Differences in gender, age, intactness, breed and behavioural characteristics between stray and relinquished dogs in Dutch animal shelters.

E.H.A. Sterk[1,2], Ir. I.R. van Herwijnen[1], Dr. M.J.H.M. Duchateau[2], Dr. J. de Vries[2]

[1] *Royal Dutch Association for the Protection of Dogs*

[2] *The Behavioural Biology Department, Biology Faculty, Utrecht University, Utrecht, the Netherlands*

Universiteit Utrecht

Inhoud

Abstract

In The Netherlands around 25.000 dogs are annually taken in by animal shelters(Dierenbescherming, 2013). Being in a shelter has many negative effects on animal welfare and produces costs for society, so it is important that this number is reduced. The largest proportion of dogs in animal shelters are stray dogs, so to improve the effectiveness of prevention campaigns the target group needs to be narrowed. This study focuses on identifying differences between stray and relinquished dogs in Dutch animal shelters, to lay the foundation for a previous owner risk profile. It was found that stray dogs were more often sturdy breeds and intact dogs, and also the proportion of females tended to be higher in stray dogs. These findings suggest that previous owners of stray dogs are overall more impulsive buyers and irresponsible owners, and have a poorer relationship with their dog than owners of relinquished dogs. Psychologists might be able to help with more specifically reaching the target group. The government could also play a role by regulating websites that offer dogs for low prices.

1. Introduction

Many dogs enter animal shelters worldwide. Surveys carried out by the National Council on Pet Population Study & Policy (NCPPSP), report that around 2 million dogs are yearly taken in by animal shelters in the United States alone(NCPPSP, 2009). In The Netherlands this number lies around 25.000 (Dierenbescherming, 2013).

Being in an animal shelter is considered to affect canine welfare in a negative way(Hennesy, *et al.* 1997). When a dog is taken in by a shelter, a number of stressors are likely to be encountered, such as social separation and exposure to novel surroundings(Hennesy, *et al.* 1997). Also, the dog will need to deal with high noise levels, alterations in its familiar habits, unfamiliar dogs and a feeling of loss of control and unpredictability(Hennesy, *et al.* 1997). The latter, a feeling of control and predictability has proven to play an important role in animal welfare(Cooper & Albentosa, 2005).

Aforementioned stressors first provoke a short term stress response, but when persistent, the long term stress response will be activated. During acute stress(short term stress), the SAM-as (Sympathetic Adrenal Medullary Axis) is activated (Glaser & Kiecolt-Glaser, 2005).This happens through activation of the sympathic nervous system, which leads to the adrenal glands producing norepinephrine en epinephrine (Glaser & Kiecolt-Glaser, 2005). This puts the individual in a state to react quickly, which is usually referred to as the fight-or-flight response (Jansen *et al.,* 1995). Usually this is reflected in the behaviour of an individual. It will try to react to the stressor such as to make it disappear, by either fleeing from it or “fighting” it (Jansen *et al.,* 1995). If however the stressor is persistent, the HPA axis is activated (Glaser & Kiecolt-Glaser, 2005).

This is the hypothalamic-pituitary-adrenal axis(Herman & Cullinan, 1997). Corticotropin releasing factor (CRH) is released, which stimulates the production of ACTH (adrenocorticotropic hormone) by the pituitary. This in turn stimulates production of corticosterioids (Glaser & Kiecolt-Glaser, 2005). Metabolic processes such as growth, reproduction and development consequently are being repressed (Glaser & Kiecolt-Glaser, 2005). If the HPA-axis is activated for a long period of time, for example by being in a shelter for several weeks, the individual enters a state of chronic stress (Glaser & Kiecolt-Glaser, 2005). Chronic stress has multiple negative effects, such as suppression of the immune system, making the individual more vulnerable for diseases, and weight loss (Glaser & Kiecolt-Glaser, 2005). Behavioural effects are also seen. Animals can become unresponsive, and they may develop abnormal behaviour, such as injurious behaviour or stereotypies. The first is behaviour in which the animal damages either itself or its conspecifics (Wiepkema & Koolhaas, 1993), and the latter is a behaviour pattern that is repetitive and invariant, and does not serve an obvious goal or function (Luescher, 2003). Abnormal behaviour is rewarding behaviour in which the motivational system is involved. Performing stereotypic behaviour leads to the release of opiods, giving the

animal a rewarding sensation, which reinforces the animal to repeat the pattern again and again, and making it self-rewarding (Luescher, 2000) (Wiepkema & Koolhaas, 1993).

Studies found that initial elevated stress levels in dogs admitted to shelters subside after a number of days. However, some stressors remain persistent. Also, other experiences the dog needs to deal with while being in a shelter might affect welfare negatively(Hennesy *et al.* 2001 ; Hennesy *et al.* 1997). For instance, separation in the shelter and exposure to novelties might sensitize the dog for these kind of experiences (Hennesy *et al.* 1997). When such a dog is adopted by a new owner, it could enhance the attachment of the dog to this owner, leading to separation anxiety (Hennesy *et al.* 1997), or the dog might be very fearful (Wells & Hepper, 2000). So, being in a shelter is not only stressful for a dog, at least in the short term, but might also contribute to the development of behavior problems after adoption, making it more difficult to reinstate the dog (Hennesy *et al.* 2001 ; Hennesy *et al.* 1997 ; Tuber *et al.* 1999).

Many animal welfare organizations worldwide try to decrease the number of dogs in shelters. This is done by promoting the purchase of a shelter dog instead of purchasing one elsewhere, and through educational campaigns. The latter are campaigns that are focused on preventing impulsive or irresponsible buying of dogs, thus preventing dogs to end up in a shelter. In these campaigns, communication channels such as informative websites, TV commercials and social media such as Facebook are used. For these campaigns to be (more) successful, it is important to understand why there are so many dogs in animal shelters.

Dogs in animal shelters have different backgrounds. For instance, they can be relinquished by their owner, they can be stray dogs which were either born on the street or dumped by their owner, or dogs that have been seized by animal control. It is seen that most dogs in animal shelters belong to the category stray dogs, as was found in multiple studies done in America (Marston *et al.*, 2004 ; NSPPCP, 2009). This trend is also seen in The Netherlands. In 2008 and 2009, 61% of dogs taken in by shelters were stray dogs, opposed to around 25% relinquished dogs (Leenstra *et al.* 2011).

There have been studies on the most important reasons for relinquishment of dogs to animal shelters. The most important reason for owners to relinquish their dog is a behavioural problem (Salman *et al.* 1998 ; Ortega-pachego *et al.*, 2007). This is followed by medical reasons, housing issues and lifestyle changes (Salman *et al.* 1998). Seized dogs are often brought in at shelters with only a short description of the situation they were found in, but no further background. For stray dogs, of course, no background information is available. So, this skewed distribution poses a problem, with regards to the understanding of the underlying reasons for dogs to be in a shelter, since the largest proportion of dogs occupying animal shelters are stray dogs. To reduce the number of dogs in shelters, through campaigns focused on the right target group, it is therefore important to study these stray dogs and possibly identify risk factors. Namely, by identifying these risk factors, a previous owner profile can be carefully composed.

Even though the background of these dogs is often missing, there are nevertheless factors that can be studied in stray dogs in shelters that might provide insight in possible common features of stray dogs which are different from relinquished dogs. For example, breed, gender, age, intactness, and behavioural characteristics, such as aggression problems.

In this study these different factors will be studied in stray and relinquished dogs in Dutch animal shelters. In the sections underneath, these different factors and how they might differ between stray and relinquished dogs are argued.

1.1 Gender

The most common behaviour problem in dogs is aggression (Knol, 1987). Many studies have reviewed male dogs to be more aggressive than females (Wells, 2012 ; Borchelt, 1983).

Overall, male dogs tend to be more prone to developing behaviour problems than female dogs (Jagoe, 1994). In a one year study where data of three Australian shelters was collected, it was found that 60% of the dogs were male (Marston, 2004). There are no numbers available on the distribution of male and female dogs in Dutch animal shelters, but based on aforementioned literature it is expected that there will be more males than females, and that there is a higher proportion of males in stray dogs compared to the relinquished dogs.

1.2 Age

When viewing the age distribution of dogs in animal shelters, it is seen that most dogs belong to the adult age category. In a one year analysis of three Australian shelters, it was found that of the more than 20.000 dogs, around 90 % were adult dogs (Marston *et al.,*2004). Adult dogs were defined as dogs being older than 6 months(Marston *et al.,*2004). A survey done in Mexico found that behavioural changes of dogs becoming adults was one of the most important reasons for people to abandon their dogs(Ortega-Pachego *et al.,*2007).

The National Council on Pet Population Study and Policy (NCPPSP)conducted a study in 12 shelters in the United States, and found that the majority of relinquished dogs was between 5 months and three years of age (Salman *et al.* 1998). This is in line with the study of Ortega-Pachego *et al.* (2007) who mentioned behavioural changes as a result of maturing, as an important reason for relinquishment.

Salman *et al.* (1998) found that 18,9 % of the dogs in their study was 3-8 years, and 18,2 % was older than 8 years. It is therefore expected, that also in The Netherlands, most dogs will be adults, with a peak around 5 months up to three years, the period in a dog's life when he/she matures and starts showing adult behaviour. The studies done have their focus mainly on relinquished dogs, and do not mention age distribution of stray dogs. Based on the literature mentioned above, and with regard to susceptibility for developing behaviour problems after puppyhood, it seems probable that also in stray dogs this same peak will be seen around the age period of 5 months up to three years.

It is however expected that even though both groups will likely show a peak around a certain age, the age distribution of relinquished dogs will be more varied than for stray dogs. This is expected because other than behavior problems, dogs are also relinquished due life events of owners, such as divorce or other household problems which can occur at any age(Salman *et al.* 1998).

In a study done for the Royal Dutch Association for the Protection of Dogs (Hondenbescherming) by Hermsen(2012) it was found that for relinquished dogs in half of the cases life events of the owner are the reason for relinquishment to a shelter. It is expected that for stray dogs the commitment of the owner to the (welfare of the) dog is lower. Thus, an elderly dog that may have medical issues or that may start to suffer from incontinence requires more care and consequently might be seen as a nuisance. As a result it is expected that for stray dogs there will be two peaks, one for juvenile dogs, just after their puppy time, and one for senior dogs.

1.3 Intactness

The majority of dogs brought in at shelters are intact dogs, which means they have not been castrated or sterilized(Marston 2004). A study on risks for relinquishment of dogs found that intact dogs are at higher risk of being relinquished (Salman *et al.* ,1998). This is probably due to the fact that the intactness of dogs can influence their behaviour.

Veterinarians or behaviourists, when presented with dogs with aggression problems, often advice castration to decrease the aggression (Line & Voith, 1986) (Blackshaw, 1991). And indeed, a

study of Bamberger and Houpt (2006) found that intact males are more associated with aggression problems than their not intact counterparts. It is therefore expected that there will be more intact dogs in animal shelters, and that this number will be higher under the stray dogs than the relinquished dogs.

1.4 Breed

Some dog breeds are thought of to be more difficult to handle, due to the traits they were selected for in the past. For instance, some dog breeds are known to have issues in the field of dominance problems more often than other breeds, such as the Akita and the Rottweiler(American Kennel Club 2013) (Division of animal control 2013). These dog breeds are advised to be kept/purchased by more experienced dog owners, since these breeds require a more consistent training(American Kennel Club 2013).

