Hunden i kontorsmiljö – en beteendestudie

Dogs in the office environment - a behavioural study

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Abstract

Deciding what to do with the dog during working hours is a problem that many dog owners are faced with. One possible solution is to bring the dog to work, for example the office. It is, however, not known how this environment and the everyday events and situations there affect the welfare of the dogs. The aim of this project was to study how the dog is affected by commonly occurring situations when at the owner at work in an office environment. The subjects were 12 privately owned dogs which routinely accompanied their owners to the office at the University of Agricultural Sciences. Dogs and owners were filmed in the office during four different treatments. Behaviours were analyzed separately, but some were also grouped in physically active (in motion), mentally active (in motion, or not moving but focused) and behaviours often suggested to indicate arousal (yawn, lick, shake and stretch). Numbers of transitions between different states (how often the dog switched body position and/or switched between different activities) were recorded. The four 30 minute treatments were: I) Control; dog and owner together, telephone rings II) Separation and Return; owner leaves dog and returns for short visits repeatedly III) Alone; the dog is alone for 20 minutes with disturbances: an unfamiliar dog passes the doorway, and a sudden noise is heard IV) Visitors; two minute visits from two unfamiliar persons, one enthusiastic and contact seeking (E), and one neutral which ignores the dog (N).

Results of this study show that even though there were individual differences, dogs' reactions in the different situations were mild. Overall mean values show that dogs on average spent 89.5% of the time lying down. Very little barking occurred. During Control treatment dogs were least active. The Visitor treatment caused an increased mental activity ($P<0.05$), which in large part could be explained by physically dynamic behaviour such as the dog moving around to interact with visitors. This treatment also elicited high frequencies of indicators of arousal ($P<0.05$) and caused an increased number of posture changes ($P<0.05$). Also in Separation and Return, mental activity increased ($P<0.05$), but the average dog was to a larger proportion physically stationary during their mental behaviour, i e the dog was not as much in motion but focused on the environment, such as the owner and doorway. Variation in mental activity was large in the treatment Alone, indicating that dogs coped with being left for 20 minutes in different ways. Some were physically active; others were static but still mentally active, while some showed little reaction. There was a tendency ($P=0.055$) for dogs to be located near the door to a greater extent when the owner was absent (15.2% time) compared to present (4.5%). As expected, the enthusiastic visitor elicited much stronger reactions than the neutral. Out of 12 dogs, 11 interacted with visitor E, but only 3 with visitor N. Although both visitors caused reactions initially, visitor E had both a significantly larger ($P<0.05$) and more long-lasting effect even after the visit. It is unclear if these effects could have a negative impact on the dog, or if they can function as a stimulating enrichment. An unfamiliar dog passing caused increased intensities of restlessness ($P<0.05$) and mental activity ($P<0.01$), while the only reaction to the noise was that HR increased initially ($P<0.01$) probably indicating that there was an element of surprise, from which the dog quickly recovered. Results do not show any clear indications that bringing the dog to the office would affect the welfare of the dog. To consider the character of and the effects on the individual dog is a crucial key when determining whether to bring the dog to the office or not.

Introduction

Dogs are part of human everyday life since ancient history, and both dogs and dog owners must continuously deal with the various problematic situations of their time age. Deciding what to do with the dog during working hours is a problem of today, which many dog owners must find a solution to. One possible solution is to bring the dog to work, for example in the office. It is, however, little known of how this environment and the everyday events and situations there affect the welfare of the dogs.

A dog-man history

To understand the welfare of the dog, it is relevant to consider its process of evolution and domestication. The relationship between dogs and people is the result of successful co-evolution. By 12 000 years ago, humans of the Pleistocene age had established a way of life that enabled other species to successfully form a cooperative link with them (Bleed, 2006). Wolf individuals with a "tameable" personality were preferred and tolerated in close relationships with humans, and through this selection procedure the domestication process that would create the dog was in progress (Clutton-Brock, 1999). The strong link between humans and dogs is proven by the many examples of dog burial sites, ranging from as early as 14 000 to 12 000 years ago (Morey, 2006).

During the course of domestication, many of the original properties of the wolf have been altered – some traits selected for, and others against (Vas et al., 2005). The series of behaviours involved in attacking and killing a prey is an example of where the corresponding action pattern in dogs has been inhibited – the killing bite is an element that seems to be missing in most individuals (Fox, 1976). However, other sequences of the prey-catching behaviour have instead been genetically reinforced in some dog types, such as the impulse to follow prey (but without killing it!) in shepherd dogs (Coppinger & Schneider, 1995). Much of the ritualized aggression and submission behaviour seen in wolves has also been fragmented in the modern dog. The reasons for this could be that human provision of food make consequences of possible injuries less costly, in addition to the diminishing need for hierarchy establishment for the purpose of population regulation (Frank & Gialdini Frank, 1982).

The human need for dog company or assistance related to different areas of use, created a development where dogs diverged into different types. We ended up with many different breeds, all of them the evolutionary results of selection for certain qualities which helped dogs adapt to the intended association with humans (Vas et al., 2005).

How dogs and humans bond

The propensity to form bonds with specific humans individuals is something unseen in wolves, but typical for dogs. Even though hand-reared wolf pups may develop a high level of tameness, they do not discriminate between the "owner" and an unfamiliar person, something which dog pups do. It is likely that during domestication, genetic changes took place which affected the dog's attachment system (Topál et al., 2005).

Through the process of domestication, the dog has also gained some unique socio-cognitive abilities which facilitate our inter-species communication. The domesticated

canines' capacity to read human signals and cues, such as gazing and pointing, is a well documented feature (Vas et al, 2005; Viraányi et al, 2003; Hare et al, 2002; Soproni et al, 2002). Human gaze is one of our most important visual cues. According to Virányi et al (2003), a dog is more prone to beg for food from a person with whom it has eye contact than a person that is looking away. Dogs are more willing to obey a command from their owner if the owner is attending them, rather than looking away or being hidden (Virányi et al, 2003). Compared to hand-reared wolves and chimpanzees, dogs also have a much more developed ability to find food in a hidden location with help from a human's direction of gaze or pointing gesture, even at early age (Hare et al., 2002; Soproni et al, 2002). In addition, dogs even have the capacity to understand combinations of the human repertoire of signals.

The apparent question is how dogs have acquired these inherent skills. Since other canids such as wolves and foxes do not have them even after being hand-reared, it has been concluded that the trait is a result of the domestication process. In an experimental domestication process during 45 years where a population of foxes was selectively bred for fearlessness and non-aggressiveness towards humans, it was discovered that the ability to interpret human gestures appeared in the domesticated fox kits, even though this had not been specifically selected for. This indicates that this example of social-cognitive evolution is a by-product of domestication, rather than a result of direct selection for the trait (Hare et al., 2005) as has been suggested previously (Hare et al., 2002).

The dog of today

There are many different dog types, of which many by selection are designed to perform a specific line of work or fulfill a task desired by humans. However, there have probably been significant changes in the role of dogs in the Western society household during the last century.

There are an estimated 950 000 dogs in Sweden today, distributed over 20% of all households (Manimalisrapporten, 2006). When looking at the Swedish dog population, one can state in general that many dogs are used differently today compared to when the breed of the dog first originated. For example, not many terriers are used for hunting, and only a fraction of the shepherd breeds are actually used for working sheep. Instead, the participation in dog shows has become an important activity for dog breeders. A large number of breeds have undergone great changes when it comes to morphological, genetical and behavioural factors. An evaluation of standardized Dog Mentality Assessment tests in Sweden shows that much of the behavioural inter-breed differences today, such as levels of playfulness, social and non-social fearfulness, curiosity in potentially fearful situations and aggressiveness, can no longer be explained by the breeds' origin. This indicates that a lot of the inter-breed differences are due to recent selection rather than the original different purposes, and that today the main selection pressure for many breeds is the use in dog shows (Svartberg, 2005). It is apparent that the domestication of the dog is still very much a work in progress.

So, what niche must our modern dogs fit into? The dog today is a part of the human family to a much greater extent than in the past. We no longer expect the dog to wander about the farm for its entire life, but rather that it should behave civilized in furnished rooms, get along with familiar or unfamiliar people and other dogs, and accompany us in many different locations without causing trouble. Because of the increasing popularity of keeping

dogs as pets only, it might be reasonable to assume we will continue to prefer those individuals which can meet the high demands of being able to form strong bonds to humans and function well in a human social setting, and thereby reinforcing traits related to this function.

However, the everyday life of humans has changed drastically as well. Most of us do not work at home, and during day time the home is often abandoned when the grown-ups have gone to work and the younger ones attend school or day care. According to the Statistical Central Bureau (2006), people are away from home approximately 6-7 hours a day. The dilemma is obvious: the dog is capable of forming bonds with humans and in many cases it develops a strong attachment to us. When we have to go to work, we put the dog in situations which may include social isolation from other dogs, spatial restriction, separation from the owner, or elements that might be unfamiliar to the dog. For the dog owner there is a number of alternatives to choose from: leaving the dog at home, putting it in dog day care, leaving it with a dog sitter or – if permitted – taking the dog with them to work. The most frequently used solutions are to leave the dog at home (73%) or bring it to work (16%) (Norling, unpublished data). Each solution presents a unique set of challenges, and each and every one of those challenges will inevitably have an impact on the dogs' welfare. Only by evaluating the different elements of the alternatives, can we get an idea of how the welfare of the dog is affected by our way of keeping the dog during the work day.

What is welfare?

The definition of welfare has been much debated. Animals have a wide variety of functional systems through which they deal with their environment in order to maintain a state of mental and physical homeostasis. Feelings are one part of these functions, which also include physical, immunological and behavioural systems. According to one definition, all of these aspects should be considered when talking about welfare. From this point of view, the quality of welfare is to be defined as the extent to which the animal must use its functional systems to cope with the environment and maintain acceptable homeostasis. An animal with difficulties to cope would, by this definition, have poor welfare (Broom, 1996). Duncan (1996) regards that welfare should be defined solely in terms of feelings, since the word can only be applied to sentient animals. It has been argued that focusing too much on factors such as biological functioning can be misleading. One argument for this is that animals in some situations may be showing signs of stress, even though the situation is in fact rewarding, such as in sexual activities. The picture of the physiological state in a situation might therefore not correspond correctly with the picture of the feelings in the same situation. A high level of negative feelings would, according to this definition, be equal to poor welfare.

Even though there are various opinions about the definition of welfare, the concept is useful only if we can somehow quantify the welfare of an animal. A predominant part of scientists agree that it is of great importance to develop methods for asking animals *directly* about their preferences. The existing repertoire of methods available for doing so is still quite insufficient. However, it is possible to measure and observe a number of other variables that are related to the animals' physical and mental state. These variables include measurements of behaviour, heart rate, adrenal action and immunological conditions. Some of these measurements may give indications of emotional states that could be interpreted both as positive or negative (Broom, 1991).

