coping strategies: a behavioural view. *Applied Animal Behaviour Science*, 43: 123-134.

Willis, L. R. and Besch Jr, H. R., 1995. Effects of experience on medical students' attitudes toward animal laboratories in pharmacology education. *Academic Medicine*, 70: 67-69.

Wilsson, E and Sinn D.L., 2012. Are there differences between behavioral measurement methods. A comparison of the predictive validity of two methods in a working dog program. *Applied Animal Behaviour Science*, 141: 158-172.

Wilsson, E. and Sundgren, P-E., 1996. The use of a behavior test for the selection of dogs for service and breeding, I: Method of testing and evaluating test results in the adult dog, demands on different kinds of service dogs, sex and breed differences. *Applied Animal Behaviour Science*, 53: 279-295.

7. Appendix

7.1 Appendix A – C-BARQ

Doc's ID:	Date when answered:
Doc's birth date:	Date of T-test:

Canine Behavioral Assessment & Research Questionnaire (C-BARQ)

Following questions are designed to allow you to describe how your dog has been behaving in the recent past (i.e from the day you got the dog to today). Please try to answer all of the questions. Only leave a question blank if you cannot answer if for some reason (for instance, if you have never observed the dog in the situation described).

SECTION 1: Training and obedience

Some dogs are more obedient and trainable than others. By checking the appropriate boxes, please indicate how trainable or obedient your dog has been in each of the following situations in the recent past (i.e. from the day you got the dog to today)

	Never	Seldom	Sometimes	Usually	Always
1. When off the leash, returns immediately when called	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Obeys the "sit" command immediately	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Obeys the "stay" command immediately	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Seems to attend/listen closely to everything you say or do	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Slow to respond to correction or punishment; 'thick-skinned'	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Slow to learn new tricks or tasks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Easily distracted by interesting sights, sounds or smells	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Will 'fetch' or attempt to fetch sticks, balls or objects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 2: Aggression

Some dogs display aggressive behaviour from time to time. Typical signs of moderate (2) aggression in dogs include barking, growling and baring teeth. More serious (4) aggression generally includes snapping, lunging, biting, or attempting to bite.

By checking the box with corresponding number on the following 5-point scale (0=no aggression, 2= moderate aggression, 4=serious aggression), please indicate your own dog's recent tendency to display aggressive behaviour in each of the following contexts:

9. When verbally corrected or punished (scolded, shouted at, etc) by you or household member

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. When approached directly by an unfamiliar ADULT while being walked/exercised on a leash

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11. When approached directly by an unfamiliar CHILD while being walked/exercised on a leash

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. Toward unfamiliar persons approaching the dog while she/he is in your car

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

13. When toys, bones or other objects are taken away by a household member

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

14. When bathed or groomed by a household member

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

15. When an unfamiliar person approaches you or another member of your family at home

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

16. When an unfamiliar person approach you or another member of your family away from your home

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

17. When approached directly by household member while she/he (the dog) is eating

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

18. When mailmen or other delivery workers approach your home

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

19. When his/her food is taken away by a household member

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

20. When strangers walk past your home while your dog is outside or in the yard

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

21. When an unfamiliar person tries to touch or pet the dog

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

22. When joggers, cyclists, rollerblades, or skateboarders pass your home while your dog is outside or in the yard

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

23. When approached directly by an unfamiliar MALE dig while being walked/exercised on a leash

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

24. When approached directly by an unfamiliar female dog while being walked/exercised on a leash

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

25. When stared at directly by a member of the household

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

26. Toward unfamiliar dogs visiting your home

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

27. Toward cats, squirrels or other animals entering your yard

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

28. Toward unfamiliar persons visiting your home

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

29. When barked, growled, or lunged at by another (unfamiliar) dog.

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

30. When stepped over by a member of the household

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

31. When you or a household member retrieves food or objects stolen by the dog

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

32. Towards another (familiar) dog in your household (leave blank if no other dogs)

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

33. When approached at a favourite resting/sleeping place by another (familiar) household dog (leave blank if no other dogs)

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

34. When approached while eating by another (familiar) household dog (leave blank if no other dogs)

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

35. When approached while playing with/chewing a favourite toy, bone, object, etc., by another (familiar) household dog (leave blank if no other dogs)

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Are there any other situations in which your dog is sometimes aggressive? If so, please describe briefly:

SECTION 3: Fear and Anxiety

Dogs sometimes show signs of anxiety or fear when exposed to particular sounds, objects, persons or situations. Typical signs of mild to moderate (2) fear include: avoiding eye contact, avoidance of the feared object; crouching or cringing with tail lowered or tucked between the legs; whimpering or whining, freezing, and shaking or trembling. Extreme (4) fear is characterised by exaggerated cowering, and/or vigorous attempts to escape, retreat or hide from the feared object, person or situation.

