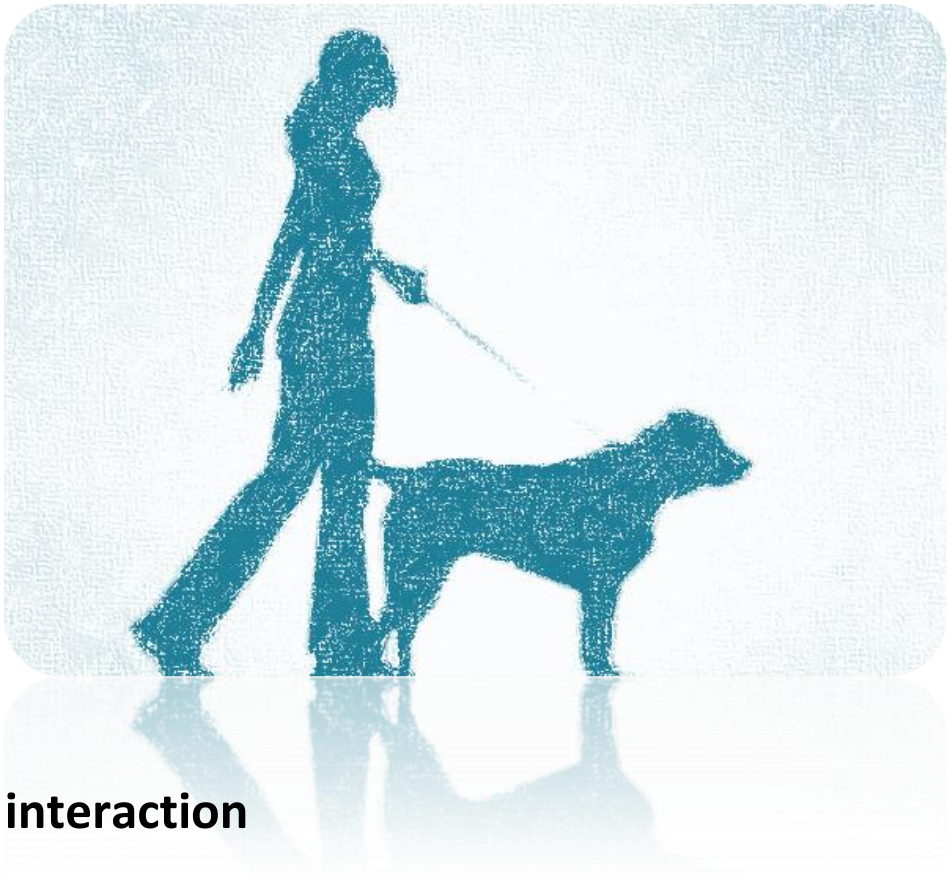

Human-Canine interaction

Active support versus passive support: The influence of type of support given by the owner on the behaviour of the domestic dog (*canis familiaris)* in an approach test.

Major Thesis
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Abstract

Strong emotional responses in domestic dogs (*canis familiaris*) to unfamiliar people or in situations, for example during walks, may increase the risk of dogs biting people. Aggressive behaviour by dogs towards humans is much discussed and has significant consequences for society. The calming effects of dog-owners on dogs could prevent such unwanted responses. However, to what degree owners directly influence their dog's behaviour in situations that may cause tension in the dog is largely unknown. The way dog-owners react in general and interact with their dog will in part be a reflection of their personality whereas a dog's response to signals from its owner will reflect its personality, making the personalities of both dogs and owners relevant when investigating owner-dog interactions. In this research the effect of active support (tactile and vocal) versus passive support (only presence) given by the owner on the dogs' behaviour towards a strange-looking approaching person was investigated. In total 66 dog-owner combinations were tested via an approach paradigm, in which a strange-looking person approaches the dog-owner combination three times, while the owner received an instruction on how to behave during such confrontations. Also characteristics of the owner (using the Five Factor Model of personality and the Monash Dog Owner Relationship Scale) and the dog (using the Canine Behavioural assessment & Research Questionnaire) were taken into account. The behaviour of the dog and the effect of the instruction and the repeated exposure on the behaviour was analysed via multiple restricted maximum likelihood analyses. Owners ignoring the dog seemed to facilitate 'Looking at the stranger', 'Looking away' and 'Boldness' behaviours, indicating a stronger sensitisation for passive avoidance or approach behaviour. However, responses to the degree of social support differed between types of dogs. Relatively, when supported actively by the owner, aggressive dogs seemed to become more aroused and showed more extravert behaviours and fearful dogs showed more active-avoidance behaviour. Thus, when owners gave active support to their dog this reduced conflict-related behaviour towards an approaching person, but effects differed in dogs known to be aggressive or fearful towards strangers in general. In such dogs active support resulted in more aggressive or fear-related behaviour, in comparison to when these dogs received passive support. Social support may attenuate behavioural inhibition in fear-aggressive dogs, facilitating the expression of conflict behaviour like avoidance and aggression.

The personality of the owner had an effect on the behaviour of the dog in that active support given by extravert or conscientious owners reduced the conflict-related behaviour of the dog and active support given by introvert or non-conscientious owners resulted in more conflict-related behaviour. Independently of type of support, dogs of agreeable owners showed relatively high levels of avoidance behaviour and became more aroused with repeated exposure. Dogs of neurotic owners showed relatively much fearful behaviour and those owned by closed people acted less calm towards the approaching person. Owner-dog relationship also had an influence on the effect of active support. Active support given by owners who reported having a good emotional bond with the dogs had a stronger conflict-reducing effect than active support given by owners who had weaker emotional bonds, however former these dogs did respond with more unease as compared to the passive support, which could be linked to behavioural inhibition release. Also a strong opposite of the proposed effect of active support was seen when the dog was seen as costly.

Results produced by this type of studies could be used in the future to give advice to dog owners in how to respond in future threatening situations. Preliminary results indicate that giving active support is a good way to reduce the emotional responses in dogs confronted with unfamiliar people. However, if the dog is known to be aggressive or fearful, then it might be better for the surrounding people to ignore the dog, otherwise the reduction of stress might disinhibit unwanted responses of

the dog. It is also seen that personality of the owner and the bond the owner has with the dog has an effect on the behaviour of the dog and how the dog responds to support. Thus dog-owner interaction is important in understanding the dogs' behaviour and should be included in the investigation towards reducing problem behaviour in dogs.

Samenvatting

Sterke emotionele reacties van de domesticeerde honden (*canis familiaris*), bijvoorbeeld tijdens het uitgelaten, kan het risico tot hondenbeten vergroten. Agressief gedrag van honden is een veel besproken onderwerp en heeft significante consequenties voor de samenleving. Het rustgevende effect van eigenaren op honden kan een manier zijn om deze ongewenste reacties tijdens het uitlaten te verminderen, maar op welke manier de eigenaren het gedrag van hun hond direct beïnvloeden in situaties die druk veroorzaken, is grotendeels onbekend. De manier waarop eigenaren reageren en omgaan met hun hond zal gedeeltelijk een weerspiegeling zijn van hun eigen persoonlijkheid en de manier waarop hun hond reageert op de signalen die de eigenaar afgeeft zal de honds' persoonlijkheid weerspiegelen. Hierdoor is het van belang om de persoonlijkheid van de honden en de eigenaren te onderzoeken tijdens het bekijken van hond-eigenaar interacties. In dit onderzoek werd het effect van actieve steun (via aanraking en woorden) versus passieve steun (alleen aanwezigheid) gegeven door de eigenaar, op het gedrag van de hond richting een vreemd uitziend tegemoetkomend persoon onderzocht. In totaal waren 66 hond-eigenaar combinaties getest via een benaderingsparadigma. De vreemd uitziende persoon liep drie keer richting de hond-eigenaar combinatie, terwijl de eigenaar een instructie kreeg om op een bepaalde manier te reageren. Daarnaast zijn de persoonlijkheidskenmerken van de eigenaar (via Five Factor Model), de hond-eigenaar relatie (via Monash Dog Owner Relationship Scale) en kenmerken van de hond (via Canine Behavioural assessment & Research Questionnaire) meegenomen in de analyse. Het gedrag van de hond en het effect van de instructie en herhaalde blootstelling op het gedrag was geanalyseerd via multiple restricted maximum likelihood analyses. Het negeren van de hond faciliteerde het kijkgedrag naar de onbekende persoon, het wegkijken en proactieve gedragingen. Dit laat een sterkere sensitisatie voor vermijding of benaderend gedrag zien. Maar agressieve honden lieten juist meer opgewonden en extraverte gedragingen zien en angstige honden juist meer actief vermijdingsgedrag als ze actief gesteund werden. Vanuit de resultaten van dit onderzoek kan de conclusie worden getrokken dat het geven van actieve steun een vermindering van conflict-gerelateerd gedrag richting een benaderende persoon veroorzaakt. Dit effect is echter anders als de hond bekend staat om zijn agressiviteit of angst richting vreemde personen. In dat geval resulteerde de actieve steun juist in agressief of angst-gerelateerd gedrag. Dit kan verklaard worden met dat sociale steun gedragsmatige inhibitie in angst-agressieve honden verminderd, waardoor de uiting van conflict gedragingen zoals vermijding en agressie mogelijk wordt.

Daarnaast laten de resultaten zien dat persoonlijkheid van de eigenaar een invloed heeft op het gedrag van de hond, op de manier dat actieve steun resulteert in minder conflict-gerelateerd gedrag van de honden van extraverte of consciëntieuze eigenaren. Dit effect was andersom voor honden van eigenaren die niet consciëntieus of introvert waren. Ook bleek dat honden van meegaande eigenaren meer vermijdingsgedrag laten zien en meer opgewonden raakte bij herhaalde blootstelling en honden van gesloten eigenaren waren minder kalm naar de tegemoetkomende persoon toe. Hond-eigenaar relatie had ook een invloed op het effect van actieve steun. Actieve steun gegeven door eigenaren die een goede emotionele band hadden met hun hond, gaf een sterker conflict-

reducerend effect, dan actieve steun gegeven door eigenaren die een minder goede band hadden. De honden bleken wel meer ongemak te vertonen in vergelijking met de honden die genegeerd werden. Dit laatste is mogelijk te verklaren door een verlichting van de gedragsmatige inhibitie. Het tegenovergestelde effect van actieve steun was te zien als de hond gezien word als een kostenpost.
De resultaten van dit onderzoek kunnen in de toekomst worden gebruikt om advies te geven aan eigenaren betreffende hun eigen reactie in een toekomstige bedreigende situatie. Voorlopige resultaten geven aan dat actieve steun een goede manier is om ongewilde reacties van de hond richting onbekende personen te verminderen. Echter als de hond bekend staat om zijn agressieve of angstig gedrag, dan is het verstandiger om de hond te negeren, anders kan de vermindering van conflict leiden tot meer ongewilde reacties van de hond richting de omstanders. Persoonlijkheid van de eigenaar en de relatie tussen de eigenaar en de hond bleken ook een effect op het gedrag van de hond en het effect van steun daarop. Hond-eigenaar interactie is dus ook van belang in het onderzoek naar het gedrag en het verminderen van probleem gedrag van de hond.

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Dog-owner interaction

Inappropriate emotional responses of domestic dogs (*canis familiaris*), e.g. during walks, may lead to bites, and this phenomenon may have significant consequences for society. People may get serious injuries and sometimes these injuries even lead to fatalities (Cornelissen & Hopster, 2010). Cornelissen and Hopster (2010) performed a survey among Dutch citizens and found that most dog-related biting incidents involve dogs in public areas with non-owners being the victims, and that these bites typically appeared to be intentional and without clear triggers. Owners are likely to affect their dogs' behaviour and they may (unintentionally) play a role in their dogs' unwanted responses, and thus owner behaviour is a potential source to reduce the number of dog bites. One way this owner-dog relationship can possibly reduce the number of dog bites is by reducing the stress of the dog during encounters with other dogs and humans by providing social support. The effect of owner provided social support in conflict situations is not yet researched, but the calming effects of human presence on animals has been reported for different situations and species (including dogs).

1.1 Anxiolytic effects of human support

Humans can have calming (anti-anxiety) effects on other humans, for example resulting from a parent-child bond. Wolfram and Turner (1996) investigated the effect of the presence of the parent on children subject to a venipuncture procedure. Both the parent and the child had to indicate their level of distress right after the procedure using a 10cm visual analogue scale. Both parent and child indicated to experience less distress when the parent was present. Not only does the presence of the parent have an anxiolytic effect, but they also serve as a social reference for the infant. Infants use emotional expressions of the parent in order to regulate their own emotional response. This was tested by De Rosnay et al. (2006), who instructed mothers to interact with a stranger in a socially anxious manner and in a non-anxious manner, without directly interacting with their child. First the stranger interacted with the mother and after 90s they interacted with the child while the mother ignored the interaction. The results showed that children (between 12 and 14 month old) were more fearful towards the stranger and avoided that person more, when the mother previously interacted anxiously towards this same person. Children also look at the parent's expression in uncertain situations (e.g. a novel toy) (Mumme et al., 1996; Vaish & Striano, 2004). When the emotional vocal expression of the parent is then fearful, the child is more hesitant to approach the toy. In this experiment negative vocal expression showed a strong effect on the behaviour of the child, but neutral or positive expression did not (Mumme et al., 1996). The authors did not find an effect of the mothers' facial expressions on the children's reactions. Vaish and Striano (2004) investigated the effect of vocal versus facial expressions via a visual cliff paradigm. The children were placed on a table of which a chequered pattern created a visual illusion of a 28cm deep cliff between the child and the mother. Then the child was given positive cues by the mother (vocal cues, facial cues and a combination of the two) to cross. They also found that vocal cues were more effective in convincing the child to cross a (imaginable) cliff (as in shorter latency to cross). However the children also crossed the cliff based on facial cues only, which is not consistent with the findings of Mumme et al. (1996). In other experiments using the visual cliff paradigm the facial cues were also evident. An explanation of this could be that the visual cliff paradigm is more threatening than the novel toy and the children will thus use also facial cues instead of focusing only on vocal cues (Mumme et al., 1996; Vaish & Striano, 2004).

Humans do not only have anxiolytic effects on other humans, but effects also exist between humans and animals. An example of this is an experiment based on the Ainsworth's Strange situation procedure. In this procedure the behaviour of the dogs was examined when they were in an unfamiliar room with their owner. After a while a stranger entered the room and the owner left, returning after a short time. This experiment showed that when the owner was present the dog explored more and played more with the stranger, than when the owner was not present. According to the researchers the presence of the owner served as a secure base in which the dogs could explore the environment. This experiment was counterbalanced for the order in which treatments were applied so the results are not because of habituation (Palmer & Custance, 2008; Valsecchi et al., 2010).

Anxiolytic effects in dog by their owner's presence (Palmer and Custance 2008, Valsecchi et al. 2010) implies an extensive familiarization period, but the study of Rault et al. (2011) demonstrated that shorter periods of familiarization can be effective too. They familiarized lambs to a person and during a subsequent experiment isolated a lamb from groups consisting of two or three individuals. These individuals could consist of lambs alone or one lamb was replaced with the familiar human. The results showed that the remaining group perceived the absence of a group mate less stressful (less vocalizations) when originally they were together in a group of three than when they were in a group of two. Whether this group consisted of two sheep and a human or three sheep did not affect the response of the sheep. According to Rault et al. (2011) this implies that the person can replace another sheep when looking at the support the group can give. Comparable results were reported in pigs (Bolhuis et al., 2006). Pigs were constrained and tested for heart rate, cortisol levels and behaviour. During this constraint test a familiar pig, familiar human or nobody was present. The results showed that the pigs with a human companion showed less escape behaviour, were less alert and defecated less than when they were alone. Also heart rate was lower in the groups that were provided social support.