Stress and welfare

Stress is an important factor to consider when assessing welfare quality. In this report, the term *stress* will be used to describe the reaction that occurs when something in the environment (a *stressor*) demands an active regulation to maintain homeostasis at different times. The stress reaction is a generalized tool which allows the animal to respond quickly to threatening or demanding situations. A stress response, activated by a stressor, is positive to the sense that it is designed to facilitate the survival of the animal, but if the response is triggered too often or for a longer duration of time, the consequences will be negative. The physical responses to stress are many and include activation of the sympathetic nervous system and the hypothalamus pituitary axis (HPA). A stressed animal shows an increased heart and breathing rate and inhibition of digestive and sexual mechanisms, while cognition and alertness are sharpened. Several hormone levels, such as cortisol, will be elevated. Cortisol is released from the adrenal cortex and promotes glucose availability for the body (Hill et al., 2004). If the cortisol levels remain high for a longer period of time, it can lead to muscle breakdown and suppression of the immune system (Broom & Johnson, 1993). When the stressor disappears, a feedback mechanism ensures the stress reaction shuts off. Even if a stressor is of a kind that might actually be perceived as rewarding for the animal, such as sexual or feeding behaviours, any long term activation of the stress response will be damaging (Hill et al., 2004) and welfare will be diminished.
There are also other physiological systems which actually promotes anti-stress and restoration, and an important component in this matter is the nonapeptide oxytocin. Oxytocin has been shown for example to reduce blood pressure and cortisol levels, increase pain tresholds and support growth and healing. In humans, oxytocin can be released by sensory stimulation such as touch and warmth, ingestion of food and positive social interaction (Uvnäs-Moberg & Petersson, 2005).

Methods for assessing welfare

Evaluating behaviour is an important key in assessing the quality of welfare. Dogs may display a variety of behaviours during acute stress. Behaviours associated with fear and submission, such as vocalizing, paw lifting, snout licking and lowering of the body posture have been reported (Beerda et al., 1997). Situations inducing more severe stress may trigger panting, increased salivation and other thermoregulatory behaviour (Beerda et al., 1997). Symptoms of chronic stress are more difficult to assess. Possible indications of chronic stress are low body posture, repetitive movements, coprophagy and autogrooming (Beerda et al., 1997). When challenged, a dog subjected to chronic stress may show increased signs of aggression, uncertainty or excitement (Beerda et al., 1998b).

Combining behavioural observations with physiological measurements makes the picture much more complete. There are several invasive and non-invasive methods available for doing this. Since elevated levels of the hormone cortisol results from an attempt to cope during stress, measurements of cortisol in samples of blood, urine or saliva give valuable clues when assessing welfare (Beerda et al., 1997). The measuring of cardiac activity is another commonly used method to evaluate physical stress and identify which environmental challenges produce reactions. Mean heart rate (HR) has proved to be a useful tool to measure behavioural states associated with sympathetic stimulation in several species (Palestrini et al., 2005; Vincent et al., 1997). However, HR is strongly affected by physical activity and body position, so if results are screened in search of clues for assessing the mental state, HR values are relevant only if one is comparing time

intervals of similar activity (Baldock & Sibly, 1990; Maros et al., 2007). Another method, which has recently been evaluated for dogs, is the option of looking at heart rate variability (HRV). This is done by measuring the variable interval between heart beats, an additional parameter which indicates the sympatho-vagal balance of the organism (Maros et al., 2007). It is possible that this is a more useful parameter than HR when assessing emotional states, since it is not as strongly linked to motor activity.

It is still not entirely clear how heart rate measurements should be interpreted, and possibly both options give valuable information. One study has found that dogs separated from their owner showed an increase in HR even when the behaviour remained static, and this suggests that the increase in HR might be due to the emotionally stressful situation (Palestrini et al., 2005).

Dogs in the workplace

Many dog owners are reluctant to the idea of leaving their dog at home, or being separated from their dog for many hours every day. Bringing the dog to work might seem like an attractive solution to this problem. But what about the effects on the dog? At the workplace it is likely that the dog will have to deal with several situations and challenges on a day to day basis. Being left alone for various periods of time, encountering visitors in the office or experiencing disturbances outside the room in form of people or other dogs would hardly be rare occurrences.

A search through the available scientific literature in the subject of dogs at the workplace, reveals that there is more work done about how people are affected by dogs at the office, than the other way around. A work environment which allows pets is likely to be perceived as informal and flexible, and the people who work there - whether they bring an animal or not - enjoy increased social interaction and a relaxed atmosphere (McCullough, 1998; Perrine & Wells, 2006). A dog in the office could make the room seem more comfortable, and visitors might get an impression of friendliness of the person using the office (Wells & Perrine, 2001). However, the workplace might appear less clean and safe (Perrine & Wells, 2006).

Although there are no previous welfare studies specifically about dogs in the workplace, there are still other articles that can be of relevance when looking into this. When interpreting the observations of this study, the results of generic dog studies about separation, interaction with strangers, spatial restriction and reactions to auditory stimuli in other environments can be of great help, and give an idea of what to expect.

It is likely that an owner who brings the dog to work would have to leave the dog alone for shorter or longer periods of time during the day. When being separated from the owner, dogs may show different passive or active behaviours of distress such as staring at or scratching on the door, pacing around and vocalizing, as well as an increase in HR (Palestrini et al., 2005). Dogs with a pronounced separation anxiety may even perform severely negative behaviours such as destruction of objects in its environment, inappropriate elimination and self-inflicted trauma. Separation anxiety is believed to be related more to hyperattachment to the owner, rather than boredom or lack of obedience (Flannigan & Dodman, 2001; Lund & Jørgensen, 1999). However, general lack of stimulation when the owner is at home, can cause an increase in activity – destructive anxiety behaviour included - once the owner is gone (Lund & Jørgensen, 1999).

Hyperattachment may be recognized by excessive following of the owner, sensitivity to cues which signal on-coming separation, and overenthusiastic greeting of the owner (Flannigan & Dodman, 2001).

The owner returning from absence might also have an effect on the dog. A dog greeting its owner will in many ways show behaviours similar to that of a wolf greeting a more dominant conspecific. Submission and, perhaps, affection is displayed by a lowering of the body posture, ears drawn back and a lowered, wagging tail. The dog commonly rubs up against the owner and tries to lick the hands and face. More eager attempts to affirm submission might include rolling over to show the inguinal region (Bradshaw & Nott, 1995).

If there are visitors entering the room where the dog spends the work day, this too could have an effect on the dogs' state. When dealing with the appearance of a stranger, dogs are very flexible thanks to their special ability to interpret complex patterns of human cues. In a study where dogs were approached by a human in a friendly or threatening manner respectively, half of the dogs relied on the human cues and altered their behaviour according to the situation, responding to the threatening approach with avoidance or aggression. The other half ignored the changed cues of the stranger and responded with a consistent, tolerant behaviour to both approaches. This difference seemed to be due to different types of breed, implying that artificial selection has resulted in variations between breed types when it comes to sensitivity to human cues (Vas et al., 2005). In a study that measured HR in dogs during The Ainsworth Strange Situation Test, HR increased in a similar way both when the dog was greeting its owner and a friendly stranger (Palestrini, 2005).

Spending the day in the office usually means that the dog is confined in an area that is smaller than area where the dog is allowed at home. However, spatial restriction does not seem to be the greatest factor of importance regarding the well-being of dogs. Social isolation probably has a more negative impact than size of room. Repetitive movements such as pacing, tail chasing, wall bouncing, flank sucking and auto-grooming have been observed in dogs subjected to social isolation in restricted areas (Hubrecht et al., 1992). Dogs housed in pairs spend more time sleeping and less time vocalizing compared to dogs housed singly (Hetts et al., 1992).

Disturbances in the form of noise could also affect the welfare of dogs in the workplace. Dogs sleep part of the day, and it is possible that auditory stimuli, such as the telephone ringing or noise from outside the room, would occur also in the office environment so that dogs could be disturbed while sleeping. In contrast to humans, it does not matter if the dog is in quiet or active sleep – it will just as frequently respond to noise. Dogs are more likely to become alert or bark when they hear other dog barks, compared to auditory stimuli such as human voices or passing traffic (Adams & Johnson, 1994). Very loud noises (> 98 dB) can cause an increase in HR and elicit behaviours such as snout lick, paw lift, body shake and a low posture (Beerda et al., 1997). The more sudden a stimulus is, the stronger a stress reaction it will cause, especially if it is unanticipated by the dog. An increased saliva cortisol level and a low posture are common. If the stimulus is administered by a person visible to the dog, reactions such as restlessness, body shaking, yawning and oral behaviours are more likely to occur (King et al., 2003; Beerda et al., 1998a).

Aim

The purpose of this study was to investigate how dogs cope with the different situations that they are likely to come across when being with the owner at his or her workplace.
Since many dogs do accompany their owner to work and deal with the challenges presented there on an everyday basis, there is a need to assess how the welfare of the dog is affected by this environment. We expected the welfare to be affected negatively by dogs being temporarily left alone by their owners in the office, and interrupting events such as visitors, noises and other disturbances.

In this study, behaviour and heart rate were examined in dogs that regularly accompany their owner to work in the office. Each dog went through four different treatments which simulated situations that would be common in the office environment, including visual and auditory disturbances, separation from the owner, being alone and encountering unfamiliar visitors. Through the results we can gain a better understanding of how the welfare of the dog is affected in the office environment. Results could be used to increase the welfare of the dog in our society, and also help dog owners to decide what to do with the dog when they go to work. In addition, results could be of use for companies considering a policy for dogs in the work place.

Materials and methods

Sample

The subjects of this study were 12 privately owned pet dogs of different breeds. Ages of the dogs ranged from 2 to 12 years (median 6 years, mean 6.6 years), 6 were females and 6 males (see table 1). All dogs participated with their owners' signed approval and cooperation. Each dog had been with the owner at the workplace for at least 6 months, which was a criterion for participating. Out of the 12 dogs, 10 had accompanied their owner to work for more than 2 years. Some owners and dogs had changed office rooms recently; 5 dogs had been in the present room for 6 months or less, while 7 dogs and owners had been situated in their office for longer.

The environment in which the study was performed consisted of the owner's individual office rooms within the buildings of SLU in Ultuna, Uppsala. Rooms varied in size, but all dogs were used to the door being open with only a gate to keep the dog contained. Another criterion for participating in the study was that the owner and the dog spent at least half of the working hours with no co-workers or other dogs present in the room.