Using the following 5-point scale (0=no fear, 2=moderate fear, 4=extreme fear), please indicate your own dog's recent tendency to display fearful behaviour in each of the following circumstances:

36. When approached directly by an unfamiliar ADULT while away from your home

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

37. When approached directly by an unfamiliar CHILD while away from your home

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

38. In response to sudden or loud noises (e.g. vacuum cleaner, car backfire, road drills, objects being dropped, etc.)

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

39. When unfamiliar persons visit your home

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

40. When an unfamiliar person tries to touch or pet the dog

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

41. In heavy traffic

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

42. In response to strange or unfamiliar objects on or near the sidewalk (e.g. plastic trash bags, leaves, litter, flags flapping, etc.)

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

43. When examined/treated by a veterinarian

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

44. During thunderstorms, firework displays, or similar events

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

45. When approached directly by an unfamiliar dog of the same or larger size

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

46. When approached directly by an unfamiliar dog of a smaller size

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

47. When first exposed to unfamiliar situations (e.g. first car trip, first time in elevator, first visit to veterinarian, etc.)

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

48. In response to wind or wind-blown objects

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

49. When having nails clipped by a household member (leave blank if nails are not clipped by a household member)

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

50. When groomed or bathed by a household member

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

51. When stepped over by a member of the household

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

52. When having his/her feet towelled by a member of the household

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

53. When unfamiliar dogs visit your home

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

54. When barked, growled, or lunged at by an unfamiliar dog

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 4: Separation-related behaviour

Some dogs show signs of anxiety or abnormal behaviour when left alone, even for relatively short periods of time. Thinking back over the recent past, how often has your dog shown each of the following signs of separation-related behaviour when left, or about to be left, on its own (check appropriate boxes):

	Never	Seldom	Sometimes	Usually	Always
55. Shaking, shivering or trembling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
56. Excessive salivation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
57. Restlessness/agitation/pacing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
58. Whining	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
59. Barking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
60. Howling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
61. Chewing at/destroying objects or furniture (e.g. pillows, couches, curtains, chairs, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
62. Chewing/scratching at doors, floor, windows, curtains, etc.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
63. Loss of appetite	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Is the dog restrained in any way, e.g. shut into a singular room, when left alone?

Are there any other situations in which your dog is fearful or anxious? If so, please describe:

SECTION 5: Excitability

Some dogs show relatively little reaction to sudden or potentially exciting events and disturbances in their environment, while others become highly excited at the slightest novelty. Signs of mild to moderate (2) excitability include increased alertness, movement toward the source of novelty, and brief episodes of barking. Extreme (4) excitability is characterised by a general tendency to over-react. The excitable dog barks or yelps hysterically at the slightest disturbance, rushes towards and around any source of excitement, and is difficult to calm down.

Using the following 5-point scale (0=calm, 2=moderate excitable, 4=extremely excitable), please indicate your own dog's recent tendency to become excitable in each of the following circumstances:

64. When you or other members of the household come home after a brief absence

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

65. When playing with you or other members of your household

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

66. When doorbell rings

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

67. Just before being taken for a walk

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

68. Just before being taken on a car trip

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

69. When visitors arrive at your home

0	1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Are there any other situations in which your dog sometimes becomes over-excited? If so, please describe briefly:

SECTION 6: Attachment and Attention-seeking

Most dogs are strongly attached to their people, and some demand a great deal of attention and affection from them. Thinking back over the recent past, how often has your dog shown each of the following signs of attachment or attention-seeking.

	Never	Seldom	Sometimes	Usually	Always
70. Displays a strong attachment for one particular member of the household	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
71. Tends to follow you (or others) when you (or others) move around at home, from room to room	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
72. Tends to sit close to, or in contact with you (or others) for attention when you are sitting down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
73. Tends to nudge, nuzzle or paw you (or others) for attention when you are sitting down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
74. Becomes agitated (whines, jumps up, tries to intervene) when you (or others) show affection for another dog or animal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
75. Becomes agitated (whines, jumps up, tries to intervene) when you (or others) show affection for another person	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
76. Becomes overjoyed when you (or other household member) comes home after a short time away	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 7: Miscellaneous

Dogs display a wide range of miscellaneous behaviour problems in addition to those already covered by this questionnaire. Thinking back over the recent past, please indicate how often your dog has shown any of the following behaviours:

	Never	Seldom	Sometimes	Usually	Always
77. Chases or would chase cats given the opportunity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
78. Chases or would chase birds given the opportunity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
79. Chases or would chase squirrels, rabbits and other small animals given the opportunity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
80. Escapes or would escape when walking/exercising to find wild animals if given the opportunity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
81. Kills or would kill wild animals if given the opportunity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
82. Escapes or would escape from home or yard given the chance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
83. Rolls in own or other animal droppings or other 'smelly' substances	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
84. Eats own or other animals' droppings or faeces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
85. Chews at inappropriate objects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
86. 'Mounts' (sexually) objects, furniture or people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
87. Begg persistently for food when people are eating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
88. Steals food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Never	Seldom	Sometimes	Usually	Always
89. Nervous or frightened on stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
90. Pulls excessively hard when on the leash	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
91. Urinates against objects/ furnishings in your home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
92. Urinates when approached, petted, handled or picked up	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
93. Urinates when left alone at night or during the daytime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
94. Defecates when left alone at night, or during the daytime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
95. Hyperactive, restless, has trouble settling down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
96. Playful, 'puppyish', boisterous	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
97. Active, energetic, always on the go	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
98. Stares intently at nothing visible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
99. Snaps at (invisible) flies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
100. Chases own tail/hind end	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101. Chases/follows shadows, light spots, etc.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
102. Barks persistently when alarmed or excited	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
103. Licks him-/herself excessively	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
104. Licks people or objects excessively	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Never	Seldom	Sometimes	Usually	Always
105. Displays other bizarre, strange or repetitive behaviour(s)?*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*Please describe: _____