The above mentioned studies were all about the effect of human presence only, and it is thus unsurprising that human handling affects fear-related behaviour in animals. In an experiment of Waiblinger et al. (2004) it has been shown that gentle handling of cows by a familiar handler during veterinary procedure reduces restless behaviour and lowers increases in heart rate. During the veterinary procedures (e.g. rectalisation and sham insemination) the handlers, whom the cows were previously familiarized to, petted the cow and spoke to them in a soothing way. This was also done by one of the caretakers and an unknown person. The heart rate increased during the tests in general, but less so when they were stroked during the treatment by a familiar person. Also, the cows showed less restless behaviour. Stroking by a familiar person thus seems to be perceived positively by animals at times of stress. These effects were not seen when the unknown person or one of the caretakers petted the cow, indicating the importance of the bond between animal and person. A similar result is found in an experiment with dogs (Hennesy et al., 1998). People were instructed to stroke the dog gently and speak to it in a soothing tone for 20 minutes. This petting session was preceded and followed by the collection of blood. During the collection of the blood the person that petted the dog previously was not present. It appeared that the cortisol levels of the dogs that were petted increased less than when they were not petted in between the blood collection. In an earlier experiment, Hennesy et al. (1997) found that there was a difference of effect between female and male petters, with only females being are able to reduce the increase in stress. When they trained the men to pet the dogs like the females did the gender effects disappeared

(Hennesy et al., 1998). The difference in response of the dog towards the gender thus appeared to be a direct response to the person's behaviour (Hennesy et al., 1998).

Thus humans have calming effects on animals during a specific short stressful event. However human contact can also reduce stress during a longer period than the actual time of interaction or presence. This was shown in shelter dogs that received a human contact session (Coppola et al., 2006). This session (on day 2 of arrival) took place in different places (inside kennel, visitation room and outside). The human played and walked with the dog, gave commands and rewarded the dogs. They also had verbal and tactile contact with each other. The session took around 45 minutes. Saliva cortisol levels were measured on the day after the contact session) and days 3, 4 and 9. The results showed that there was a peak in stress, indicated by a higher saliva cortisol level, on day 3 from arrival in the kennel environment for dogs that did not receive a human contact session. Dogs that received this session did not experience this peak (Coppola et al., 2006). Bergamasco et al. (2010) also looked at the effect of a human contact session in shelter dogs. They tested dogs that were potentially suitable for adoption (thus highly socialized towards humans). They performed the human interaction session, which was similar as in the experiment of Coppola et al. (2006), for 25 minutes for three days over 8 weeks. The results of behavioural temperament test showed that the dogs were more sociable and showed a better temperament.

The effect of human contact does not only have to be in the context of a stressful event and in general beneficial effects are found. Handlin et al. (2011) put the owner and the dog in a room and the owner petted the dog for 3 minutes. The rest of the hour the owner was instructed to ignore the dog physically but verbal contact was allowed. The control group consisted of owners sitting in the room without a dog. The oxytocin levels of the dog increased in the three minutes of contact and the heart rate lowered. Also the owners' heart rate was lower after 55 minutes than at the start of the experiment. The heart rate of the human controls did not change. The cortisol levels of the owners were also lower after 15 minutes of interaction as compared to the control group.

1.2 Anxiolytic effects of animals on humans

The lowered heart rate and cortisol levels of the owners in the experiment of Handlin et al. (2011), as explained in the previous section, is an example of the anxiolytic effect of animals on humans. This shows how calming effects of human-animal interactions work in both directions. This is also seen in the experiment of Shiloh et al. (2003). Petting animals reduced anxiety in humans when they believed that they were about to hold a tarantula spider. The participants were asked to indicate how anxious they were at the time as well as their attitude towards animals. While waiting to hold the spider, the participants were asked to hold and pet an animal or a toy animal. The reducing effect was only shown when they were asked to pet a living animal thus the effects were not restricted to the mere movement of the petting. The effects were not linked to the subject's attitude towards animals. This effect may also have an indirect effect to the dog. If the owner is less anxious when petting the dog, the dog might be less anxious too.

1.3 Communication between dogs and owners

Communication between dogs and owners seems to be relatively good compared to that between humans and other animal species. Dogs show better skills in reading human communicative behaviour than animals that are genetically closer to humans (primates). When humans look or point towards the location where something is hidden, the dogs were able to find these items by

interpreting these signals (Agnetta et al., 2000). Chimpanzees, however, were not able to use this skill in a similar experiment (Call et al., 2000). Dogs also adjust their behaviour to cues given by the human when faced with a problem (Horn et al., 2012). The dogs in this experiment were asked to solve a puzzle; however the puzzle was for instance blocked, so that the dog was not able to solve it. The owners, which received an instruction during a training phase, were present in the room during this problem. The instruction was either to encourage the dog when they looked at them or not (only vocally) during the test phase, but not during the test phase. All dogs looked at the owner when they were faced with the problem; however dogs that were previously encouraged looked longer at the owner during the test phase, than dogs that were not encouraged. Thus the behaviour of the owner also influences the dogs' use and reliance on human communication signals.

Not only gaze is important in the dogs' reactions to human communication, but also the facial expression (Guo et al., 2009). Dogs were shown images of faces of humans, rhesus monkeys, other dogs and objects. These images were upright or inverted. Eye and head movements demonstrated that dogs looked more at the left side of the face (right hemiface) of the human and they looked in general more to the upright face of the human, like humans do when observing each other and this effect is not shown in the other species faces or when viewing objects. Recognizing the emotions are biological important in survival (Guo et al., 2009). A possible explanation for the left gaze bias was found by Indersmitten and Gur (2003). They analysed the efficiency of recognition of hemifaces. They constructed a large amount of images of faces which express certain emotions. These faces were rotated laterally, vertically and medially to investigate which area shows the emotions the best. Viewers needed to score the images. It is shown that the most efficient recognition of emotions is seen in the right hemiface of the image. Apparently the right side of the face shows the emotions more accurately, in contrast to the higher intensity of the expressions in the left hemiface.

The use of gaze and facial expression to interpret owners' behaviour is thus better developed in dogs than in other animals. Hare and Tomasello (2005) discussed that the domestication process of dogs is responsible for these kinds of skills. They made this interference on the basis that foxes selected for the tameness towards humans show the same communicative skills and hand-reared wolfs do not. Also they mentioned that these skills are not learned because young puppies already show this ability. These good social skills in dogs reflect the dog's sensitivity to human communication, which is stronger as compared to humans and other species. Therefore, there might be an indication that the previous described calming effects of positive human presence / contact may be stronger between owners and their dogs as compared to humans and other species.

1.4 Effect personality of owner and perceived owner-dog relationship on the dogs' behaviour

Personality is one of the characteristics that influences a person's reaction in a stressful situation. Ebstrup et al. (2011) related scores on a Perceived stress scale (questionnaire) with the personality scores of healthy adults and found that neurotic humans perceive a similar situation more stressful than humans that score low on Neuroticism. The dimensions Extraversion and Conscientiousness showed a moderate negative relationship with perceived stress. This effect was also seen in Agreeableness but not for Openness. This shows that people with different personality view a similar situation as more or less stressful (Ebstrup et al., 2011). This will have an effect on the actual behaviour of the person. In the foregoing discussion it has been argued that dogs use their owners as information source when faced with a novel / challenging situation and this makes it likely that the

owners' reaction to this problem situation influences the dogs' reaction. However, little scientific research has been done to confirm this or quantify such possible effects.

The way owners behave towards their dog will in part reflect their personality, but so far research focusing on the influence of characteristics of the owner on the dogs' behaviour mainly involved characteristics like gender, living condition and experiences with dogs (Řezáč et al., 2011) and not personality. Podberscek and Serpell (1997) did investigate the link between owners' personality and the behaviour of their dog, to be specific the link between personality based on the Catell 16 Personality Questionnaire and aggressive behaviour in English cocker spaniels. They found a relationship between aggression in dogs and the owner characteristics tension, emotional instability and shyness. Also undisciplined owners have more aggressive dogs (Podberscek & Serpell, 1997). Translating these results to the personality factors according to the five factor model, it could be said that high Neuroticism and low Conscientiousness score are related to aggressive dogs. Whether this relation is cause or effect is not clear. It could thus be that owners become more anxious when having an aggressive dog or that the dog becomes aggressive because the owner is behaving in a certain way (Podberscek & Serpell, 1997). This match might have a negative result on the perceived relationship the owner has with the dogs. Thus, there is some evidence for dog-owner personality traits reflecting in the dog's behaviour, but relevant data are scarce and the present study aims to contribute in addressing this gap.

1.5 Effect repeated exposure to stressor

So far, the positive effects of human support on the behaviour of the dog during the first exposure to anything new have been discussed. However it is likely that a dog-owner combination sometimes encounters the same person during a walk, thus it is of interest to investigate the effect of repeated exposure on the effect of human support. The simplest form of learning is habituation (or in the opposite direction, sensitization). This refers to the decrease in responsiveness towards a stimulus which becomes familiar (Gleitman et al., 2004). This type of learning does not involve any positive or negative relations with the stimulus, thus the animal learns that the stimulus is not worth responding to. In an experiment of Górecka et al. (2007) the effect of habituation to a frightening stimulus (opened umbrella) was investigated. They led each individual horse in a paddock and let them walk freely without a handler. Then their response to an opening umbrella was analysed during 5 consecutive days. The heart rate of the horse and the percentage of vigilant standing were lowered with repeated exposure, thus indicating habituation. This experiment was also repeated with the difference that the handler stayed with the horse during the exposure. They then found that the horses were more willing to approach the umbrella than when the handler was not present. This indicates that habituation may even be facilitated by human support. Even though Górecka et al. (2007) found that human support facilitated habituation, one can also argue that learning via conditioning would occur when animals are given human support. When behaviour is rewarded via positive reinforcement (a positive stimulus is added in response to a given behaviour) or negative reinforcement (the aversive stimulus is taken away) then the occurrence of that behaviour will intensify. This is a form of operant conditioning (Gleitman et al., 2004). When arguing based on operant conditioning it would be expected that human support intensifies the behaviour expressed during the support. When an animal responds in a stressful manner, then support will result in more stress-related behaviours. The other way around is also true, when the owners support at the moment the dog did not respond in a stressful manner, than the dog will become calmer with

repeated exposure. Which type of learning occurs when a dog-owner combination encounters an unfamiliar strange person during walks, is however not clear. The manner in which learned responses are shown in different situations also depends on the type of stimulus. The more the stimulus differs from the original stimulus the weaker the learned response will be (Gleitman et al., 2004).

1.6 Current study

To summarize there are several positive effects of human support on the behaviour of the dog in general and in stressful situations. However it is not clear how this effect influences the owner-dog interaction, during for example walks, and if social support (tactile and verbal) provided by the owner can thus be a way to reduce aggression in dogs. Also the influence of certain characteristics of owners (personality and perceived owner dog relationship) on this process is not clear and here we want to investigate this.

In the present study, the effect of support by the owner on the dogs' reaction to threats is investigated. The owners are instructed to ignore the dog (passively) or to support the dog (actively) while they are approached by an unfamiliar strange-looking person. Social support might be seen as a positive reinforcement which will result in a higher frequency of the performed behaviour, or the 'strange person' stimulus might be seen as less threatening because of the stress reducing effects of support. Based on the literature it is hypothesized that active support reduces the response of the dog towards the approaching person. The main research question can be divided into two parts.

> *Is there an effect of the type of support given by the owner to the dog on the dogs' reaction towards an unfamiliar approaching person and does it change with repeated exposure to the latter stimulus?*
>
> Are *the effects of support mediated by characteristics of the dog (aggression and fear scores) and owner (personality and dog-owner relationship)?*

Based on the characteristic of learning, it can be hypothesised that the response of the dog towards the unfamiliar approaching person changes, when the characteristics of this person changes. To test this, a sub question will be added.

> *Is there a difference in the behaviour of the dog when the behaviour and appearance of the approaching person changes?*

The results of this experiment will give more insight in the owner-dog interaction and the results may be used to give advice to dog owners on how to respond in situations where an unfamiliar person approaches their dog.

2. Material and Methods

In order to investigate the effect of social support on the behaviour of the dog towards an unfamiliar approaching person an animal experiment was conducted, by creating a situation which simulates a walk. A strange-looking person approached the owner and the dog, while the owner was instructed to react in a certain way. The same procedure was done three times for each owner-dog combination. The fourth time the behaviour of the approaching person was changed to get an answer on the sub question of this research.

2.1 Participants

To recruit owners and their dogs, dog owners were contacted via flyers, advertisements in different newsletters (e.g. Dogvision or Nederlandse vereniging voor honden opvoeding en opleiding) and on websites. Via this method the owners were asked to fill in an online recruitment questionnaire. This questionnaire contained general questions about the owner, dog, behaviour of the dog and living conditions. Dogs younger than 1.5 years were excluded from this experiment. From the remaining volunteers, in total 69 dog-owner combinations were randomly selected and invited to come to Wageningen. Of these combinations, 66 of them were used for analysis because of disturbances during the three repetitions of the tests. For three of the combinations, trial 4, in which the behaviour of the approaching person changed, was not executed. Of the owners, 95 percent was female and 5 percent male. The distribution of sex of the dogs was as follows: 44.6 percent was male (of which 53 percent castrated) and 55.4 percent female (of which 69 percent castrated). The average age of the dogs was 4.92 (S.E.M = 0.31) and different breeds of dogs were tested (see table 1).

Table 1 Distribution of breeds. Descriptions as given by Fédération Cynologique Internationals (www.fci.be)

FCI Standards Group	Description	# dogs
1	Sheepdogs and Cattle Dogs (except Swiss Cattle Dogs)	17
2	Pinscher and Schnauzer - Molossoid Breeds - Swiss Mountain and Cattle Dogs	10
3	Terriers	2
4	Dachshunds	0
5	Spitz and Primitive types	10
6	Scent hounds and Related Breeds	2
7	Pointing Dogs	4
8	Retrievers - Flushing Dogs - Water Dogs	13
9	Companion and Toy Dogs	1
10	Sight hounds	1
-	unknown breed	6

2.2 Procedure

The tests took place from 14 November until 23 December 2011 outside on the premises of Wageningen University. Tents were placed to eliminate weather influences as much as possible; however halfway during the testing period there was some storm damage, which forced us to remove the tents. The testing took then place in the same test area only now the surroundings were more open. Owner-dog combinations participated in multiple tests (of other researchers of Wageningen University) lasting a maximum of 2 hours. The owners and dogs came by car from various cities across the Netherlands. After arriving, the owner was asked if he/she wanted

something to drink and during that time it was explained to the owner what was going to happen and the dog was able to get used to the surroundings. Before starting the first test, the first of three saliva samples (for cortisol measurements) was taken. To minimize contact between the dog and the experimenters, the owner collected the saliva. The first outdoors test was a test course in which the dog was exposed to dummy dogs and neutral objects. The owner did not see these objects, but received correct or incorrect information about the object before walking towards it. After this test course, the stranger approach test (SAT), which was the focus of this study, was performed, also outside. After the SAT a second saliva cortisol measurement was taken and testing procedures continued indoors. The results from these indoors tests could not influence the results, therefore details of these tests can be found in appendix A. After all tests were done a third saliva sample was collected. In between tests, the owner and the dog had breaks of approximately 5 minutes. The owners could play with the dog or let the dog sniff around. Also during all tests, the owner and experimenters could stop the test if the dog showed too much stress or did not show any interest in the test.

2.3 Stranger Approach Test

During a stranger approach test a strange-looking unfamiliar person approached the dog-owner combination. This was done to create a situation in which the dog might respond towards the stranger. During the approach the owner was instructed to respond in a certain manner (active or passive). This was done to investigate the influence of the owners' behaviour on the dogs' behaviour.

Of the 66 combinations correctly tested, 33 owners received the active instruction and 33 of them the passive instruction. Assigning the instruction was done by giving alternately an active and a passive instruction, under the assumption that the scheduling of dog-owner combinations was done randomly. The passive instruction entailed ignoring their dog. The owners were instructed to look at the approaching person in a neutral way and were asked to stay quiet. The active instruction meant giving support to their dog. This support was auditory (calmly speaking to the dog) and tactile (petting from head to tail). All combinations were asked to stand on a fixed position, so that the cameras could be placed appropriately. The dog was, beside its own leash, also put on a secure line, so the safety of the approaching person could be guaranteed.