Table 1. *Dogs participating in the study*

Dog	**Breed**	**Sex**	**Age**	**Experience of workplace**	**Experience of Room**
Smilla	Fox terrier	female	2	> 2 years	> 6 months
Garcon	Berner Sennen hund	male	3	> 2 years	≤ 1 month
Mini	Jack Russel terrier	female	3	6 months ≤ 1 year	1 month ≤ 6 months
Amos	German shepherd	male	4	6 months ≤ 1 year	≤ 1 month
Hallon	Border terrier	female	5	> 2 years	> 6 months
Koffi	Springer spaniel/Kelpie mix	female	5	> 2 years	> 6 months
Camelia	Appenzeller Sennen	female	7	> 2 years	≤ 1 month
Leo	Cavalier	male	8	> 2 years	> 6 months
Bachus	Irish setter	male	9	> 2 years	> 6 months
Pirat	Nov. Scot. duck toll. retriever	male	10	> 2 years	1 month ≤ 6 months
Samba	Nov. Scot. duck toll. retriever	female	11	> 2 years	> 6 months
Gigo	Australian cattle dog	male	12	> 2 years	> 6 months

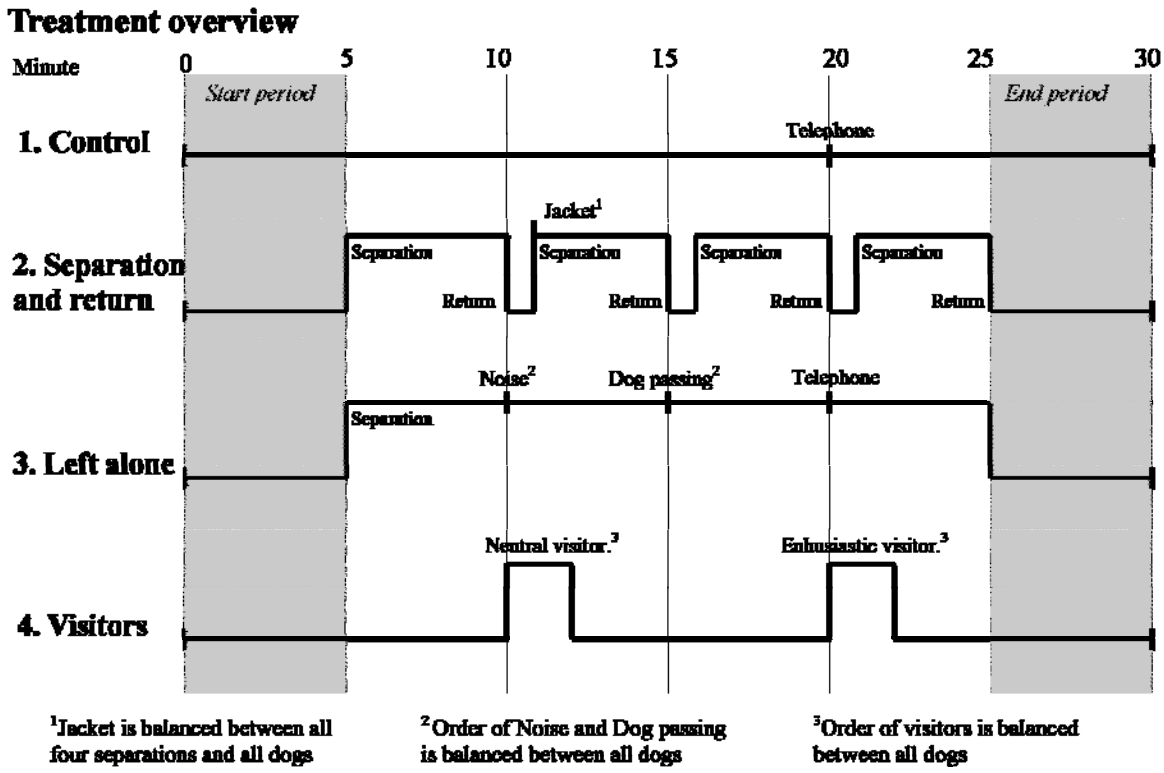
Equipment

In all treatments, the office space was observed using two wireless surveillance cameras (Vivotek 54Mbps Pan/Tilt) in the room. In addition to the filming, a Polar Vantage heart monitor strapped around the dog's chest recorded the dog's mean heart rate with an interval of 15 seconds during all treatments. The dogs fur was not removed, but contact between body and electrodes was accomplished using an electrode gel (Blågel). The dog also wore a common harness used to tie the electrode belt to, in order to keep it in place. The harness also served as a place on which to attach the Polar Vantage wrist unit receiver, on top of the dogs back. The dogs were allowed at least 30 minutes to get used to the equipment before the first filming started (see below), and at least 15 minutes for the consecutive filmings.

Treatments

The study consisted of four different treatments of 30 minutes. Each treatment started and ended with a 5 minute eventless episode (*start period* and *end period*) during which the dog and the owner were alone in the room without any controlled disturbances; the owner working quietly at the desk. This episode worked as a "buffer" for each treatment and helped minimize carry-over effects.

Figure 1. *The four treatments.*



Each dog was allowed to undergo only one treatment per day, and for each dog all the treatments were performed at the same time of day (±1 hour). After the filming equipment had been set up in the room and the dog had the heart rate monitor strapped on, the experimenter left the room for some time to give the dog a chance to settle down before the test started. Before a dogs' first treatment this pause was at least 30 minutes, and at the following treatments the pause was at least 15 minutes. After the pause, the experimenter would return to give the owner brief instructions. The cameras were then started, followed by the heart rate recording. The treatment started a few seconds after the experimenter again left the room.

Signs were put up outside the room to discourage uncontrolled visitors from entering the room. Apart from this, the activity outside the office room was not controlled. However, in the corridor or space outside the room, 2 lines were marked at a distance of 5 m in both directions from the door. The area between those marking represented the Proximity Area. The experimenter, placed a few meters outside the Proximity Area, continuously took notes if any persons or dogs were present, or if anyone was talking, in that area. Any dog barks heard by the experimenter was also noted, even if the dog might not be within the Proximity Area.

The 12 dogs were divided into 3 groups in a 3 x 4 block design. Within each group, the treatment order was balanced using a latin square (Williams design).

Treatment 1 – Control treatment + telephone. This treatment served as a control. During the entire treatment, the owner was sitting quietly working at the desk. After 15 minutes, the office telephone rang, 4 signals. The owner had been instructed not to answer.

Treatment 2 – Separation and Return. This treatment simulated the owner running multiple errands, repeatedly leaving the dog and making quick visits to the room as if just to fetch something. After the 5 minute start period, the owner left the dog. The owner then returned for a 30 second visit in minute 10, 15 and 20. During these visits, the owner took no notice of the dog and remained standing up, acting like he/she was looking for something on the desk. In total, the owner left and returned on 4 occasions. Before one of the separations, the owner put on his/her jacket. Before which of the 4 separations this occurred, was balanced between the dogs of each block. At the last return, the owner was allowed to greet the dog as usual before sitting down at the desk for the final 5 minute end period.

Treatment 3 – Left alone + disturbances. The treatment studied the dog left alone in the room with different disturbances. After the initial start period, the owner left the room and two different disturbances occurred in minute 10 and 15, respectively. Which disturbance came first was balanced between the dogs of each block. The disturbances were I) a tin cookie jar with six metal teaspoons inside being dropped to the floor from the height of 1 m, creating a loud noise at a distance of 5 m from the door II) a dog unfamiliar to the subject dog passed by the doorway together with the experimenter, continued for 3 meters, turned around and then passed the doorway again. The dog used as a disturbance was a 13 year old, spayed, female Australian kelpie who paid very little attention to other dogs. A third disturbance occurred in minute 20, when the telephone rang, 4 signals. The owner returned in minute 25, and was allowed to greet the dog as usual before sitting down at the desk for the end period.

Treatment 4 – Visitors. This treatment simulated two different, unfamiliar visitors coming into the room. During the entire treatment, the owner remained sitting at the desk. Acting as the visitors were two women ages 27 and 30. The same person always played the same visitor (N or E, see below). The visitors arrived in minute 10 and 20, respectively. They stayed in the room for 2 minutes each. Which visitor came first was balanced between the dogs of each block.

Visitor N was the "neutral" visitor. Visitor N greeted the owner verbally when visible in the doorway, and then proceeded through the gate and into the room. This visitor took no eye contact with the dog. If the dog barked or showed any type of aggressive behaviour, the visitor stopped and remained in the same place until the dog no longer displayed that behaviour. Visitor N stopped at an approximate distance of 1.5 m from the owner, and they had a conversation in a calm and neutral voice. Visitor N was allowed to greet the dog only if the dog initiated direct physical contact (such as jumping up on, leaning on or nudging) and the visitor could do so only once, using only a short verbal cue, together with a short pat. The owner also had this same rule of passiveness towards the dog.

Visitor E was the "enthusiastic" visitor. Visitor E greeted the owner verbally when visible in the doorway, and then proceeded through the gate and into the room. This visitor

immediately sought eye contact with the dog, and talked in a calm but very positive voice. If the dog barked or showed any type of aggressive behaviour, the visitor stopped and remained in the same place while talking to the dog in a positive voice, until the dog no longer displayed that behaviour. Visitor E stopped at an approximate distance of 1.5 m from the owner and tried to make physical contact with the dog by patting, scratching and stroking. If the dog was out of reach, the visitor in a positive and inviting way used her voice, body posture and gestures in an increasing intensity until physical contact with the dog was re-established. As in the episode with the other visitor, the owner ignored the dog unless the dog took direct physical contact (such as jumping up on, leaning on or nudging), and contact could only consist of a short verbal cue, together with a short pat.

Variables used

The collected films were analysed using ethograms designed for this study (see Appendix I). Relevant behaviours of a typically longer duration, such as position in the room and basic activities such as lying, sitting and walking were recorded instantaneously. Behaviours with a character of shorter duration, such as barking och stretching, were recorded continuously.

All behaviours were analysed separately. In addition, some behaviours were also grouped together in certain constellations, in order to obtain variables of a more comprehensive nature. These new variables were:

Physical activity. When evaluating HR, it is relevant to try and discriminate between those HR changes which are due to physical activity, and those which are not. Therefore, all behaviours were categorized as either static or dynamic, and each 15 second interval was then classified as either static or dynamic. A static interval was scored as 0, and during this the dog showed *only* static behaviours, that is sitting/lying/standing without moving at all. A dynamic interval was one during which the dog displayed one or more behaviours which included physical motion or sound, and it was scored as 1.

Mental activity. This variable aimed at indicating mental activity. In order to observe the extent to which the dog is relaxed/passive or mentally occupied, all behaviours were categorized as either inactive or active. Being mentally active included all physical activity, but also other behaviours; i. e. the dog was occupied with something other than resting or being alert, this including the dog being focused or exploring (see ethogram in Appendix I). This definition means that a dog that might have been more or less immobile, could still have been rated as mentally active. The dog was regared as mentally inactive when displaying inactive behaviours, i. e. sitting/lying/standing with the head resting on a surface/floor, or being alert (see ethogram in Appendix I). Each 15 second interval was classified as either inactive or active (inactive if the dog showed *only* inactive behaviours). An active interval was scored as 1, and an inactive as 0.

