



Case Report

Volume 12 Issue 2 - June 2019  
DOI: 10.19080/JDVS.2019.12.555835

Dairy and Vet Sci J

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# Comparison of the Social Behaviour of Intact and Neutered Female Domestic Dogs (*Canis Lupus Familiaris*): Questionnaires and Case Studies



Lorenz Kristin Petra<sup>1</sup>, Kolkmeier Carina Anna<sup>2</sup> and Gansloßer Udo<sup>1,3</sup>

<sup>1</sup>Institut für Spezielle Zoologie und Evolutionsbiologie mit Phyletischem Museum, Friedrich-Schiller-Universität Jena, , Germany

<sup>2</sup>Department of Zoology, Institute for Behavioral Biology, Universität Osnabrück, Germany

<sup>3</sup>Zoological Institute and Museum, Universität Greifswald, Germany

Submission: May 23, 2019; Published: June 07, 2019

\*Corresponding author: Kristin Petra Lorenz, Institut für Spezielle Zoologie und Evolutionsbiologie mit Phyletischem Museum, Friedrich-Schiller-Universität Jena, Erbertstraße 1. 07743 Jena, Germany

## Abstract

In close contact between dogs and humans' undesirable behaviours pose a lot of problems. Neutering is often used as the method of choice, whether to prevent dogs from reproduction, to reduce all behaviours associated with reproduction, to prevent diseases or to alter undesirable behaviours, without taking the impact on behaviour into consideration. To point out differences in personality and general behaviours of intact and neutered female dogs, these behaviours were compared in this study by evaluating questionnaires. 180 personality questionnaires and anamnesis questionnaires, provided by the behavioural consultancy "Einzelfelle", completed by owners of female dogs were evaluated. It was possible to compare the personalities of intact and neutered female dogs, with intact female dogs being significantly calmer (Mann-Whitney-U-Test (MWU):  $W=5477.5$ ,  $p=0.009$ ), more trainable (MWU:  $W=5842.5$ ,  $p=0.000$ ) and sociable towards dogs (MWU:  $W=5483.5$ ,  $p=0.010$ ) and neutered female dogs tending to be less bold than intact ones (MWU:  $W=5208.5$ ,  $p=0.060$ ). Based on questionnaires neutered female dogs are more anxious (G-Test:  $G=8.470$ ,  $p=0.004$ ) and nervous (G-Test:  $G=6.928$ ,  $p=0.009$ ), tremble more often (G-Test:  $G=13.299$ ,  $p=0.000$ ), and are more aggressive towards humans in general (G-Test:  $G=5.351$ ,  $p=0.021$ ), humans of the same household (G-Test:  $G=6.502$ ,  $p=0.011$ ) and towards specific objects (G-Test:  $G=5.85$ ,  $p=0.016$ ). The results of this study based on questionnaires have shown that behaviour differs between intact and neutered female dogs. The effects of castration on the behaviour should be considered when deciding whether to neuter a dog.

**Keywords:** Neutering; Female Dogs; Social Behaviour; Personality Questionnaires; Case Studies

## Introduction

It is not only important in handling free ranging and zoo animals, but in dealing with domestic animals as well. Especially in domestic dogs, however, expectations of behavioural improvement after castration often lead to a decision to neuter a dog [1,2]. There are different possibilities of contraception, but in pet's sterilization and castration are the most frequently used methods. Among pets, especially the dog has become important to humans. The domestic dog (*Canis lupus familiaris* Linnaeus, 1758) accompanies humans for more than 30,000 years [3,4]. The dog was adapted more and more to the life with and alongside humans [5]. Today, many dogs no longer serve in their original tasks, but live with humans as a family member or a companion, at least in western societies [6]. Due to the changed role of the dog and the coexistence in immediate proximity it is immensely important to know and understand behaviour, nature and needs of dogs [7].

Scientists are largely in agreement that the loss of sexual hormones through neutering affects the body [8-11], but

behaviour also changes as a result of the loss of sexual hormones. As Niepel has shown, dogs are often neutered to improve their behaviour [2]. However, most authors agree that a specific change in behaviour through neutering cannot be reliably achieved and neutering therefore should be rejected without specific indication [1,2,12]. It appears to be more successful for reliable behavioural changes in other species than dogs, such as horses [13,14]. In addition to the observable behaviour, changes in personality must also be considered when comparing intact and neutered dogs. In a review that included 51 publications published between 1934 and 2004, Jones and Gosling were able to highlight seven personality traits for dogs: Reactivity, Fearfulness, Activity, Sociability, Responsiveness to Training, Submissiveness and Aggression [15]. In the study by Turcsán et al. [6] a questionnaire was developed, which includes four personality values that coincide with those of Jones and Gosling as well as the "Big Five" of human personality: Dog sociability, trainability (which corresponds to openness in the "Big Five"), calmness that is inverse to the property of