One of the most important reasons for handing a dog over to an animal shelter is a behavioural problem (Salman *et al.* 1998). Salman *et al.* (2000) enlisted the top ten most important behavioural problems in dogs leading to relinquishment. They found that aggression was the most important one (Salman *et al.* 2000). This is a problem which is more common in certain dog breeds, such as fighting dogs and protection dogs, due to the traits they were originally selected for in the past(American Kennel Club 2013)(Division of animal control 2013). Breeds belonging to these breed groups will further on be referred to as sturdy dogs. Because these sturdy dogs are regarded as more difficult to handle, and since these breeds are more often associated with aggression problems than other breeds (Blackshaw, 1991), it is expected that dogs of these breeds will be more abundant in animal shelters, and also more abundant in stray dogs.

1.5 Behavioural characteristics

As mentioned in the sections above, many dogs are relinquished due to behaviour problems, and it is also probable that many of the stray dogs have been abandoned due to this.
The most common behaviour problem in dogs is aggression (Knol, 1987). This might express itself in different types of aggression, such as aggression towards strangers or unfamiliar dogs, towards the owner, territorial aggression or fear aggression(Salman *et al.* 2000).

Separation anxiety and soiling the house are also in the top ten of reasons for relinquishment, as well as unruly/uncontrollable behaviour (Salman *et al.*, 2000). In a study done on behavioural problems in dogs purchased from an animal shelter it was found that stray dogs more often suffered from certain behavioural problems compared to relinquished dogs, such as aggression, excessive barking, inappropriate elimination and excessive activity (Wells & Hepper ,2000). It is thus to be expected that these problems will also be more prevalent in stray dogs in Dutch animal shelters compared to relinquished dogs. Some of these problems are expected to be more important with regards to repositionability, such as aggression and uncontrollable behaviour, so the focus of this study will be on these problems.

In summary, multiple factors which can be measured in stray dogs and relinquished dogs will be determined, and these might provide insight in why the percentage of stray dogs in Dutch shelters is much higher than the percentage of relinquished dogs, and if certain risk factors for dogs to be dumped can be identified. This study is a pilot study to find if these factors do indeed differ between stray dogs and relinquished dogs, to lay a foundation for further research on stray dogs. The main research question of this study is: "*Are there differences in gender, breed, age, intactness, and behavioural characteristics between stray dogs and relinquished dogs in Dutch animal shelters"?*

2. Methods

This study was performed at three shelters in The Netherlands:

-Dierenopvangcentrum Amsterdam
-Dierentehuis ‘s Hertogenbosch
-Dieren Opvang Centrum Tilburg (DOC-T)

The first two shelters are accredited by the Dutch Association for the Protection of Animals (Dierenbescherming), the third shelter is part of a learn and work project that offers opportunities to people who find themselves challenged to find a job. All three are among the bigger shelters in the country and have participated in studies on shelter situations before.

This study was divided in two parts with regards to the data that had to be collected. There was a general characteristics part and a behavioural part. For breed, gender, age and intactness data of the DIPO system of each shelter was used. This is a system where information of all the dogs that have been brought in, is stored in. For the behavioural data part, behaviour tests were performed at each shelter. So in total, two different groups of dogs were used in the entire data set.

2.1 General characteristics part

2.1.1 Subjects

Data of 3198 subjects was collected. In each shelter, data was collected during five weeks.
For analysis 2413 subjects were used, see section 2.1.3. An overview of these subjects can be found in table 1.

Table 1. Overview of subjects used for analysis

	Amsterdam	Den Bosch	Tilburg
Relinquished	400	460	246
Male	237	295	151
Intact	118	188	115
Not-intact	119	107	36
Female	163	163	93
Intact	128	121	80
Not-intact	35	42	13
Unknown		2	2
Stray	353	378	369
Male	213	214	221
Intact	130	170	200
Not-intact	83	44	21
Female	140	164	148
Intact	128	158	145
Not-intact	12	6	3
Crisis	140	36	31
Male	81	22	12
Intact	48	20	12
Not-intact	34	2	0
Female	58	14	19
Intact	52	14	19
Not-intact	6	0	0
Total	893	874	646

2.1.2 Housing

All subjects were housed in kennels. Sizes of the kennels varied from 1.20 x 1.98 x 2, 1.80 x 1,98 x 2 and 2 x 2 x 2, varying on the size of the dog. Kennels were cleaned daily following the shelter's cleaning schedule.

Stray dogs had to be in the quarantine for 14 days. During this period they were checked by a vet and medically treated if necessary. The vet also assessed the age for stray and seized dogs. All dogs received vaccination (if they had not yet been vaccinated), were de-flead and de-wormed. For relinquished dogs the period in the quarantine could vary dependent on their physical condition, and if they had been vaccinated properly. This period could vary from 1 day up to two weeks. Dogs had inside and outside kennels. All dogs had water ad libitum. Handling, feeding, walking with the dogs and the relinquishment policy differed per shelter.

Amsterdam: Dogs had one caretaker, and were fed twice a day, in the morning and afternoon. They also received fresh treats such as tripe. They were allowed on outside playfields for around 1,5 hour per day. If they were social they could be there with other dogs as playmates. It was dependent on the number of volunteers if the dog was being walked and for how long. Dogs were adopted if the shelter considered them to be repositionable (behaviourally and medically), and if

they were from the same municipality. All Stafford breeds, and Stafford crossbreeds were not eligible to be relinquished during this study. This policy is because the changes of adoption for these dogs were very low, because there were already many dogs of this type in the shelter.

's Hertogenbosch: Dogs had multiple caretakers. They were fed once a day, at 12:00, with an exception for dogs that were too lean and puppies, who were fed twice a day. Dogs were being walked by different persons at least three times a day, and went on the outside playfield at least once a day for around 0,5 hour per day. Dogs were adopted if they were considered to be repositionable (behaviourally and medically), and if they were from the same municipality. During this research Belgian Shepherds or American Staffordshire Terriers were not eligible to be relinquished. (For the same reason as mentioned above in Amsterdam.)

Tilburg: Dogs had multiple caretakers. They were fed twice a day, in the morning and afternoon. They were walked at least three times a day by different persons, and were allowed on the playfield for a maximum of one hour daily. Dogs were adopted if considered to be repositionable (behaviourally and medically) within a reasonable amount of time. All breeds were accepted for adoption.

In each shelter the owner had to pay a certain amount of money upon relinquishing his/her dog, to cover for the veterinary consult. This amount varied between the shelters from 60 euro to 150 euro. Stray dogs were always taken in.

2.1.3 Data collection and analysis

Data was collected with the use of Dipo Asiel by Anemaat Engineering. Data entry was done in Excel 2010 by Microsoft Office. Analysis were performed with IBM SPSS statistics 21.0

Stray dogs consisted of the group stray and crisis dogs, see 2.2.4.

For sturdy breeds, a number of different breeds, and crossbreeds of these breeds were added together, see table 2. Breeds that were regarded as sturdy breeds in this study, were breeds that were originally selected for fighting and protection. This list has been composed based on information of the Dutch Kennel Club (Raad van Beheer op Kynologisch gebied), the American Kennel Club, and the knowledge of an expert in dog breeds employed by the Royal Dutch Association for the Protection of Dogs.

Table 2. List of breeds regarded as sturdy in this study

Anatolian Shepherd	**Dobermann**
Akita	**Dogo Canario**
American Bulldog	**English Bulldog**
American Staffordshire Terrier	**Mastiff**
Bull Terrier	**Mastino Napoletano**
Dogo Argentino	**Rottweiler**
Dogue de Bordeaux	**Shar-Pei**
Boxer	**Staffordshire Bull Terrier**
Bull Mastiff	**Tosa**
Cane Corso	

For the analysis, only dogs of breeds that had an occurrence of at least 1% of the total sample size were analyzed, this were 21 breeds, and a total of 2413 dogs. An explanation of which dogs were included in these breeds can be found in section 2.1.3.1 A list of the breeds that had an occurrence of 1% or more can be found in table 3.

Analysis was done with crosstabs chi-square tests, and the analysis for age was done with a Kolmogorov-Smirnov test. Significance level was set at $p \leq 0,05$. Since most tests were done with a Crosstabs Chi-Square test, this meant that if there was a significant difference in one group, there was also a significant difference in the other group, vice versa for not-significant differences. Hence,

only differences for one group are shown in each graph for readability throughout the results section.

2.1.3.1 Breeds

Since there are very few pure breeds in the shelter, all dogs that were regarded as a particular breed by appearance, and crossbreeds with a similar physical appearance to that breed were grouped together. For example, all dogs listed as American Staffordshire Terriers, and all dogs listed as American Staffordshire Terrier crossbreeds were grouped together under the group American Staffordshire Terriers & alike dogs. There were two exceptions to this, the group Sighthounds and the different groups of Shepherds. For Sighthounds, the Royal Dutch Association for the Protection of Dogs states that these are less frequent in Dutch pounds. Hence it is doubted that personnel will be accurate in identifying breeds. To avoid errors, they were grouped together in one category. Also, this group consisted only of Greyhounds and Whippets, with exception of one Saluki, which are breeds that also have a very similar character and selection background.

As for the Shepherds; there are many different Shepherd type dogs acknowledged by the Fédération Cynologique Internationale (FCI), which are very distinctive in appearance and character. Sometimes dogs were only listed as a crossbreed with a Shepherd-like appearance, and not with *which* Shepherd type dog. This is why Shepherds were divided in multiple categories, being: Belgian Shepherds, German Shepherds and Shepherd crossbreeds. The Belgian and German Shepherd groups consisted of dogs listed as either Belgian or German Shepherd, and crossbreeds listed as crosses with a similar appearance to one of these breeds. The shepherd crossbreed group consisted of dogs listed as a crossbreed with a Shepherd-like appearance.

Table3. List of breeds used for analysis

Breed	Nr. of dogs	Breed	Nr. of dogs
American Bulldog & alike dogs	109	Jack Russell Terrier & alike dogs	360
American Staffordshire Terrier & alike dogs	255	Labrador Retriever & alike dogs	124
Beagle & alike dogs	52	Maltese& alike dogs	116
Belgian Shepherd & alike dogs	139	Rottweiler & alike dogs	86
Boerenfox& alike dogs	91	Sharpei& alike dogs	32
Boomer & alike dogs	42	Shepherd Cross	91
Boxer & alike dogs	33	Shih Tzu & alike dogs	71
Chihuahua & alike dogs	48	Sighthounds& alike dogs	66
Crossbreed unknown	496	Staffordshire Bull Terrier & alike dogs	38
German Shepherd & alike dogs	67	Yorkshire Terrier & alike dogs	58
Golden Retriever & alike dogs	39		

2.2 Behavioural part

2.2.1 Subjects

101 dogs were observed in three different shelters. A short overview of the subjects can be found in table 4.Dogs could be either relinquished by their owners, confiscated by animal service, or taken in as stray dogs. For an expanded view of the subjects and their background see appendix 1.

Table 4. Overview of subjects

	Amsterdam	Den Bosch	Tilburg
Relinquished	10	8	17
Male	7	3	10
Intact	3	1	5
Not/intact	4	2	5
Female	3	5	7
Intact	3	3	5
Not-intact	0	2	2
Stray	16	10	23
Male	13	6	13
Intact	11	5	10
Not-intact	2	1	3
Female	3	4	10
Intact	3	4	9
Not-intact	0	0	1
Crisis	12	5	0
Male	4	4	0
Intact	4	3	0
Not-intact	0	1	0
Female	8	1	0
Intact	8	0	0
Not-intact	0	1	0
Total	38	23	40

2.2.2 Housing

See section 2.1.2 above.