Vocal. This variable includes bark, growl, howl and whine. If the dog made any of these sounds during an interval, that interval was scored as 1. If the dog was silent, the score was 0.

Transition variables. These variables strive to evaluate the level of restlessness by instantaneously counting the number of times the dog transferred from one body posture or activity to another between intervals. The transition variable consists of two different parts,

I) Changing Main, where the number of transitions between main positions such as standing/sitting/lying/walking were calculated, and II) Changing Secondary, which counts the number of transitions between minor activities such as changing lying position, point of focus, grooming or exploring (see ethogram in Appendix I for a full list of secondary behaviours).

Indicators of arousal. This variable includes yawn, lick, stretch and body shake. In this study, these behaviours often occurred sequentially. Arousal is a word with many definitions, but it is often used in context with reactivity, restlessness and excitement. The behaviours included in this variable have all been suggested to be possible signs of positive or negative stress in relation to an event (Beerda et al., 1998a; Beerda et al., 1998b) so a measure of these behaviours together could help in assessing arousal in general. Naturally, one must keep in mind that these behaviours are also seen frequently under other circumstances, such as licking lips after drinking, yawning after sleeping etc.

Indicators of arousal was calculated in a scoring system based on the typical time duration of the four different behaviours included in the variable, e.g. a maximum number of each behaviour that could reasonably be fitted into a 15 second interval should be given a maximum score. The maximum score was 10. For licks, then the score (1-9) was the same as the number of licks. But for other behaviours (yawn, stretch and shake) which require more time, then one occurrence was rated 3, two occurrences rated 6 and three occurrences rated 9. More than three occurrences gave the maximum score of 10 (Table 2).

Table 2. *Indicators of arousal. Numbers in italic means the actual numbers of behaviours performed, bold show the corresponding score.*

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Yawn	0			1			2			3	4, 5...
Lick	0	1	2	3	4	5	6	7	8	9	10, 11...
Stretch	0			1			2			3	4, 5...
Shake	0			1			2			3	4, 5...

Interaction with Owner/Visitor. As a measure of how much dogs interacted with each person present during the treatments, all five types of interaction (near, approach, follow, physical contact, and play) occurring with that person were added up. Each different interaction type observed within an interval was given the score 1, with a maximum score of 5 if all of the different interaction types were observed

Analyses

All statistical testing of hypotheses was performed using non-parametric tests. Unless otherwise specified, the Wilcoxon signed rank test was used, where observations were paired within dogs.

Single events and multiple events. Two main ways were used to study effect of events: Effect of single events, and comparison of effects of multiple events. The 2 minutes immediately following an event (post-event time) was compared with a time period from before the event happened (base period). The base period was chosen to represent an eventless and "neutral", day specific moment. The time used as the base period was different depending on the analyses. In some cases, the base period was the time just before the event, e.g. before the telephone rang. In other cases, the base period was minute

3-4 in the start period of the treatment, to eliminate any effect of any upcoming treatment events such as the owner getting ready to leave etc.

For each time period observed behaviours were summarized as intensities with which the behaviour had been observed (frequency of observed behaviour/number of observations in the time period). This was to correct for any minor differences in the duration of the time period.

Development of reaction over time. To evaluate the effect of a single event, e.g. the telephone ringing, the observations in the post-event time were compared statistically to the observations in the base period. Unless stated otherwise, the calculation of how the reaction of a separate event developed over time was made by dividing the 2 minute post-event time into four 30 second periods (1-4). The intensity of the behaviour of each period (1-4) was then compared to the intensity of the behaviour of the base period using Wilcoxon signed rank test. The Wilcoxon signed rank test pairs the base period and post-event period observations within dogs.

Comparing effects of different events. To compare the effects of different events, e.g. the difference between visitors N and E, the effect of each event was first summarized as a measure of the intensity in the post-event time, in relation to the intensity of the base period. For HR, this measure consisted of the ratio (intensity in post-event time)/(intensity in base period), i.e. the increase in the behaviour. For all other variables, the ratio statistic fails to work due to observed zero frequencies in the base period. These variables were measured as the (intensity in post-event time)-(intensity in base period). We will refer to measures as the "relative intensities". Unless stated otherwise, the calculation of differences between reactions to two separate events was made by comparing the relative intensities for the post-event periods (1-4) of one event, with the relative intensities for the post-event periods (1-4) of the other event, using Wilcoxon signed rank test. For example, period 1 of the one event was compared with period 1 of the other event; period 2 of one event compared with period 2 of the other event, etc.

Testing the overall effect. Overall effects of events, including all the post-event periods (1-4), were also analysed using Wilcoxon signed rank test.

I) The overall mean effect of an event was evaluated by comparing the dog-specific mean intensities over all the 4 post-event periods. To compare the overall effects of two different events, the average relative intensities (averaged over the post-event periods 1-4 - see section "Comparing effects of different events") for the first type of event was compared to the average relative intensities for the second type of event.
II) When comparing differences between the effects of two different events, the overall maximum effect was calculated by comparing the maximum value of all post-event period (1-4) relative intensities of one event, with the maximum value of all post-event period relative intensities of another event.
III) Another test used to assess the difference in reaction between two types of events was the All-versus-all effect, where all the post-event period (1-4) relative intensities of one event were compared to all the post-event period relative intensities of another event. In this test, we hence regarded the 4 post-event periods as independent, and assumed that the difference in relative intensities between the two events would have a similar magnitude in each of the four periods. However, if an event which does in fact not cause any reaction would be compared to an event which causes a reaction, it is possible that the reaction of

the latter event decreases through the four post-event periods. In that case, we expect a larger difference between the events period 1 relative intensities than between the period 4 relative intensities. In this situation, the assumptions of independence are not fulfilled, and the results should not be used as formal evidence. However, it can still give us some information, as this All-versus-all test has more power than the other tests and might display statistically significant differences where the other tests do not. Significant effects revealed by this method can indicate where a difference might have been found if the sample size had been larger. The results of this test could be seen as suggestions for future research.

Standard variables. Standard variables used in all analyses were HR, mental activity, physical activity, Changing Main, Changing Secondary, vocal and indicators of arousal. Behaviours that were also analysed separately were bark, tail wagging, yawn, licking snout, stretch, and shake. In analyses where this was relevant, the variable interaction with owner/visitor was added.

General/Time budget. In order to see how different behaviours were distributed over different treatments, a general time budget was made. The time budget was determined by calculating overall intensities of all variables. For each variable, we also liked to test the hypothesis of no difference between the four treatments versus the hypothesis of there being some difference. We therefore derived the intensities for all variables from minute 6 through 25 for each treatment; hence excluding the start period (minute 1-5) and end period (minute 26-30). Based on these intensities, the comparison between all four treatments was made using a Kruskal-Wallis test. Pair wise comparisons between treatment 1 and all other treatments, plus treatment 2 versus 3 were done using Wilcoxon signed rank tests.

Location. To see if there was a difference between how much time dogs spent at the door (within 30 cm) depending on owner presence, the proportion of the binomial variable Near Door/Not Near Door was compared between the time periods as defined by the owner present/not present variable for each dog. The significance test used was Wilcoxon signed rank test.

Disturbances. The dogs' reactions to another dog passing, a sudden noise and the telephone ringing (2 versions: when the owner was present and not present) were analysed separately. The 2 minutes immediately preceeding the event was used as base period. The exception was the HR variable, for which the base period was 30 seconds. For each event, each period 1-4 were tested, as well as the mean effect ((i) in section Testing the overall effect).

Comparing telephone disturbance in treatment 1 and 3. We wanted to investigate if the dog reacted differently to the telephone signal depending on whether the owner was present or not. The reaction to the telephone signal when the owner was present was then compared to the reaction to the telephone signal when the owner was absent. Values used were the relative intensities for the separate telephone events, with base period and post event time defined as above in section *Disturbances*. Each period 1-4, as well as the overall mean effect, maximum effect and All-versus-all effect were tested.

Comparing noise and dog passing in treatment 3. To find out if there was a difference in reaction between two different disturbances, the reactions to an unfamiliar dog passing and

a sudden noise were also compared. Relative intensities for each event were derived as described in section *Disturbances*, and these were tested for equality using the Wilcoxon signed rank test. Each period 1-4, as well as the overall mean effect, maximum effect and All-versus-all effect were tested.

The Neutral and the Enthusiastic visitor. When analysing the reaction to visitors, it was of interest to look at reactions both during and after the visit from each person. This makes the visitor analysis different, with 8 periods instead of 4. The base period used was the 2 minutes immediately preceding the visitor's entrance, with the exception for HR where the base period was 30 seconds. To calculate how the reaction developed over time, the 2 minutes immediately following the entrance of the visitor was, as usual, divided into four 30 second periods (1-4), and then the 2 minutes immediately following the exit was also divided into four 30 second periods (5-8). For each variable, the intensity level of each period (1-8) was then compared to the intensity of the base period using Wilcoxon signed rank tests. The overall mean effect was then calculated by comparing mean intensities over all the periods after visitor entrance (1-8) with the intensity of the base period.

Comparing visitor N and visitor E. Also when comparing the two visitors, it was of interest to look at reactions both during and after the visits. The relative intensities of each visitor event, based on the base period and 8 event periods as described in the above section, were used for comparison. The reactions to the two visitors were compared for each period (1-8) as well as for the overall mean effect, maximum effect and All-versus-all effect, using Wilcoxon signed rank test.

Questionnaire

The study also included a questionnaire (see Appendix II), in which the dog owner was asked questions concerning what the dog was mainly used for and how much the dog was activated daily. The owners could also rate how reactive they personally thought the dog to be in situations such as the telephone ringing, the dog being alone and when visitors coming.

Results

In general, intensities describing states are given as a percentage of total observation time, while event intensities are reported in terms of frequency of occurrence. All intensities given are relative intensities, with the exception of the General time budget section where intensities are absolute.

General time budget. When adding all treatments together, dogs spent on average 89.5 ± 2.4% (mean + SE) of the time lying down. The rest of the time was divided between standing (5 ± 1.4% time), sitting (3 ± 0.7% time) walking (2 ± 0.8% time) and grooming (1 ± 0.5% time). Due to differences in dogs' age, breed and character, there was a wide spread in the range of behaviour between individual dogs. This was compensated for by using each dog as its' own control, using paired Wilcoxon signed rank test.