neuroticism, and boldness which is inversely related to the category of fearfulness established by Jones and Gosling 2005. Boldness here is not to be understood as “boldness” like in the shy-bold-supertrait system, used i.a. by Svartberg & Forkman [16], but more corresponds to extraversion in the “Big Five”. The effects of neutering should also include the dog’s personality as it may reveal whether, for example, emotional stability or stress resistance is enough to assume or reject neutering about the loss of sexual hormones and their effects [17]. In previous studies it has been shown that there are differences in the personality of neutered and intact dogs [6,18].

This study was conducted within a series of studies dealing with social behaviour in general, as well as differences between intact and neutered dogs about certain behaviours and personality values. Social behaviour in general should be considered, since this regulates the coexistence between people and dogs as well as dog-to-dog in everyday life. In a previous study the consequences of neutering for male dogs have already been examined [19], so this study focuses on the females. In a previous study, where video recordings were analysed, few significant differences in the social behaviour of dogs were shown [20]. In this study, by means of questionnaire evaluations, the behaviour and personality of intact and neutered female dogs will be compared, expecting significant differences in the behaviour. Especially behaviours related to fear and aggression should differ significantly, since these behaviours are assumed to be affected by sexual hormones.

**Material and Methods**

The study consisted of two parts: Evaluation of personality questionnaires and evaluation of case studies.

**Personality Questionnaires**

In this part of the study personality questionnaires were evaluated, which were developed within a study by Turcsán et al. [6]. This questionnaire contains 24 questions, 17 of which are assigned to the personality traits of calmness, trainability, dog sociability and boldness. Here boldness can be compared to extraversion as one of the five factors of personality and is not equal to boldness used in connection with the shy-bold-concept. Therefore, it is called “extraversion” in the following. Using scores of 0, 1 or 2 for each question an overall score for each trait can be evaluated. A total of 190 questionnaires were analysed. The scores of intact and neutered female dogs were examined for significant differences in each personality trait (calmness, trainability, dog sociability and extraversion). Using Mann-Whitney-U-Test all data were tested two-tailed and the significance level was set to  $\alpha = 0.05\%$ .

**Case Studies**

The case study part was conducted using anamnesis questionnaires from the behavioural consultancy “Einzelfelle”, which is run by zoologist Udo Gansloßer and veterinarian Sophie Strodbeck. This consultancy is contacted by dog owners, who are seeking advice about their dog’s behaviour and health. Therefore, anamnesis questionnaires (English version published by Hoppe

[21] and personality questionnaires identical to the ones above [6] are sent to the owners. Here, information about the diet, the environment, the living and the keeping are collected. The reasons for consultation, some behavioural categories and the level of obedience were considered when evaluating the anamnesis questionnaires for this study (Table 1). The given reasons for consultation were only presented graphically. In contrast, data on behavioural categories compiled from the evaluation of the case studies were statistically analysed by means of a G-test. Therefore, the responses were divided into the categories of “yes” (behaviour observed) or “no” (behaviour never observed).

**Table 1:** Considered behaviours of the anamnesis questionnaires. In addition to the reasons given by the owners for the behavioural consultation and different behavioural patterns were investigated. Listed are the categories and the associated behavioural patterns.

Reasons for Consultation	Multi-Dog Household
	Epilepsy
	Thyroid gland abnormality
	Stress/insecurity
	Panic
	Hyperactivity
	Aggression
	Scent marking
Behavioural Categories	Marking behaviour
	Restlessness
	Dog never gets tired
	Nervous or aggressive behaviour
	Absent-mindedness
	Shaking
	Panting without prior effort or heat
	Excessive licking or scratching
	Stereotypes
	Destroying objects
	Barking, Whimpering
	Not house-trained
	Disruptive pulling on the leash
	Excessive attention-seeking behaviour
	Aggression against other dogs
	Aggression against humans
	Aggression against humans of the same household
Aggression against other	
Fear	General fear
	Afraid of something
Obedience	Hunting
	Down
	Sit
	No

For the evaluation of obedience, the owners could choose between three categories: “works reliably”, “works often” and “works rarely”. The values one to three were allotted to these