At the beginning of the test the 'stranger' (read stimulus) was out of sight behind a screen. The stranger wore a strange mask, wig and she walked with a cane in a lively stand-up matter towards the owner-dog combination until 2 meters in front of them. This method was chosen to elicit a moderate reaction of the dogs and to keep their attention. After five seconds standing still, she walked back again. Walking towards the dog-owner combination, waiting and walking back took approximately 30 seconds. The owners performed the given instruction (regardless of the reaction of the dog), during the time that the approaching person was in sight. This method was repeated three times. In between these repeats, the dog-owner combinations were asked to stand in the starting position again. During the fourth trial the stranger took off the mask and wig and laid down the cane when she was close to the dog. She then enthusiastically talked to the dog, before she walked back again. This last repeat was done to see if the dog changed its behaviour, when the behaviour and appearance of the stranger changed.

2.4 Measurements

Behaviour

The behaviour of the dog and the owner was recorded digitally, as to check if the instructions were followed correctly by owner, to measure the dogs' responses to the strange person with respect to the instruction and to examine the level of habituation or sensitization towards this person. The digital recordings were analysed using the program Observer (Version 10.1, Noldus, The Netherlands). The behaviours were analysed via a continuous sampling method. The ethogram of the dog that was used for analysis of the videos can be found in appendix B and the ethogram of the owner in appendix C. Briefly, the position of the dog was analysed (e.g. tail and ear) and behaviours of the dog indicating a stress response (e.g. lip licking, yawning and panting). Also behaviours indicating communication between owner and dog were analysed. The analysed behaviour of the owner was all related to the instruction, e.g. looking at dog. When a certain behaviour could not be seen, it was scored 'out of sight'. During the analysis, the percentage of the behaviour was corrected for the percentage 'out of sight'.

Questionnaires

After the test day the owners were asked to fill in a second questionnaire with more detailed questions about their dog and relationship with it and owner personality traits. This questionnaire contained three subparts. These parts were the Canine Behavioural assessment & Research Questionnaire (C-BARQ), Monash Dog Owner Relationship Scale (MDORS) and the Five Factor Model (FFM) personality questionnaire. The results of these questionnaires were used to examine if these aspects determine the dogs' responses to the stranger or interfere with the direct effect owner behaviour (read instructions during tests).

C-BARQ: The adapted C-BARQ contained the questions validated by Hsu and Serpell (2003) to detect problem behaviour and some additional questions. These were added to, for instance, separate the factor "dog-directed fear or aggression". In total, the answers were translated into scores for 12 factors. If owners were asked how many times the dogs reacted, for instance, in a fearful manner in a specific situation this resulted in a score on a 5-point scale (from never to always). Scores for questions about the same trait were then added and expressed as a % of the maximum score possible. The factors of importance in this study were 'Stranger-directed fear' and 'Stranger-directed aggression'. The factors that were extracted from the C-BARQ and the questions that produced a given factor score are shown in appendix D1.

MDORS: Dwyer et al. (2006) constructed a scale which could indicate the relationship between the dog and the owner. This scale was divided into 2 parts. In the first part certain facts were asked, for instance, about how many times the owner cuddles the dog. This part reflected the level of participation of the dog in its owners' life. In the second part the perceived costs and benefits were examined. The answers were given on a 5-point scale. In the end this resulted in scores for 3 dimensions. A higher score on part 1 meant a better owner-dog relationship based on the factual items. A high score for the two dimensions in part 2 reflected strong perceived emotional closeness and low perceived costs. The dimensions and questions of the MDORS are shown in appendix D2.

FFM: The final part of the second questionnaire that the owners filled in was about the personality of the owner him/herself. The five-factor model (FMM) model describes a human personality using 5

factors, namely Neuroticism, Extraversion, Openness, Altruism and Conscientiousness (Carver & Scheier, 2008; Digman, 1990). Owners were asked to respond on a 5-point scale (from completely disagree to completely agree) on different statements. Each statement was related to one of the 5 factors. The dimensions and the statements of the FFM are shown in appendix D3.

Saliva cortisol measurement

Saliva samples were collected by the owners using a cotton roll. To make sure that dogs had enough saliva production, they were allowed to smell a small piece of dried rumen. The cotton roll was put in the cheek pouches and turned around. After that the samples were placed in a tube and placed in cold environment. The saliva cortisol levels were measured via competitive immunoassay using the Salimetrics™ cortisol kit (Salimetrics Europe, UK).

2.5 Statistical Analysis

The dogs' responses were expressed as behaviour scores (frequencies of occurrence or percentages of the observation time) per observation (i.e. approach by a stranger) of 20 – 30 s. This resulted in data sets of X records representing Z trials per dog (n = Y). Behaviours that occurred less than ten times were excluded from further analysis. The behaviours concerning vocalizations were added and formed in one variable 'Vocal'. Further data reduction was established by Principal components analyses (PCA) (Jolliffe, 1986) using procedures as described by Van Reenen et al. (2004). Components identify behaviour parameters that co-vary (in the same or opposite direction) as indicated by relatively high absolute loadings. Component scores were calculated from individual scores for the different behaviours, using loadings as weighing factors, thus integrating multiple behaviours that reflect as same state / trait.

Next, behaviour scores, including those expressed as component scores, were analysed with Restricted Maximum Likelihood (REML) by use of a Linear Mixed Model in the computer program GenStat®. REML accounts for repeated measurements on the same individual. The data were checked for deviation from the normal distribution by plotting fitted values against residuals.

To examine what effect the behaviour of the owner has on the behaviour of the dog towards a strange object, the behaviour of the owner was manipulated and this independent variable (fixed effect) was called 'Type of instruction'. The first 3 repeats were included in the mixed model as trial and individual dog was included in the random component. The dependent variables were the behaviours of the dog. Besides these variables, the results of the questionnaires were used as co-variates. The p-values mentioned in the next section are generally the non-transformed results.

Thus, the effect of instruction and habituation was examined using the following restricted maximum likelihood (REML) model:

$$Y_{nop} = \mu + TRIAL_n + INSTRUCT_o + (TRIAL_n \cdot INSTRUCT_o) + DOG_p + e_{nop}$$

with Y_{nop} indicating a measurement on dog *p* (1-66) during trial *n* (1-3) when owners received instruction *o* (active, passive). DOG made up the random component of the model as to account for repeated measurements on the same individual. Trial was inserted as a co-variable as linear-like effects of repeated exposure on the dogs' behaviour were expected on beforehand.

To examine the effect of the C-BARQ, MDORS and the FFM, the scores for these factors were added as co-variables leading to the following statistical model:

$$Y_{nopq} = \mu + (TRIAL_n * INSTRUCT_o * CHARACTERISTIC_q) + DOG_p + e_{nopq}$$

with Y_{nopq} indicating a measurement on dog *p* (1-62) with the characteristic *q* during trial *n* (1-3) when owners received instruction *o* (active, passive). The characteristics (C-BARQ, FFM and MDORS as co-variates) were tested one at a time and inserted like describe above. The co-variates of the C-BARQ that were investigated were stranger-directed aggression, with scores ranging 0-62 % of the maximum, stranger-directed fear (0-88%). The co-variates of the FFM were Agreeableness (scores ranging from 11 to 28, maximum = 28), Conscientiousness (12-40, maximum = 40), Extraversion (9-34, maximum = 36), Neuroticism (0-29, maximum = 32) and Openness (6-28, maximum = 28) . The co-variates derived from the MDORS were Part 1 F1 (31-86%) of the maximum, Part 2 F1 (30-100%) and Part 2 F2 (64-100%). For the REML including co-variable Part 1 F1 the number of dogs included in the analysis was 61.

In addition to the data reduction step the PCA was used to see if there are any patterns of behaviours in relation to the characteristics of the dogs or owners, using records on the level of individual dogs. This implies that the number of records was restricted and with this the number of parameters that could be analysed simultaneously, and for this reason separate PCA's were performed between the dogs' behaviour scores and those obtained in a given questionnaire. Also, PCAs were performed within the C-BARQ in order to see if certain dimensions were related to each other and if there were relationships between dimensions of the MDORS and the FFM.

To examine the effect of the changed behaviour and appearance of the stimulus on the behaviour of the dog, the data of trial 4 was included in the REML:

$$Y_{nop} = \mu + TRIAL_n + INSTRUCT_o + (TRIAL_n \cdot INSTRUCT_o) + DOG_p + e_{nop}$$

with Y_{nop} indicating a measurement on dog *p* (1-66) during trial *n* (1-4) when owners received instruction *o* (active, passive). Only the trial effects that were related to trial 4 were examined.

3. Results

3.1 General behaviour and data reduction

The behaviour of the dogs during the Stranger Approach Test was recorded and analysed via the program observer (Version 10.1, Noldus, The Netherlands). The SAT entailed 3 trials in which the owner was instructed a certain way and the fourth trial in which the approaching stranger took off the disguise. The predicted overall means and standard errors for the dogs' behaviour are summarized in table 2. The percentages of tail position, ear position, panting and tail wagging were corrected for the time that these behaviours were out of sight. The behaviours which did not occur (10 or less) were excluded from this table and further statistical analyses. Stress-indicating behaviours were observed (e.g. low postures, 'Paw lifting' and 'Redirected sniff') and the dogs showed behaviours indicating attention towards the stimulus (e.g. 'Retreating', 'Approaching stimulus' and 'Looking at stimulus'). This means that the SAT was successful in inducing a state of conflict (anxiety).

The results of the saliva cortisol measurement (see appendix E1) showed that the dogs did not perceived too much stress during the (max) 2-h period of testing. The mean values of the 3 saliva samples were respectively, 2.7, 2.5 and 2.5 nmol/L. The cortisol concentrations of the second measurement were overall similar to those of the first measurement.

In order to reduce the data, a principal component analysis (PCA) was performed over all (corrected) behaviours. Behaviours that did not load significantly onto any component were excluded from subsequent analyses, as to restrict the number of readout parameters relative to the number of records and minimize the influence of non-loading parameters on component scores. The resulting loading pattern is shown in table 3. Only the first two components were considered to be relevant. Looking at the first component it can be seen that dogs interacting with and looking towards their owner were also 'Panting' and 'Wagging their tail'. Also they showed more 'Tongue flicking' and their ears were positioned lower in comparison to other dogs. A low tail position on the other hand was inversely related to such behaviour. For further analysis this component was interpreted as 'Social excitement towards owner'. The second component showed a positive loading of the behaviours 'Approaching the stimulus', 'Stretching leash' and 'Moving'. This was interpreted as 'Boldness'. The component scores of these factors were used in the following restricted maximum likelihood analyses.

Table 2 The predicted means and standard errors of the observed behaviours during the stranger approach test. The analysis was run on the data of 66 dogs, with four repetitions (trial 1 to 4) per dog, resulting 261 records. The average observed time was around 25 s per trial.

	N	mean	S.E		N	Mean	S.E.
States (% of observed time)				*Events (times per trial)*			
Neutral ear	240	77.66	1.97	Looking at owner	261	1.08	0.085
Looking at stimulus	261	68.71	1.57	Vocal	261	1.03	0.111
Lying	242	67.16	1.06	Looking away	261	0.85	0.067
Standing	261	59.87	2.27	Tongue flicking	261	0.52	0.053
Neutral tail	197	51.82	3.21	Stay in background	261	0.40	0.033
Wagging	210	41.23	2.90	Approaching stimulus	261	0.28	0.030
Low tail	197	30.08	3.06	Stretch leash	261	0.26	0.030

Sitting	261	28.45	2.30	Retreating	261	0.13	0.021
Panting	260	25.89	2.34	Redirected sniff	261	0.08	0.019
Low ear	240	21.83	1.96	Alternating paws	261	0.07	0.016
High tail	197	18.10	2.50	Paw lifting	261	0.06	0.016
Interaction with owner	261	9.52	0.98	Shutting mouth	261	0.05	0.017
Moving	261	7.91	0.75	Check look	216	0.05	0.018
Exploration	261	1.05	0.44	Shaking	261	0.04	0.013
High ear	240	0.51	0.26				

Table 3 Results of the data reduction using the Principal component analysis (PCA) between behavioural parameters.

Component	Social excitement towards owner (19% variation explained)	Boldness (13 % variation explained)
Interaction with owner	**0.75**[A]	-0.17
Neutral ear	**-0.52**[A]	0.35
Low ear	**0.52**[A]	-0.35
Low tail	**-0.52**[A]	-0.03
Moving	0.28	**0.68**[A]
Sitting	0.12	**-0.52**[A]
Panting	**0.41**[A]	-0.12
Wagging	**0.56**[A]	0.08
Approaching stimulus	0.35	**0.65**[A]
Stretching leash	0.31	**0.64**[A]
Looking at owner	**0.73**[A]	-0.12
Tongue flicking	**0.48**[A]	0.10

[A] Indicated significant loadings (< 0.4 and > -0.4)

n=261

The behaviours 'Exploration', 'High ear', 'Lying', 'Paw lifting', 'Looking away', 'Shaking', 'Retreating' and 'Redirected sniff' were also analysed in the initial PCA, however they did not load onto one of the five components and were thus excluded from subsequent analysis. The behaviours 'Looking at stimulus', 'High tail', 'Neutral tail' and 'Standing' did load onto a component, however not on components 'Social excitement towards owner' and 'Boldness' and are thus not shown in this table.

3.2 Effect of instruction and trial on the dogs' behaviour

In order to look for the effect of the instruction and trial on the behaviour of the dog, a restricted maximum likelihood analysis was used with the fixed effects Instruction (INS) (Active, Passive) and Trial (TRL) (1-3) and the interaction between them (INS*TRL), using 198 records on 66 dogs. The data of trial 4 was excluded from this analysis, because of the different nature of this trial. The scores for the components 'Boldness' and 'Social excitement towards owner' and all other behaviours that did not load onto a component in the PCA (data reduction) were analysed and a summary of these results are shown in appendix F1. The significant results are further visualized in figure 1, including interaction effects between instruction and trial. Dogs receiving passive support had higher scores for 'Looking at stimulus' than the dogs receiving active support, but this difference disappeared with repeated exposure and decreasing frequencies of this behaviour (INS*TRL, $p<0.01$). The dogs that were passively supported increasingly showed 'Looking away' (INS*TRL, $p<0.005$) and 'Boldness' related behaviour (INS*TRL, $p<0.05$) with repeated testing. These behaviours were relatively stable when dogs were supported actively. Another significant observation was that dogs showed less of 'High ear' in trial 3 than in the first trial (TRL, $p<0.05$). This effect was the other way around for the behaviour 'Check look' (TRL, $p<0.05$). Dogs of owners receiving the passive instruction were lying

more than dogs of owners that received the active instruction (INS, p<0.05). Regarding the effects of owner-instructions the findings seemed to reflect that the passive support facilitated looking at the stranger, which waned with repeated exposure, and 'Looking away' or 'Approaching the stimulus' (Boldness) during the later trials. Also, such dogs were lying down more. It seems that when receiving passive support (being ignored) dogs were more focused on the stranger with stronger sensitization of either avoidance (looking away) or approach (boldness) with repeated exposures.