A comparison between all treatments (Kruskal-Wallis test) showed that there were significant differences between treatments in the variables physical (P=0.01), shake (P=0.006) and groom (P=0.05). When treatments were tested pair wise (Wilcoxon), there were clear signs that dogs were less mentally active during Control treatment with 12.1 ± 5.7% than in any other treatment. There was a significant difference in mental activity between Control treatment and both Sep & Ret with 21.8 ± 7.1% (P=0.037) and Visitors 21.8 ± 3.5% (P=0.03). In addition, the proportion of time during which the dog was mentally active was almost twice as large in Alone with 23.9 ± 7.9% compared to Control treatment (tendency P=0.07) (*Figure 2*). There was always less physical activity in the Control treatment with 1.9 ± 0.7% time compared to in any other treatment. Significant differences were found in comparison with Sep & Ret (P=0.012) with 7.3 ± 2.8% and Visitors (P=0.001) with 11.7 ± 2.4%. Thus, significant differences were found between the same treatments for both physical and mental activity; all physically active behaviours are part of the mental activity variable.

When taking a closer look at the mental activity variable, in the Control treatment 84% of mental activity consisted of non-physical behaviour. The non-physical behaviour dominated the mental activity also in Sep & Ret and Alone, but not in Visitors. When comparing two treatments with almost exactly the same proportion of mental activity, namely Sep & Ret with Visitors, it is notable that in Visitors the physical part of activity is only 34% in Sep & Ret, but 51% in Visitors.

Figure 2. *Mental activity in different treatments (with SE). *P<0.05 **P<0.01 **P<0.001*

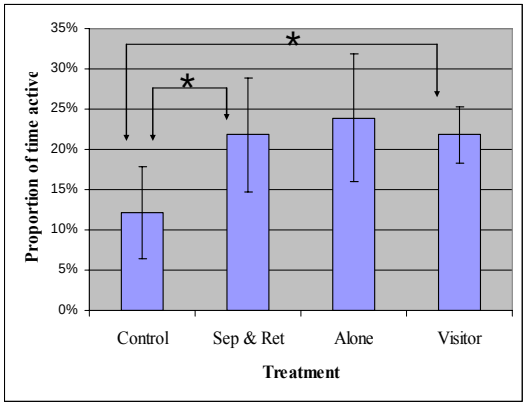
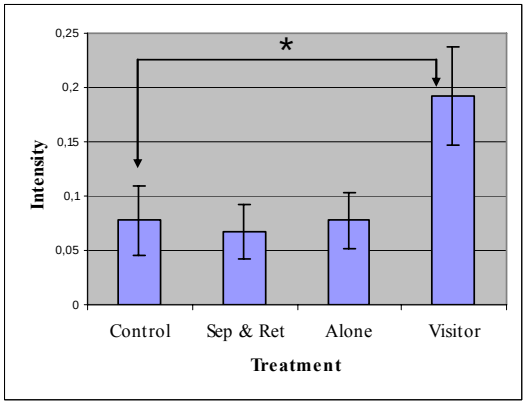


Figure 3. *Indicators of arousal in different treatments (with SE). *P<0.05 **P<0.01*



In both of the transition variables, Changing Main and Changing Secondary, intensities were always the highest for treatment Sep & Ret, and lowest for Control. In Changing Secondary, Sep & Ret treatment had almost double the intensity compared to Control, a difference which was significant (P=0.049) with the intensity 0.09 ± 0.04 (transitions per interval) for Control, and Sep & Ret with 0.19 ± 0.04.

Differences from Control were also found in the Visitors treatment for both transition variables; a significant one in Changing Main (P=0.039), where the intensity was 0.07 ± 0.01 and Control 0.04 ± 0.02, and a tendency in Changing Secondary (P=0.09) where the Visitors treatment intensity for Changing Secondary was 0.16 ± 0.03.

In Changing Secondary, there was also a tendency (P=0.054) to a difference between Control and Alone, where Alone had the intensity 0.16 ± 0.03.

In comparison with Control, The Visitors treatment elicited the highest frequency of shake (P=0.008) with 0.014 per interval. In this comparison, the Visitors treatment significantly (P=0.015) had the highest intensity of indicators of arousal (which includes shake), with dogs more than doubling their demonstration of these behaviours (e.g. 0.08 in Control; 0.20 in Visitors) in this treatment compared to all other treatments (*Figure 3*). Also, the majority (79%) of all tail wagging occurred in this treatment.

Out of 48 filmed treatments, barking occurred in three of them, of which two were in the Visitors treatment and the other in Alone. These barking episodes came from three different dogs.

Location. There was a strong tendency (P=0.055) that dogs spent more time near the door when the owner was absent, compared to when the owner was present. When the owner was present, dogs spent 4.5 ± 3% time near the door, and the corresponding proportion was 15.2 ± 3% when the owner was absent. The largest proportion of time spent near door was found in Sep & Ret with 19 ± 9% time, which was significant compared to Control (P=0.031). During Control treatment, dogs were hardly ever observed near the door (0.1 ± 0.3%).

Telephone. When the telephone rang in Control and Alone, there were no significant before to after differences within either of the treatments. Neither were there any significant differences found when comparing the two treatments, with the exception of in the overall effect test All versus all. In this test, some significant differences were found regarding the transition variables Changing Main (P=0.008) and Changing Secondary (P=0.022). As seen in *Figure 4* and *Figure 5*, results indicate that main and secondary transitions occurred at different times depending on whether the owner was present or not (please note that some bars have the value 0 and are therefore not visible in the figure). When the owner was present, the dog performed an increased number of transitions during the first 60 seconds after the telephone started ringing. When the dog was alone, however, the transitions instead peaked between 60-120 seconds. The effect that the telephone signal had on transitions seems to have been delayed when the owner was not present. These results should however be interpreted with caution, since both in Changing Main and Changing Secondary there are only 1-3 dogs that actually perform any transitions after the telephone signal. Due to technical failure, only 8 out of 12 dogs were exposed to the telephone signal in treatment Alone, while all 12 dogs were exposed in Control.

Figure 4. *Effect of telephone signal when owner present/not present on Changing Main (with SE. Present: 12 dogs, not present: 8 dogs). *P<0.05 **P<0.01 **P<0.001*

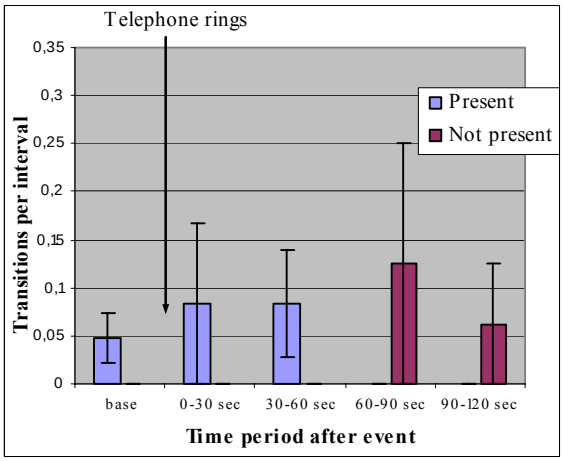
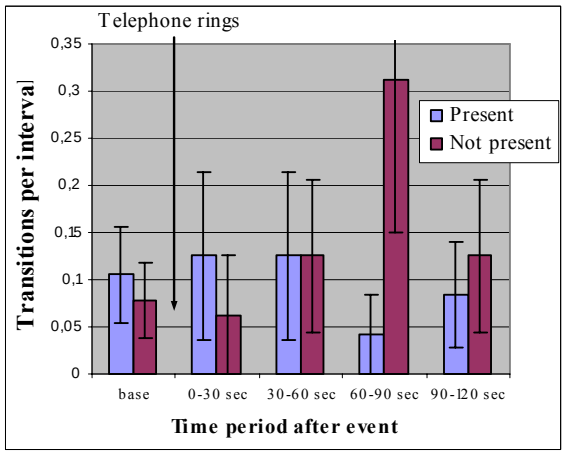


Figure 5. *Effect of telephone signal when owner present/not present on Changing Secondary (with SE). Present: 12 dogs, not present: 8 dogs). *P<0.05 **P<0.01 **P<0.001*

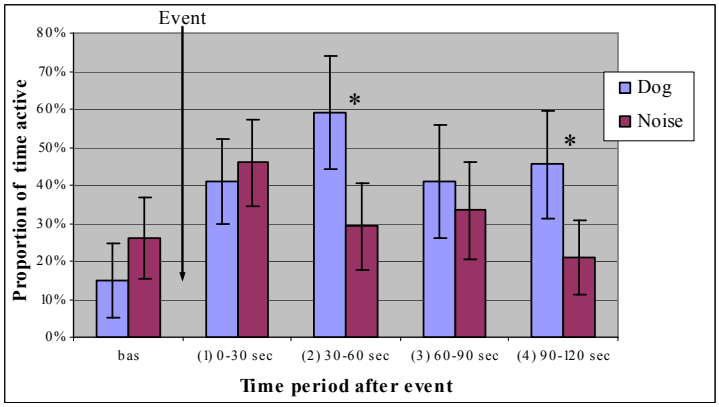


When only looking at mean intensities 2 minutes before and 2 minutes after the telephone signal, whether the owner is present or not, there are in *total* an equal or greater number of transitions performed *after* than *before* the telephone signal, both in Changing Main and Changing Secondary. The difference was, however, not statistically significant. The number of dogs performing these transitions is however the same before and after the telephone signal in both transition variables, but the transitions before and after are not necessarily displayed by the same dogs.

Dog passing and noise. When a strange dog passed the doorway, dogs reacted with an increased overall mean effect on the intensity of mental activity (*P* =0.008) from 14.7 ± 9.7% to 46.6 ± 1.4%, and a mean overall increase in number of transitions from 0 to 0.18 ± 0.08 in Changing Main (*P* =0.031). The noise on the other hand elicited no significant reactions in either of those variables. On the other hand, HR increased significantly (*P*=0.008), from 75.22 ± 4.13 bpm to 85 ± 4.54 bpm in period 1, which means a 13% increase during the first 30 seconds after the noise.

When comparing the reaction to noise versus dog passing, relative intensities for mental activity were always higher for dog passing than noise, with the exception for the first 30 seconds after the event. Significant differences were found in time periods 2 (*P*=0.031) and 4 (*P*=0.047) (*Figure 6*). In these two periods, the absolute intensity for dog passing was almost twice as high as for noise. The overall mean difference was also significant (*P*=0.047) in this variable.

Figure 6. *Effect of dog passing/noise on mental activity (with SE). *P<0.05 **P<0.01 **P<0.001*



When comparing reactions to dog passing and noise, there was also a tendency to a difference (*P*=0.065) in the transition variable Changing Main in period 2. The intensity of Changing Main in this period

was 0.23 ± 0.10 transitions per interval for dog passing, and 0 for noise. One dog did not participate in the dog passing test.

Visitors. In the Visitors treatment, there were several large differences found between how dogs reacted to the two different visitors. Out of 12 dogs, 11 approached the enthusiastic visitor E, while only 3 approached the neutral visitor N.