	Never	Seldom	Sometimes	Usually	Always
106. The dog plays when you invite	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
107. You play when the dog invites	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
108. You reward with play when the dog does something good	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
109. You reward with treats when the dog does something good	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

110. Are there other dogs in the household? If yes, how many and which breeds?

111. Are there other animals than dogs in the household? If yes, what animals?

112. Are there any children in your household? If yes, how old? _____

113. Has the dog been moved? If yes, how long ago? _____

114. Has the dog been in a car accident? If yes, how long ago? _____

115. Has the dog been in a dogfight? If yes, how long ago? _____

116. Has the dog been biting? If yes, how long ago? _____

117. Have you been training the dog? If yes, what have you been training? _____

118. Has the dog shown any tendency to be afraid of shooting sounds? If yes, how?

119. Which food has been given to the dog? Any supplements, if yes what?

120. Has the dog been visiting the veterinarian? If yes, why? _____

121. How many hours a day, in average, is the dog home alone? _____

122. How many hours a day, in average, is the dog being activated (e.g. walking and exercise)?

7.2 Appendix B – C-BARQ scoring method

C-BARQ⁽¹⁰¹⁾ scoring method

The C-BARQ provides a set of quantitative scores for the following fourteen different subscales or categories of behaviour:

1. **Stranger-directed aggression:** Dog shows threatening or aggressive responses to strangers approaching or invading the dog's or owner's personal space, territory, or home range.
2. **Owner-directed aggression:** Dog shows threatening or aggressive responses to the owner or other members of the household when challenged, manhandled, stared at, stepped over, or when approached while in possession of food or objects.
3. **Dog-directed aggression:** Dog shows threatening or aggressive responses when approached directly by unfamiliar dogs.
4. **Stranger-directed fear:** Dog shows fearful or wary responses when approached directly by strangers.
5. **Nonsocial fear:** Dog shows fearful or wary responses to sudden or loud noises, traffic, and unfamiliar objects and situations.
6. **Dog-directed fear:** Dog shows fearful or wary responses when approached directly by unfamiliar dogs.
7. **Separation-related behavior:** Dog vocalizes and/or is destructive when separated from the owner, often accompanied or preceded by behavioral and autonomic signs of anxiety including restlessness, loss of appetite, trembling, and excessive salivation.
8. **Attachment and attention-seeking:** Dog maintains close proximity to the owner or other members of the household, solicits affection or attention, and displays agitation when the owner gives attention to third parties.
9. **Trainability:** Dog shows willingness to attend to the owner, obeys simple commands, learns quickly, fetches objects, responds positively to correction, and ignores distracting stimuli.
10. **Chasing:** Dog chases cats, birds, and/or other small animals, given the opportunity.
11. **Excitability:** Dog displays strong reaction to potentially exciting or arousing events, such as going for walks or car trips, doorbells, arrival of visitors, and the owner arriving home; has difficulty settling down after such events.
12. **Touch sensitivity:** Dog shows fearful or wary responses to potentially painful procedures, including bathing, grooming, nail-clipping, and veterinary examinations.
13. **Energy level:** Dog is energetic, "always on the go", and/or playful.
14. **Dog rivalry:** Dog shows aggressive or threatening responses to other familiar dogs in the household.

In addition, the C-BARQ provides useful information on the occurrence of a further 22 miscellaneous behaviour problems ranging from coprophagia to stereotypic spinning/tail-chasing.

Each subscale is represented by a number of 5-point scales (questions). Some are graduated scales that measure severity of particular behaviours (e.g. aggression) and are numbered from 0–4 in the questionnaire. The remainder are frequency scales which should be scored as: Never = 0, Seldom = 1, Sometimes = 2, Usually = 3 and

Always = 4, **except for scales 5, 6 and 7 in Section 1. FOR THESE SCALES ONLY, reverse the scores to: Never = 4, Seldom = 3, etc.**

To calculate behavior subscale scores, use the following formulae:

“Stranger-directed aggression” score = (questionnaire items 10 + 11 + 12 + 15 + 16 + 18 + 20 + 21 + 22 + 28)/10.

“Owner-directed aggression” score = (items 9 + 13 + 14 + 17 + 19 + 25 + 30 + 31 + 51)/9.