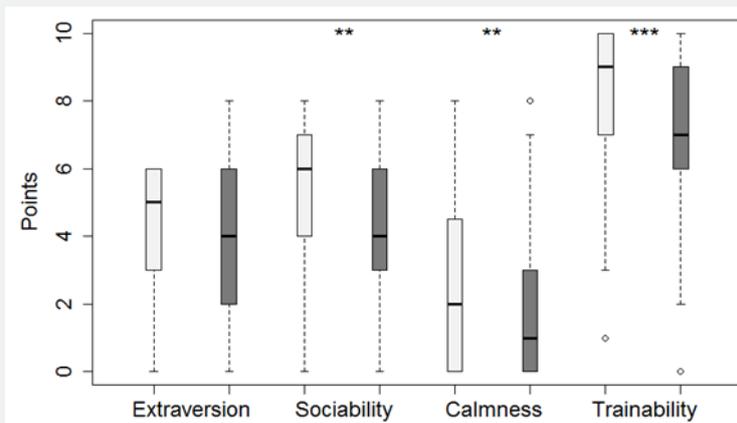
categories with three working out reliably. The data were analysed using the Mann-Whitney-U-Test, tested two-tailed and the significance level was set to  $\alpha = 0.05\%$ .

**Results**

**Personality Questionnaires**

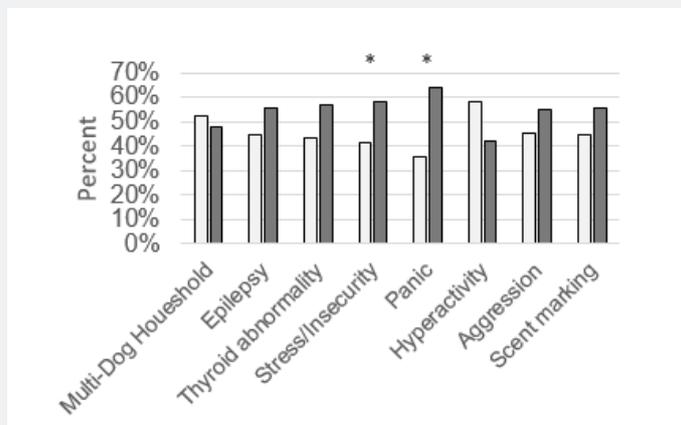
A total of 190 personality questionnaires (95 intact and 95 neutered female dogs) were evaluated and intact and neutered

female dogs were compared regarding the personality traits of Boldness, Sociability, Calmness and Trainability (Figure 1). Intact females scored significantly higher points than neutered ones for Sociability (Mann-Whitney-U-Test:  $W = 5483.5$ ,  $p = 0.010$ ), Calmness (Mann-Whitney-U-Test:  $W = 5477.5$ ,  $p = 0.009$ ) and Trainability (Mann-Whitney-U-Test:  $W = 5842.5$ ,  $p = 0.000$ ). For Extraversion a trend was shown (Mann-Whitney-U-Test:  $W = 5208.5$ ,  $p = 0.060$ ).



**Figure 1:** Boxplots of the personality traits of Extraversion, Sociability, Calmness and Trainability (n=190). Intact females in light grey, neutered ones in dark grey. Significance levels:  $t \leq 0.1$ , \* =  $<0.05$ , \*\* =  $<0.01$ , \*\*\* =  $<0.001$ , Mann-Whitney-U-Test.

**Case Studies**



**Figure 2:** Reasons stated by owners for contacting a consultation. Intact females in light grey, neutered ones in dark grey (n=180). Significance levels:  $t = < 0.1$ , \* =  $<0.05$ , \*\* =  $<0.01$ , \*\*\* =  $<0.001$ , G-Test.

**Table 2:** Results of the G-Test for reasons of consultation, given by the owners. For each reason G-value, number of degrees of freedom and p-value are presented. Significance levels:  $t = < 0.1$ , \* =  $<0.05$ , \*\* =  $<0.01$ , \*\*\* =  $<0.001$ .