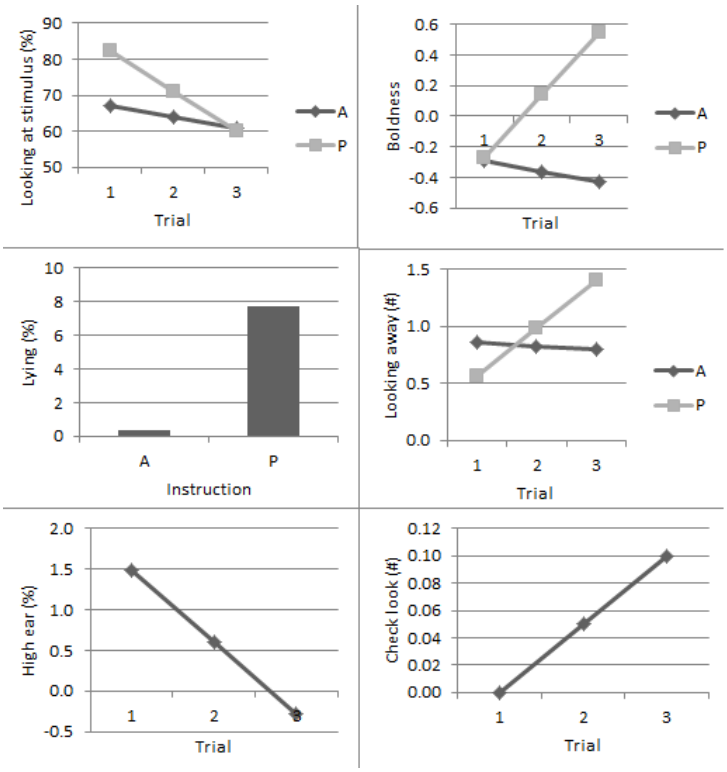

Figure 1 Effect trial and instruction. Results restricted maximum likelihood analysis (REML). Significant main and interaction effects of instruction (A=Active instruction; P=Passive instruction) and trial (1-3) on the behaviour during the first three trials are shown (n=198).

3.3 Effect C-BARQ scores on the dogs' behaviour

Only the scores on stranger-directed aggression and stranger-directed fear were used in this analysis (co-variates). This as dogs that were known to be fearful or aggressive towards strangers were assumed most likely to react accordingly when approached by the strange-looking unfamiliar person. The mean of stranger-directed aggression scores was 13.0 (S.E.M. = 1.9) and for stranger-directed fear 13.2 (S.E.M. = 2.5). A restricted maximum likelihood analysis was used with the fixed effects Instruction*Trial*Stranger-directed aggression (AGG), using 186 records (62 dogs over 3 trials). For the effect of stranger-directed fear, the fixed effect aggression was replaced by the scores of fear (FE). The results are summarized in appendix F3.

Results stranger-directed aggression: Aggressive dogs were lying relatively often or rarely (AGG*TRL, p<0.01) during trials 1 and 3, respectively, suggesting an increased activity with repeated exposures. Such aggressive dogs 'Looked away' relatively often (AGG*TRL, p<0.05), especially during trial 3, and when provided with active support by their owner acted relatively 'Bold' (AGG*INS, p<0.05) and 'Vocal' (AGG*INS, p<0.05) whilst 'shutting their mouth' often (AGG*INS, p<0.05). The significant effects are visualized in figure 2. The results seemed to indicate that aggressive dogs became sensitized (aroused) with repeated exposure to the stranger, showing extravert behaviour towards the strangers especially when (socially) supported by their owner.

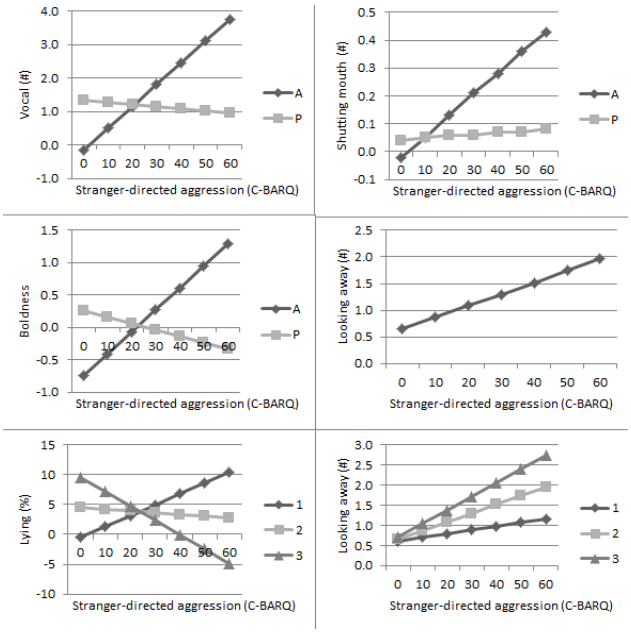

Figure 2 Effect stranger-directed aggression. Results restricted maximum likelihood analysis (REML). Significant main and interaction effects of instruction (A=Active instruction; P=Passive instruction), trial (1-3) and stranger-directed aggression on behaviour during the first three trials are shown (n=186).

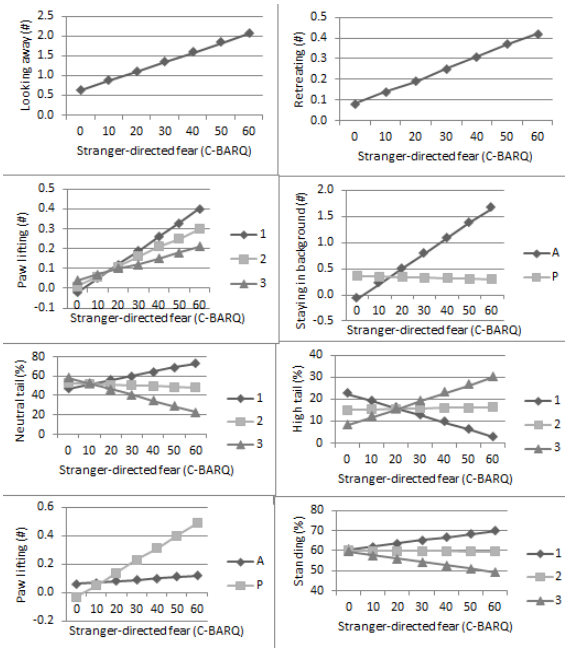

Figure 3 Effect stranger-directed fear. Results restricted maximum likelihood analysis (REML). Significant main and interaction effects of instruction (A=Active instruction; P=Passive instruction), trial (1-3) and stranger-directed fear on behaviour during the first three trials are shown (n=186).

Results stranger-directed fear: Fearful dogs relatively often 'Looked away' (FE, $p<0.001$) and 'Retreated' (FE, $p<0.01$), with 'staying in the back' typical occurring, while receiving active support from their owner (FE*INS, $p<0.05$). Also, these dogs showed high levels of 'Paw lifting', especially in trial 1 (FE*TRL, $p<0.01$) or when receiving passive support by the owner (FE*INS, $p<0.01$). Across trials, fearful dogs developed a tendency to show 'High tail' (FE*TRL, $p<0.05$) (less neutral) and stand less (FE*TRL, $p<0.05$), possibly reflecting alternative strategies to deal with a persistent challenge. Avoidance, by looking away or 'hiding', seemed the preferred response by fearful dogs to a stranger, which to some degree was strengthened by providing social support. Some fearful dogs seemed to respond with 'High tail' to a recurrent challenge possible trying to scare off the perceived threat. 'Paw lifting' characterizes fearful dogs that are challenged and if so this indicates that novelty (first trial) and absence of social support by the owner were associated with more intense anxiety. Significant effects are visualized in figure 3.

As an alternative way to investigate relationships between the dogs' aggressiveness or fearfulness and behavioural responses to a stranger, a principal component analysis was performed on the behaviours shown during the first trial (thus n=62) and C-BARQ scores. The results are shown in table 4. Components one, three and four did not load onto the stranger-directed aggression or fear dimension of the C-BARQ and therefore not relevant. Component two showed that dogs that score high on fear, but not per se on aggression, were 'Standing' more, 'Retreated' and 'Stayed in the background'. It was also shown that 'High tail' positions, 'Approaching stimulus', 'Shutting mouth' and 'Sitting' were negatively related. These results indicate that in some dogs fearfulness and aggressiveness were combined, likely as some dogs aggress out of fear. 'Shutting mouth' could, to a minor degree, be a marker of such dogs. Interestingly, fearful dogs that were not known to show aggression also did not show 'mouth shutting' (component 2). In general, active avoidance behaviour seemed to characterize fearful dogs that were challenged.

Table 4 The relation between stranger-directed aggression and fear (as measured by the C-BARQ) and the behaviour of the dog shown in the first trial (n=62). Principal component analysis results.

	Component 2. 14 % variance explained	Component 5. 9% variance explained
High tail	**-0.58**[A]	0.37
Standing	**0.41**[A]	-0.34
Sitting	**-0.45**[A]	0.37
Wagging	**-0.42**[A]	0.103
Approaching stimulus	**-0.46**[A]	-0.21
Retreating	**0.57**[A]	0.10
Shutting mouth	**-0.49**[A]	**0.41**[A]
Staying in background	**0.50**[A]	0.22
Stranger-directed aggression	0.17	**0.57**[A]
Stranger-directed fear	**0.53**[A]	**0.56**[A]

[A] Indicated significant loadings (< 0.4 and > -0.4)

The behaviours 'Exploration', 'High ear', 'Lying', 'Panting', 'Paw lifting', 'Looking away', 'Shaking', 'Check look', 'Tongue flicking', 'Vocal' and 'Alternating paws' were also analysed in the initial PCA, however they did not load onto one of the five components and were thus excluded from subsequent analysis. The behaviours 'Interaction with owner', 'Looking at stimulus', 'Neutral ear', 'Low ear', 'Neutral tail', 'Low tail', 'Moving', 'Stretch leash', 'Looking at owner' and 'Redirected sniff' did load onto a component, however not on component two, and are thus not shown in this table. The components (1, 3 & 4) that did not include a dimension of the C-BARQ are also not shown.

To analyse if the link between fear and stranger-directed aggression is also seen between fear and other types of aggression (as measured in the C-BARQ) another principal component analysis (n=62) was performed. The results are summarized in table 5. These results confirm that stranger-directed aggression and fear were related to each other. The components that did not load onto these two dimensions are not shown. Component 1 showed that dog-directed aggression and fear and owner-directed aggression and non-social fear were positively related to the stranger-directed aspects. When stranger-directed fear was not related to the aggression counterpart, then it was negatively related to owner-directed aggression. When stranger-directed aggression was not related to its fear counterpart, then it was negatively related with non-social fear and positively related with dog-directed aggression. In general the results showed that the effects of instruction found in stranger-directed fear-aggressive dogs could possibly be extrapolated to dogs which show other types of fear-aggression.

Table 5 The relation between stranger-directed aggression and fear (as measured by the C-BARQ) and the other dimensions of the C-BARQ (n=62). Principal component analysis results.

	1. 20% variance explained	2. 16% variance explained	4. 11% variance explained
Pain Sensitivity	**0.50**[A]	**0.47**[A]	-0.08
Dog-directed fear	**0.55**[A]	**0.43**[A]	0.05
Separation Anxiety	**0.56**[A]	-0.21	-0.07
Excitability	**0.50**[A]	**-0.42**[A]	0.10
Attachment	0.39	**-0.57**[A]	**0.46**[A]
Chase	0.20	**-0.44**[A]	-0.02
Trainability	-0.17	0.17	**0.42**[A]
Stranger-directed aggression	**0.51**[A]	0.09	**-0.52**[A]
Owner-directed aggression	**0.40**[A]	**-0.40**[A]	0.26
Dog-directed aggression	**0.59**[A]	-0.27	**-0.52**[A]
Non-Social Fear	**0.53**[A]	0.32	**0.42**[A]
Stranger-directed fear	**0.67**[A]	**0.46**[A]	0.22

[A] Indicated significant loadings (< 0.4 and > -0.4)
The components that did not include the dimension 'stranger-directed fear' or 'stranger-directed aggression' are not shown.

3.4 Effect MDORS scores on the dogs' behaviour

To find the effect of the owner-dog relationship on the effect of instruction and trial on the behaviour of the dog, a restricted maximum likelihood analysis was used, with the fixed effects Instruction*Trial*Part1F1, using 186 records (62 dogs over 3 trials). For the effects of the other parts of the MDORS the fixed effect was replaced by another co-variate. The results are shown in appendix F4. The means and standard errors are shown in table 6.

Table 6 The predicted means and standard errors of the three aspects of the MDORS. High score on the factual items relates to the participation of the dog in the owners life. High score on perceived emotional closeness and perceived costs relates to a good owner-dog relationship, meaning that a high score on costs means that the dogs were not perceived as costly.

	N	mean	S.E.M.
Part 1 F1 Factual items	61	67.3	1.6
Part 2 F1 Perceived emotional closeness	62	66.4	1.8
Part 2 F2 Perceived costs	62	87.2	1.1

Results part 1 factual items: From the figures (4) it could be concluded that a good relationship between owner and dogs (as reported by the former) facilitated dogs to 'Look at the stimulus' (Main effect (MD), $p<0.001$) and to show fewer 'Check looks' (MD*TRL, $p<0.001$) in response to a persistent challenge (i.e. in trial 3). Active support reduced the time that dogs showed a 'Neutral tail' with this effect being most strong when the relationship between owner and dog was weak (MD*INS, $p<0.05$). The finding that dogs of such combinations showed little looking away (MD*TRL, $P<0.01$) in the third trial is difficult to interpret. The significant effects are visualized in figure 4.

Results part 2.1 perceived emotional closeness: Active support increased the number of times that dogs showed 'Paw lifting', indicating anxiety. This effect was stronger when the owners did not perceive an emotional close bond with their dog (MD*INS, $p<0.05$) (see figure 5). Thus when the owner-dog relationship was weak, active support increased anxiety more than when the relationship was good.

Results part 2.2 perceived costs (see figure 6): Active support increased the time that the dogs showed 'High tail' (MD*INS, $p<0.05$) and the number of times the dog showed 'Redirected sniffing' (conflict behaviour) (MD*INS, $p<0.05$). This effect was stronger when the owners perceived the dog as costly. With repeated exposure the dogs showed less 'High tail' (MD*INS, $p<0.05$). Thus when the owner-dog relationship was weak, active support induced conflict behaviour more strongly than when the relationship was good.

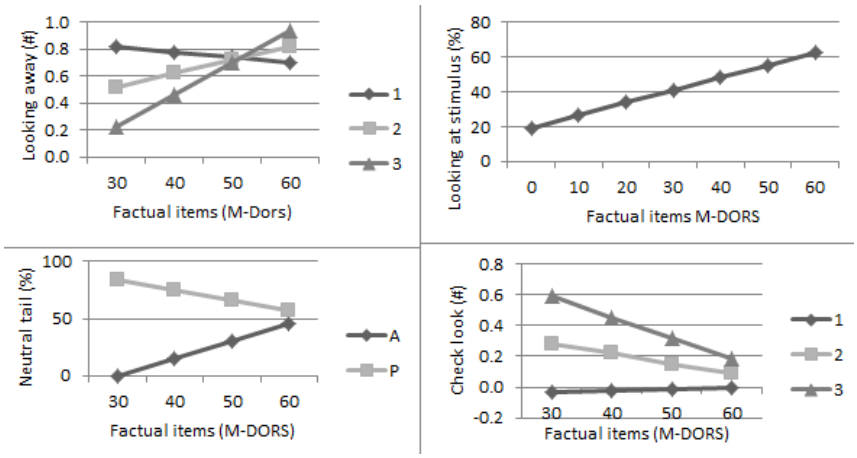

Figure 4 Effect dog-owner relationship (factual items). Results restricted maximum likelihood analysis (REML). Significant main and interaction effects of instruction (A=Active instruction; P=Passive instruction), trial (1-3) and owner-dog relationship (part 1 factual items) on behaviour during the first three trials are shown (n=183).

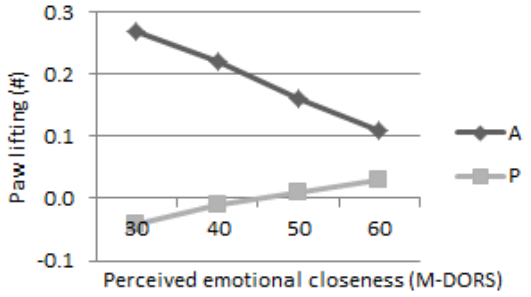

Figure 5 Effect perceived emotional closeness. Results restricted maximum likelihood analysis (REML). Significant interaction effect of instruction (A=Active instruction; P=Passive instruction) and owner-dog relationship (part 2.1 perceived emotional closeness) on 'Paw lifting' is shown (n=186).