2.2.3 Behavioural observations

A behavioural test was designed to test for three different behavioural problems; aggression towards strangers, aggression towards unfamiliar dogs and unruly behaviour. The test protocol is shown in table 5.

The test was executed by an employee of the shelter. In each shelter, this was done by the same employee. In Amsterdam this employee was not a familiar person to the dog. In ‘s Hertogenbosch and Tilburg the employee was familiar to the dog. The test was videotaped, and behavior was scored afterwards by watching the recorded material. Behaviour was scored with the use of an ethogram. The ethogram was composed based on the article of van den Berg *et* al. (2003) and the book of Landsberg *et al.* (2003), and can be found in appendix 2. The ethogram consisted of 2 behavioural categories: aggressive and unruly behavior.

The frequency and if a behaviour occurred was scored. Based on these scores it was assessed if there was a behavioural problem present.

Aggression towards strangers and unfamiliar dogs was considered to be present if during the test the dog scored positively on:

-Direct staring and stiff posture at/in presence of the test subject(s), or:
-Direct staring and barking at test subject(s), or:
-Stiff posture and barking at test subject(s), or:
-One or more of the following elements: growl-barking, growling, pulling up lip, baring teeth, snapping, attacking, or biting directed at the test subject(s).

The test was divided in different parts to score for these behavioural problems (thus for aggression towards strangers and unfamiliar dogs) separately.

Unruly behaviour was considered to be present if during the entire test the dog scored positively on two or more of the following elements:

-jumping up
-pulling the lead
-excessive vocalization
-poor command responding
-mounting
-concentration not present

Behavioural tests were done from the 14th of January until the 3th of May.
Dogs had to be in the shelter for at least a week before they could be tested.
Because of practical limitations in the shelter it was not possible to execute the behavioural tests on a fixed moment of the day. The locations where the test took place were fixed per shelter however.

Table 5. Test protocol

Step	Action	Distance/Time/nr. Of times
1	Dog is put on the leash by employee	
2	Dog is taken out of the kennel	
3	Dog is being walked by employee outside. During the walk a stranger is encountered	150 meters
4	Dog is being walked along kennels with unfamiliar dogs	
5	Dog is taken to test room	
6	Dog is being played with by employee (with a ball and rope)	2 min
7	Dog is being given the command sit	3 times

2.2.4 Data collection and analysis

Data was collected with the use of behavioural observations. Data entry was done in Excel 2010 by Microsoft office. Analysis were performed with IBM SPSS statistics 21.0

Dogs that had been confiscated by the police were regarded as stray dogs. This was done because in line with stray dogs, the background of these confiscated dogs remained largely unknown to the shelter. Also, these dogs were usually confiscated for denial of care, which suggests a bad relationship between the dog and its owner, which is assumed in this study to also often be the case with stray dogs.

Data were analyzed with a crosstabs chi-square test, and a one sample chi-square test. Significance level was set at $p \leq 0,05$. Because tests were done with a Crosstabs Chi-Square test, this meant that if there was a significant difference in one group, there was also a significant difference in the other group, vice versa for not-significant differences. Hence, only differences for one group are shown in each graph for readability for readability throughout the results section.

3. Results

3.1 General characteristics

3.1.1 Difference in gender between stray and relinquished dogs

It was analysed if there were overall more stray dogs then relinquished dogs in the data that had been collected in this study. It was expected that there would be more stray dogs, and the data did indeed support this expectation (N=2413, χ^2=16,74, df=1, p<0,00), see figure 1.

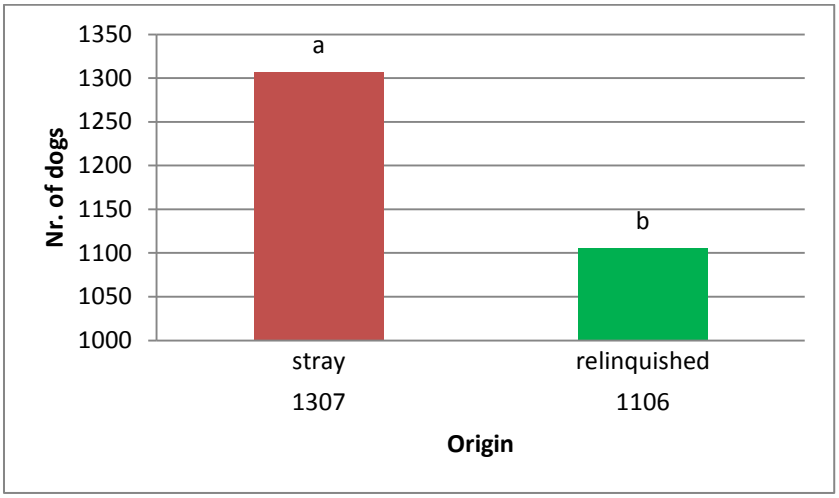

Figure 1. Origin of subjects (n= 2413). Bars with different superscripts differ significantly.

3.1.2 Difference in gender between stray and relinquished dogs

It was studied if there was a gender difference between stray dogs and relinquished dogs.
It was expected that there would be more males than females amongst the stray dogs compared to the relinquished dogs. The data did not support this hypothesis There was a trend for the proportion of females to be higher in stray dogs (41,5%) than in relinquished dogs (38%), (χ^2= 3,22, df=1, p=0,073) , see figure 2.

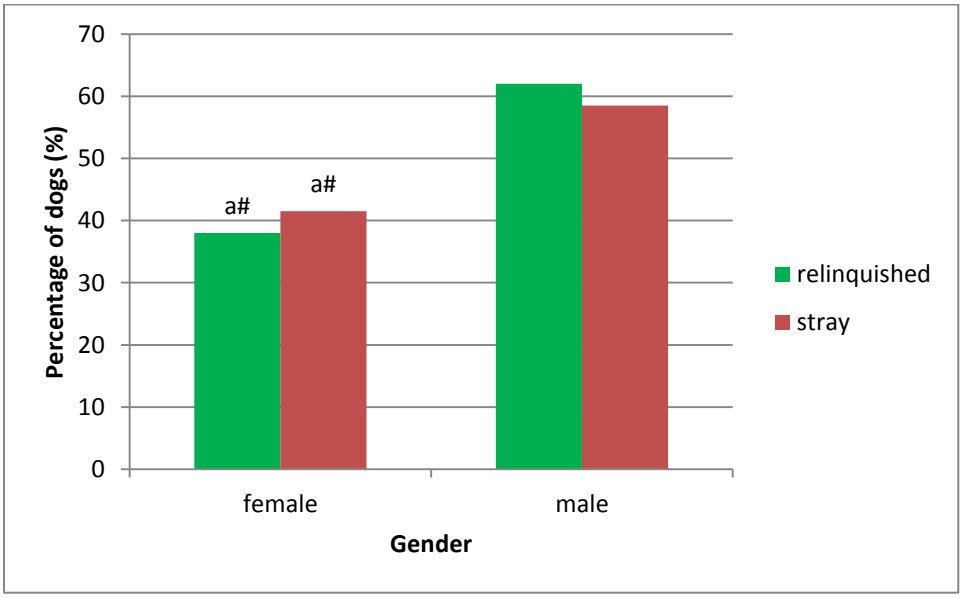

Figure 2. Relative difference between males and females (%) in relinquished and stray dogs.
Bars with different superscripts differ significantly. Letters with a # indicate a trend. If one group differs significantly, the other automatically also differs significantly.

3.1.3 Differences in age between stray dogs and relinquished dogs

It was studied if there was a difference in age between stray dogs and relinquished dogs.
It was expected that stray dogs and relinquished dogs would differ in age, with relinquished dogs having one peak at the end of puppyhood, and with stray dogs having two peaks, one at puppyhood and one at the start of senior life. The data did not support this expectation. There was no age difference between stray dogs and relinquished dogs (kolmogorov-smirnov =1.33, p=0,059) Analysis was performed with a Kolmogorov-Smirnov test.

When viewing both graphs of stray and relinquished dogs, it is seen that there is indeed a peak at the end of puppyhood, at 0,5 years, around 2,5/3 years and around 6/7 years. After 8 or 9 years, a clear decrease is seen for both groups, see figure 3 and 4. Keep in mind that these graphs do not differ significantly.

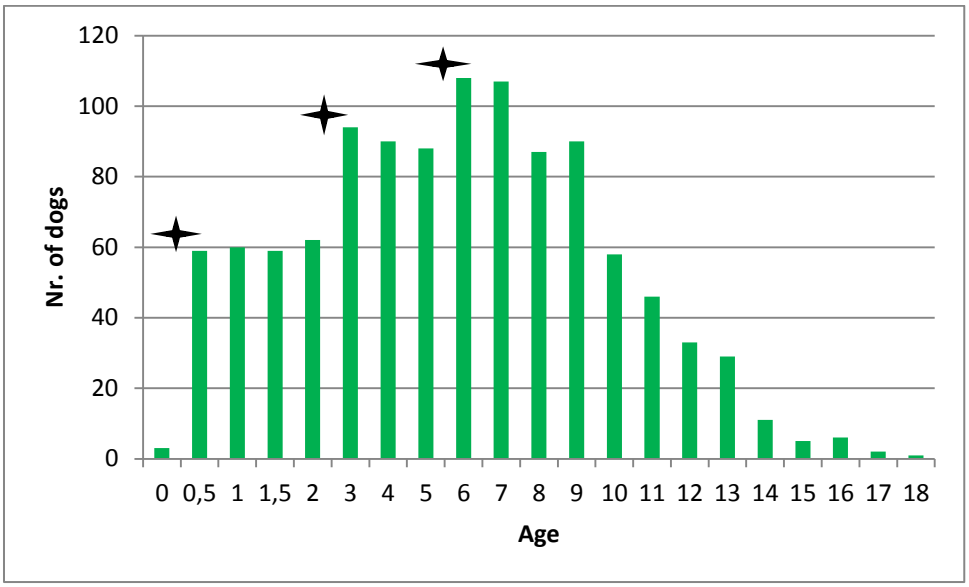

Figure 3. Age of relinquished dogs (n=1098). Stars indicate peaks.

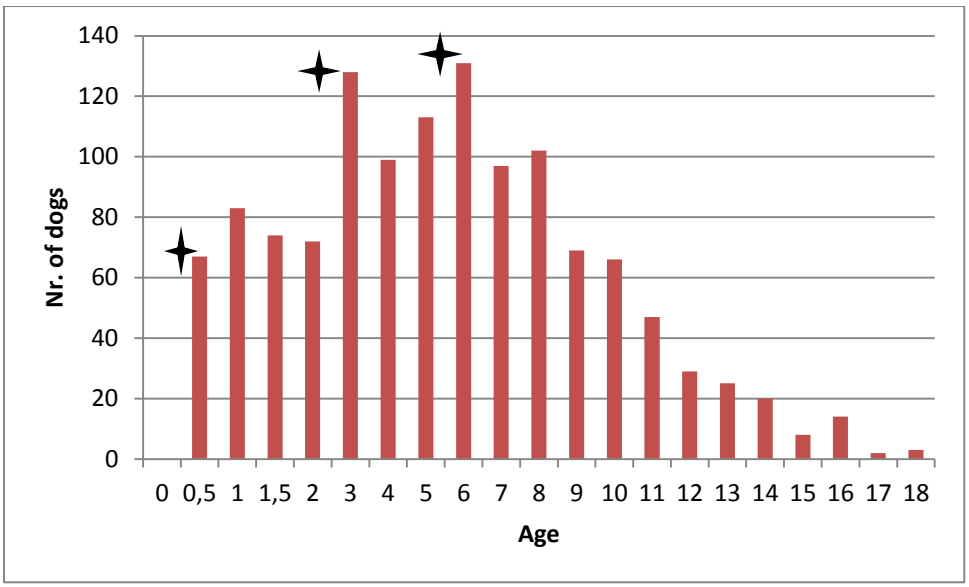

Figure 4. Age of stray dogs (n=1251). Stars indicate peaks.