“Dog-directed aggression/fear” score = (items 23 + 24 + 26 + 29 + 45 + 46 + 53 + 54)/8. This subscale can also be split into two separate “dog-directed aggression” and “dog-directed fear” subscales using the following formulae: “dog-directed aggression” = (items 23 + 24 + 26 + 29)/4, and “dog-directed fear” = (items 45 + 46 + 53 + 54)/4.

“Dog rivalry” score = (items 32 + 33 + 34 + 35)/4

“Trainability” score = (items 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8)/8—remember to reverse scoring order for items 5, 6 & 7 (see above).

“Chasing” score = (items 27 + 77 + 78 + 79)/4

“Stranger-directed fear” score = (items 36 + 37 + 39 + 40)/4

“Non-social fear” score = (items 38 + 41 + 42 + 44 + 47 + 48)/6

“Separation-related problems” score = (items 55 + 56 + 57 + 58 + 59 + 60 + 61 + 62 + 63)/9

“Touch sensitivity” score = (items 43 + 49 + 50 + 52)/4

“Excitability” score = (items 64 + 65 + 66 + 67 + 68 + 69)/6

“Attachment/attention-seeking” score = (items 70 + 71 + 72 + 73 + 74 + 75 + 76)/7

“Energy” score = (items 96 + 97)/2

Items 1–79 & 96–97 cannot be removed from the questionnaire without potentially reducing the reliability and/or validity of one or other of the behaviour subscales. Other “Miscellaneous” items are optional, and can be removed from the questionnaire as desired. If retained, they should be scored individually, 0–4.

NB: This version of the C-BARQ has been modified since Hsu & Serpell (2003) to improve the reliability of some existing factors, and to include new “Dog rivalry (familiar dog aggression)” and “Energy” factors. The subscales “Dog rivalry”, “Chasing”, “Touch sensitivity”, “Trainability”, “Energy” and “Excitability” have not been formally validated, although they have been shown to have predictive validity in long-term studies of guide dogs (Duffy & Serpell, 2008).

7.3 Appendix C – Categorisation of question 110-122

No.	Question	Categorisation
110	Are there other dogs in the household? If yes, how many and which breeds?	The number of other dogs in the household. The breeds were not taken into account.
111	Are there other animals than dogs in the household? If yes, what animals?	Divided into four categories, (1) cat, (2) horse, (3) rabbit, hamster, guinea pig, etc. and (4) bird. The number of animals was not taken into account.
112	Are there any children in your household? If yes, how old?	Divided into three categories, (1) 0-3 year old children, (2) 4-10 year old, and (3) 11-19 year old. The number of children in the different categories was not taken into account.
113	Has the dog been moving houses? If yes how long ago?	If the dog had not been moving houses it scored a 0, and if the dog had been moving houses it scored a 1. The time was not taken into account.
114	Has the dog been in a car accident? If yes, how long ago?	If the dog had not been in a car accident it scored a 0, and if the dog had been in a car accident it scored a 1. The time was not taken into account.
115	Has the dog been in a dogfight? If yes, how long ago?	If the dog had not been in a dogfight it scored a 0, and if the dog had been in a dogfight it scored a 1. The time was not taken into account.
116	Has the dog been biting? If yes, how long ago?	If the dog had not been biting it scored a 0, if the dog had bit another dog it scored a 1, and if the dog had bit a human it scored a 2. The time was not taken into account.
117	Have you been training the dog? If yes, what have you been training?	Divided into: Tracking, Searching, Obedience, Environment- and Social training, Tricks, Agility, Tug-of-war
118	Has the dog shown any tendencies to be afraid of shooting sounds? If yes, how?	If the dog had not shown any tendencies it scored a 0, and if the dog shown any tendencies it scored a 1. How the dogs reacted was not taken into account.
119	Which food has been given to the dog? Any supplements, if yes, what?	This question was excluded due to that the dogs had ate the same food.
120	Has the dog been visiting the veterinarian? If yes, why?	If the dog had not been to the veterinarian it scored a 0, and if the dog had been to the veterinarian it scored a 1. The reason to the visit was not taken into account.
121	How many hours a day, in average, is the dog left home alone?	The mean of the written hours. 3-4 hours are treated as 3,5 hour.
122	How many hours a day, in average, is the dog being activated (e.g. walking and exercise)?	The mean of the written hours. 3-4 hours are treated as 3,5 hour.

7.4 Appendix D – Standardised behaviour test

1. Affability and handling sub-test

First the dog is led through a group of people, who are told not to actively interact with the dog, for one minute. Then the test leader is examining the dog's teeth and paws. The dog gets scores for Affability and Handling.

2. Leash test

The test leader leads the dog in the leash and randomly and repetitively changes the directions. This continues for approximately one minute.

3. Tug-of-war sub-test

Directly after the leash sub-test the test leader pulls out a cotton rag and invites the dog into a tug-of-war play. The dog is encouraged to play with the test leader for two minutes.