Visitor N had a significant overall mean effect on the variable Changing Secondary (*P*=0.031), with significantly increased relative intensities in period 1 after entrance, (*P*=0.031) and the first period after exit, period 5 (*P*=0.031) (*Figure 8*). An overall mean effect (*P*=0.05) was noted also regarding mental activity. In period 1 after visitor entrance the mental activity significantly increased (*P*=0.016) from 8.5 ± 5% (base) to 45 ± 12% (*Figure 9*).

Visitor E also had a significant overall mean effect on mental activity (P=0.0005), with significant and dramatic increases in mental activity in each of the periods 1-6 (period 1: *P*=0.002; periods 2-4: *P*=0.0005; period 5: *P*=0.004; period 6: *P*=0.016), with the mean mental activity of these six periods being 83.8 ± 7.6% compared to 10.4 ± 1% (base), as seen in *Figure 9*.

Significant increases in the transition variables were also found, both during and after entrance and exit of visitor E, with an overall mean increase in Changing Main (*P*=0.019) (*Figure 7*) and Changing Secondary (*P*=0.0005) (*Figure 8*). Immediately after entrance, Changing Main transitions showed significant increases in periods 1 (*P*=0.016) and 2 (*P*=0.008), and Changing secondary transitions likewise increased in period 1 (*P*=0.004), 2 (*P*=0.016) and 3 (*P*=0.03). In the periods directly following exit, a significantly increased frequency in Changing Main again occurred in period 5 (*P*=0.016), together with an increased frequency in Changing Secondary in period 5 (*P*=0.004) and 6 (*P*=0.002).

Figure 7. *Effect of visitor N and E on Changing Main (with SE).*

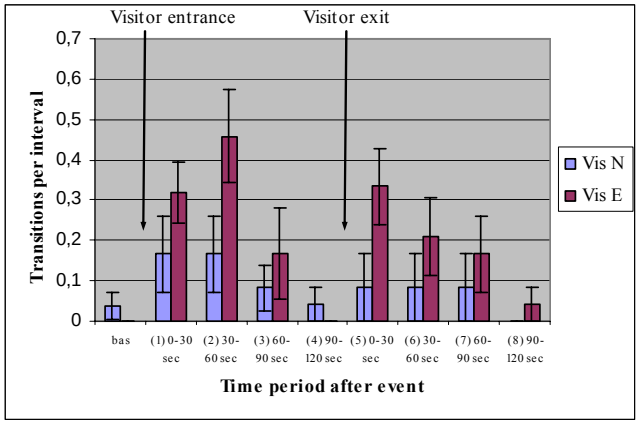
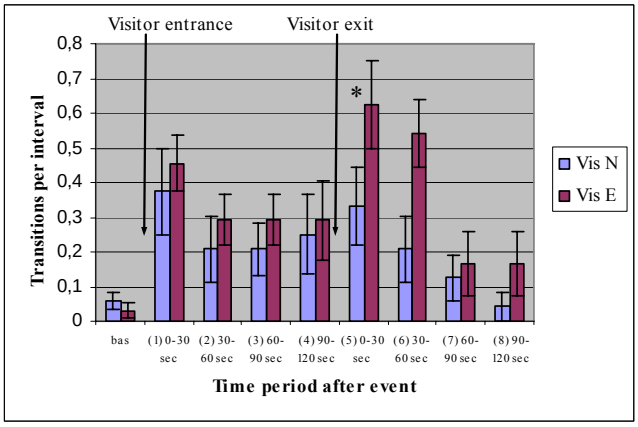


Figure 8. *Effect of visitor N and E on Changing Secondary (with SE). *P<0.05*



Indicators of arousal was another variable affected by the entrance and exit of visitor E, with a significant difference in overall mean effect (*P*=0.002). In period 1, there was a tendency (*P*=0.062) for indicators of arousal to occur more often, with an intensity raise from 0 (base) to 0.54 ± 0.20. Indicators of arousal again increased significantly (*P*=0.016) during period 5 to 1.21 ± 0.45, with a remaining tendency still at period 6 (*P*=0.06) with 1.25 ± 0.54 (*Figure 10*).

Figure 9. *Effect of visitor N and E on Mental activity (with SE). *P<0.05 **P<0.01 **P<0.001*

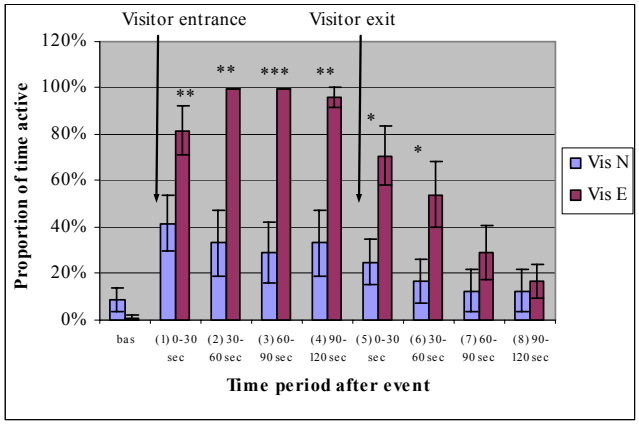
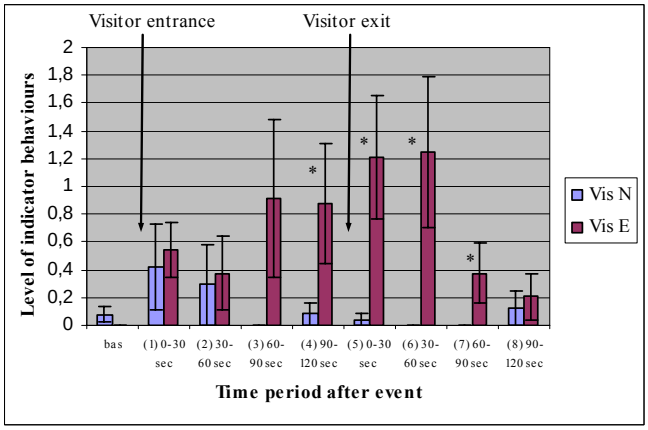


Figure 10. *Effect of visitor N and E on Indicators of arousal (with SE). *P<0.05 **P<0.01 **P<0.001*

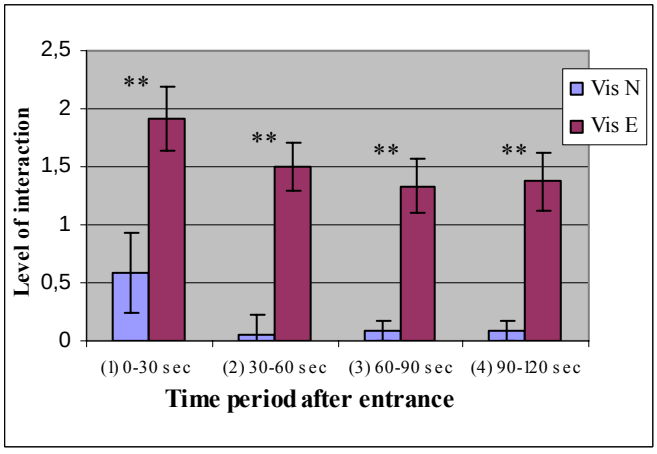


When comparing visitors N and E, there were significant differences (*P*=0.001) in mental activity between the two (*Figure 9*). Mental activity differed significantly throughout periods 1-6 (1: *P*=0.008; 2: *P*=0.002; 3: *P*=0.001; 4: *P*=0.002; 5: *P*=0.016; 6: *P*=0.16). Intensities were always higher in visitor E, in periods 1-6 with values exceeding those of visitor N with 96.4 – 242.9 % (±20.8%).

There were also overall differences between the visitors regarding the transition variables, with a tendency in Changing Main (*P*=0.55) and significance in Changing Secondary (*P*=0.012). Regarding Changing Main, although there were no significances, intensities were higher for visitor E in 7 out of the 8 periods, and there was a tendency to a difference in period 2 (*P*=0.056) where the intensity was 0.46 ± 0.11 for visitor E and 0.17 ± 0.09 for visitor N (*Figure 7*). In Changing Secondary, intensities were always higher for visitor E. The difference was significant in period 6 (*P*=0.02) with the intensity 0.54 ± 0.09 for visitor E and 0.21 ± 0.09 for visitor N. There were also tendencies to differences in period 5 (*P*=0.07) and 8 (*P*=0.06) (*Figure 8*).

The overall difference in indicators of arousal between visitor N and E was significant (*P*=0.02). Intensities were higher for visitor E in all of the 8 periods. Indicator behaviours were nonexistent for visitor N in periods 3, 6 and 7. The highest intensities for visitor E occurred during the first 60 seconds after exit with the intensity 1.21 ± 0.43 for period 5 and 1.25 ± 0.54 for period 6, compared to base which was 0. Significantly higher intensities were also found in period 4 and 7 (*P*=0.03 for both) (*Figure 10*).

Figure 11. *Interaction with visitors N and E (with SE). *P<0.05 **P<0.01 **P<0.001*



The extent of dogs' interaction with the visitor was much higher with visitor E than N (*Figure 11*). This difference was dramatic throughout the entire 2 minute visit (overall mean difference *P*=0.002), since only 3 dogs interacted with visitor N, and 11 dogs with visitor E. Out of the 11 dogs that interacted with visitor E, 10 interacted with the visitor to some extent in all of the 4 periods.

It is noteworthy that the only significant difference in HR was found in the reaction to the sudden noise in the Alone treatment. No other significant differences in HR were found as effect of events, or comparison between effects or treatments.

Summarizing the questionnaire, 10 dogs (84%) were used mainly as companion dogs, 1 dog (8%) as a working dog and 1 dog (8%) for agility. On the question of how much the dog in general was activated per day, half of the dog owners answered $1 \leq 2$ hours, the other half answered $2 \leq 4$ hours. Dog owners were also asked to rate how much their dog usually reacts to certain situations at home versus at work anywhere on a line ranging from "no reaction" in one end and "very strong reaction" in the other end (see Appendix II). Regarding all three situations, dog owners rated their dogs as being more reactive at home compared to work. On telephone signal, the mean answer was 6.17 ± 3.5 % at home, and 3.50 ± 1.73% at work. On dog left alone, the mean answer was 10.4 ± 4.2% at home, and 8.08 ± 2.68% at work. On visitors coming, the mean answer was 69.3 ± 7.4 at home, and 49.50 ± 9.06%. On the question of colleagues' attitudes to their dog at the workplace, 5 (42%) answers "very positive" and 7 (58%) answers "positive". The main reason for bringing the dog to work was not wanting the dog to be alone (6 owners, 50%), a more rewarding work day for the owner (3 owners, 25%), being unable to otherwise walk the dog during the day (2 owners, 17%) and feeling that the dog had special needs to be with its owner (1 owner, 8%). If dog owners would not be able to bring their dog to work, according to the survey their second choice would be leaving it with someone they know or with a dog sitter (9 owners, 45%) or in professional dog day care (3 owners, 25%).