3.1.4 Difference in intactness between stray and relinquished dogs

It was studied if there was a difference in intactness between stray dogs and relinquished dogs. It was expected that there would be more intact dogs in the stray group then in the relinquished group. The data did support this expectation. The proportion of intact dogs was significantly higher in the stray dogs compared to the relinquished dogs (χ^2=82.42, df=1, p<0,001), see figure 5.

In addition, it was studied if there was a gender difference. It was found that for both males and females, the same trend as mentioned above applied. (χ^2=33,99, p<0,001 (males), χ^2= 60,33, p<0.001 (females))**.**

It was also found that the proportion of not-intact females was higher in the relinquished (25,6%) group compared to the stray group (12,7%) (χ^2=13,25, df=1, p<0,001). For intact males and females, the proportion did not differ between stray and relinquished (χ^2=1,90, df=1, p=0,168) . See figure 6.

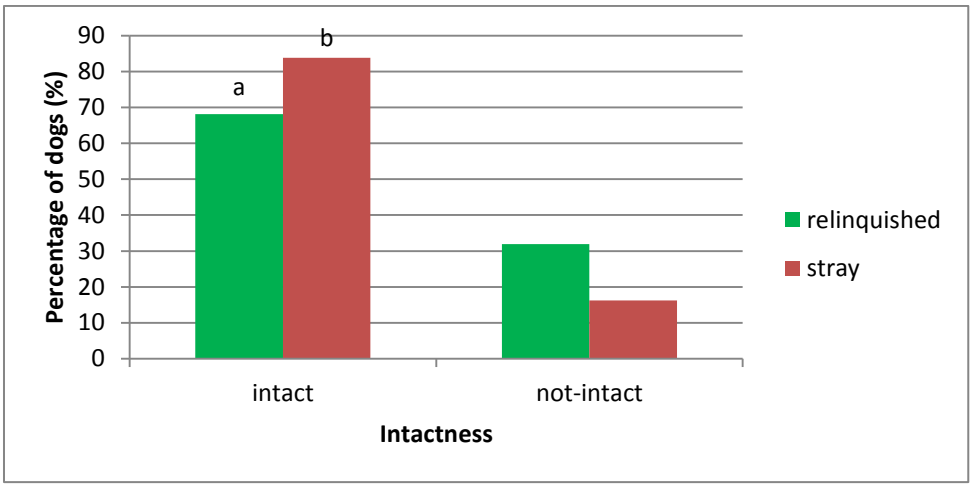

Figure 5. Difference in intactness between stray and relinquished dogs(%). Bars with different superscripts indicate significant differences. If one group differs significantly, the other automatically also differs significantly.

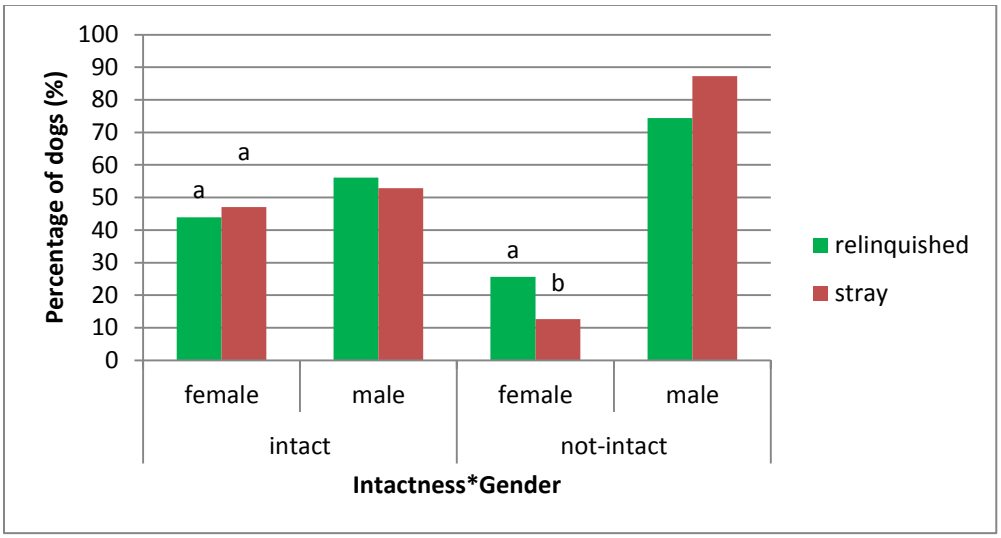

Figure 6. Relative difference between intact males and females per origin-group (%). Bars with different superscripts differ significantly. If one group differs significantly, the other automatically also differs significantly.

3.1.5 Difference in breed between stray and relinquished dogs

It was studied if there were differences in breed between stray dogs and relinquished dogs. It was expected that there would be more sturdy breeds in the stray group then in the relinquished group. The data supported this hypothesis. The proportion of sturdy breeds was higher in the stray group(25,9%) compared to the relinquished group (19,4%) (χ^2=13,98, df=1, p<0,001),see figure 7.

In addition, it was studied if specific breeds were more prevalent in either the stray or relinquished group. It was found that the proportion of American Staffordshire Terriers &alike dogs, and Sighthounds was higher in the stray group (respectively 14% &4,5%) than in the relinquished group (respectively, 6,5% &0,6%) (χ^2= 108,94, df= 20, p<0,001). The proportion of Beagles & alike dogs, and Labrador Retriever & alike dogs was higher in the relinquished group (respectively, 3,6% & 6,5%) compared to the stray group (respectively, 0,9% & 4%) (χ^2=108,94, df= 20, p<0,001), see figure 8.

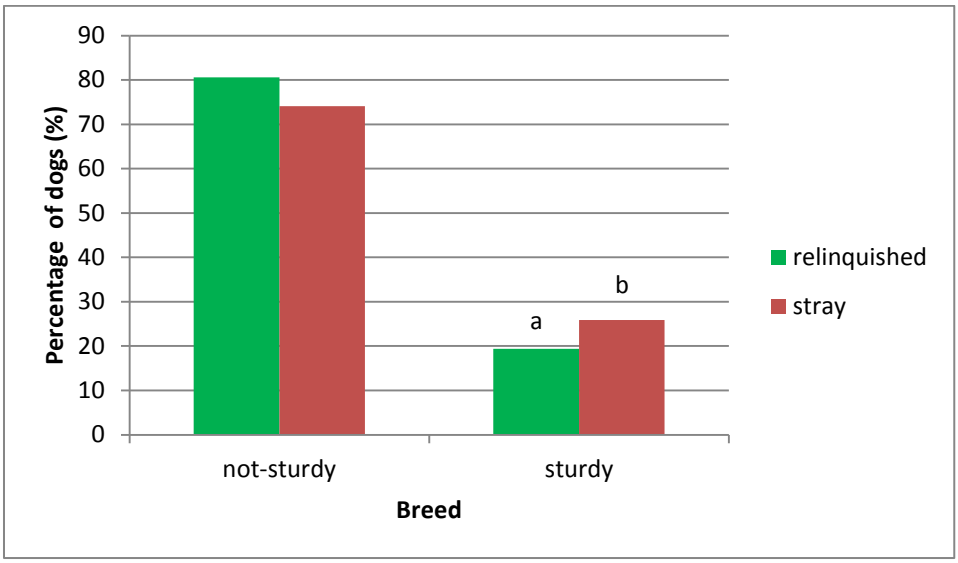

Figure 7. Differences in distribution of sturdy and not-sturdy breeds in relinquished and stray dogs(%). Bars with different superscripts differ significantly. If one group differs significantly, the other automatically also differs significantly.

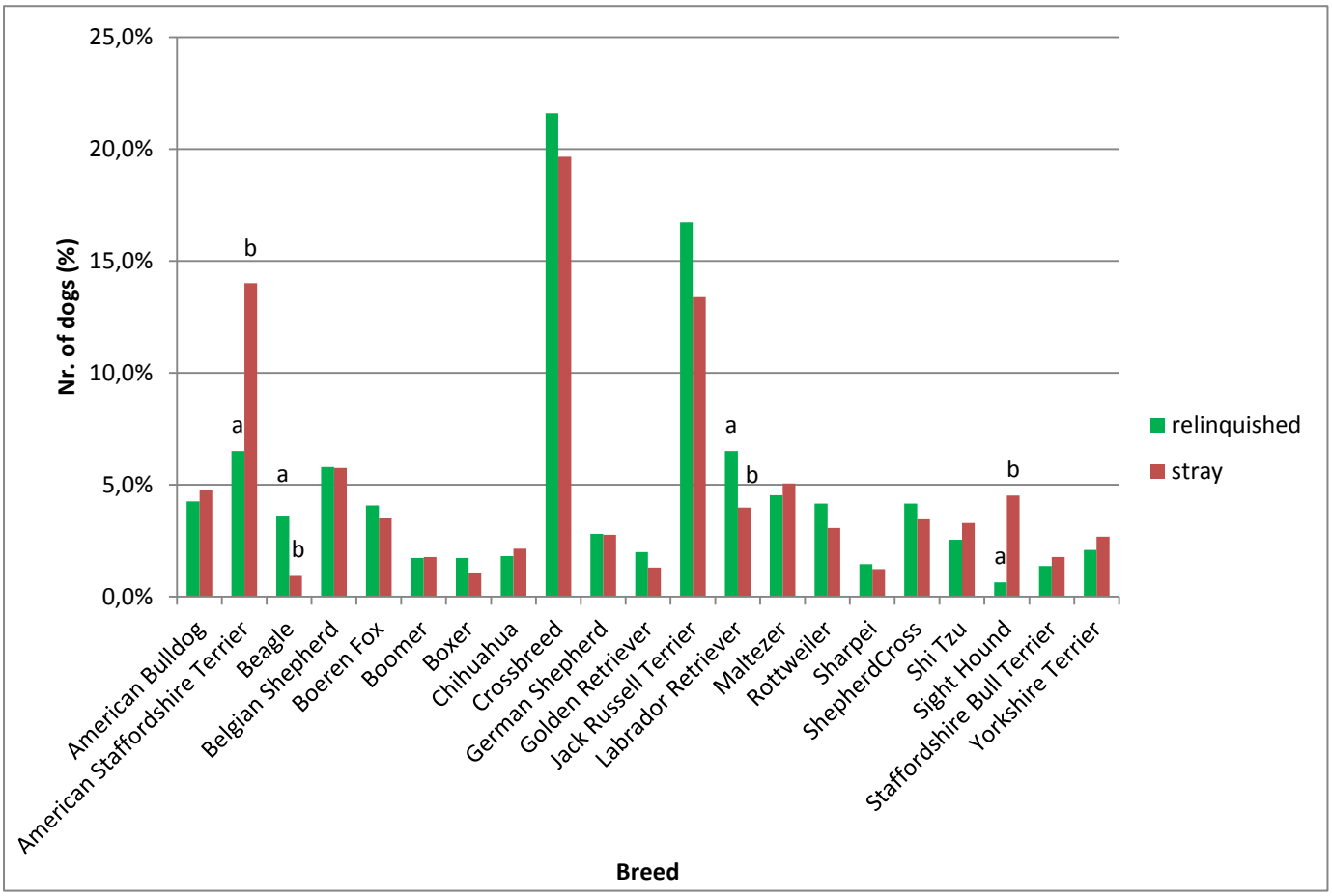

Figure 8. Differences between breed prevalence between stray and relinquished dogs(%). For readability the addition & alike dogs has been left out, and only significant results have been displayed. Bars with different superscripts differ significantly.