4. Retrieving sub-test

The cotton rag is removed and the test leader now rolls a tennis ball three times to test the dog's willingness to retrieve an object. The dog gets scores for Chasing and Interest in object.

5. Dark room sub-test

The puppy raiser of the dog enters a room, in which the lights are turned off before the dog is called for, and then the puppy raiser calls for the dog.

6. Metal stair sub-test

The puppy raiser and the dog walk up and down a steep metal stair three times.

7. Unstable table sub-test

The dog is asked to jump up on a table, when in place the test leader wobbles the table back and forth, moving it about 2-3 centimetres. While the table is moving the dog is offered a tennis ball. The dog gets scores for Reaction on table, and Object.

8. Acoustic startle sub-test

While the dog is walking, in leash, with its puppy raiser a pair of metal buckets is dropped approximately 2 meters away from the dog. The puppy raiser lets go of the leash when the buckets are dropped, allowing the dog to flee. The dog is then encouraged to investigate the buckets. The dog gets scores for Flight distance, Secondary response, and Lasting effect.

9. Visual startle sub-test

Next sub-test involves a pair of life-sized overall which is pulled up into the air, forming an 'X', about two meters in front of the dog. When pulled up by the test leader the puppy raiser drops the leash, allowing the dog to flee. The puppy raiser

then regains the leash and walks through the overall until the dog no longer reacts on it. The dog gets scores for Flight distance, Aggression, Secondary response and Lasting response.

10. Gradual visual startle sub-test

A top half of a human, made in paper, is placed on a pair of wooden planks. The paper figure is pulled slowly towards the dog from a 15 meter distance. The figure is stopped when three meters from the dog and the leash is dropped, allowing the dog to examine the paper figure. When the dog has examined the figure, the puppy raiser regains the leash and walks back and forth close to the figure three times. The dog gets scores for Fearfulness, Aggression, Secondary response and Lasting response.

11. Search sub-test

The puppy raiser rolls a tennis ball to the test leader, who hides the ball under a wooden pallet. Right after the ball has been hidden the dog is released and allowed to search for the ball, independent of the puppy raiser or the test leader. The hiding and searching is repeated three times. If the dog does not find the ball or loses interest the test leader encourages or helps the dog to find it. The dog gets scores for Intensity and Persistence.

12. Gun fire sub-test

The gun fire sub-test contains two sub-tests, one passive and one active part. During the passive part the dog is held, leashed, by the puppy raiser while two 9 mm blank shots are fired about 25 meters away, and out of sight, from the dogs location. Next up, the test leader engages the dog into a tug-of-war and again two blank shots are fired, from the same location. The dog gets scores for Fearfulness and Curiosity.

7.5 Appendix E - Scoring for the behavioural test

Definitions of behaviour ratings given during the 12 sub-tests of the behaviour test. TL = test leader.

Sub-test	Rating	1	2	3	4	5
Affability and handling	Affability	Reject contact, withdraws.	Does not reject contact. No withdrawal.	Does not reject contact. No withdrawal. Makes contact within 15 s.	Makes spontaneous contact without jumping and vocalisation.	Intensive contact with vocalisation or jumping at person.
	Handling	Rejects, growls, tries to bite/escape.	Pulls away, seeks support from handler.	Accepts handling	Accepts handling, seeks contact with TL.	Overwhelming contact toward TL when handled.
Leash	Leash	Acts on its own. No contact with handler	Acts on its own. Attentive when handler demanding	Follows without handler demanding.	Dependent. Looking for confirmation from handler.	-
Tug-of-war	Tug-of-war	Does not take rag.	Takes rag. Let's go before handler pulls.	Takes rag. Let's go when handler pulls.	Pulls hard on rag but let's go when handler pulls back hard or make loud noises.	Pulls hard on rag. Does not let go despite hard resistance or disturbances.
Retrieving	Chasing	Does not run after ball.	Starts running but stops before reaching the ball.	Runs after and takes the ball.	Runs after and carries ball back to handler.	Runs after with high intensity and carries ball back to handler.
	Interest in object	Does not take ball.	Grabs ball but let's go immediately	Grabs ball, carries less than 5 s.	Grabs ball, carries.	Grabs ball intensely, carries.
Dark room	Reaction in dark room	Attempts to leave the room.	Freezes when light are out.	Walks into the room less than 3 m and stops.	Investigates but is affected. Goes to puppy raiser but with help.	Investigates without hesitation or finds puppy raiser directly.
Metal stair	Metal stair	Refuses to follow puppy raiser	Starts to follow but then refuses after some steps.	Manages to walk the whole stairway but with major hesitation.	Easily walks the stairway, but with slight hesitation.	Walks the stairway without hesitation.
Unstable table	Reaction on table	Tries to escape before table is moving.	Tries to escape when table is moving.	Visibly uncomfortable with a low tense body posture but does not try to escape.	Tense but not annoyed.	Unaffected. Dog is just standing still while table is moving.
	Object	Does not take ball.	Takes ball but let's go when table moves.	Holds ball despite moving table.	-	-