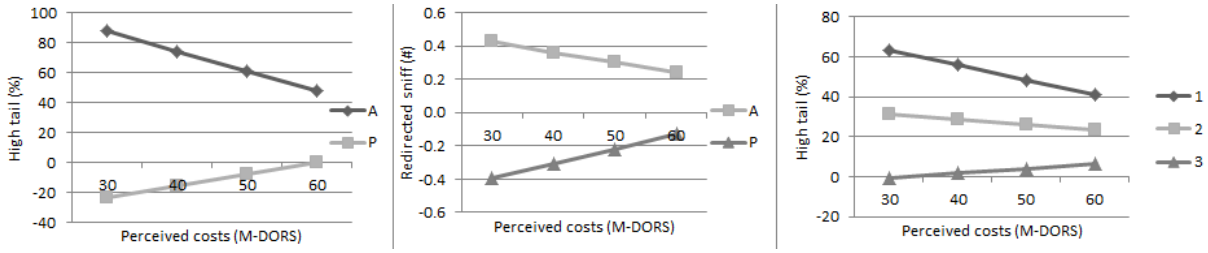

Figure 6 Effect perceived costs. Results restricted maximum likelihood analysis (REML). Significant main and interaction effects of instruction (A=Active instruction; P=Passive instruction), trial (1-3) and owner-dog relationship (part 2.2 perceived costs) on behaviour are shown (n=186).

As an alternative way to investigate the relation between the owner-dog relationship and the response of the dog towards a stranger, a principal component analysis was performed on the behaviours shown during the first trial (n=62) and the MDORS scores. The results of the PCA are shown in table 7. Components one, three and five did not include an aspect of the MDORS and a behavioural component, thus not usable to investigate the relation between them. Component two showed that owners of dogs that moved, approached the stimulus and put tension on the leash (i.e. 'Boldness'), did not perceive themselves as emotional close to their dog. Component four showed that dogs, of owners that perceived them costly, showed a low posture (low ear and tail) and dogs

that showed 'Alternating paws' and 'Moved' were seen less costly. If this perception was caused by the behaviour of the dog, or the other way around, could not be explained from these results.

Table 7 The relation between dog-owner relationship (as measured by the MDORS) and the behaviour of the dog shown in the first trial (n=62). Principal component analysis results.

	2. 14% variance explained	4. 11% variance explained
Neutral ear	-0.26	**0.48**[A]
Low ear	0.29	**-0.48**[A]
Neutral tail	**0.60**[A]	**0.50**[A]
Low tail	-0.39	**-0.59**[A]
Moving	**-0.60**[A]	**0.45**[A]
Approaching stimulus	**-0.66**[A]	0.001
Stretching leash	**-0.82**[A]	-0.09
Alternating paws	-0.16	**0.43**[A]
MDORS part 2 F1 (emotional closeness)	**0.48**[A]	0.06
MDORS part 2 F2 (costs)	0.28	**0.43**[A]

[A] Indicated significant loadings (< 0.4 and > -0.4)

The behaviours 'Exploration', 'High ear', 'Lying', 'Panting', 'Paw lifting', 'Looking away', 'Shaking', 'Redirected sniff', 'Check look', 'Tongue flicking' and 'Vocal' were also analysed in the initial PCA, however they did not load onto one of the five components and were thus excluded from subsequent analysis. The behaviours 'Interaction with owner', 'Looking at stimulus', 'High tail', 'Standing', 'Sitting', 'wagging', 'Retreating', 'Looking at owner', 'Shutting mouth', 'Staying in background' and 'MDORS part 1 F1' did load onto a component, however not on components two and four, and are thus not shown in this table. The components that did not include a dimension of the MDORS are also not shown.

3.5 Effect personality scores owner on the dogs' behaviour

To find the effect of personality of the owner on the effect of instruction and trial on the behaviour of the dog, a restricted maximum likelihood analysis was used, with the fixed effects Instruction (INS)*Trial (TRL) *Agreeableness, using 186 records (62 dogs over 3 trials). For the effects of the other parts of the FFM the fixed effect was replaced by another co-variate. The results are shown in appendix F5. The mean and the standard errors are summarized in table 8.

Table 8 The predicted means and standard errors of the five aspects of the FFM (personality owner). N=62

	mean	S.E.M.
Agreeableness	20.8	0.4
Conscientiousness	26.2	0.7
Extraversion	20.4	0.7
Neuroticism	10.8	0.7
Openness	16.7	0.6

Agreeableness (AG) (see figure 7): Dogs of agreeable owners showed a decrease for 'Standing' (AG*TRL, $p<0.05$) and 'Neutral tail' (AG*TRL, $p<0.01$) with repeated exposure and they showed an increase for 'Redirected sniff' (AG*TRL, $p<0.01$) and 'High tail' (AG*TRL, $p< 0.01$) with repeated exposure. These effects showed the opposite trend for owners that scored low on Agreeableness. Dogs of owners that scored high on Agreeableness 'Looked away' more (AG, $p<0.05$), 'Retreated' more (AG, $p<0.05$), 'Stayed more in the background' (AG, $p<0.05$). These results seemed to indicate that dogs of agreeable owners became more aroused with repeated exposure to the stranger and that these dogs in general showed more fear-related behaviours.

Conscientiousness (CO) (see figure 8): Conscientiousness owners, giving passive support and non-conscientious owners, giving active support had dogs that showed more 'Check looks' (CO*INS, $p<0.05$). Also dogs of conscientious owners became 'bolder' with repeated exposure (CO*TRL, $p<0.001$). This was the other way around for dog of non-conscientious owners as they became less bold with repeated exposure.

Extraversion (EX) (see figure 9): Dogs of introvert owners which received active support, showed more 'Alternating paws' (EX*INS, $p<0.05$) and 'High ear' (EX*INS, $p<0.05$), while dogs of extravert owners did not show this behaviour at all. Dogs of introvert owners were less 'Socially excited towards the owner' with repeated exposure, while dogs of extrovert owners, showed 'Social excitement' during the last repeat (EX*TRL, $p<0.01$) and were 'Standing' more (EX, $p<0.05$). These results seemed to indicate that dogs of extravert owners seemed to become more focused on the owners with repeated exposure and while receiving active support. Dogs of introvert owners became more aroused while receiving active support and focused less on the owner with repeated exposure.

Openness (OP) (see figure 10): Dogs of owners that had a closed personality relatively often 'Looked at the stimulus' (OP, $p<0.05$) and 'Shut their mouth' (OP, $p<0.05$). This could indicate that these dogs were less calm; however this was not a strong indication.

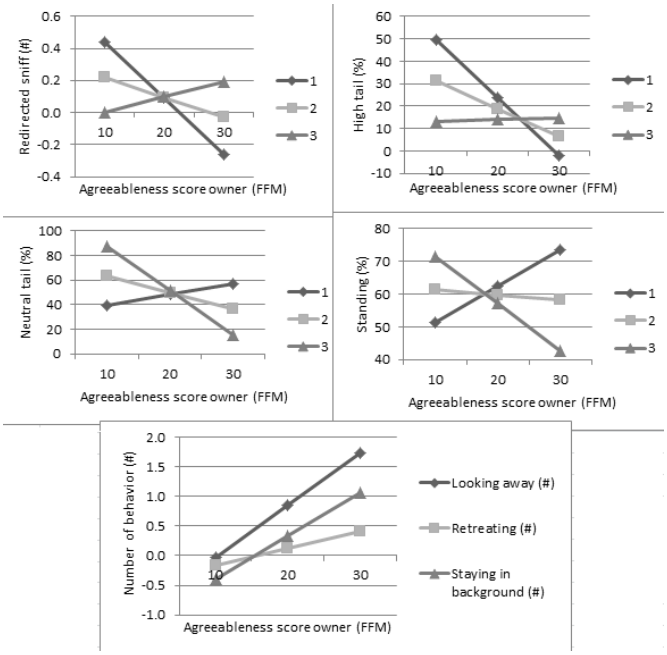

Figure 7 Effect Agreeableness score owner. Results restricted maximum likelihood analysis (REML). Significant interaction effects of instruction (A=Active instruction; P=Passive instruction), trial (1-3) and Agreeableness score owner on behaviour are shown (n=186).

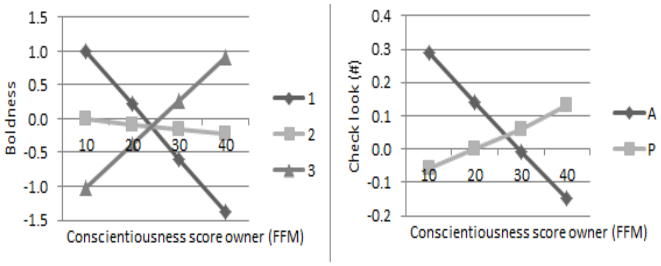

Figure 8 Effect Conscientiousness owner. Results restricted maximum likelihood analysis (REML). Significant interaction effects of instruction (A=Active instruction; P=Passive instruction), trial (1-3) and Conscientiousness score owner on behaviour are shown

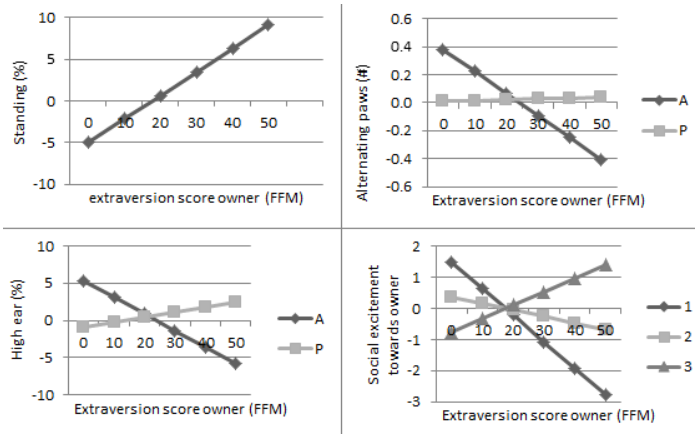

Figure 9 Effect Extraversion owner. Results restricted maximum likelihood analysis (REML). Significant main and interaction effects of instruction (A=Active instruction; P=Passive instruction), trial (1-3) and Extraversion score owner on behaviour are shown (n=186).

Neuroticism (NC) (see figure 11): Neurotic owners had dogs that with repeated exposure expressed an increase of the behaviour 'Look away' (NC*TRL, $p<0.05$) and a decrease of the 'High ear' position (NC*TRL, $p<0.05$), while dogs of non–neurotic owners did not show a clear difference of these behaviours with repeated exposure, but did show more 'Retreating' behaviour in general (NC, $p<0.05$). It can also be seen that dogs of neurotic owners were 'Socially excited towards their owner' during the first exposure while dogs of non-neurotic owners were especially 'Socially excited towards their owners' during the third exposure (NC*TRL, $p<0.01$). This was also seen for the 'Boldness' behaviour (NC*TRL, $p<0.01$). The findings seemed to indicate that the dogs chose between focussing on the owner or on the stimulus as ways of responding.

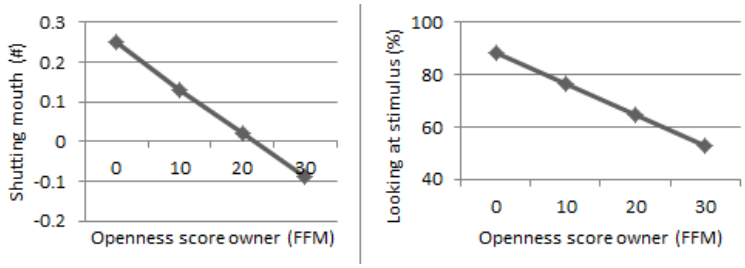

Figure 10 Effect Openness owner. Results restricted maximum likelihood analysis (REML). Significant main effects of the Openness score owner on behaviour are shown (n=186).

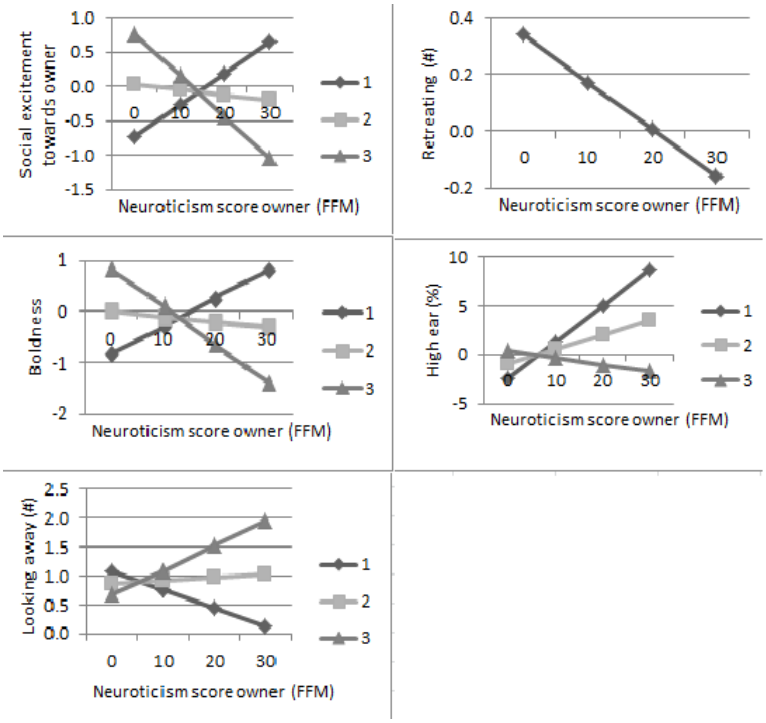

Figure 11 Effect Neuroticism owner. Results restricted maximum likelihood analysis (REML). Significant main and interaction effects of instruction (A=Active instruction; P=Passive instruction), trial (1-3) and Neuroticism score owner on behaviour are shown (n=186).

An alternative way to investigate the relation between the owners personality and the behaviour of their dogs in the SAT is to perform a principal component analysis on the behaviours shown during the first trial (n=62) and the FFM scores. The results are shown in table 9. Components 1, and 5 are not shown because they did not include a dimension of the FFM and a behavioural component, thus did not show any relationship between the behaviour of the dog and personality. Component two showed that dogs of owners that were agreeable 'Stayed more in the background', 'Retreated' more and 'Lifted their paws' more. On the other hand they showed less 'High tail', 'Wagging' and 'Sitting'. Component three showed that neurotic owners had dogs that were more focused on the stimulus. These dogs also 'Shut their mouth' more. In general, dogs of agreeable owners showed more fear-related behaviour and dogs of neurotic owners were not at ease.

Table 9 The relation between the owners personality (as measured by FFM) and the behaviour of the dog shown in the first trial (n=62). Principal component analysis results.

	2. 14% variance explained	3. 12% variance explained	4. 10% variance explained
Interaction with owner	0.21	**-0.51**[A]	0.15
Looking at stimulus	-0.20	**0.44**[A]	0.19
High ear	0.09	0.21	**0.51**[A]
High tail	**0.46**[A]	0.31	**-0.58**[A]
Low tail	-0.39	0.23	**0.48**[A]
Sitting	**0.42**[A]	-0.02	0.11
Wagging	**0.60**[A]	-0.03	-0.13
Approaching stimulus	0.21	**0.61**[A]	0.25
Paw lifting	**-0.44**[A]	-0.01	-0.03
Stretching leash	-0.06	**0.63**[A]	0.18
Retreating	**-0.69**[A]	-0.06	-0.28
Looking at owner	0.18	**-0.53**[A]	0.11
Shutting mouth	0.28	**0.44**[A]	**-0.62**$_{A}$
Stay in background	**-0.69**[A]	0.13	-0.23
Openness	0.01	-0.39	**0.41**[A]
Neuroticism	0.32	**0.44**[A]	0.32
Extraversion	-0.10	-0.27	**-0.41**[A]
Agreeableness	**-0.46**[A]	0.03	0.09

[A] Indicated significant loadings (< 0.4 and > -0.4)

The behaviours 'Exploration', 'Lying', 'Low ear', 'Panting', 'Looking away', 'Shaking', 'Redirected sniff', 'Check look', 'Tongue flicking' and 'Vocal' were also analysed in the initial PCA, however they did not load onto one of the five components and were thus excluded from subsequent analysis. Because the number of behaviours was still more than 30% of the number of records use in the PCA, the behaviours 'Neutral ear', 'Neutral tail' and 'Standing' were also excluded. These were chosen because of the biological insignificance. The behaviours 'Moving' and 'Alternating paws' and the factor Conscientiousness did load onto a component, however not on components two, three or four, and are thus not shown in this table. The components that did not include a dimension of the FFM and a behavioural aspect are also not shown.