Reason	G	df	p-value	
Multi-Dog Household	0.046	1	0.829	
Epilepsy	0.114	1	0.735	
Thyroid abnormality	1.319	1	0.251	
Stress/Insecurity	4.629	1	0.031	*
Panic	5.037	1	0.025	*
Hyperactivity	1.063	1	0.302	
Aggression	0.826	1	0.363	
Scent Marking	1.929	1	0.165	

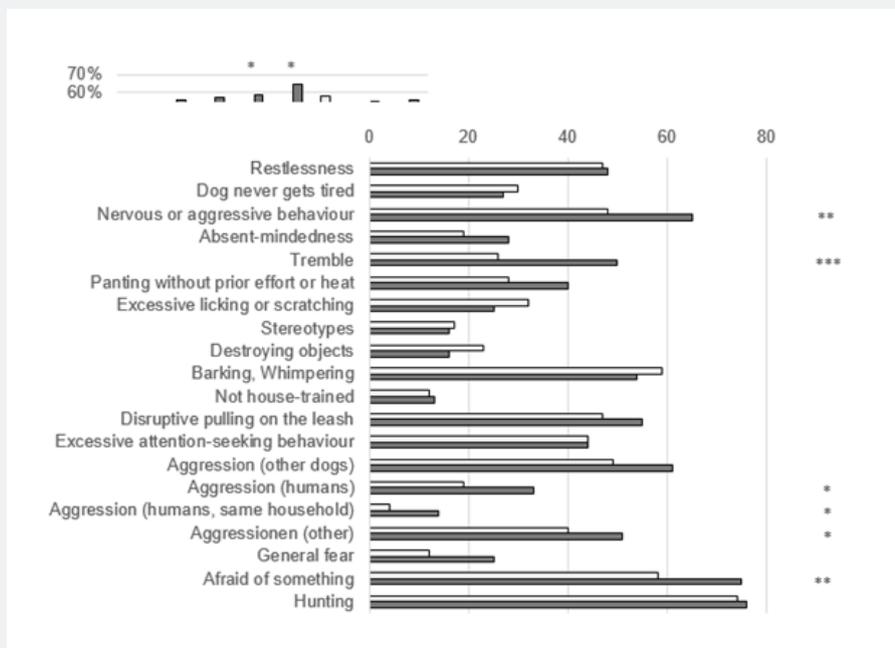
In relation to case studies, a total of 180 anamnesis questionnaires were evaluated (90 intact and 90 neutered female dogs). The reasons for consultation, given by the owners of female dogs, differed about Stress/Insecurity and Panic significantly (Figure 2). No other significant difference was found (see Table 2). In terms of several behavioural categories, taken from the anamnesis questionnaires, significant differences were found (Figure 3, for all results see Table 3). Therefore, neutered dog is more nervous/aggressive, aggressive towards humans in general, humans of the same household and towards specific objects, afraid of something and tremble more often. Moreover, neutered females tend to pant more frequently without prior effort or heat and tend to be more aggressive towards other dogs. Obedience of 100 female dogs, determined by their owners, was compared.

Here no significant difference was found (Figure 4, for statistical results see Table 4).

**Discussion**

One point of criticism that Podberscek und Serpell [12] maintained in their work is that neutering has to be seen more

as a consequence of aggression and less as a reason for it. This influence can be ignored in this study because no owner of a female dog, which was examined during anamnesis questionnaires, had their dog neutered due to behavioral problems, especially with regard to problems with aggression.



**Figure 3:** Number of female dogs showing specific behavioural categories, taken from anamnesis questionnaires (n=180). Intact females in light grey, neutered ones in dark grey. Significance levels: t = < 0.1, \* = < 0.05, \*\* = < 0.01, \*\*\* = < 0.001, G-Test.

**Table 3:** Results of the G-Test for several behavioural categories, taken from anamnesis questionnaires. For each category G-value, number of degrees of freedom and p-value are presented. Significance levels: t = < 0.1, \* = < 0.05, \*\* = < 0.01, \*\*\* = < 0.001.

Behavioural Category	G	df	p-value	
Restlessness	0.022	1	0.881	
Dog never gets tired	0.231	1	0.631	
Nervous or aggressive behaviour	6.928	1	0.009	**
Absent-mindedness	2.343	1	0.126	
Tremble	13.299	1	0.000	***
Panting without prior effort or heat	3.417	1	0.065	t
Excessive licking or scratching	1.260	1	0.262	
Stereotypes	0.037	1	0.847	
Destroying objects	1.611	1	0.204	
Barking, Whimpering	0.595	1	0.441	
Not house-trained	0.047	1	0.829	
Disruptive pulling on the leash	1.450	1	0.229	
Excessive attention-seeking behaviour	0	1	1	
Aggression against other dogs	3.379	1	0.066	t
Aggression against humans	5.351	1	0.021	*
Aggression against humans of the same household	6.502	1	0.011	*
Aggression against other	5.850	1	0.016	*
General fear	2.696	1	0.101	
Afraid of something	8.470	1	0.004	**
Hunting	0.160	1	0.689	