Acoustic startle	Flight distance	Escapes >5 m.	Escapes 2–5 m.	Escapes 1–2 m	Takes one or two steps backwards without escaping.	No fear response.
	Secondary response	Does not want to investigate buckets despite encouragement.	Investigates buckets but only with major encouragement.	Investigates buckets with some help from handler.	Investigates buckets without help but with hesitation	Investigates buckets without hesitation.
	Lasting effect	Very affected. Persistent avoidance.	Affected. Is passing but active avoidance.	A bit affected. Change in body posture when passing.	Unaffected but is looking at object.	No lasting effect.
Visual startle	Flight distance	Escapes >5 m.	Escapes 2–5 m.	Escapes 1–2 m	Takes one or two steps backwards without escaping.	No fear response.
	Aggression	No sign of aggression, i.e. piloerection, barking or growling.	Some sign of aggression. Barking or piloerection.	Clear signs of aggression, piloerection or growling.	Strong aggression, including mouth threat.	Attacks and bites the overall.
	Secondary response	Does not investigate overalls.	Investigates overalls with major encouragement.	Investigates overalls with some encouragement.	Investigates coveralls without help but with hesitation.	Investigates coveralls without hesitation.
	Lasting effect	Very affected. Persistent avoidance of coverall.	Affected. Passes but shows active avoidance of coverall.	Mildly affected. Change in body posture when passing.	Unaffected but is looking at object when passing.	No lasting effect.
Gradual visual startle	Fearfulness	Freezes or tries to escape.	No reaction.	Switches between fight/flight responses	Strong fight reaction toward figure, but without attack.	Attacks and bites figure.
	Aggression	No sign of aggression, i.e. piloerection, barking, growling	Some sign of aggression. Barking or piloerection.	Clear sign of aggression, piloerection.	Strong aggression, growls, mouth threat	Bites.
	Secondary response	Does not investigate figure.	Investigates figure with major encouragement.	Investigates figure with some encouragement.	Investigates figure without help but with hesitation.	Investigates figure without hesitation.
Search	Lasting effect	Very affected. Persistent avoidance of figure.	Affected. Passes but shows active avoidance of figure.	Mildly affected. Change in body posture when passing.	Unaffected but is looking at object when passing	No lasting effect.
	Intensity	Does not search.	Searches but stops.	Searches from different directions	Searches intensively, use mouth or paws.	Searches intensively, uses mouth and paws
	Persistence	Does not start search	Searches <10 s.	Searches <1 min.	Searches <2 min.	Searches >2 min.

Gunfire	Fearfulness	Very fearful, tries to escape in leash	Stops playing, not playful afterwards	Stops playing, cannot be encountered in play afterwards.	No reaction.	-
	Curiosity	No reaction.	Stops playing, looks in direction of gunfire.	Stops playing, pulling on leash in direction of gunfire	Stops playing, want to investigate, whines, whimpers	Very excited, pulling on leash in direction of gunfire cannot be calmed

7.6 Appendix F – Correlation between categories and sub-tests

		Stranger Directed Aggression	Owner Directed Aggression	Dog Directed Aggression	Stranger Directed Fear	Non- Social Fear	Dog Directed Fear	Separation Related Fear	Attachment Attention Seeking	Trainability	Chase	Excitability	Touch Sensitivity	Energy Level	Dog Rivalry
1. Affability	R	-0.39*	0.04	-0.22	-0.31*	-0.16	-0.18	-0.04	-0.12	0.08	-0.09	-0.18	-0.19	-0.01	-0.37
	Sig	<0.01	0.75	0.15	0.02	0.24	0.24	0.76	0.35	0.53	0.53	0.16	0.16	0.95	0.13
	N	59	59	45	58	59	43	57	59	59	52	59	56	59	18
2a. Handling	R	-0.11	0.19	0.30*	-0.20	0.03	-0.03	0.00	-0.04	0.04	0.21	0.05	0.00	-0.17	0.33
	Sig	0.43	0.15	0.05	0.13	0.85	0.87	0.98	0.76	0.77	0.14	0.70	1.00	0.22	0.20
	N	57	57	43	56	57	41	55	57	57	50	57	54	57	17
2b. Co-operation	R	-0.11	0.03	0.21	-0.12	0.03	-0.06	0.09	-0.07	0.13	0.11	-0.10	-0.09	-0.14	-0.09
	Sig	0.41	0.80	0.18	0.40	0.82	0.71	0.52	0.61	0.34	0.44	0.46	0.51	0.31	0.75
	N	57	57	43	56	57	41	55	57	57	50	57	54	57	17
3. Tug-of-war	R	0.13	0.12	0.14	-0.07	-0.12	-0.15	-0.10	-0.06	0.19	0.15	-0.06	-0.15	0.07	-0.16
	Sig	0.33	0.38	0.36	0.59	0.37	0.34	0.46	0.64	0.17	0.31	0.66	0.28	0.60	0.53
	N	57	57	43	56	57	41	55	57	57	50	57	54	57	17
4a. Retrieving	R	-0.01	0.24	-0.08	-0.19	-0.24	-0.33*	-0.20	-0.05	0.36*	-0.13	0.00	-0.09	0.15	0.05
	Sig	0.94	0.07	0.62	0.16	0.07	0.04	0.14	0.71	0.01	0.36	0.99	0.51	0.26	0.84
	N	57	57	43	56	57	41	55	57	57	50	57	54	57	17
4b. Interest in object	R	-0.08	0.11	-0.29	-0.22	-0.35*	-0.49*	-0.14	-0.02	0.43*	-0.31*	0.03	-0.25	0.17	-0.11
	Sig	0.54	0.41	0.06	0.11	0.01	<0.01	0.31	0.89	<0.01	0.03	0.80	0.07	0.20	0.69
	N	57	57	43	56	57	41	55	57	57	50	57	54	57	17
5. Dark room	R	-0.14	0.11	-0.21	-0.30*	-0.24	-0.05	-0.10	-0.10	0.26*	-0.04	-0.30*	0.03	0.07	-0.11
	Sig	0.31	0.43	0.19	0.03	0.07	0.74	0.47	0.44	0.05	0.81	0.02	0.83	0.61	0.68
	N	57	57	43	56	57	41	55	57	57	50	57	54	57	17