In addition, a principal component analysis was performed between the personality factors and the dimensions of the owner-dog relationship (MDORS). The results are summarized in table 10. It can be seen that neurotic owners feel emotional close to their dogs. Also conscientious owners and owners that scored low on Openness, scored high on the first part of the MDORS (factual items), which indicated that their dog participate in the daily life of these owners. It can also been seen that open owners saw their dogs as less costly than other owners. Components two and three are not shown because they did not onto at least one of the FFM factors and one of the MDORS dimensions, thus not did not show any relationship between personality and owner-dog relationship.

Table 10 Principal component analysis results. The relation between the owners personality (as measured by FFM) and the owner-dog relationship (as measured by MDORS) (n=62).

	1. 20% variance explained	4. 11% variance explained	5. 10% variance explained
Conscientiousness	**0.62**[A]	**0.60**[A]	0.06
Agreeableness	**0.64**[A]	0.14	-0.13
Extraversion	0.31	-0.12	0.34
Openness	0.28	**-0.48**[A]	**0.62**[A]
Neuroticism	**-0.75**[A]	0.08	0.17
MDORS part 1 F1	-0.39	**0.42**[A]	0.23
MDORS part 2 F1	**-0.40**[A]	0.20	0.10
MDORS part 2 F2	0.05	0.38	**0.50**[A]

[A] Indicated significant loadings (< 0.4 and > -0.4)

3.6 Effect of changing the behaviour of the stimulus

To analyse the effect of the fourth trial, a restricted maximum likelihood method was used with the fixed effects Instruction (INS) (Active, Passive) and Trial (TRL) (1-4), now expressed as a factor, and the interaction between them, using 261 records (e.g. 66 dogs). The results are shown in appendix F2. The results showed that changing the appearance and behaviour of the approaching person resulted in dogs 'Looking more at the stimulus' (TRL, $p<0.001$), 'Alternating paws' (TRL, $p<0.001$) and they 'Looked less away' (TRL, $p<0.01$) compared to the previous exposure (see figure 12). These results indicated that they were less intimidated and became excited towards the stranger.

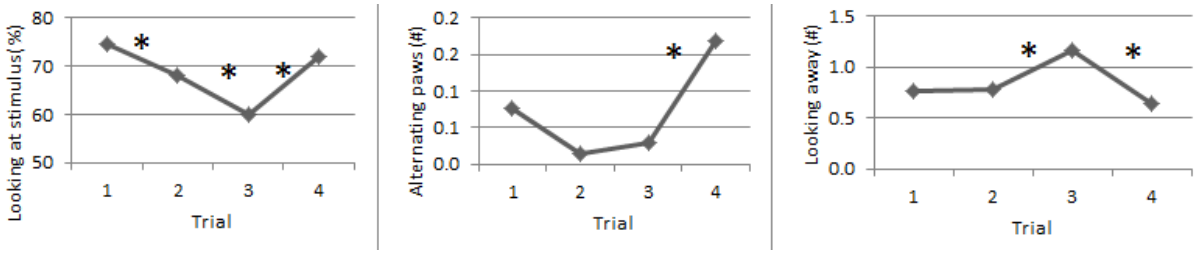

Figure 12 Effect changed behaviour approaching stimulus. Results restricted maximum likelihood analysis (REML). Significant trial effects on the dogs' behaviour when the behaviour of the stimulus changed. In the analysis all trials (1-4) were included in a REML (n=261 and 66 dogs) and where the trial effect is significant in trial 4 are shown in the table. (* significant difference as compare to the previous trial)

4. Discussion

This research set out to test the influence of the type of support given by the owners on the dogs' behaviour. This was tested using an approach paradigm in which a strange-looking person approached the owner-dog combination. The owners were given an instruction on how to behave. This instruction was either to act passive, which entailed ignoring their dog, or providing active support, which entailed soothing their dog in a tactile and vocal manner. The behaviour of the dogs was analysed, in which boldness behaviours indicated approach-like behaviours (pro-active coping style) and active avoidance behaviour was indicated by e.g. 'Retreating' and 'Staying in the background'. Active avoidance behaviour was classified as fear-related behaviour, while passive avoidance and risk assessment was classified as anxiety-related behaviour (McNaughton & Corr, 2004). Passive avoidance was indicated as 'Looking away' and 'Check look'. While being in this anxiety state, the animals were in conflict and showed behaviours related to that, like 'Paw lifting', 'Redirected sniff', as well (McNaughton & Corr, 2004). Other behaviours, like 'Vocalisations' and 'Alternating paws' indicated arousal. In general it could be seen that all dogs responded to the stimulus in one way or the other. Ignoring of the stimulus was not seen. Also the saliva cortisol concentrations showed that the stress perceived during the day was not increased by the tests itself; however cortisol concentrations indicated that some dogs perceived the overall setting, possibly including traveling by car, as stressful.

This research addressed three questions, the first question being: '*Is there an effect of the type of support given by the owner to the dog on the dogs' reaction towards an unfamiliar approaching person and does it change with repeated exposure to the latter stimulus?*' The results showed that dogs that were actively supported showed relative stable behaviour with repeated exposure and were calmer. The dogs that were passively supported reacted stronger to the approaching person over trials. Initially they focused more and after repeated exposure were either bolder towards the stranger or showed more avoidance behaviour (averting their gaze), which indicated that they were less comfortable. This showed that active support by the owner does establish stress reduction in the dog. This interpretation is supported by the literature, which showed several examples of the anxiolytic effects of human support. This support was not specifically linked to the dog-owner relation, but it was seen between parents and children in a way that the presence of the parent reduced the distress of the child during a venepuncture procedure (Wolfram & Turner, 1996). This effect occurs also in other species, for instance in cows. Supporting the cow by soothing words and petting during a veterinary procedure reduced the restless behaviour of the animal (Waiblinger et al., 2004). In the present experiment the owner was always present and according to results in an Ainsworth's Stranger situation procedure, the presence of the owner is already enough to change the behaviour of the dog, as expressed in more exploring and playing with the stranger, as compared to the owner not being present (Palmer & Custance, 2008; Valsecchi et al., 2010). This means that the dogs in this experiment likely were already calmer than when they would have been when alone. The added effect of tactile and vocal support shown in this research indicates that the owner-dog interaction could directly reduce stress (as compared to owner-presence only).

The second question was: 'Are *the effects of support mediated by characteristics of the dog (aggression and fear scores) and owner (personality and dog-owner relationship)?*' The aggression and fear scores of the dogs were based on the C-BARQ. In this questionnaire the owners were asked to indicate whether or not their dog expressed aggressive behaviour (e.g. barking, growling, baring

teeth and lunging) or fearful behaviours (e.g. avoidance of the feared object, crouching with tail lowered, whining, freezing and escaping) in specific situations. Based on their answers, scores on several types of aggression or fear were given to the dogs. The effects of support on the dogs that scored high on aggression or fear towards strangers were then investigated. The results showed how dogs that were aggressive towards strangers, as reported by their owners, reacted in a specific way to the support given by their owner. These aggressive dogs tend to become aroused with repeated exposure to the stranger, and especially when supported by their owner, showed overt behaviours. When these aggressive dogs received passive support from their owners they reacted similar to dogs that did not score high on aggression, indicating their specific way of responding to active support. A similar effect of instruction was found for dogs that were fearful towards strangers, as reported by their owners. The avoidance behaviour generally seen in these fearful dogs seem to, to some degree, be strengthened by giving social support (Staying in the background). They also showed more 'Paw lifting' in combination with passive support and during the first exposure, indicating intense anxiety during the SAT. With repeated exposure, fearful dogs showed more a high tail position. This last effect might indicate the overlap between aggressive dogs and fearful dogs, which also surfaced in the results of the principal component analysis. In this analysis it was found that dogs that were fearful towards strangers also appeared to respond aggressively towards them. The high tail position might thus be a strategy to warn of the strange person. The stronger avoidance or approach behaviour of fear-aggressive dogs, while supported actively, seem to indicate the opposite of what the literature states, which is that active support reduces these behaviours. However the result makes sense when aggressive and fearful dogs experience intense conflict when they were approached by a stranger, so leading them to show behavioural inhibition. This could be explained via the three regulation systems which McNaughton and Corr (2004) proposed. An animal can respond via the behavioural activation system (BAS), which is involved in generation of emotional states relative to approaching or withdrawing from the situation, or via the fight, flight and freeze system (FFFS). When an animal is in conflict about the manner how to respond, it activates the behavioural inhibition system (BIS), which inhibits any on-going behaviour. This can result in immobility, when perceived threat is of high intensity, or exploration of the environment to make a risk assessment, when perceived threat is of medium intensity (McNaughton & Corr, 2004). The dogs that received the passive instruction, might be in a relatively intense BIS state, and when the stress was in part relieved by the owner's active support it might be that the behavioural inhibition was released, resulting in aggressive or fearful behaviour. In these aggressive dogs the stress-relieving aspect of active support might thus result in negative effects, creating danger for people in the environment and increasing the risk of bite incidences. The aforementioned negative effect of active support may not be restricted to stranger-directed aggressive dogs and apply to dogs with other types of aggression and fear, because the principal component analysis over the different factors of the C-BARQ showed that dogs that scored high on stranger-directed aggression or fear also scored high on the other types of aggression and fear (e.g. owner-directed and dog-directed).

The effect of the characteristics of the owner on the behaviour of the dogs, while giving either active or passive support, was also investigated. Based on the literature it could be stated that characteristics of the owner could be a possible influence on the behaviour of the dog. In the human psychology it is seen that children use their parents to regulate their own emotional responses. For instance, when mothers reacted in a socially anxious manner towards a stranger, the child responded more fearful towards the stranger as well (De Rosnay et al., 2006). Children also use the parents'

vocal and facial expressions when faced with uncertain situations (a new toy or crossing a visual cliff) to determine their following actions (Mumme et al., 1996; Vaish & Striano, 2004). Since dogs are sensitive to human communication it could be argued that they use their owners as social referencing just like children do. Personality influences the way the owners interpret certain situations. Humans that scored high on Neuroticism perceived the environment more stressful. The opposite was found for the personality dimensions Extraversion, Agreeableness and Conscientiousness (Ebstrup et al., 2011). Thus if the owners perceive the situation more stressful, then the dog might detect this and perceive the situation also more stressful. It would therefore be expected that extravert, agreeable and conscientious owners giving active support would reduce the effects of the approaching person on the dogs' behaviour, because they interpret the setting as less stressful, and that neurotic owners which give active support might be less effective in reducing the reaction, because they might perceive the situation as more stressful than others. Also in combination with the previous results that active support given to aggressive or fearful dogs, only intensifies the incidence of aggressive and fearful behaviour, it would be expected that high Neuroticism and low Conscientiousness has an inverted effect with active support than the other dimensions of personality, since research indicated that these types of owners are more likely to own aggressive dogs (Podberscek & Serpell, 1997).

In this research the stress-reducing effects of active support for Extraversion were confirmed. Dogs of extravert owners seemed to become more focused on the owners with repeated exposure and while receiving active support. Dogs of introvert owners seemed to become more aroused while receiving active support and focused less on the owner with repeated exposure. Active support thus had a positive effect on the behaviour of the dog of extravert owner, which was expected based on the literature. However this positive effect was not found for dogs of introvert owners. The latter could indicate that dogs of introvert owners have a higher risk of acting aggressively or fearful towards strangers. This research also confirmed the stronger stress-reducing effect of active support by conscientious owners as compared to when such support is given by owners that scored low on Conscientiousness. Conscientious owners, giving passive support and non-conscientious owners, giving active support had dogs that showed more 'Check looks', which could indicate uneasiness. However dogs of conscientious owners, unrelated to type of support, became bolder with repeated exposure. This was the other way around for dog of non-conscientious owners as they became less bold with repeated exposure. This change in boldness could indicate a reduced anxiety (less behavioural inhibition), leading to more exploration behaviour for dogs of conscientious owners.

The results in this research showed that dogs of agreeable owners become more aroused with repeated exposure to the stranger and that these dogs in general showed more fear-related behaviours. This is the opposite of what would be expected.

The results of the effect of Neuroticism on the behaviour of the dog showed that dogs of neurotic owners were 'Socially excited towards their owner' and 'Bolder' during the first exposure while dogs of non-neurotic owners were especially 'Socially excited towards their owners' and 'Bold' during the third exposure. These findings seemed to indicate that the dogs chose between focussing on the owner or on the stimulus as ways of responding. However it was also seen that dogs of neurotic owners 'Retreated' more and increasingly 'Looked away'. This could indicate that they showed more avoidance with repeated exposure, possibly indicating a lack of positive effect of support. These dogs thus perceived the situation as more stressful; possibly indicating a higher stress level in neurotic

owners as compared to non-neurotic owners as described by the literature. Dogs of owners that have a closed personality appeared to be less calm (more 'Looking away' and 'Shutting mouth'). This could be interpreted as that closed owners were more difficult to read by the dogs (i.e. use as social referencing), resulting in insecurity of the dog, as compared to dogs of owners with an open personality. This could possibly result in less effect of social support; however this was not confirmed by this research.

To summarize the effect of personality on the dogs' behaviour; active support given by extravert or conscientious owners reduced the conflict-related behaviour of the dog and active support given by introvert or non-conscientious owners resulted in more conflict-related behaviour. Also, dogs of agreeable owners showed more avoidance behaviour and became aroused with repeated exposure and dogs of neurotic owners showed more fearful behaviour. Dogs of closed people were less calm towards the approaching person.

There is little known on the effect of the quality of the relationship between the owners and the dogs on the dogs' behaviour and no a priori predictions could be made based on literature. However when examining the relationship between the MDORS scores and the personality of the owners, it could be seen that owners that were emotional close to their dog scored high on Neuroticism, which was also confirmed by Kotrschal et al. (2009), and low on Conscientiousness and Agreeableness. When connecting this to the literature, which stated that these types of owners have more aggressive dogs than other owners (Podberscek & Serpell, 1997), this might seem strange, however it could be argued that these owners need to invest a lot of time in these dogs to keep them in check and this investment could result in a stronger bond between them. When examining the relationship between the MDORS scores and the behaviour of the dog, it could be seen that owners were not emotionally close to the dogs that 'Approached the stimulus', 'Stretched the leash' and 'Moved around' (i.e. Boldness). Dogs of owners who perceived little costs associated with their dog showed more 'Alternating paws' and 'Moving around' (arousal). The dogs that often showed a low posture were seen as costly. Dogs of owners who were emotional close to their dog showed less paw lifting, than dogs of owners who were less attached, i.e. in the situation that they receive active support. This suggests that such dogs experience support from their owner and stress reduction when given attention. However the dogs that were given active support did showed more 'Paw lifting' than when given passive support, which again could be explained by behavioural inhibition. The passively supported dogs, might perceive the situation more stressful, but the stress-signals are suppressed by behavioural inhibition. When owners that perceived the dogs as costly gave their dogs active support, these dogs responded relatively strongly to the approaching person i.e. more 'Redirected sniff' and 'High tail', which seems to contradict pronounced calming effects of such owners on their dogs. When looking at the influence of the factual participation of the dogs in their owners' life (part 1 MDORS) on the behaviour of the dog in this experiment, it can be seen that dogs of owners that have a good relationship were focused on the stimulus and their behaviour was quite stable across repeated confrontations. However a significant effect of the instruction type was not seen. Thus to summarize, active support given by owners who reported having a good emotional bond with the dogs had a stronger conflict-reducing effect than active support given owners who had weaker emotional bonds, however former these dogs did respond with more unease as compared to the passive support, which could be linked to behavioural inhibition release. Also a strong opposite of the proposed effect of active support was seen when the dog was seen as costly.