3.2 Behavioural Part

3.2.1 Difference in behaviour problems of stray and relinquished dogs

The difference in occurrence of behaviour problems between stray and relinquished dogs was studied. Aggression towards strangers, aggression towards unfamiliar dogs and unruly behaviour were taken into account. It was expected that these behavioural problems would be more common in stray dogs then relinquished dogs. The data did not support this expectation. There were no statistical differences between stray dogs and relinquished dogs for aggression towards strangers (p=1,00), aggression towards unfamiliar dogs (p=0,54) and unruly behaviour (p=0,51), see table 6.

Aggression towards unfamiliar dogs was further analysed, to see if there was a gender and intactness difference. There was no statistical difference in aggression towards unfamiliar dogs between males and females (n males = 13, n females =9, χ^2=0.73, df=1, p=0,523). There was however a difference in aggression towards unfamiliar dogs between intact and not-intact dogs. The proportion of aggression in intact dogs (26,6%) is significantly higher than in not-intact dogs (4,6%), (χ^2=4.6, df=1, p=0,038), see figure 9.

When viewing the occurrence of behaviour problems overall in this study, unruly behaviour was the most common behaviour problem (65%), followed by aggression towards unfamiliar dogs (22%) and lastly by aggression towards strangers (1%).

Table 6. Behavioural problems for stray (n=66) and relinquished(n=35) dogs.

	Yes		**No**					
Behaviour problem	Relinquished	Stray	Relinquished	Stray	N	DF	P	χ^2
Aggression towards strangers	0	1	34	65	100	1	0.47	0.52
Aggression towards unfamiliar dogs	9	13	25	53	100	1	0,44	0.6
Unruly behaviour	21	45	14	21	101	1	0,41	0.68

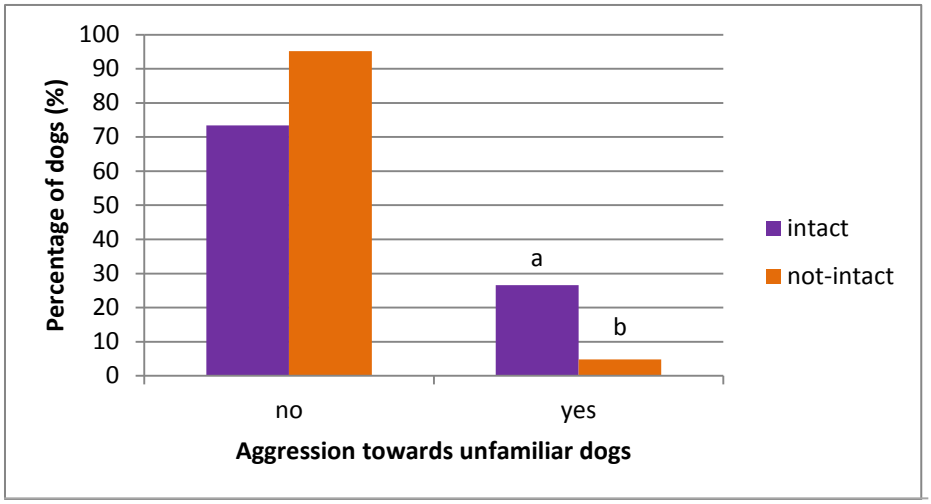

Figure 9. Aggression towards unfamiliar dogs in intact (n=79) and not-intact dogs (21) (%). Bars with different superscripts differ significantly. If one group differs significantly, the other automatically also differs significantly.

4. Discussion

The aim of this study was to identify differences between stray and relinquished dogs, and to use this information for the improvement of prevention campaigns by putting together an owner risk profile. Factors taken into account were breed, gender, age, intactness and behavioural characteristics such as aggression and unruly behaviour. The research question of this study was: "Is there a difference in breed, gender, age, intactness and behavioural characteristics between stray dogs and relinquished dogs?"

Firstly, a profile based on found risk factors will be composed. This will be followed by a future research, recommendation and an improvements section.

4.1 Owner risk profile

In the three shelters used in this study there were more stray dogs then relinquished dogs, which is in line with data of multiple surveys (Marston *et al.*, 2004; NSPPCP, 2009; Leenstra *et al.* 2011). The data also showed that stray dogs tended to more often be females than relinquished dogs, were more often sturdy breeds, and more often intact dogs (so not castrated or sterilized). Furthermore, the proportion of not-intact males was higher than not-intact females amongst stray dogs. Also, American Staffordshire Terriers & alike dogs, and Sight hounds were breeds that were significantly more common in the stray group compared to the relinquished group, which contained significantly more Beagles & alike dogs, and Labrador Retriever & alike dogs. So, based on this information, the type of previous owners of these groups (and possible different characteristics of each) has to be identified.

It was expected that the proportion of males would be higher in the stray group compared to the relinquished group, since males are overall more dominant than females, and are more associated with aggression problems (Wells, 2012). However, it was found that the proportion of females tended to be higher in the stray group compared to the relinquished group. Other studies have not found such a difference (Marston *et al.,* 2012; NSPPCP, 2009). However, the difference in this study is only a trend, so the sample size needs to be increased to find if this is a true effect. No other literature on this subject could be found.

Age did not differ among stray and relinquished dogs. It was expected that for relinquished dogs the distribution would be more equal compared to stray dogs, but the data did not support this expectation. When viewing both graphs, it is seen that both graphs indeed have a peak after puppyhood, when dogs start to become mature and go through behavioural changes, in line with the results found by Salman *et al.,* 1998. Furthermore, two other peaks are seen. One at the age of three, and one at the age of 7/8 years old. Most dogs become mature at the age of 2/3 years. Different studies found that around this age there is a high peak for the occurrence of aggression problems in dogs, mainly aggression towards other dogs and aggression towards strangers (Takeuchi *et al.,* 2000; Lund, 1995; K9 Station, 2013) Aggression problems are one of the most mentioned reasons for relinquishment, so this might explain this peak. The third peak is seen at ages around 7. It is not sure why there is a peak at this point. However, perhaps people do not expect the dog to live longer and when it does, do no longer want to own it. Also, as dogs become older they are also more likely to develop medical problems, which can be quite expensive to treat. Another possibility is that people are at a stage in their relationship or their life for certain life events to take place that cause them to no longer be able or want to own a dog. This might be an interesting topic for further research.

There was a difference seen in breed types. There was a significantly higher proportion of sturdy breeds in the stray group compared to the relinquished group. Recently, more studies have focused on owner personality and breed preferences (Wells & Hepper, 2012 ; Kratz *et al,* 1994 ; Ragatz *et al.,* 2009 ; Schenk *et al.,* 2012). These studies found that owners of "aggressive" dogs shared a number of characteristics, such as aggression, impulsiveness, antisocial behaviour, and attention seeking (Wells & Hepper, 2012 ; Ragatz *et al.,* 2009 ; Barnes *et al.,* 2006). Owners of these breeds were also found to engage more in criminal activities (Wells & Hepper, 2012 ; Ragatz *et al.,* 2009). Breeds regarded as "aggressive" or "vicious" in these studies correspond to the breeds

regarded as sturdy in this study. It seems very likely that the in above study mentioned people, being more often impulsive, more often purchase a dog without overseeing the consequences of owning a dog, and purchase dogs more impulsively. However, after having purchased the dog, owners will probably come upon multiple problems they had not accounted for, such as the costs, the amount of time need to be spend on a dog, and behaviour problems, such as soiling, chewing on furniture, or not being able to be alone (separation anxiety). In a study of New *et al.* (2010) this same theory is also proposed.

Serpell (1996) investigated owner attachment to their dogs, and found that attachment was lowest in owners who felt that there was a big difference in the behaviour of their dog in reality and how their dog should ideally behave. This of course connects to impulsive buyers, who will probably have not thought of the consequences and "disadvantages" of owning a dog. When there is a poor relationship between owner and dog, it seems more likely for these dogs to be abandoned instead of being handed over to a shelter, once the owner starts to see the dog as a nuisance. When handing your dog over to a shelter, you have to fill in a questionnaire and pay a certain amount of money. People with a poor relationship with their dog will probably be less willing to do this, and more often choose to abandon their dog.

Another factor to take into account is that sturdy breeds are breeds that are sometimes bought to be so called "status dogs" (Maher & Pierpont, 2011). They are often bought by adolescents living in urban areas (Maher & Pierpont, 2011). These adolescents are often associated with criminal activities and animal abuse or cruelty(Maher & Pierpont, 2011). Status-dogs are often used for protection, to threaten other people, or in illegal activities such as dog fights (Maher & Pierpont, 2011). When a dog is bought as status symbol, it is often seen as an inanimate object (Maher & Pierpont, 2011). These dogs are very often seized by animal control due to neglect (Maher & Pierpont, 2011), and will very likely be abandoned instead of being handed over to a shelter. Indeed, when viewing the data of this study, it is seen that in Amsterdam and Tilburg, there were more sturdy breeds in the shelter compared to Den Bosch. In Amsterdam and Tilburg are also known for a higher number of urban problem areas with a high occurrence of criminality compared to Den Bosch (Ministerie van Infrastructuur en Milieu, 2008), so the data seems to correspond with this study.

It was furthermore found that there were significantly more American Staffordshire & alike dogs and Sight hounds in the stray group, and significantly more Beagles & alike dogs and Labrador Retriever & alike dogs in the relinquished group. Again, this fits in the irresponsible, lower attached owner profile as found in above mentioned previous studies. American Staffordshire Terriers are regarded as sturdy breeds, and have become more popular throughout the years. Originally these dogs were selected for hunting and killing vermin (American Kennel Club, 2013) and were used in dog fights (ASPCA, 1997). One might imagine these dogs are often bought as status-dogs. These dogs are regarded to be more difficult to handle, compared to other breeds, especially when becoming adults (American Kennel Club, 2013). One might imagine that once this happens, these owners will choose to abandon their dog.

Sight hounds in Holland, compared to other breeds, more often have a foreign origin (Hondenbescherming, 2011). These dogs are brought to Holland by different welfare organizations, and often have an origin of stray in their country of origin. A survey of the Royal Association for the Protection of Dogs found that owners of such dogs more often mention straying behaviour (Hondenbescherming, 2011). This might be a reason as to why Sight hounds are more common in the stray group compared to the relinquished group; if the straying behaviour continues, owners might become fed up with this behaviour and eventually stop retrieving the dog from the shelter or because of the straying, they may be at a higher risk of the owner not finding the dog back after it strays.