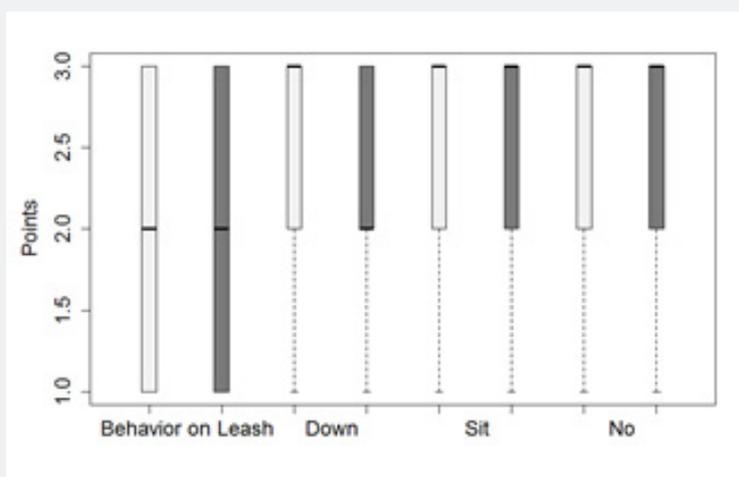
**Table 4:** Results of the Mann-Whitney-U-Test for obedience, determined by the owners of female dogs. For each command W-value and p-value are presented. Significance levels:  $t < 0.1$ , \* =  $<0.05$ , \*\* =  $<0.01$ , \*\*\* =  $<0.001$ .

	W	p-value
Behaviour on the leash	1172.5	0.837
Down	1168	0.456
Sit	1250	0.527
No	1158.5	0.955

### Personality Questionnaires

As here, other studies have shown that neutered dogs are less calm or more nervous than intact ones [6,18,22,23]. In addition to reproductive status, which both Kubinyi & Turcsán [6,18] were able to associate with calmness, the current age and age at acquisition of the dog also influence calmness [18]. Intact and neutered females differed significantly in terms of trainability, which was also shown in another study by Farhooody & Zink [24]. In contrast, Kubinyi [18] found that neutered female dogs are more trainable than intact ones. However, that study found that reproductive status was not one of the biggest influencing factors

[18]. On the other hand, neutering male dogs seems to improve their trainability [19,25]. The authors point out that neutering does not have to be the immediate cause of better trainability but can be indirectly responsible for that [25]. Regarding dog sociability, it could be determined that intact females are significantly more sociable than neutered ones. This is supported by the reasons given by the owners for behavioural consultation, as owners of neutered females more frequently stated stress, insecurity, panic and aggression as problems. Reproductive status could therefore have an indirect impact on sociability. Because of these problems, dealing with other dogs could be impeded. However, Kubinyi et al. [18] related age, sex, training experience, and the time spent with the owner, but less the reproductive status with sociability. About extraversion, neutered and intact females only tend to differ from each other. In one study it was shown that intact dogs of both sexes are generally bolder than neutered dogs [7]. It was found that it is not the reproductive status, but mainly sex, age at acquisition, and training method [6], but also the current age, sex of the owner and the number of other dogs in the household that influence extraversion [18]. Nevertheless, neutering seems to have an indirect effect on this as well.



**Figure 4:** Boxplot of obedience levels, determined by the owners of female dogs. Intact females in light grey, neutered ones in dark grey (n=180). 1 = “works rarely”, 2 = “works often”, 3 = “works reliably”.

### Case Studies

Although dogs are repeatedly neutered due to marking behaviour [17], this study showed that marking behaviour of intact and neutered females did not differ significantly from each other. Other studies are in line with these results [1,19,26,27] and could not find a connection between marking behaviour and sexual hormones [26,27]. Both, in this study and in others, it has been shown that neutered females are significantly more anxious [24,28] and nervous [23] than neutered ones, whereas some other authors did not find a connection between reproductive status and anxiety [1,29,30]. The cause of anxiety and fear, as well as for nervous behaviour, is often stress, which can finally lead to aggression because of anxiety [17]. Responsible for this is the so called “passive stress hormone” cortisol, whose effects are counteracted by sexual hormones [31]. When a drop occurs

in the level of sexual hormones due to neutering, the latter do not counteract cortisol, which promotes stress and increases associated behaviours such as anxiety, fear and nervousness.