A Sub question was added in this research, which was: '*Is there a difference in the behaviour of the dog when the behaviour and appearance of the approaching person changes?'* The results showed that dogs did differ in their behaviour when the appearance of the approaching person changed. When the wig and the mask were taken off and the approaching person spoke enthusiastically to the dog, it could be seen that the dogs were getting excited by the person and thus looked at them more and consequently 'Looked away' less. This was expected because the person looked less threatening in the fourth trial because she took off the mask and the wig. Now the dog recognised her from earlier that day and she sat down and spoke to the dog enthusiastically. In the literature it is stated that the way people approach a dog is influential to the way the dog responds. Vas et al. (2005) investigated the difference in response of dogs towards a person that approaches in a friendly manner and in a threatening manner. The dogs averted their gaze, were more vocal and showed less contact seeking when approached in a threatening way as compared to the friendly way. Even though in the approach test of this research the approaching person was not particularly aggressive in her approach, the difference of approach was clearly visible in the fourth trial and thus also in the response by the dogs. This also showed that the possible learned response was not persistent when the approaching person changed.

Some methodological issues may have increased the variation in the results, complicating the detection of effects. In general it could be seen that it was difficult to make sure that the owners performed the active instruction in a similar manner. There was thus quite some variation in the way and the amount of vocal and tactile support the owners gave. Owners did perform the passive instruction very well. Even though there was some variation, there were significant results and the effect of an active support was visible. However the effects might have been even stronger if the owners had all given the same amount of active support. Also the scores used for the determination of aggression and fear of the dog, were owner-reported scores. This might give a different outcome compared to when the dogs were scored on aggressiveness or fear by an independent trained scorer, because of the inexperience of the owners to detect aggression and/or fear and the owners' memory of the proposed situations. However scoring by an independent trained scorer also has drawbacks, like the inability to see the behaviour of the dog over several different situations, including the home situation, and the extensive testing of the dog; therefore it was chosen to use the owner-reported data. We also based the owner-dog relationship based on the owners' report, thus on how the owner interprets the relationship. This does however not always mean that the dog sees this relationship as good, while this might influence how the dog perceives the support as helpful. In future research the dog-owner relationship based on the behaviour of the dog could be determined and used to investigate the effect of the quality of the relationship on the influence of the support given.

To conclude, when owners gave active support to their dog this reduced conflict-related behaviour towards an approaching person, but effects differed in dogs known to be aggressive or fearful towards strangers in general. In such dogs active support resulted in more aggressive or fear-related behaviour, in comparison to when dogs received passive support. Social support may attenuate behavioural inhibition in fear-aggressive dogs, facilitating the expression of conflict behaviour like avoidance and aggression. It could also be concluded that the personality of the owner did have an effect on the behaviour of the dog in that active support given by extravert or conscientious owners reduced the conflict-related behaviour of the dog and active support given by introvert or non-conscientious owners resulted in more conflict-related behaviour. Also, dogs of agreeable owners

showed relatively high levels of avoidance behaviour and became more aroused with repeated exposure. Dogs of neurotic owners showed relatively much fearful behaviour and those owned by closed people acted less calm towards the approaching person. Owner-dog relationship also had an influence on the effect of active support. Active support given by owners who reported having a good emotional bond with the dogs had a stronger conflict-reducing effect than active support given by owners who had weaker emotional bonds, however former these dogs did respond with more unease as compared to the passive support, which could be linked to behavioural inhibition release. Also a strong opposite of the proposed effect of active support was seen when the dog was seen as costly.

Even though the anxiolytic effects of support were confirmed, the processes behind these effects are not clear. More research needs to be done on this. Especially, the processes behind the difference in response between aggressive and fearful dogs and other dogs need to be investigated. Also the effect of the owner-dog relationship, viewed from the dogs' point of view, on the anxiolytic effects of support need to be investigated, because of the possible different outcome. The results from this research could be used in the future to give advice to dog owners in how to respond in future threatening situations. Preliminary results indicate that giving active support is a good way to reduce emotional responses in dogs confronted with unfamiliar people. However, if the dog is known to be aggressive or fearful, then it might be better for the surrounding people to ignore the dog, otherwise the reduction of stress might disinhibit unwanted responses of the dog. It is also seen that personality of the owner and the bond the owner has with the dog has an effect on the behaviour of the dog and how he responds to support. Thus owner-dog interaction is important in understanding the dogs' behaviour and should be included in the investigation towards reducing problem behaviour in dogs.

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Appendix A

Indoor tests performed after the stranger approach test.

T-maze: The dog was put in a starting box and at one point the box opens and the dog was called by the owner, which stands on the other side of the T-maze. The dog could go to the owner via the left or right side. This was repeated a number of times in each phase. During the training phase the dog was rewarded on one side and not on the other and during the test phase the rewarding side switched.

Puzzle test: The dog was asked to solve a puzzle. After three times, the level of the puzzle was increased. In total there were three levels, thus the puzzle had to be solved 9 times, each within a 30s timeframe. The owner was present, but could only give positive cues to the dog, no direct interaction.

Memory test: Three cups (same or different cups) were shown to the dog. The experimenter hid a treat in one of the cups and the dog had 5 seconds time to go to the cup. This short timeframe eliminated searching techniques. This was done 3 times each phase. The phases consisted of a round with three equal cups and no screen, a round with three equal cups and a screen was placed before the dog for 3 seconds after hiding the treat and before letting the dog go and the last phase consists of three different cups (in form and colour) and with screen. The owner was asked to not give any clues.

Barking test: The owner was asked to sit on a chair with the dog sitting in front of the owner with its back towards the owner. Then a sound was played and the behaviour of the dog was observed. The sound was a playful and a defensive bark.

Appendix B

Table 1 Ethogram dog

Behaviour dog	Type	Description
View		
In sight	State	Dog is visible in video recordings
Out of sight	State	Dog is not visible in video recordings
General behaviour		
Interaction with owner	State	Behaviour that is intended to make contact with the owner or is the act of having contact
looking at stimulus	State	Turn its eyes in the direction of the stimulus
Explore environment	State	Nose is within 3 cm of any feature of the physical environment, for longer than 3 seconds
Other behaviour	State	Behaviour that does not entail abovementioned behaviours
Ear positions		
High	State	Position of the ear is higher than in 'neutral'
Neutral	State	Natural position of the ear
Low	State	Position of the ear is lower than in 'neutral'
Out of sight	State	As it implies
Tail position		
High	State	Position of the tail is higher than in 'neutral'.
Neutral	State	Natural position of tail.
Low	State	Position of the tail is lower than in 'neutral'.
Out of sight	State	As it implies.
Locomotion		
Moving (walking)	State	Walking at least one step with all four paws.
Standing	State	All four paws on ground with legs upright and extended supporting the body. the dog may move two steps from its original position.
Sitting	State	Hind quarters on ground and forelegs supporting the body.
Lying	State	In ventral or lateral position, all four legs make contact with ground (belly on ground).
Panting		
Panting on	State	Breathing in high frequency, this is often accompanied by the protrusion of the tongue.
Panting off	State	No panting.
Not visible	State	As it implies.

Tail wagging		
Wagging off	State	No tail wagging.
Wagging on	State	Sideward movements of the tail.
Tail not visible	State	As it implies.
vocalizations		
Repeat bark	Event	Loud and regular barking that is often repeated quickly (characteristic of dogs), directed at the stimulus. Maximum of 5s, then scored again.
Bark	Event	One single short bark, directed at the stimulus.
High barking	Event	Barking with a higher pitched intonation than normal barking (the vocal cords are pressed together due to stress) directed at the stimulus. Maximum of 5s, then scored again.
High vocalization	Event	Peeping, whining, yelling or howling (all vocalizations are characteristic of dogs). Maximum of 5s, then scored again.
Intention bark	Event	Low bark while the mouth is partly closed, it is less loud than the normal barking. Maximum of 5s, then scored again.
Growling	Event	Low buzzing sound. Maximum of 5s, then scored again.
Events		
Fleeing	Event	Fast movement from the stimulus, with head in opposite direction of the stimulus.
Freezing	Event	General rigidity of the body without staring at the stimulus.
Startle reflex	Event	Short lasting reflex to the stimulus. The dog moves up to 2 steps from the stimulus.
Crouching	Event	Rapid and pronounced lowering of posture without large movement. The dog withdraws its head and legs.
Trembling	Event	Shaking of the body or part of the body.
Staring	Event	Fixated look at the stimulus. The pupils are slightly widened and the dog freezes.
Lifting lip	Event	Tension of the upper lip muscles, so it is lifted (teeth not shown).
Jump intention	Event	Movement that resembles a jump, but full jump is not completed. Both front paws are lifted from the ground at the same time, in the direction of the stimulus.
Baring teeth	Event	Uncover the whole or part of the upper teeth. The corner of the mouth can be drawn back or shortened. It may be accompanied by wrinkle of the nose.
Jumping owner	Event	Jumping up at the owner.
Press nose owner	Event	The dog presses the owner using its nose.
Approaching stimulus	Event	Walking towards the stimulus.
Tilting head	Event	The head is directed towards the stimulus and is held bent.
Paw lifting	Event	Lifting one of the fore paws, the wrist is bent up at an angle of 45 degrees.
Biting leash	Event	The upper and lower teeth make physical contact, pressuring the leash.
Stretch leash	Event	The leash reaches its maximal length on the opposite direction in relation to the stimulus.
Looking away	Event	Only the head away from the stimulus (~ 90 degrees). Only once.
Piloerection	Event	Erection of hairs, e.g. neck, shoulder, back, legs, and/or tail.

Yawning	Event	An involuntary intake of breath through a wide open mouth.
Teeth clapping	Event	Multiple, fast and continue movements, open and close of the jaws, may be accompanied by bare teeth.
Restless walking	Event	Fast walking towards and from the stimulus.
Shaking	Event	Fast sideward movements with the parts of the body.
Sneezing	Event	An involuntary, sudden, intense, and audible expulsion of air through the mouth and nose.
Stretching	Event	Mechanical lengthening of the body, when it is at maximum length the forelegs are lowered it creates a hollow back (similar to play bow).
Circling	Event	Movement roughly in a circular pattern, returning to the same spot at least once.
Shrink back	Event	Fast movement from the stimulus.
Retreating	Event	Not accelerated movement from the stimulus.
Looking around	Event	Fast sideward movements with the head (restless).
Snapping	Event	Fast movement towards the stimulus, attempt to bite but the dog does not make physical contact.
Lunging bite	Event	Moves quickly towards the stimulus, but does not make physical contact. The dog moves more than 1 step.
Looking owner	Event	The dog looks in the direction of the owner.
Leaning owner	Event	The dog's body makes contact with the owner, exerting pressure.
Disregard stimulus	Event	The dog is walking around disregarding the stimulus. Absence of any behaviour towards the stimulus.
Redirect sniff	Event	The dog noses other surface than the stimulus. If it continues longer than 3s, it is scored as exploration.
Shutting mouth	Event	The dog closes its mouth, behaviour directed towards the stimulus.
Check look	Event	Trunk or side of the body is directed to the stimulus. Slightly turns its head to the shoulder. Up to 1 second.
Alternating paws	Event	A quick sequence of lifting fore paws without excessive removal from its original body position (no more than 2 steps aside).
Tongue flicking	Event	The dog briefly shows the tip of the tongue straight ahead towards the nose, possibly even up to the nose (over the nose).
Auto grooming	Event	Behaviours directed towards the dog's own body, like scratching, licking and biting.
Staying in background	Event	The dog stays in the background relative to the owner. Maximum of 5s, then scored again.

Appendix C

Table 1 Ethogram owner

Behaviour	Type	Description
Vocalization		
praising	Event	Vocally addressing the dog in a supporting manner.
Correcting	Event	Vocally addressing the dog in a correcting in order to change its behaviour.
Neutral	Event	Vocally addressing the dog in a neutral manner.
Tactile contact		
Petting	State	Petting the dog from head to tail.
Petting solicited by dog	State	Petting the dog. Dog initiated this contact.
Scratching	State	Short movements with fingers or hand on a small area of the dog's body.
No tactile contact	State	Owner does not touch the dog.
Out of sight	State	As it implies.
Repositioning dog	Event	Owner changes position of the dog, either by pulling the leash or repositioning the dog by hand.
Gaze		
Looking towards dog	State	The owners' eyes turn in the direction of the dog.
Looking towards stimulus	State	The owners' eyes turn in the direction of the stimulus.
Looking towards other	State	The owners' eyes turn in the direction of something else than dog or stimulus.
Out of sight	State	As it implies.

Appendix D

Table 1 Dimensions of the C-BARQ and related questions (adapted from Hsu and Serpell, 2003).

Dimension	Questions
Trainability	*By checking the appropriate boxes, please indicate how trainable or obedient your dog has been in each of the following situations in the recent past*
	When off the leash, returns immediately when called.
	Obeys the "sit" command immediately.
	Obeys the "stay" command immediately.
	Seems to attend/listen closely to everything you say or do.
	Fast to respond to correction or punishment.
	Fast to learn new tricks or tasks.
	Not easily distracted by interesting sights, sounds or smells.
	Will 'retrieve' or attempt to retrieve sticks, balls, or objects.
	Obeys the 'Down' command immediately.
	Obeys the 'Heel' command immediately.
Stranger-directed aggression	*Please indicate your own dog's recent tendency to display aggressive behaviour in each of the following contexts*
	When approached directly by an unfamiliar female while being walked/exercised on a leash.
	When approached directly by an unfamiliar male while being walked/exercised on a leash.
	When approached directly by an unfamiliar child while being walked/exercised on a leash.
	Toward unfamiliar persons approaching the dog while s/he is in your car (at the gas station for
	When an unfamiliar person approaches you or another member of your family at home.
	When unfamiliar persons approach you or another member of your family away from your home.
	When mailmen or other delivery workers approach your home.
	When strangers walk past your home while your dog is in the yard.
	When joggers, cyclists, rollerbladers or skateboarders pass your home while your dog is in the yard.
	Toward unfamiliar persons visiting your home.
Owner-directed aggression	*Please indicate your own dog's recent tendency to display aggressive behaviour in each of the following contexts*
	When verbally corrected or punished (scolded, shouted at, etcetera) by you or a household member.
	When toys, bones or other objects are taken away by a household member.

	When bathed or groomed by a household member.
	When approached directly by a household member while s/he is eating.
	When his/her food is taken away by a household member.
	When stared at directly by a member of the household.
	When stepped over by a member of the household.
	When you or a household member retrieves food or objects stolen by the dog.
Dog-directed aggression	*Please indicate your own dog's recent tendency to display aggressive behaviour in each of the following contexts*
	When approached directly by an unfamiliar male dog while being walked/exercised on a leash
	When approached directly by an unfamiliar female dog while being walked/exercised on a leash.
	When approached directly by an unfamiliar puppy while being walked/exercised on a leash.
	When approached directly by a smaller dog than your dog while being walked/exercised on a leash.
	When approached directly by a larger or of similar size dog than your dog while being walked/exercised on a leash.
	Toward unfamiliar dogs visiting your home.
	When barked, growled, or lunged at by another (unfamiliar) dog.
	Towards another (familiar) dog in your household (leave blank if no other dogs).
	When approached at a favourite resting/sleeping place by another (familiar) household dog
	When approached while eating by another (familiar) household dog (leave blank if no other dogs).
	When approached while playing with/chewing a favourite toy, bone, object, etc., by another (familiar) household dog (leave blank if no other dogs).
Stranger-directed fear	*please indicate your own dog's recent tendency to display fearful behaviour in each of the following circumstances*
	When approached directly by an unfamiliar man while away from your home.
	When approached directly by an unfamiliar woman while away from your home.
	When approached directly by an unfamiliar child while away from your home.
	When unfamiliar persons visit your home.
Pain sensitivity	*please indicate your own dog's recent tendency to display fearful behaviour in each of the following circumstances*
	When examined/treated by a veterinarian.
	When having claws clipped by a household member.
	When groomed or bathed by a household member.
	When having his/her feet towelled by a member of the household.
Dog-directed fear	*please indicate your own dog's recent tendency to display fearful behaviour in each of the following circumstances*
	When approached directly by an unfamiliar dog of the same or larger size.

