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Separation-related behavior in dogs (*Canis familiaris*) – a review and an experimental analysis

Article 1: Separation-related behavior problems in dogs *(Canis familiaris)* – a review

Article 2: An experimental analysis of variables influencing behavior in dogs *(Canis familiaris)* under separation conditions

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Abstract

In modern society many dogs *(Canis familiaris)* spend time home alone, and behavior problems specifically occurring in conjunction with caregivers' departure and absence are a matter of great concern for dog owners and professionals. Article 1 reviews the current status of knowledge on dogs' separation-related behavior, focusing on three aspects: First a description of the behaviors described as problematic and current data on their prevalence, then an examination of what is known what is known or hypothesized about the causes of these behaviors, and finally a review of interventions that have been attempted in the past. The first article concludes with suggestions to advance the understanding of dogs' separation-related behavior through further research on how manipulable antecedent and consequence variables influence behavior under separation conditions, which is then the topic for the second article. Article 2 presents an experiment that used a functional analysis approach to examine weather access to a person functioned as a reinforcer in teaching and maintaining an arbitrary response under separation conditions, and whether antecedent enrichment affected such responding. The results of the study contribute to the current understanding of dogs' behavior under separation conditions by experimentally demonstrating that human access can be an effective reinforcer. Further, the experiment demonstrated that antecedent access to different forms of food can compete with responding that gives access to an attentive human. The study was limited to three dogs but clearly demonstrated the usefulness of the functional analysis approach, and concludes with proposing further research investigating functional relations in separation-related behavior problems in individual dogs.

Key words: Animal welfare, Dog, Enrichment, Functional analysis, Reinforcement, Separation anxiety, Separation distress, Separation-related problems

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Separation-related behavior problems in dogs *(Canis familiaris)* – a literature review

Master Thesis

Article 1

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Abstract

Many family dogs *(Canis familiaris)* exhibit aberrant behavior when left home alone. Variably labelled as separation-related problems, separation distress or separation anxiety, dogs home alone behavior problems are a matter of serious concern for dog owners and behavior specialists. Separation-related behaviors can cause property destruction and disturbance of neighbors, pose a risk for the dog's welfare, and may lead to dogs being given up for adoption or even euthanized. This paper provides an overview of the present understanding of separation-related behavior problems in family dogs. The behavior of dogs under separation conditions and the prevalence of separation-related behavior problems is examined, current knowledge and hypotheses regarding what causes dogs' home-alone behavior problems are reviewed, and interventions for separation-related behavior problems are discussed. The paper concludes with suggestions for further research aimed at examining how manipulable variables influence dogs' home alone behavior.

Key words: Animal welfare, Dog, Separation anxiety, Separation-distress, Separation-related problems

Separation-related behavior in dogs *(Canis familiaris)* – a literature review

In urban societies dogs often have to stay home alone, for example while the owners go to work (Cannas, Frank, Minero, Godbout, & Palestrini, 2010; Rehn & Keeling, 2011). When left alone at home, many dogs vocalize, destroy property in the house, eliminate indoors, pace back and forth, or exhibit other behaviors described as problematic by owners and professionals. Terms for labelling the phenomenon include separation-related behavior problems, separation-related distress, separation anxiety and separation-disorder, and are often used interchangeably (Ogata, 2016).

Separation-related behavior problems range from mild to severe, with dogs badly injuring themselves or destroying property such as doors, walls and crates (Beaver, 1998; Overall, 1998a; Sargisson, 2014). The dogs' health and welfare can be at risk (Horowitz, 2001), and for the caregivers the home alone problems can be stressful due to concern for the dog's wellbeing as well as due to practical problems such as destroyed property or complaints from neighbors, according to professionals (DeMartini-Price, 2014; Thompson, 2012). Dogs are often considered to be members of the family (The Harris Poll, 2011), but behavior problems can be detrimental to the dog-human relationship and may lead to the dog being given up for adoption or even euthanized (Houpt et al., 2007; Overall, 1997; Sherman & Mills, 2008).

Separation-related problems are among the most frequently reported behavioral issues in dogs. Of dogs referred to behavior clinics in North America, approximately 20-40% are diagnosed with separation anxiety (Simpson et al., 2007; Takeuchi, Houpt, & Scarlett, 2000; Voith & Borchelt, 1996), and home-alone behavior problems are estimated to affect 14-17% of the family dog population (Bamberger & Houpt, 2006; J. N. King et al., 2000; Simpson et al., 2007) with possibly 50% of dogs showing separation-related problems at some time in their lives (Bradshaw, McPherson, Casey, & Larter, 2002). Considering the total number of

dogs in human households, over 800 000 in Sweden (Jordbruksverket, 2015), 8.5 millions in the United Kingdom (Association of Pet Dog Trainers, 2016) and 78.5 millions in the United States (Statista, 2016) to give some examples, separation-related behavior problems in dogs is an issue of great magnitude.

A factor to consider in the literature on separation-related behavior problems is that terminology, definitions and inclusion criteria vary between authors. This variation can be illustrated by the inclusion criteria in studies, which varies from the dog being presented to a behavior clinic for separation-related problems (Palestrini, Minero, Cannas, Rossi, & Frank, 2010) or the owner reporting behavior such as vocalization or destructiveness to occur when home alone (Blackwell, Casey, & Bradshaw, 2006; Sargisson, Butler, & Elliffe, 2011) to veterinarians' or behavior specialists' diagnosis of separation anxiety (Flannigan & Dodman, 2001; J. N. King et al., 2000; Storengen, Boge, Strøm, Løberg, & Lingaas, 2014).