Beagles and Labradors are both considered to be "family" dogs (Several breed websites,2013). Next to behavioural problems, life changing events are also mentioned quite often as reason for relinquishment. This is probably why these dogs are more common in the relinquished group, compared to the stray group. This fits in line with the view of the responsible owner. Previous owners of these dogs have probably put more time into the purchase of a dog, have a closer

attachment to the animal and hence will be more willing to go through the emotion and effort of taking it to the shelter

It is important to take in regard that during the time of this study, two of the three shelters did not accept American Staffordshire Terriers & alike dogs for relinquishment. This might have skewed the data for breed distribution between stray and relinquished dogs. However, in the shelter that did accept American Staffordshire Terriers & alike dogs, this trend was also found. There were only two relinquished American Staffordshire Terriers & alike dogs, opposed to 15 stray. The number of shelters in needs to be increased to check the outcome of this study.

When taking intactness into account as well, it is seen that the proportion of intact dogs is higher among stray dogs compared to the relinquished group. When this is split into males and females, it is seen that for intact males and females there is no difference in relinquished or stray, but when viewing the not-intact males and females, it is seen that the proportion of not-intact females is much higher in the relinquished group compared to the stray group, and vice versa for the males. This fits the profile of previous owners as sketched above in regards to sturdy breeds. It is assumed that previous owners of stray dogs have a poorer relationship with their dog, are less responsible and are less willing to invest in their dogs (time and money wise) (New *et al.* 2000).

To prevent unwanted pregnancies it can be wise to neuter your female dog. This is a decision a responsible owner might make more easily, and might be more willing to invest in, contrary to irresponsible owners (neutering female dogs is more expensive than male dogs, (Dierenziekenhuizen, 2013)). Not only do owners neuter their female dogs to prevent unwanted pregnancies, females also become in heat twice a year, which can be viewed as a nuisance to the owners. Attached owners might be willing to either neuter their dog, or just deal with it, whereas less attached owners might become irritated and choose to abandon their dog.

Another possibility is that intact dogs (especially females) can be used for breeding. Many of these females end up in the rogue dog breeding. In the Netherlands, each year around 100.000 pups are born through these rogue breeders (Dierenbescherming, 2013). After being used for several nests, these owners abandon their dogs and purchase a younger one. These owners are also viewed as irresponsible owners, who view their dogs as inanimate objects.

So, to summarize the shelter data: based on factors that did differ among stray and relinquished dogs (breed, breed type and intactness) an owner profile can be made up.
It is likely that previous owners of stray dogs are overall people who are more likely to be impulsive, attention seeking, more inclined to engage in criminal activities, irresponsible, have a poorer relationship with their dog and purchase their dog more impulsively.

Behavioural tests were done to find if there was a difference in behavioural problems between stray and relinquished dogs, it was found that there was no difference for the occurrence of aggression towards strangers, aggression towards unfamiliar dogs and unruly behaviour between stray dogs and relinquished dogs, although It was expected that stray dogs would have more behavioural problems compared to relinquished dogs. The most common behaviour problem was unruly behaviour (65%). It could be that not many owners find it important for their dog to follow some sort of obedience training, or that they do not mind their dog to be unruly. Another explanation could be that they seemed more unruly because they were in a more stressful situation, namely being in a shelter. Research found that exposing dogs to stressors increases vocalization, and dogs experiencing anxiety show increased restlessness, which could thus make the dog seem more unruly in a stressful situation(Beerda *et al.,* 1997 & Beerda *et al.,* 1998). Especially loud noises seemed to evoke stress reactions, which were also correlated to high cortisol levels (Beerda *et al.,* 1998). Post hoc analysis showed that there was no difference in unruly behaviour between males and females (p=0,192).

There was also no difference among both groups for aggression towards unfamiliar dogs, in total 22% of the dogs in this study showed this behaviour. In other studies performed in America it was found that aggression towards other animals accounted for 11.3 % and 7.8 % of reasons for relinquishment (Salman *et al.,* 2000 ; Salman *et al.,*1998). The percentage of aggression towards animals is higher in this study. It could be that because the dogs of this study were in a stressful

situation (being in a shelter) that there is an increase in aggression towards unfamiliar dogs. In a future study these dogs could be observed after being re-homed, to find if this was indeed the case.

Upon further analysis it was found that among the dogs that showed aggression towards unfamiliar dogs, a significant majority was intact. There was however no relation between gender and aggression towards unfamiliar dogs. The interaction between aggression, intactness and gender is quite complicated. In this study it was only noted if there was aggression, and not what kind of aggression this was. A dog can for instance show aggression towards another dog out of uncertainty, or out of dominance (Borchelt, 1983). In a dominant aggressive male dog, sometimes castration can help to decrease the aggressiveness, in an uncertain male dog, this could however lead to an increase of the problem. For females, sterilization can lead to an increase of aggression (Blackshaw, 1991). That is why further research is necessary to understand the interaction effect found in this study.

There was only one dog who displayed aggression towards a stranger, so more data needs to be collected before drawing any conclusions regarding this behavioural problem.

The behavioural data could not provide any further insight in the previous owner profile, which hence remains unaltered.

It is important to keep in mind that this a very generalized profile, and that there are of course also other reasons that might lead to abandoning one's dog, such as financial problems. However, it is assumed that the above mentioned profile holds true for the largest part of previous owners of stray dogs.

4.2 Future research

This study was a pilot study to find if there were significant differences between stray and relinquished dogs. This study suggests that these differences do indeed exist. It would thus be very interesting to expand the sample size, and expand the number of shelters where data is collected. Not only to increase the sample size, but also to discover geographic and demographic differences, to compose a better owner risk profile.

Future research might also take more factors that can be measured into account, such as medical issues, repositionability, and time spent in the shelter. It would also be interesting to perform another behavioural test after the dogs have been placed in a new home.

In a future study, it could also provide new insights if more behaviour aspects would be taken into account, such as posture. Then one would be able to tell more about the motivation behind the observed behaviour.

4.3 Recommendations

The objective of the study was to identify differences between stray and relinquished animals in shelters. Differences that might be translated back to previous owners of these animals and their purchase choices when they obtained the dog(s). This information can provide vital clues for prevention campaigns. Based on the owner risk profile that has been composed in section 4.1, how can this information be used in prevention campaigns?

The difficulty lies in the fact that the profile of previous owners of stray dogs identifies these owners as generally more irresponsible and more impulsive people, who are overall more likely to behave in an "anti-social" way. Probably, this type of owner will be less motivated to participate in research, which makes it difficult to obtain further information for prevention campaigns. Also, it will be challenging to reach them with information that will help them not to make incorrect pet purchase decisions or to convince them to relinquish instead of dumping their dog. Future research might focus on how purchase decisions in more and less impulsive/responsible buyers and buying situations are made and affected.

It seems wiser to aim prevention campaigns on the process of purchase. Thus far it seems that there is at least a difference for owners who make a "responsible" dog purchase, since these

dogs are less likely to end up in a shelter (Hermsen, 2012). When developing new prevention campaigns it might be wise to involve a psychologist, to include in the campaign set up more insight in the thinking patterns of the target group and how they make decisions. Also, maybe alternative and more creative channels need to be used when providing information, such as using social media sites. These prevention campaigns could focus on what it is like to own a dog in reality, and the responsibilities and difficulties that could come along, to lower the discrepancy between reality and ideal.

Promoting obedience training could also work, since this might improve the relationship between the owner and it's dog. Not only do owners follow this course with their dog, which could create a better relationship, they might also enjoy their dog if they feel they are more in control and come upon less problems in daily life.

Not only prevention campaigns can help to reduce the number of stray dogs. The Government could also play a role. As from April the first of this year (2013), chipping your dog within 7 weeks after it is born is obliged (Rijksoverheid, 2013). This will help to track down owners of stray dogs, and maybe this might increase the threshold to dump your dog. However, this policy is not very actively enforced. Another improvement might be for the government to regulate animal transfers through the way of internet. Many websites offer dogs for low prices, lowering the threshold to purchase a dog and enhancing irresponsible and impulsive buyers.

Another interesting angle might be for animal shelters to do more with behaviour. This study had quite high percentages of the occurrence of dog on dog aggression and unruly behvaiour compared to other studies (Salman, M.D., *et al.,* 2000 & 1998**)**. It could be that this is because stress levels in Dutch animal shelters are relatively high, so it would be interesting to study this and if necessary try to improve the housing situations. Also, animal shelters could cooperate with behaviourists and stress lowering/training programs to improve problem behaviour of "difficult" dogs, to increase their repositionability and lower the chance for these dogs to be returned to the shelter.

4.4 Improvements

-Increase the sample size
-Increase the number of shelters to check for geographic and demographic differences
-Repeat the behavioural test after dogs have been adopted

Acknowledgements

I would like to thank Ineke van Herwijnen and Sieneke Groenman, for providing useful insights and feedback during my research and enlarging my knowledge on dogs. I would also like to thank Majori Meijer, Door Jagers, Jolanda van Daalen, Hajo Horvers and Harrie Herkens for making it possible to conduct my research and collect my behavioural data, with a special thanks to Majori for teaching me so much about canine behaviour. Also, thanks to Hannah, Kelly, Mandy and Michiel for helping me during the behavioural tests. Furthermore I would like to thank Han de Vries for helping me with the data analysis and visualizing my data, and Marie-José Duchateau for providing feedback on my report.

5. References

American Kennel Club. 2013. http://www.akc.org/breeds/index.cfm

American Kennel Club, 2013. http://www.akc.org/breeds/american_staffordshire_terrier/index.cfm

ASPCA, 1997. http://www.aspca.org/fight-animal-cruelty/dog-fighting/history-of-dog-fighting.aspx

Bamberger, M., Houpt, K.A.. 2006. Signalment factors, comorbidity, and trends in behavior diagnoses in dogs: 1,644 cases (1991-2001). *JAVMA, Vol229, No. 10*

Blackshaw, J.K. 1991. An overview of types of aggressive behaviour in dogs and methods and treatment.*Applied Animal Behaviour Science,* 30 (1991) 351-361

Barnes, J.E., Boat, B.W., Putnam, F.W., Dates, H.F., Mahlman, A.R. 2006. Owners of high-risk ("vicious") dogs as a marker for deviant behaviors. *Journal of interpersonal violence. Vol. 21, Nr. 12. Pp. 1616-1634*

Beerda, B., Schilder, M.B.H., Van Hooff, J.A.R.A.M., de Vries, H.W. 1997. Manifestations of chronic and acute stress in dogs. *Applied animal behaviour Science (52)307-319*

Beerda, B., Schilder, M.B.H., Van Hooff, J.A.R.A.M., de Vries, H.W., Mol, J.A. 1998. Behavioural, saliva cortisol and heart rate responses to different types of stimuli in dogs. *Applied animal behavior Science (58) 365-381*

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

Dierenbescherming. 2013. http://www.dierenbescherming.nl/de-aanschaf-van-een-hond

Dierenbescherming. 2013. http://www.dierenbescherming.nl/malafide-hondenhandel

Division of animal control.,Merced County. 2013. Dog Breed characteristics &behavior.http://www.co.merced.ca.us

Cooper, J.J., Albentosa, M.J., 2005. Behavioural adaptation in the domestic horse: potential role of apparently abnormal responses including stereotypic behaviour. *Livestock production science. Vol. 92. No.2 177-182.*

Glaser, R., Kiecolt-Glaser, J.K. 2005. Stress-induced immune dysfunction: implications for health. *Nature revieuws immunology 5. 243-251.*

Hanson, J.D., Larson, M.E., Snowdon, C.T., 1976. The effects of control over high intensity noise on plasma cortisol levels in Rhesus Monkeys. *Behavioural biology 16, 333-340*

Hennesy, M.B., Davis, H.N., Williams, M.T., Mellott, C., Douglas, C.W. 1997. Plasma Cortisol Levels of Dogs at a County Animal Shelter.*Physiology & Behavior, Vol. 62, No. 3, pp. 485–490, 1997*

Hennesy,M.B., Voith, V.L., Mazzei, S.J., Buttram, J., Miller, D. D., Linde, F. 2001. Behavior and cortisol levels of dogs in a public animal shelter, and an exploration of the ability of these measures to predict problem behavior after adoption. *Applied Animal Behaviour science 73. 217-233.*

Herman, J.P., Cullinan, W.E. 1997. Neurocircuitry of stress: central control of the hypothalamo – pituitary – adrenocortical axis. *Trends. Neuroscience. 20. 78-84.*

Hermsen, C. 2012. Bezint eer ge begint. De oorzaken van het afstaan van een hond aan een dierenasiel en verslag van een interventie om dit tegen te gaan.