	When barked, growled, or lunged at by an unfamiliar dog.
	When approached directly by an unfamiliar dog of a smaller size.
	When approached directly by an unfamiliar male dog while being walked/exercised on a leash
	When approached directly by an unfamiliar female dog while being walked/exercised on a leash.
	When approached directly by an unfamiliar puppy while being walked/exercised on a leash.
	Toward unfamiliar dogs visiting your home.
	Towards another (familiar) dog in your household (leave blank if no other dogs).
	When approached at a favourite resting/sleeping place by another (familiar) household dog
	When approached while eating by another (familiar) household dog (leave blank if no other dogs).
	When approached while playing with/chewing a favourite toy, bone, object, etc., by another (familiar) household dog (leave blank if no other dogs).
Non-social fear	*please indicate your own dog's recent tendency to display fearful behaviour in each of the following circumstances*
	In response to sudden or loud noises (e.g. vacuum cleaner, car backfire, road drills, objects
	In heavy traffic
	In response to strange or unfamiliar objects on or near the sidewalk (e.g. plastic trash bags, leaves, litter, flags flapping, etc.
	During thunderstorms.
	When first exposed to unfamiliar situations (e.g. first car trip, first time in elevator, first visit to Veterinarian, etc.)
	In response to wind or wind-blown objects.
Separation anxiety	*Thinking back over the recent past, how often has your dog shown each of the following signs of separation-related behaviour when left, or about to be left, on its own*
	Shaking, shivering or trembling.
	Excessive salivation.
	Restlessness/agitation/pacing.
	Whining.
	Barking.
	Howling.
	Chewing/scratching at doors, floor, windows, curtains, etcetera
	Loss of appetite.
Excitability	*please indicate your own dog's recent tendency to become excitable in each of the following circumstances*
	When you or other members of the household come home after a brief absence.
	When playing with you or other members of your household.
	When doorbell rings.

	Just before being taken for a walk.
	Just before being taken on a car trip.
	When visitors arrive at your home.
Attachment or attention-seeking	*Thinking back over the recent past, how often has your dog shown each of the following signs of attachment or attention-seeking*
	Becomes agitated (whines, jumps up, tries to intervene) when you (or others) show affection for another dog or animal.
	Displays a strong attachment for one particular member of the household.
	Tends to follow you (or other members of household) about the house, from room to room.
	Tends to sit close to, or in contact with, you (or others) when you are sitting down.
	Tends to nudge, nuzzle or paw you (or others) for attention when you are sitting down.
	Becomes agitated (whines, jumps up, tries to intervene) when you (or others) show affection for another person.
Chasing	*Thinking back over the recent past, please indicate how often your dog has shown any of the following behaviours*
	Chases cats (given the chance).
	Chases birds (given the chance).
	Chases other animals (squirrels, rabbits, etcetera) (given the chance).
	Reacts aggressively towards cats or other animals entering your yard.

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Table 2 Dimensions of the MDORS and related questions (Dwyer et al., 2006).

Dimension	Questions
Part 1 F1 'Factual items'	
	How often do you play games with your dog?
	How often do you take your dog to visit people?
	How often do you give your dog food treats
	How often do you kiss your dog?
	How often do you take your dog in the car?
	How often do you hug your dog?
	How often do you buy your dog presents?
	How often do you have your dog with you while relaxing, i.e., watching TV?
	How often do you groom your dog?
Part 2 F1 'Perceived emotional closeness'	
	My dog helps me get through tough times.
	My dog is there whenever I need to be comforted.
	I would like to have my dog near me all the time.
	My dog provides me with constant companionship.
	If everyone else left me my dog would still be there for me.
	My dog gives me a reason to get up in the morning.
	I wish my dog and I never had to be apart.
	My dog is constantly attentive to me.
	How traumatic do you think it will be for you when your dog dies?
	How often do you tell your dog things you don't tell anyone else?
Part 2 F2 'Perceived costs'	
	It is annoying that I sometimes have to change my plans because of my dog.
	It bothers me that my dog stops me doing things I enjoyed doing before I owned it.
	There are major aspects of owning a dog I don't like.
	My dog makes too much mess.
	My dog costs too much.
	How often do you feel than looking after your dog is a chore?
	How often does your dog stop you doing things you want to?
	How often do you feel that having a dog is more trouble than it is worth?
	How hard is it to look after your dog?

Table 3 Dimensions of the FFM and related statements.

Dimension	Statements
Openness	
	Vote for conservative political parties.
	Consider arts as important.
	Are not interested in abstract ideas.
	Vote for liberal political parties.
	Avoid philosophical discussions.
	Go reluctantly to art museum.
	Not interested in arts.
Neuroticism	
	Have regular mood swings.
	Are not easily emotional.
	Hate myself.
	Feel seldom sad.
	Panic easy.
	Are satisfied with myself.
	Are often very unhappy.
	Feel often down.
Extraversion	
	Am the focus of attention at parties.
	Are skilled in social situations.
	Do not like to draw attention.
	Make easily friends.
	Know how to interest people.
	Stay in the background.
	Do not talk a lot.
	Feel comfortable in the company of others.
	Have nothing to say.
Conscientiousness	
	Am always prepared.
	Make plans and follow them.
	Execute my plans.
	Work just enough to finish the job.
	Difficult to start working.
	Attention for detail.
	Wasting my time.
	Perform tasks and jobs directly.
	Avoid doing my tasks.
	Do not finish stuff.
Agreeableness	
	Respect others.
	Offend people.
	Belief in the good intentions of others.
	Accept people the way they are.
	Take revenge on the people who deceived me.
	Criticise other people.
	Always a good word for everyone.

Appendix E

Table 1 Results of saliva cortisol measurements (nmol/L).

Voter ID	*8705*	*8640*	*8724*	*8727*	*8711*	*8631*	*8622*	*8637*	*8630*	*8659*	*8643*	*8672*	*8635*	*8616*	*8623*	*8696*	*8681*	*8666*
1	9.85	4.76	5.7	4.39	4.95	3.61	3.27	2	2.94		3.01		3.75	2.65		3.14	1.85	2.78
2	5.31			3.8	3.54	4.11	3.4		3.43		2.78	2.51		2.9	2.67	2.22	3.75	2.84
3	4.57		2.82	3.74	2.07	2.69		4.44		3.17	3.52	3.65	2.38	3.52	3.29	3.41	2.92	
Mean	6.58	4.76	4.26	3.98	3.52	3.47	3.34	3.22	3.19	3.17	3.10	3.08	3.07	3.02	2.98	2.92	2.84	2.81

Voter ID	*8764*	*8613*	*8686*	*8709*	*8590*	*9998*	*8652*	*8687*	*8685*	*8736*	*8596*	*8688*	*8625*	*8626*	*8602*	*8624*	*8710*	*8669*
1	2.93				2.32	2.4		2.05	2.46	2.85	2.13	2.49	2.28		2.26	1.72	2.09	2.01
2	2.92	2.39	2.71	2.64	2.96	2.58		2.42	2.54	2.07	2.49			2.21	1.99		2.12	
3	2.41	3.08				2.87	2.56	3.04		2.09		2.09				2.5		1.94
Mean	2.75	2.74	2.71	2.64	2.64	2.62	2.56	2.50	2.50	2.34	2.31	2.29	2.28	2.21	2.13	2.11	2.11	1.98

Voter ID	*8695*	*8639*	*8733*	*8633*	*8647*	*8649*	*8660*	*8721*	*8612*	*8667*	*8683*	*8655*	*8621*	*8611*	*8723*	*8657*	*8737*
1	1.68	2.25			1.58		1.31	1.51	1.84		1.21	0.8		0.84		0.78	2.1
2	2.23	1.41	1.23	1.76	1.87	1.7			1.2			1.31		1.2		0.8	
3		1.82	2.3		1.76	1.55	1.61	1.39	1.23	1.34		1.36	1.11	1.15	1.02	0.82	1.84
Mean	1.96	1.83	1.77	1.76	1.74	1.63	1.46	1.45	1.42	1.34	1.21	1.16	1.11	1.06	1.02	0.80	1.97

The first sample was taken at the beginning of the test day, the second after the outside tests and the third at the end of the test day. The voter ID is the number given to individual dogs. In total at least one of the measurements of 53 dogs were successfully taken. Not all measurements were successfully taken to analyse

Appendix F

Table 1 Results (p-values) of restricted maximum likelihood (REML) model, which included Instruction*Trial and was run over the data of 66 dogs and has three repetitions (trial 1 to 3). The average observed time was around 25sec per trial.

	Instruction effect	Trial effect	Interaction effect
States (% of observed time)			
Looking at stimulus	**0.008**[AC]	**<0.001**[A]	**0.006**[A]
High ear		**0.031**[A]	
Standing			**0.06**[B]
Lying	**0.036**[A]	**0.069**[BC]	
Events (times per trial)			
Look away		**0.006**[A]	**0.002**[A]
shutting mouth			**0.091**[B]
check look		**0.037**[A]	
Alternating paws		**0.098**[B]	**0.098**[B]
Component loading			
Social excitement towards owner	**0.052**[B]		
Boldness	**0.040**[A]		**0.040**[A]

[A] Indicated significant p-values (<0.05)
[B] Indicated p-values that showed a trend (between 0.051 and 0.1)
[C] P-values from transformed data
n=198 except High ear (n=182), High tail (n=140) and Neutral tail (n=140).
The variables 'Exploration', 'High tail', 'Neutral tail', 'Vocal', 'Paw lifting', 'Shaking', 'Retreating', 'Redirected sniff' and 'Staying in background' were analysed, however there were no significant or trend effects found for these variables.

Table 2 Results (p-values) of restricted maximum likelihood (REML) model, which included Instruction*Trial and was run over the data of 66 dogs and has four repetitions (trial 1 to 4). The average observed time was around 25sec per trial.

	Trial effect	Location of the trial effect (related to trial 4)
States (% of observed time)		
Looking at stimulus	**<0.001**[A]	Trial 3-4
Events (times per trial)		
Look away	**0.004**[A]	Trial 3-4
Retreating	**0.075**[B]	Trial 1-4; 2-4
Alternating paws	**<0.001**[A]	Trial 1-4; 2-4; 3-4
Component loading		
Boldness	**0.014**[A]	Trial 1-4; 2-4

[A] Indicated significant values (p<0.05) and the significance effect lies in the addition of trial 4
[B] Indicated p-values that showed a trend (between 0.051 and 0.1) and the effect was in the addition of trial 4
n=261 except High ear (n=240), High tail (n=187) and Neutral tail (n=197).
The variables 'Exploration', 'High ear', 'High tail', 'Neutral tail', 'Standing', 'Lying', 'Vocal', 'Paw lifting', 'Shaking', 'Redirected sniff', 'Shutting mouth', 'Check look', 'Staying in background' and 'Social excitement towards owner' were analysed, however there were no significant or trend interaction effects with trial found for these variables.

Table 3 Results (p-values) of two restricted maximum likelihood (REML) models, one which included Instruction*Trial*Stranger-directed aggression and one which included Instruction*Trial*Stranger-directed fear and was run over the data of 62 dogs and has three repetitions (trial 1 to 3). The average observed time is around 25sec per trial.

	Stranger-directed aggression			**Stranger-directed fear**		
	Main effect	X Instruction	X Trial	Main effect	X Instruction	X Trial
States (% of observed time)						
High tail						**0.041**[A]
Neutral tail						**0.024**[A]
Standing						**0.018**[A]
Lying			**0.002**[A]		**0.071**[B]	
Events (times per trial)						
Vocal		**0.012**[A]				
Paw lifting				**0.006**[A]	**0.003**[A]	**0.005**[A]
Look away	**0.005**[A]		**0.018**[A]	**<0.001**[A]		
Retreating				**0.005**[A]		
shutting mouth		**0.046**[A]				
Stay in background				**<0.001**[A]	**0.016**[A]	
Component loading						
Boldness		**0.018**[A]				

[A] Indicated significant p-values (<0.05)
[B] Indicated p-values that showed a trend (between 0.051 and 0.1)
n=186 except High ear (n=173), High tail (n=131) and Neutral tail (n=131).
The variables 'Looking at stimulus', 'Exploration', 'High ear', 'Shaking', 'Redirected sniff', 'Check look', 'Alternating paws' and 'Social excitement towards owner' were analysed, however there were no significant or trend effects found for these variables.

Table 4 Results (p-values) of three restricted maximum likelihood (REML) models, one which included Instruction*Trial*Part 1 MDORS, one which included Instruction*Trial*Part 2.1 MDORS and one which included Instruction*Trial*Part 2.2 MDORS was run over the data of 62 dogs and has three repetitions (trial 1 to 3). The average observed time is around 25sec per trial.

	Part 1 factual items			**Part 2.1 perceived emotional closeness**			**Part 2.2 perceived costs**		
	Main effect	X Instruction	X Trial	Main effect	X Instruction	X Trial	Main effect	X Instruction	X Trial
States (% of observed time)									
Looking at stimulus	**<0.001**[A]								
High tail								**0.019**[A]	**0.026**[A]
Neutral tail	**0.072**[B]	**0.033**[A]						**0.076**[B]	
Events (times per trial)									
Vocal	**0.066**[B]								**0.087**[B]
Paw lifting	**0.078**[B]				**0.02**[A]		**0.082**[B]		
Look away			**0.002**[A]						
Retreating						**0.078**[B]			
redirected sniff								**0.018**[A]	
shutting mouth						**0.073**[B]			
check look	**0.002**[A]		**<0.001**[A]						
Component loading									
Boldness	**0.068**[B]	**0.092**[B]							

[A] Indicated significant p-values (<0.05)
[B] Indicated p-values that showed a trend (between 0.051 and 0.1)
For part 1 n=183 except High ear (n=170), High tail (n=128) and Neutral tail (n=128)
For part 2 n=186 except High ear (n=173), High tail (n=131) and Neutral tail (n=131)
The variables 'Exploration', 'High ear', 'Standing', 'Lying', 'Shaking', 'Alternating paws', 'Staying in background' and 'Social excitement towards owner' were analyzed, however there were no significant or trend effects found for these variables.

Table 5 Results (p-values) of multiple restricted maximum likelihood (REML) models, each one included Instruction*Trial*Personality factor (Agreeableness, Conscientiousness, Extraversion, Neuroticism or Openness) was run over the data of 62 dogs and has three repetitions (trial 1 to 3). The average observed time is around 25sec per trial.

	Agreeableness		**Conscientiousness**		**Extraversion**			**Neuroticism**		**Openness**	
	Main effect	X Trial	X Instruction	X Trial	Main effect	X Instruction	X Trial	Main effect	X Trial	Main effect	X Trial
States (% of observed time)											
Looking at stimulus										**0,04**[A]	
High ear									**0,031**[A]		
High tail		**0,008**[A]	**0,06**[B]								
Neutral tail		**0,003**[A]	**0,078**[B]						**0,067**[B]		
Standing		**0,015**[A]			**0,034**[AC]			**0,064**[B]			
Lying							**0,092**[B]				
Events (times per trial)											
Look away	**0,01**[A]								**0,011**[A]		
Retreating	**0,01**[A]							**0,032**[A]			
redirected sniff	**0,085**[B]	**0,002**[A]									
shutting mouth										**0,026**[A]	**0,067**[B]
check look			**0,012**[A]								
Alternating paws					**0,036**[A]	**0,017**[A]					
Staying in background	**0,029**[A]										
Component loading											
Social excitement towards owner				**0,093**[B]			**0,005**[A]		**0,008**[A]		
Boldness				**<0,001**[A]					**0,004**[A]		

[A] Indicated significant p-values (<0.05)
[B] Indicated p-values that showed a trend (between 0.051 and 0.1)
[C] P-values from transformed data
n=186 except High ear (n=173), High tail (n=131) and Neutral tail (n=131)
The variables 'Exploration', 'Vocal', 'Paw lifting' and 'Shaking' were analysed, however there were no significant or trend effects found for these variables. Also no interaction between instruction and Agreeableness, Neuroticism and Openness was found and no main effects of Conscientiousness.