		Stranger Directed Aggression	Owner Directed Aggression	Dog Directed Aggression	Stranger Directed Fear	Non- Social Fear	Dog Directed Fear	Separation Related Fear	Attachment Attention Seeking	Trainability	Chase	Excitability	Touch Sensitivity	Energy Level	Dog Rivalry
6. Metal Stair	R	-0.05	-0.01	-0.04	-0.27*	-0.18	-0.36*	-0.04	-0.14	0.01	0.01	-0.04	0.06	0.00	-0.09
	Sig	0.72	0.91	0.80	0.04	0.19	0.02	0.79	0.29	0.92	0.96	0.75	0.65	1.00	0.74
	N	56	56	42	55	56	40	54	56	56	49	56	53	56	17
7a. Unstable table	R	-0.17	-0.13	-0.13	-0.25	-0.19	-0.15	-0.10	-0.05	0.37*	-0.09	-0.15	-0.23	-0.07	-0.07
	Sig	0.22	0.32	0.42	0.07	0.17	0.37	0.46	0.70	<0.01	0.52	0.27	0.10	0.59	0.78
	N	56	56	42	55	56	40	54	56	56	49	56	53	56	17
7b. Interest in object	R	-0.16	-0.11	-0.06	-0.05	-0.26	0.03	-0.10	-0.07	0.43*	-0.05	-0.05	-0.30*	-0.17	-0.07
	Sig	0.25	0.43	0.68	0.71	0.06	0.86	0.45	0.63	<0.01	0.74	0.70	0.03	0.21	0.80
	N	56	56	42	55	56	40	54	56	56	49	56	53	56	17
8a. Acoustic startle	R	-0.03	-0.23	-0.05	-0.25	-0.39*	-0.31*	-0.05	-0.10	0.16	-0.24	0.08	-0.25	0.06	-0.37
	Sig	0.83	0.09	0.74	0.07	<0.01	0.05	0.71	0.45	0.23	0.10	0.58	0.07	0.68	0.14
	N	56	56	42	55	56	40	54	56	56	49	56	53	56	17
8b. Secondary reaction	R	0.09	-0.27*	-0.10	-0.13	-0.32*	-0.15	0.02	0.12	0.15	-0.20	0.12	-0.34*	-0.02	-0.11
	Sig	0.53	0.04	0.52	0.35	0.02	0.37	0.86	0.37	0.26	0.16	0.37	0.01	0.88	0.68
	N	56	56	42	55	56	40	54	56	56	49	56	53	56	17
8c. Lasting effect	R	0.06	-0.19	-0.01	-0.16	-0.32*	-0.35*	0.04	-0.08	0.04	-0.09	0.03	-0.19	-0.01	-0.57*
	Sig	0.65	0.17	0.95	0.25	0.02	0.03	0.77	0.58	0.80	0.55	0.85	0.18	0.97	0.02
	N	55	55	41	54	55	39	53	55	55	48	55	52	55	16
9a. Visual startle	R	0.16	-0.14	0.18	-0.04	-0.29*	-0.04	0.09	0.06	0.13	0.06	-0.22	-0.30*	0.08	-0.79*
	Sig	0.24	0.31	0.25	0.77	0.03	0.83	0.54	0.68	0.34	0.68	0.11	0.03	0.58	<0.01
	N	55	55	41	54	55	39	53	55	55	48	55	52	55	16
9b. Aggression	R	0.19	-0.06	0.05	-0.15	-0.04	-0.24	-0.16	0.07	0.08	-0.11	0.12	-0.13	0.19	-0.23
	Sig	0.17	0.68	0.77	0.30	0.76	0.14	0.27	0.60	0.58	0.46	0.38	0.37	0.17	0.40
	N	55	55	41	54	55	39	53	55	55	48	55	52	55	16