Hondenbescherming. 2011. Rapport onderzoek tevredenheid hondenbezitters over hun hond.

Hondenbescherming. 2011. Buitenlandse honden in Nederland. Rapport door de Hondenbescherming.

Jagoe, A., 1994. Behaviour problems in the domestic dog: a retrospective and prospective study to identify factors influencing their development. **In**: Wells, D.L., Hepper, P.G. 2012. The personality of "aggressive" and "non-aggressive"dogowners.*Personality and invididual differences 53 (2012).770-773.*

Jansen, A.S.P., Nguyen, X. V., Karpitskiy, V., Mettenleiter, T.C., Loewy, A.D. 1995. Central command neurons of the sympathic nervous system: basis of the fight-or-flight response. *Science, Vol.270.644-646.*

K9 Station. L. Giroux, 2013 http://www.k9station.com/articles/adolescence.htm

Katz,J., Sanders,J., Parenté,F., Figler,M., 1994. "Personality traits, and demographic and lyfestyle characteristics as predictors of dog breed choice," *Proceedings of the Scientific Sessions of the International Society for Anthrozoology (ISAZ)*, *at http://www.isaz.net/conferences/ISAZ_1994.pdf, accessed 28 January 2011*

Knol, B.W., 1987. Behavioural problems in dogs..**In:** Wells, D.L., Hepper, P.G. 2012. The personality of "aggressive" and "non-aggressive"dogowners.*Personality and invididual differences 53 (2012).770-773.*

Landsberg, G., Hunthausen, W., Ackerman, L. 2003. Behavior problems of the dog and cat. Second edition.

Leenstra, F.R., Neijenhuis, F., Hanekamp, W.J.A., Vermeij, J. 2011. Staat van het dier 2. Rapport 455. Wageningen UR livestock research.

Line, S., Voith, V.L. 1986. Dominance aggression of dogs towards people: behaviour profile and response to treatment. *Applied animal behaviour science. 16. 77-83.*

Luescher, A., 2000. Compulsive behaviour in companion animals. *Recent Advances in Companion Animal Behaviour Problems, Houpt K.A. (Ed.). International Veterinary Information Service, Ithaca NY*

Luescher, A.U. 2003. Diagnosis and management of compulsive disorders in dogs and cats.Vet. Clin. Small. Anim. 33 92003) 253-267

Lund, J.D., Agger, J.F., Vestcrgaard, K.S., 1995. Reported behaviour problems in pet dogs in Denmark: age distribution and influence of breed and gender. *Preventive veterinary medicine (28) 33-48*

Maher, J., Pierpont, H., 2011. Friends, status symbols and weapons: the use of dogs by youth groups and youth gangs. *Crime law Soc Change, 2011. 55:405-420.*

Marler, C.A., Moore, M.C. 1988. Evolutionary costs of aggression revealed by testosterone manipulations in free living male lizards. *Behav. Ecol. Sociobiol.23:21-26.*

Marston, L.C., Bennet, P.C., Coleman, G.J. 2004.What Happens to Shelter Dogs? An Analysis of Data for 1 Year From Three Australian Shelters. *Journal of Applied Animal Welfare Science, 7:1, 27-47*

Ministerie van Infrastructuur en Milieu,2008. Overzicht Landelijke Alliantie Krachtwijken.

National Council of Pet Population Study & Policy. 2009. www.petpopulation.org/*statsurvey.html*

New Jr., J.C., Salman, M.D., King, M., Scarlett, J.M., Kass, P.H., Hutchison, J.M. 2000. Characteristics of Shelter-Relinquished Animals and Their Owners Compared With Animals and Their Owners in U.S. Pet Owning Households. *Journal of Applied Animal Welfare Science, 3:3, 179-201*

Ortega-Pacheco, A., Rodriquez-Buenfil, J.C., Bolio-Gonzalez, M.E., Sauri-Arceo, C.H., Jiménez-Coello, M., Forsberg, C.L., 2007.A survey of dog populations in Urban and Rural Areas of Yucatan, Mexico.*Anthrozoös Vol. 20. Issue 2. Pp 261-274*

Ragatz, L., Fremouw, W., Thomas, T., McCoy, K. 2009. Vicious dogs: The antisocial behaviors and psychological characteristics of owners. *J Forensic Sci. 2009 Sep;54(5):1206*

Rijksoverheid, 2013. *http://www.rijksoverheid.nl/onderwerpen/dieren/vraag-en-antwoord/moet-ik-mijn-hond-laten-chippen-en-registreren.html*

Salman, M.D., New, J.G., Scarlett, J.M., Kass, P.H., Ruch-Gallie, R., Hetts, S. 1998. Human and animal factors related to relinquishment of dogs and cats in 12 selected animal shelters in the United States. *Journal of applied animal welfare science. 1:3, 207-2*

Salman.M.D., Hutchison, J., Ruch-Gallie, R., Kogan, L., New, J.C., Kass, P.H., Scarlett, M. 2000. Behavioral reasons for relinquishment of dogs and cats to 12 shelters. *Journal of applied animal welfare science. 3:2. 93-106*

Schenk, A.M., Ragatz, L.L., Fremouw, W.J. 2012. Vicious dogs part 2: Criminal thinking, Callousness, and personality styles of their owners. *Journal of forensic sciencesvol.57, no.1.Pp. 152-159*

Serpell,J. A. 1996. Evidence for an association between pet behavior and owner attachment levels. Applied animal behaviour science, *Vol, 47. Pp 49-60.*

Several breed websites 2012: http://animal.discovery.com/breed-selector/dog-breeds/family-dog-breeds.html; http://www.cesarsway.com/dog-behavior/basics/The-Ten-Best-Family-Dog-Breeds; http://www.sheknows.com/pets-and-animals/articles/807366/top-10-dog-breeds-for-kids/page:9

Takeuchi, Y,.Ogata, N., Houpt, K.A., Scarlet, J.M., 2000. Differences in background and outcomes of three behavioural problems in dogs. *Applied animal behavior Science (70) 297-308*

Tuber, D.S., Miller, D.D., Caris, K.C., Halter, R., Linden, F., Hennesy, M.B. 1999. Dogs in animal shelters: Problems, suggestions and needed expertise. *American psychological society. Vol.10, No.5. 379-386.*

Van den Berg, L., Schilder, M.B.H., Knol, B.W. 2003. Behavior genetics of canine aggression: behavioral phenotyping of Golden Retrievers by means of an aggression test. *Behavior genetics, Vol. 33. No. 5*

Wells, D.L., Heppers, P.G. 2000. Prevalence of behaviour problems reported by owners of dogs purchased from an animal rescue shelter. *Applied Animal Behaviour Science 69 _2000. 55–65*

Wells, D.L., Hepper, P.G. 2012. The personality of “aggressive” and “non-aggressive”dogowners.*Personality and invididual differences 53 (2012).770-773.*

Wiepkema, P.R., Koolhaas, J.M. 1993. Stress and animal welfare. *Animal welfare 1993. 2.195-218.*

Appendix 1. Overview of subjects used in the behavioural data part.

Subject	Identification Nr.	Age	Breed	Cross with	Gender	Intactness	Origin	Aggression Human	Aggression Dog	Unruly	Entry date
Turbi	AM29476	0,42	Crossbreed	unknown	male	Intact	Stray	no	yes	yes	7-1-2013
Mazzel	AM29460	8,58	Teckel		male	Intact	Stray	unknown	unknown	yes	2-1-2013
Diva	AM29529	4,25	ShihTzu		female	Intact	Crisis	no	no	no	31-1-2013
Kaya	AM29263	3,50	Crossbreed	Shepherd	female	intact	Crisis	no	no	no	26-11-2012
Rocky	AM28260	0,92	American Bulldog		male	Intact	Relinquished	no	no	no	25-1-2013
Spikey	AM29400	5,83	Crossbreed	ShihTzu	male	intact	Relinquished	no	no	yes	10-1-2013
Noa	AM23688	12,00	Jack Russell Terrier		female	Intact	Relinquished	no	no	yes	17-10-2009
Ritchie	AM29514	2,00	Crossbreed	American Bulldog	male	Intact	Stray	no	no	yes	24-1-2013
Jack	AM29533	2,00	Jack Russell Terrier		male	Intact	Stray	no	yes	yes	2-2-2013
Max	AM29534	10,08	Crossbreed	Maltezer	male	not-intact	Stray	no	no	yes	3-2-2013
Jock	AM29554	3,92	Crossbreed	ShihTzu	male	not-intact	Relinquished	no	no	no	15-2-2013
Ido	AM29552	2,42	Crossbreed	Boxer	male	Intact	Relinquished	yes	no	yes	13-2-2013
Dora	AM29662	0,67	Crossbreed	Bordeaux Dog	female	Intact	Crisis	no	yes	yes	22-2-2013
Loebas	AM27940	1,33	Crossbreed	Staffordshire	male	not-intact	Relinquished	no	no	no	15-2-2013
Rox	AM29463	7,00	Crossbreed	unknown	male	Intact	Relinquished	no	no	no	3-1-2013
Mozes	DB10030	4,00	Jack Russell Terrier		male	Intact	Stray	no	no	yes	31-1-2013
Tank	DB9881	2,00	Crossbreed	Staffordshire	male	Intact	Stray	no	no	no	27-10-2012
Sam	DB10048	13,00	Chesapeake Bay Retriever		female	not-intact	Relinquished	no	yes	yes	14-2-2013
Rocky	DB9987	unknown	Jack Russell Terrier		male	Intact	Stray	no	no	yes	28-12-2012
Hind	DB10006	1,08	Crossbreed	Border Collie	female	Intact	Relinquished	no	no	no	13-1-2013
Laika	DB10024	7,67	English Cocker Spaniel		female	not-intact	Relinquished	no	no	no	24-1-2013
Beatrix	DB10044	7,00	Jack Russell Terrier		female	Intact	Stray	no	no	yes	12-2-2013