Discussion

In an office environment, dogs must deal with many aspects of every day work life, such as disturbances in and outside the room, being left alone and encountering new people. In this study, the 12 subject dogs' behaviour in and around different situations and events have been observed, in an attempt to see how dogs cope with the office environment, and assess effects on dog welfare. According to these results, the hypothesis that welfare is negatively affected by the office environment and the controlled situations in this study, is not supported. In general, results show that the dogs involved did not show any abnormal behaviours or extensive reactions to the controlled situations. This may not be unexpected, since on of the criteria for participation was that the dog must be used to accompanying the owner to work, and dog owners probably would not bring their dogs to work if they considered them to be non-functional in the environment. There was only one case regarding the event with an unfamiliar dog passing the doorway, when we excluded one of the test dogs from this event of consideration to the elderly dog used as a disturbance, since the owner of the dog suspected he might display excessive behaviours. This was however a decision made on a subjective basis. In fact, dogs in general acted calmly, and spent on average 89.5% of the time lying down. In general, variation was large due to the different breeds, ages and individual characters of the test dogs.

Out of 48 filmed treatments, barking occurred only in three of them, of which two were when visitors entered, and the other while the dog was left alone (and according to the owner it was not the dogs' usual behaviour – this was a male dog and on the occasion of this filming they had a female dog in heat at home). The barking episodes came from three different dogs.

The proportion of time spent near the door was three times as high when the owner was absent compared to present. However, the mean proportion spent near door in owners' absence was 15.2%, which does not seem like an overwhelming share of the time. The treatment with the most time spent near door was Separation and Return (19%). Since dogs never spent time near the door in Control treatment, it is likely that this tendency is due to dogs' wish to follow the owner, and also to supervise the owners return.

Dogs were the most inactive during the quite eventless Control treatment. Leaving the dog repeatedly, or letting it encounter visitors, activated the dog both mentally and physically. Higher and quite equal proportions of mental activity, which differed significantly from Control, were most prominent in treatments Separation & Return and Visitors. The difference between Separation & Return and Visitors was, however, the fact that in the Visitors treatment the mental activity was dominated by physical behaviour (51% of all mental activity), while in Separation & Return the mental activity to a greater extent consisted of the dog being physically static but, for example, focused (physical proportion only 34%). The reason for the higher proportion of physical activity in Visitors treatment was probably that most dogs got up and moved around to interact with the visitors. In Separation and Return the mental activity might to a greater extent be explained by static behaviours, but the dog paying attention and being focused on entrances and exits of the owner.

The theory that dogs react to visitors in a more physical way, and separations and return in an attentive way, is supported by investigating the transition variables. The same pattern was actually seen also when it came to variables which describe restlessness, in the form of

transitions between different states and activities. In these variables (Changing Main and Changing Secondary) the lowest intensities were also found in Control treatment. In Changing Main there was a significant difference in the Visitor treatment, which meant that dogs to a higher extent changed main position, i.e. shifted between lying/standing/sitting/walking. There was also a significant difference in Changing Secondary, indicating more subtle transitions such as changing lying position or changing focus of attention. In the Separation and Return treatment on the other hand, the only significance was found in Changing Secondary, which suggests that the restlessness in this case mainly consisted of switching lying positions or repeatedly going into a focused state while the owner was moving in and out of the room.

Turning the attention to the Alone treatment, it seems like dogs coped with this treatment in different ways. Some variables which describe activity and restlessness showed high mean intensities, but large variation. The mean proportion of mental and physical activity was high in Alone, but there were still no significant differences compared to Control, due to large variation, especially in the physical variable. The intensity of Changing Main was equal to Control treatment; so the dogs did not change much between lying/standing/sitting/walking. The physical activity may instead be explained by the dog moving in one part of the treatment, and then settling down. On the other hand, the mean number of Secondary transitions was about equal to the Visitor treatment, even though variation kept it from being significantly different to Control. One could suggest that in the Alone treatment, some dogs reacted stronger and others less, and of those which reacted stronger they moved around for a while, and then stayed still without resting completely, but instead kept going in and out of an attentive state, or shifting focus of attention.

Not unexpectedly, the enthusiastic visitor elicited stronger reactions than the neutral one. As mentioned, the Visitors treatment had the greatest impact on physical and mental activity. The majority of all tail wagging occurred here, with 79%. This treatment was also where the largest part of indicators of arousal was observed; the intensities were always at least twice as high compared to in any other treatment. When a visitor appeared, mental activity increased during the first 30 seconds. The enthusiastic visitor activated the dog twice as much as the neutral one, calling for the dogs' attention. Out of the 12 dogs, 3 interacted with the visitor initially, but never for the entire 2 minute visit. After 30 seconds with the neutral visitor, the dogs' mental activity dropped to an insignificant level for the remainder of the visit - dogs acknowledged that a visitor was in the room, and then lost interest. The enthusiastic visitor on the other hand usually gained the dogs full attention, and 11 out of 12 dogs decided to get up from their resting spot and interact with the enthusiastic visitor until exit. If the dog seemed to lose interest, this enthusiastic visitor would again attract the dogs attention in a friendly voice and was always able to persuade the dog to maintain interaction. Significantly higher intensities of indicators of arousal started to occur during the last 30 seconds of the visit, when the enthusiastic visitor was getting ready to leave. These behaviours then increased even further during the first 60 seconds after visitor exit, and then dropping although remaining significantly raised during the 30 seconds following. Shaking, stretching, yawning and repeated snout licks were observed, often in sequences involving more than one of these behaviours. Although these behaviours can occur for many different reasons, they were apparently clustered in this 2 minute period during and after the exit of the enthusiastic visitor. It has been argued about all of these behaviours that they can occur in situations involving stress, and specifically shaking and yawning have been suggested to indicate relief and relaxation following arousing events (Beerda et al., 1998a). Comparing the curves of mental activity and

indicators of arousal during and after the visit, the mental activity curve is at its highest in the first half of the period, while indicators of arousal peaked in the second half, when mental activity was starting to drop. In any case, the occurrence of these behaviours at this specific time period is hardly a coincidence, but caused by the aftermath of an arousing visit by a stranger, which elicited strong increases in dogs' mental activity. It is unclear whether these behaviours indicate winding down from positive or negative arousal. It may be a matter of individual character differences between dogs. What is rewarding stimulation for one dog, could be a stressor to another. In either case, there was nothing that indicated that the visitor events would have any long lasting effects on the dogs. After 1 minute and 30 seconds, all dogs were back to pre-event intensities in all variables.

As expected, dogs responded differently to an unfamiliar dog passing the doorway and a sudden noise in the corridor while being left alone. The passing dog caused a significant overall increase in both mental activity (P=0.008) and Changing main (P=0.031). The increased number of main transitions could mean that dogs commonly got up from their resting position and approached the door to try and take a closer look at the unfamiliar dog. Noise on the other hand elicited no such behavioural changes. On the other hand, there was a significant increase in HR (P=0.008) during the first 30 seconds after the noise. This indicates that the noise had a function as an element of surprise, and gave an immediate effect from which the dogs however quickly recovered.

With the exception of the mentioned reaction related to the sudden noise in the corridor, there were no significant differences in HR found in any of the analysed events or when comparing treatments.

There was no strong evidence suggesting that dogs reacted to the telephone signal differently depending on whether the owner was present or not. Only in the overall effect test All versus all (see Analyses, section Testing the overall effect) there were some significant results found. This test, however, was added to the analyses to locate possible indicators of effects that might have been found if the sample size had been larger, so these findings should not in any way be regarded as formal evidence. The differences were found in variables Physical, Changing Main and Changing Secondary. When the owner was present, the reactions were found during the first 60 seconds after the telephone signal. When the dog was alone, the reactions were instead found *after* 60 seconds. Thus, the reaction was delayed when the dog was alone during the telephone signal. Note that the phone rang 4 signals (without answer) in both treatments. A plausible explanation could be that the dog was used to the owner taking action by answering. Therefore the dog is conditioned to associate the telephone signal with immediate owner reaction. If the owner is not present, the associative link is broken and the expected response does not happen. Perhaps the telephone signal was interpreted differently when the owner is not present. It is, however, important to remember that the results of this test are only seen as interesting suggestions for future research.

In conclusion, in this study we found no clear indications that bringing the dog to the office would affect the welfare of these dogs. To the specific dogs and owners participating in the study, it seemed to be a functional solution. Dogs were generally calm and spent most of the time lying down. In fact, in the questionnaire dog owners rated their dogs to be less reactive at work than in their home. Dogs did show some behavioural reactions to the daily events and disturbances, but seemed to cope well; effects wore out within minutes. Clearly, leaving the dog affected it to some extent, but from the behavioural observations it could

not be determined that it should be considered a welfare problem – in reality it is probably part of all but a few pet dogs daily routine to be left behind for shorter or longer durations whether it be at the workplace, at home or in the car. The dogs in this study appeared to cope with it calmly.

The enthusiastic visitor clearly had the greatest impact on dogs' mental and physical activity, while the reactions to a person which ignored the dog were very mild. Enthusiastic and contact seeking people activate the dog, increase its restlessness and bring it to a state from which it afterwards has to settle down. One conclusion from this could be that one should set a limit for how much one allows other people, such as co-workers or clients, to interact with and excite the dog, to reduce the risk of stress. On the other hand, letting the dog meet and greet other people might also be stimulating and rewarding, and function as enrichment so it could actually be a factor which improves welfare. The different sides of this must be considered in relation to the temperament of the individual dog before it can be concluded what would be appropriate for that individual.

If circumstances allow it, the office environment itself and the routines involved could be adapted to what works best with the character of the dog. If the decision is to take the dog to the office, it is important to observe the dog so that any behavioural changes and abnormal behaviours that could be related to acute or chronic stress can be detected. To consider what would be appropriate for the individual is the crucial key even in the big picture, when deciding whether or not to bring the dog to work. At its best, taking the dog to work could be a satisfying solution for both dog and owner.

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Appendix I

Ethogram

Instantaneous recording, dog
15 second intervals

Location

N.D = Near Door the dog is in the door area within 0.5m.
GAT = Gate; the dog is clearly in direct physical contact with the gate.
FLO = Floor; the dog is located on the floor (and not close to the door).
BED = Bed; the dog is located in a dog bed or other place/furniture designated for dog.
OTH = Other; the dog is located at another place differing from the options described above.
NV = Not visible; the dog is out of camera range (during these periods, activities like vocalisations will be recorded if heard).

Main behaviour

LY = Lying; the dog is lying down.
SI = Sitting; the dog is sitting up with its front legs extended and hind legs curved.
ST = Standing; the dog is standing up on all four paws
WK = Walking; the dog is walking around, moving.
RN = Running; the dog is running around, trotting or galloping.
UP = Up on hind legs resting front paws on person/furniture/other, back paws on floor
ChM= Change Main position, dog changing from one position to another. Initial position is not marked (since it does not indicate a change *per se*)

Secondary behaviour

ALERT
I = Head is not resting on the floor and/or scanning – this may be in any position (lying, sitting etc). No fixed attention.