		Stranger Directed Aggression	Owner Directed Aggression	Dog Directed Aggression	Stranger Directed Fear	Non- Social Fear	Dog Directed Fear	Separation Related Fear	Attachment Attention Seeking	Trainability	Chase	Excitability	Touch Sensitivity	Energy Level	Dog Rivalry
9c. Secondary reaction	R	0.02	-0.10	-0.01	-0.11	-0.35*	-0.14	0.06	0.06	0.25	0.13	-0.17	-0.22	0.03	-0.49
	Sig	0.89	0.45	0.96	0.44	0.01	0.41	0.69	0.68	0.07	0.38	0.23	0.11	0.82	0.05
	N	55	55	41	54	55	39	53	55	55	48	55	52	55	16
9d. Lasting effect	R	0.08	-0.22	0.09	-0.13	-0.39*	0.02	0.01	0.08	0.03	0.17	-0.17	-0.29*	0.09	-0.76*
	Sig	0.59	0.11	0.56	0.34	<0.01	0.92	0.94	0.56	0.84	0.26	0.22	0.04	0.52	<0.01
	N	55	55	41	54	55	39	53	55	55	48	55	52	55	16
10a. Gradual visual startle	R	0.39*	0.07	0.05	0.01	-0.22	-0.24	-0.02	0.16	-0.09	0.08	-0.17	0.12	0.35*	-0.13
	Sig	<0.01	0.63	0.76	0.94	0.10	0.15	0.89	0.26	0.52	0.60	0.21	0.39	0.01	0.65
	N	54	54	40	53	54	38	52	54	54	47	54	51	54	15
10b. Aggression	R	0.16	0.07	0.02	-0.12	-0.18	-0.44*	-0.11	0.14	0.10	-0.09	-0.04	0.12	0.36*	0.02
	Sig	0.23	0.60	0.89	0.40	0.19	0.01	0.43	0.32	0.48	0.53	0.78	0.42	0.01	0.95
	N	54	54	40	53	54	38	52	54	54	47	54	51	54	15
10c. Secondary resopnse	R	0.12	-0.07	-0.08	-0.12	-0.41*	-0.13	0.00	0.05	0.01	0.05	-0.09	0.00	0.19	-0.38
	Sig	0.38	0.61	0.62	0.40	<0.01	0.43	0.98	0.73	0.92	0.75	0.50	1.00	0.17	0.16
	N	54	54	40	53	54	38	52	54	54	47	54	51	54	15
10d. Lasting effect	R	0.09	-0.02	0.02	-0.24	-0.38*	-0.19	-0.07	0.02	0.09	-0.06	-0.04	-0.07	0.16	-0.67*
	Sig	0.54	0.87	0.89	0.08	<0.01	0.26	0.62	0.87	0.53	0.71	0.79	0.61	0.25	0.01
	N	54	54	40	53	54	38	52	54	54	47	54	51	54	15
11a. Search	R	-0.17	0.01	-0.21	-0.13	-0.43*	-0.25	-0.16	-0.08	0.39*	-0.12	-0.17	-0.20	-0.03	-0.31
	Sig	0.21	0.94	0.20	0.36	<0.01	0.12	0.26	0.56	<0.01	0.42	0.22	0.17	0.83	0.27
	N	54	54	40	53	54	38	52	54	54	47	54	51	54	15
11b. Intensity	R	-0.12	0.11	-0.10	-0.13	-0.37*	-0.22	-0.09	-0.08	0.28*	-0.06	-0.15	-0.06	-0.08	-0.29
	Sig	0.38	0.42	0.52	0.35	0.01	0.19	0.50	0.54	0.04	0.70	0.28	0.67	0.58	0.30
	N	54	54	40	53	54	38	52	54	54	47	54	51	54	15

		Stranger Directed Aggression	Owner Directed Aggression	Dog Directed Aggression	Stranger Directed Fear	Non- Social Fear	Dog Directed Fear	Separation Related Fear	Attachment Attention Seeking	Trainability	Chase	Excitability	Touch Sensitivity	Energy Level	Dog Rivalry
12a. Gun fire fear	R	-0.14	0.12	-0.07	-0.35*	-0.50*	-0.13	-0.30*	-0.31*	0.35*	-0.02	-0.21	-0.18	0.19	-
	Sig	0.31	0.40	0.68	0.01	<0.01	0.44	0.03	0.03	0.01	0.89	0.13	0.22	0.17	-
	N	52	52	38	51	52	37	50	52	52	45	52	49	52	15
12b. Gun fire curiosity	R	0.27	0.01	0.09	0.07	0.00	0.06	0.01	0.11	0.03	0.07	-0.03	0.05	-0.06	-0.03
	Sig	0.05	0.93	0.58	0.61	0.98	0.70	0.97	0.42	0.81	0.64	0.82	0.75	0.68	0.91
	N	52	52	38	51	52	37	50	52	52	45	52	49	52	15