A major behavioural complex that is mentioned again and again in connection with neutering is aggression, which can be divided into various forms. Depending on the neural and endocrine bases, triggers and involved structures in the brain vary [32]. Results found here therefore can be very contradictory. In several studies, neutered dogs showed an increased aggression against people [33], against children of the same household [12], against people of the same household [1,33-35], and against other dogs [29]. In general, other authors also found increased aggression of neutered dogs, but did not distinguish the different forms of aggression [24,36,37]. Neutered dogs were also more aggressive in terms of affect control aggression (previously and wrongly

termed “dominance aggression” [38,39] whereby the owner [39,40], the dog’s living conditions and the interactions with the owner [40] had the greatest influence on affect control aggression. Other authors, in turn, did not associate neutering with aggression against people of the same household [12], against other people [12], or against other dogs [1,12]. In general, other studies linked aggression to neutering [22,23,30,41]. Niepel [2] also found that 5% of females were less aggressive after neutering, whereas aggression aggravated in 4% of the females. Heidenberger & Unshelm [29] found mixed results as well: While 52.2% of the dogs were less aggressive after neutering, the behavior did not change in 21.3% and exacerbated to 25.5%. Fewer studies showed a decreased aggression of neutered females [40-44]. The different results for the different forms of aggression indicate a different regulation, i.a. through hormones, as already Hsu & Sun [40] suspected.

Reference is made to a study by van de Poll [45], which showed that the injection of testosterone propionate increased aggression in rats, while estradiol benzoate reduced aggression. Consequently, estrogen could decrease aggression while the absence of estrogen through neutering leads to an increased aggression in neutered females. This could be since estrogen increases the affinity of oxytocin receptors and the number of oxytocin receptors [46]. Oxytocin on the other hand, is an antagonist of cortisol, and reduces stress-related aggression. A similar explanation is provided by Kim [37], who suggest that female dogs become more reactive after neutering either through the loss of the sedative effect of progesterone or because of the increased gonadotropin-stimulated release of androgens from the adrenal gland. Other authors also assume a sedative effect of progesterone but suspect that the behavioural changes are caused by the sudden drop in progesterone levels after neutering [47]. In addition, certain forms of aggression could also be stress-related [17]. As already mentioned above, the stress level is primarily responsible for the increased level of aggression, so that aggression can be explained by the lack of sexual hormones, which should counteract the stress reaction by cortisol.

In addition to these factors that encourage aggression, some elements of aggressive behaviour may be self-rewarding and influenced by learning [48]. Simpson summarized in her study that sexual hormones are only a small part of what influences aggression [48]. This is concurrent with the opinion of many authors who do not consider neutering as a useful tool to prevent aggression and resolve behavioural problems in dogs, as the behavioural changes are not predictable and sexual hormones are only a small part of all factors influencing aggressive behaviour [1,2,12,17]. Furthermore, it should be mentioned that neutered and intact female dogs did not differ in terms of hunting behaviour. Although in one study prey-catching behaviour could be reduced by neutering [43], other authors could not verify this connection [2,41,49,50]. Despite these studies, owners have their dogs neutered to reduce hunting behaviour [17]. “Predatory aggression” used to be considered as a form of aggression [49], but today is regarded as a separate behavioural category called

prey or hunting behaviour. It is seen as independent of aggression and sexual hormones, i.e. because of different regulating brain structures [51].

About obedience intact and neutered females did not differ significantly from each other, although this is often given as a reason for neutering [2]. However, other studies have shown that neutered females are less responsive to commands [24], or neutering does neither improve nor impair obedience clearly [2,29]. In a previous study few differences in social behavior of intact and neutered female dogs were found, when using video analyses [20]. Nevertheless, in this study using questionnaires and a bigger sample size several significant differences were found. Therefore, it would be important to conduct a follow up study using video analyses, again, to support the findings of this questionnaire-based study.

### Conclusion

Results of personality questionnaires and anamnesis questionnaires showed that neutering may change the behaviour of female dogs. Here especially behavioural patterns associated with some forms of aggression or fear are influenced by sexual hormones. Undesirable behaviours like hunting, disobedience and some forms of aggression are stated as a reason for neutering, although this and other studies have shown that a specific change in behaviour through neutering cannot be achieved. Therefore, consequences and benefits of neutering must be weighed, while taking health-wise and behavioural aspects into account.

### Acknowledgements

We would like to thank all the dog owners, who participated in this study, and all the members of our mammalian behavior study group for advices and ideas.

### Conflict of Interest

The authors declare no conflict of interest.

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DOI: [10.19080/JDVS.2019.12.555835](https://doi.org/10.19080/JDVS.2019.12.555835)

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