RESTING
Lying down with *head in contact with floor*, resting or sleeping. Without any obvious orientation toward the physical or social environment. Movements while sleeping ("dreaming") may occur.
FLA = flat with extended legs directed out from the body
SID = both hind legs on one side, curled included.
CH = on chest, one hind leg on each side of the body
EXT = extended on chest with one or both hind legs extended backwards.

EXPLORING
Motor activity directed toward physical aspects of the environment, sniffing or licking/manipulating something (do not mix up with play), i e:
E.DO = sniffing or licking the gate/doorway (in contact with)

E.OBJ = sniffing or licking floor, furniture or other “dead” objects
E.V.A = sniffing on Visitor A
E.V.B = sniffing on Visitor B

FOCUSED
Focused on person or in direction. Ears and eyes fixed, i e:
F.OW = Owner
F.V.A = Visitor A
F.V.B = Visitor B
F.DO = Doorway/Trying to see out the corridor
F.OTH = Focused on other

PLAY
I = Behaviour directed towards toy; any vigorous or galloping gaited behaviour including chewing, biting, shaking from side to side, scratching or batting with the paw, chasing rolling balls and tossing using its mouth, *without any interactions with the owner*.

GROOM
I = Cleaning/grooming its own body by licking, nibbling, picking, rubbing, scratching, sniffing (self-grooming).

CHEW
I = Chewing an object (toys excluded) or eating and/or drinking.

CHANGING SECONDARY
I =Change Secondary position, dog changing from one position to another. Initial position is not marked.

Posture

TAIL
L = lowered, submissive
R = raised

BODY LOW
I = Lowered body position (submissive)

Continuous recording, dog

Vocalisation

BARK
I = Making short, intense sounds. 1 obs = 1 clear sound.

GROWL
I = Deep, low frequency sounds from its throat. New obs if quiet for 2 s.

HOWL
I = Longer, higher frequency sounds. New obs if quiet for 2 s.

WHINE
I = Squeaking noises. New obs if quiet for 2 s.

Other behaviours

JUMP
Jumps up on something with front paws/legs. Hind paws still on the floor. New obs if front paws are touching the ground again.
J.OW = Owner
J.GA = Gate
J.V.A = Vis A
J.V.B = Vis B
J.OTH = Other

YAWN
I = Opens mouth widely and inhales. New obs after mouth closing.

LICK
I = Licking around the mouth area, tongue being visible. New obs when tongue is no longer visible.

STRETCH
I = Extending/stretching some part or many parts of its body. New obs after having gone back to "normal" position.

SHAKE
I = Shakes any part of or whole body from side to side. New obs after not moving the body from side to side.

PANT
I = Breathing with mouth open. One mark per interval.

TAIL
I = Repetitive wagging tail/body from side to side. One mark per interval.

Interactions with owner/visitor

NEARNESS
Close to the person (nose within ½ m – arms length). One mark "per person" and interval.
OW = Owner
VI = Visitor

APPROACH
Moving with person standing *still* as target. New obs if standing still or changing direction/orientation.
OW = Owner
VI = Visitor

FOLLOW
Following person within a distance of 1 m (*moving*). New obs if exceeding that distance.

OW = Owner
VI = Visitor

PLAY INVITATION
Without item; inviting the person to play, by standing in playbow position (new obs if the dog gets up from position) or *with* item; may fetch a toy/object and return to the person (within 1 m) with the item in its mouth, and/or wagging tail and/or body and/or lifting paw (>45^{o}). New obs if the dog drops the object. *Distinguish from play = no interaction with a person*
OW = Owner
VI = Visitor

PHYSICAL CONTACT
OW = Owner
VI = Visitor
The dog and the person is in physical contact during some part of the interval (only one mark "per person" and interval).

OWNER CONTACT = owner approaches and/or reaches for the dog (which has not approached the person spontaneously) and/or after calling the dog using an obedience command
DOG CONTACT = dog approaches, leans on, jumps up on and/or nudges the person.
MUTUAL CONTACT = contact initiated by both dog and person at the same time, for example if the dog approaches the person in a contact seeking manner and the person pets the dog

Instantaneous, owner
15 second intervals

MAIN
Ch= Chair, sitting at desk
St = Standing up/
Wk = Walking
Bent = Bending over or squatting (to be close to the dog)
NP = Not Present

Continuous, owner/visitors

ENTERS
00:00:00 Note time (when visible in door)

LEAVES
00:00:00 Note time (when no longer visible from doorway)

Physical interactions with the dog

POSITIVE
I Pats, scratches or strokes the dog, direct physical contact with the dog (one mark per interval).

NEGATIVE
I Hits/kicks/firmly pulls on the collar/pushes the dog (one mark per interval).

Verbal contact with the dog

POSITIVE
I Talks to and/or praises the dog in a positive or neutral voice (One mark per interval).

NEGATIVE
I Yelling, banning, strongly commanding or talking with a deep voice to the dog (One mark per interval).

Appendix II

Hundägarenkät

ENKÄT – hunden på arbetsplatsen

Ägarens namn: _____ Man □ Kvinna □

Ägarens arbetsrum/byggnad: _____

Telefonnummer till arbetsplatsen: _____

E-mailadress: _____

Hundens namn: _____ Hane □ Tik □

Hundens ras: _____

Hundens födelsedatum: _____

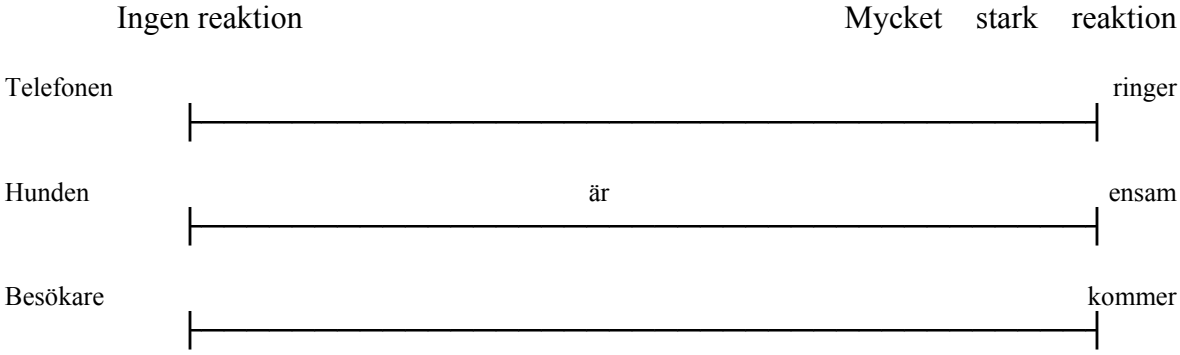
1. Vad används hunden *huvudsakligen* till?
(Välj endast 1 alternativ!)
□ Sällskap □ Lydnad, Bruksgrenar □ Jakt □ Utställning □ Agility
□ Kapplöpning, draghund □ Tjänstehund el likn.

2. Hur länge, uppskattningsvis, aktiveras din hund per dag (promenad, träning)?
□ ≤ 1 timmar per dag □ 1 ≤ 2 timmar per dag □ 2 ≤ 4 timmar per dag
□ > 4 timmar per dag

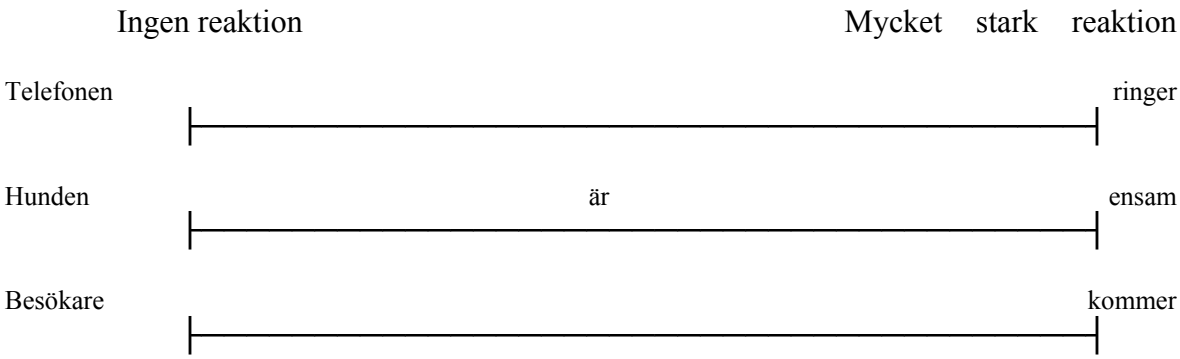
3. Under hur lång tid har hunden varit med på arbetsplatsen?
□ 6 månader ≤ 1 år □ 1 år ≤ 2 år □ > 2 år

4. Under hur lång tid har hunden varit med i det aktuella arbetsrummet?
□ ≤ 1 månad □ 1 månad ≤ 6 månader □ > 6 månader

5. Hur reaktiv upplever du att hunden är på följande situationer *hemma*? Beskriv genom att markera på linjen där du tycker att din hund hamnar. En markering längst till vänster betyder att hunden inte reagerar alls. En markering längst till höger betyder att hunden reagerar mycket starkt.



6. Hur reaktiv upplever du att hunden är på följande situationer *på arbetsplatsen*? Beskriv genom att markera på linjen där du tycker att din hund hamnar. En markering längst till vänster betyder att hunden inte reagerar alls. En markering längst till höger betyder att hunden reagerar mycket starkt.



7. Hur har dina arbetskamraters inställning varit till att du har hunden med på arbetsplatsen?
□Mycket positivt □Ganska positivt □Varken eller □Ganska negativt □Mycket negativt

8. Vad är den *huvudsakliga* orsaken till att du valt att ha hunden med på arbetsplatsen? Markera det alternativ som stämmer in bäst. *(Välj endast 1 alternativ!)*
□ Är rädd att hunden ska förstöra saker eller uträtta sina behov i hemmet
□ Är rädd att hunden ska skälla eller störa i hemmet
□ Saknar möjlighet att rasta hunden under dagen om den är kvar hemma
□ Jag vill inte att hunden ska vara ensam under dagen ens om jag kan rasta den någon gång
□ Min arbetsdag blir mer givande för mig när hunden är med mig
□ Jag har inte råd med hunddagis / pensionat

9. Om du inte kunde ta med hunden till arbetsplatsen, var skulle du då *helst vilja* att hunden befann sig under arbetstid? *(Välj endast 1 alternativ!)*
□ Ensam hemma (inne) □ I hundgård □ Hos en bekant eller ”dagmatte/husse”
□ Jag lämnar väldigt sällan hunden ensam □ Ensam i bilen □ På hunddagis/pensionat
□ Annat _____

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