Blacky	DB10042	12,00	Crossbreed	BelgianShepherd	male	not-intact	Stray	no	yes	yes	11-2-2013
Chloe	AM29705	2,33	Crossbreed	YorkshireTerrier	female	Intact	Relinquished	no	yes	yes	26-2-2013
Louis	AM29704	2,50	Crossbreed	YorkshireTerrier	male	not-intact	Relinquished	no	no	no	26-2-2013
Rico	AM29725	0,75	Cane Corso		male	Intact	Crisis	no	no	no	2-3-2013
Nena	AM29724	0,75	Cane Corso		female	Intact	Crisis	no	no	no	2-3-2013
Bas	AM29709	1,75	Dutch Barge Dog		male	Intact	Stray	no	no	yes	27-2-2013
Daan	AM29707	9,00	Crossbreed	unknown	male	Intact	Stray	no	yes	yes	26-2-2013
Hard	AM29665	1,25	Boxer		male	Intact	Stray	no	no	no	22-2-2013
Bono	AM29746	6,83	American Bulldog		male	Intact	Crisis	no	no	yes	6-3-2013
Tasja	DB10070	10,08	Beagle		female	not-intact	Crisis	no	no	yes	8-3-2013
Tender	DB10074	12,17	Beagle		male	intact	Crisis	no	yes	yes	8-3-2013
Hugo	DB10071	10,58	Beagle		male	intact	Crisis	no	yes	yes	8-3-2013
Moos	DB10051	0,25	Labrador Retriever		female	intact	Relinquished	no	no	no	19-2-2013
Scotty	DB10076	1,17	Crossbreed	unknown	female	intact	Stray	no	no	yes	8-3-2013
Zuko	DB10079	2,50	MunsterLander		male	not-intact	Relinquished	no	no	yes	11-3-2013
Sjors	DB10073	11,50	Jack Russell Terrier		male	intact	Crisis	no	no	yes	8-3-2013
Bundy	DB10072	12,92	Jack Russell Terrier		male	not-intact	Crisis	no	no	yes	8-3-2013
Lola	AM29548	2,00	American StaffordshireTerrier		female	Intact	Stray	no	no	yes	13-2-2013
Benno	AM29769	0,75	Crossbreed	unknown	male	Intact	Crisis	no	no	yes	15-3-2013
Blondie	AM29755	2,33	English Cocker Spaniel		female	Intact	Crisis	no	no	yes	13-3-2013
Marley	AM29721	4,00	American StaffordshireTerrier		male	Intact	Stray	no	no	yes	1-3-2013
Sofie	DB9937	10,42	Jack Russell Terrier		female	Intact	Relinquished	no	no	no	22-11-2012
Liedje	DB8128	11,67	Jack Russell Terrier		male	not-intact	Relinquished	no	no	no	15-12-2010
Nico	DB10078	1,00	Rottweiler		male	intact	Stray	no	no	no	11-3-2013
Banjer	AM29771	3,92	English Cocker Spaniel		male	Intact	Stray	no	no	yes	19-3-2013

Rex	AM28866	2,00	GermanShepherd		male	Intact	Stray	no	no	no	11-3-2013
Mimi	AM29402	0,58	Saluki		female	Intact	Relinquished	no	no	yes	23-3-2003
Bo	TB6208	4,33	Crossbreed	Staffordshire	male	not-intact	Stray	no	no	yes	28-12-2012
Diego	TB6299	7,25	American StaffordshireTerrier		male	Intact	Stray	no	no	yes	15-2-2013
Chelsea	TB4995	3,92	American StaffordshireTerrier		female	Intact	Relinquished	no	yes	yes	18-1-2013
Dribbel	TB6333	5,25	Crossbreed	Dutch Shepherd	female	Intact	Relinquished	no	no	yes	26-2-2013
Doerak	TB2429	6,50	Crossbreed	Staffordshire	male	not-intact	Relinquished	no	yes	yes	15-5-2013
Colt	TB4943	3,42	American StaffordshireTerrier		male	Intact	Stray	no	no	yes	18-1-2013
Gino	TB6265	7,33	American StaffordshireTerrier		male	Intact	Stray	no	no	yes	28-1-2013
Alisha	TB6313	2,58	American StaffordshireTerrier		female	Intact	Stray	no	no	yes	21-2-2013
Ace	TB6390	1,25	Staffordshire Bull Terrier		male	Intact	Stray	no	no	no	20-3-2013
Keessie	TB6364	3,33	Old English Bulldog		male	not-intact	Relinquished	no	yes	yes	15-3-2013
Foxy	TB6275	1,42	Crossbreed	Border Collie	female	Intact	Relinquished	no	no	yes	5-2-2013
Sproetje	TB6274	1,25	Dalmatian		female	Intact	Stray	no	no	yes	3-2-2013
Dizzy	TB6411	2,17	Crossbreed	Jack russellterrier	female	Intact	Relinquished	no	no	yes	26-3-2013
Bickel	TB6375	1,92	Crossbreed	West Highland White Terrier	male	not-intact	Relinquished	no	yes	no	19-3-2013
Farah	TB6297	2,25	Siberian Husky		female	Intact	Stray	no	no	no	4-4-2013
Noeke	TB6349	3,92	Bassenji		male	Intact	Relinquished	no	no	yes	7-3-2013
Kiki	TB6371	2,25	YorkshireTerrier		female	Intact	Stray	no	no	yes	16-3-2013
Jesse	TB6373	5,25	Jack Russell Terrier		male	Intact	Stray	no	yes	no	17-3-2013
Django	TB5922	3,50	West highlandwhiteterrier		male	Intact	Relinquished	no	no	no	15-3-2012

Nala	AM29850	1,67	American StaffordshireTerrier		female	Intact	Crisis	no	no	yes	12-4-2013
Lola	AM29849	3,67	American StaffordshireTerrier		female	Intact	Crisis	no	no	yes	12-4-2013
Kia	AM29848	4,17	American StaffordshireTerrier		female	Intact	Crisis	no	yes	yes	12-4-2013
Tiger	AM29800	4,83	American StaffordshireTerrier		male	not-intact	Stray	no	no	no	29-3-2013
Pepper	TB6322	2,25	Crossbreed	unknown	male	Intact	Relinquished	no	no	yes	16-4-2013
Hasse	TB4527	8,25	Jack Russell Terrier		female	not-intact	Relinquished	no	no	no	29-3-2013
Sjefke	TB6362	2,25	Boomer		male	Intact	Stray	no	no	no	13-3-2013
Moon	TB6200	2,25	Crossbreed	Staffordshire	female	Intact	Relinquished	no	yes	yes	12-4-2013
Boyke	TB4832	4,17	ScottishShepherd		male	Intact	Relinquished	no	no	yes	12-4-2013
Conan	TB5820	8,17	GermanShepherd		male	Intact	Relinquished	no	no	no	22-3-2013
Sam	TB6240	5,33	Viszla		female	not-intact	Relinquished	no	no	yes	26-2-2013
Jayden	TB6315	3,25	BelgianShepherd		male	Intact	Stray	no	no	no	21-2-2013
Rocky	TB6412	2,25	Crossbreed	Rottweiler	male	Intact	Stray	no	no	yes	26-3-2013
Charlotte	TB6425	3,33	Border Collie		female	not-intact	Stray	no	yes	no	1-4-2013
Juul	TB6429	7,33	Crossbreed	Jack russellterrier	female	Intact	Stray	no	yes	yes	3-4-2013
Milo	TB6374	1,25	ShihTzu		male	Intact	Stray	no	yes	no	18-3-2013
Hely	TB6097	1,83	GermanShepherd		female	Intact	Stray	no	no	no	6-4-2013
Lex	TB6092	5,25	BelgianShepherd		male	not-intact	Relinquished	no	no	yes	10-4-2013
April	AM29861	0,50	American StaffordshireTerrier		female	Intact	Stray	no	no	yes	15-4-2013
Woolie	AM29863	1,00	Crossbreed	Dutch Barge Dog	female	Intact	Stray	no	no	no	16-4-2013
Knoet	AM29853	0,33	AlaskanMalamute		male	Intact	Crisis	no	no	yes	13-4-2013
Jip	DB10138	2,83	Crossbreed		male	Intact	Relinquished	no	no	no	23-4-2013

Emma	DB10137	0,83	Crossbreed	Jack russellterrier	female	Intact	Stray	no	yes	yes	13-4-2013
Kimberly	DB10134	3,00	Crossbreed	ShihTzu	female	Intact	Stray	no	no	yes	9-4-2013
Capri	DB10118	1,50	BelgianShepherd		male	Intact	Stray	no	yes	yes	27-3-2013
Saba	TB6303	2,33	Crossbreed	Cane Corso	female	Intact	Stray	no	no	yes	18-2-2013
Qx3	TB6453	3,33	Crossbreed	Shepherd	female	Intact	Stray	no	no	no	16-4-2013
Envy	TB6473	2,33	Crossbreed	Jack russellterrier	male	Intact	Stray	no	no	yes	23-4-2013
Luus	TB6447	1,33	Fox Terrier		female	Intact	Stray	no	yes	no	29-4-2013
Dummie	AM29868	0,33	American StaffordshireTerrier		male	Intact	Stray	no	no	yes	19-4-2013
Jack	TB6472	7,75	Jack Russell Terrier		male	not-intact	Relinquished	no	no	yes	23-4-2013
Qx4	TB6475	6,33	Schipperke		male	not-intact	Stray	no	no	yes	24-4-2013
Jemma	TB6484	unknown	Siberian Husky		female	Intact	Stray	no	no	yes	unknown

Appendix 2. Ethogram

Aggressive behaviour

Behaviour	Description	Abbreviation
Direct staring	Staring directly at stimulus. Often accompanied by a slight widening of pupils(no whites) and freezing.	DS
Piloerection	Rising of hair on neck, hindquarters and back.	PI
Stiff Posture	Stiffening of the body. Muscles are tense.	SP
Barking	Short bark directed to stimulus	BA
Growl-barking	Barking prior with and interspersed with growling directed to stimulus	GB
Growling	Low, buzzing vocalization	GR
Pulling up lip	Tightening of the muscles in the lip causing them to slightly pull up, teeth are not visible	PU
Baring Teeth	Upper lip is pulled up, teeth are visible	BT
Snapping	A quick, snapping movement directed to the stimulus. Mouth opens and closes, teeth might be visible, and dog might be barking or growling. Dog does not move more than 1 step.	SN
Attacking	Quick maximal forward movement (may not always be possible in test situation, but moving more than 1 step), open mouth, dog might bite. Can be accompanied with growling/barking.	AT
Biting general	Dog actually bites. Biting in hair or clothing of the test evaluator/helper is also considered as biting.	BG
Biting in play	Biting during play situation. Soft bite.	BP

Unruly behaviour

Behaviour	Description	Abbreviation
Jumping up	Jumping movement towards test evaluator/helper. Paws extended and often pressed against stimulus.	JU
Pulling the Lead	When on a leash, dog lunges ahead pulling the leash. Scored when leash is tight for a minimum of 3seconds.	PL
Excessive Vocalization	Barking or whining for more than 3seconds.	VO
Poor Command Responding	Dog does not respond to command given by test evaluator or helper within 3 seconds.	CR
Mounting	Dog mounts (/tries to mount) test evaluator/helper. Can be accompanied by grasping. Paws are not extended, but try to grasp the test evaluator/helper	MO
Concentration	Dog makes eye contact with test evaluator/helper for 3 seconds	CO