In this paper I have used the terms *separation-related behavior problems* and *home-alone problems* interchangeably, including any behavior that is reported to specifically occur when a dog is left alone or separated from their caregivers and that is generally described as a problem. To find relevant literature I started through the electronic search engines Google Scholar, PubMed and ScienceDirect using inclusion criteria "AND/OR" "dog, separation, problem, distress, anxiety, review" and "home alone", and then used the reference lists of relevant articles to find further literature of relevance. I also turned to contacts in academic and professional dog behavior communities to find additional publications of relevance for the subject.

The purpose of this paper is to investigate the current status of knowledge on dogs' separation-related behavior. I will describe the problems that owners, professionals and scientists are concerned with, examine what is known about predictive and manipulable factors influencing the problems, and review prevailing interventions.

Separation-related behavior problems

Common complaints

When dog owners complain about problematic behaviors their dogs engage in when the owner is not present, they typically mention vocalizing, destructiveness and elimination (Borchelt & Voith, 1982b; Khoshnegah, Azizzadeh, & Mahmoodi Gharaie, 2011; Konok, Dóka, & Miklósi, 2011).

Vocalization. Vocalization is one of the most commonly reported home-alone behavior issues (Bradshaw et al., 2002; Konok et al., 2011; Overall, Dunham, & Frank, 2001; Storengen et al., 2014). For example, a video analysis of the home-alone behavior of adult dogs presented to behavior clinics for separation-related behavior problems showed that vocalizing (whining, barking or howling) occurred in 20 out of 23 dogs and occurred during 23% of the total observation time (Palestrini et al., 2010). Even in a study where the participating dogs were not reported to have separation-related problems, whining, howling or barking occurred during an average of 10.9% of the observed time although variably across individuals (Scaglia et al., 2013), and studies of puppies show similar averages (Cannas et al., 2010; Frank, Minero, Cannas, & Palestrini, 2007).

Destructiveness. Dogs scratching, digging or chewing on walls, doors or objects is another often noted home-alone behavior problem (Konok et al., 2011; Podberscek, Hsu, & Serpell, 1999b). Destructive behavior was the most common problem in Podberscek's (1999b) study of 49 dogs reported with separation-related problems, where 75% were biting door frames or doors and 69% chewed on furniture. Walls or furniture can be completely destroyed (Borchelt & Voith, 1982b) and some dogs injure themselves in the process (Schwartz, 2003; Thompson, 2012).

Improper elimination. Elimination is a less frequent problem, mentioned as an issue for between 6% (Konok et al., 2011) and 53% (Palestrini et al., 2010) of dogs where owners

report separation problems, and in the where half of the owners mentioned this problem only three of the 23 dogs eliminated during the observation time (Palestrini et al., 2010).

Repetitive behavior. Another type of response noted in the literature on separation-related behavior problems is repetitive and stereotypic motor behavior such as pacing and circling (Appleby & Pluijmakers, 2004; Borchelt & Voith, 1982b; McCrave, 1991; Overall, 1998b), which was observed by Lund and Jorgensen (1999) in two out of twenty dogs with reported separation related problems. Repetitive licking or chewing on body parts might also occur, and can result in tissue damage (Borchelt & Voith, 1982b; Schwartz, 2003). Clinical records of 215 dogs diagnosed with separation anxiety revealed self-mutilation in one individual (Storengen et al., 2014).

Physiological responses

One category of responses often mentioned in reports on separation-related behavior problems can be termed physiological or psychosomatic (Borchelt & Voith, 1982a). This loosely defined category includes for example lip licking, panting, excessive salivation, trembling/shivering, diarrhea and vomiting. These responses tend to co-vary with each other and with typical separation-related complaints such as vocalization (Frank et al., 2007; Palestrini et al., 2010; Scaglia et al., 2013), and are considered indicative of distress (Beerda, Schilder, van Hooff, de Vries, & Mol, 1998; Blackwell et al., 2006; Palestrini et al., 2010).

Few studies have reported on physiological responses. In one study including 118 dogs diagnosed with separation anxiety, hyper-salivation, vomiting or diarrhea was reported in 19% of the dogs (Flannigan & Dodman, 2001), and similar numbers were found by Podberscek et al. (1999b), with 24% of the dogs hyper-salivating and 12% vomiting (nonexclusive, so some dogs may have done both), while in Storengen's et al. (2014) study only 5% of the dogs hyper-salivated. Palestrini et al. (2010) videotaped the home-alone behavior of dogs presented at behavior clinics for separation-related problems and noted

additional physiological responses: On average, lip licking was seen 27 times per hour and panting occurred during 14% of the time.

Parameters such as heart rate and cortisol levels are sometimes used as additional measures of stress, potentially indicating welfare problems (Beerda et al., 1998). Mongillo et al. (2013) found that separation conditions did induce an average elevation in salivary cortisol level in a group of aged dogs, while Rehn and Keeling (2011) found no differences in heart rate and heart rate variability between 30, 120 and 240 minutes of separation in 12 dogs without overt separation-related behavior problems.

Underrepresented behaviors

In separation conditions, some behaviors are mostly noted for their absence. Many dogs do not eat or drink when home alone, a problem according to professionals who refer to it as a sign of separation distress (DeMartini-Price, 2014; Horowitz, 2001; Miller, 2016), but not often investigated in studies on separation-related problems. Flannigan and Dodman (2001) found that 20% of a general population of dogs were unwilling to eat when alone according to owner reports, and that the number was as high as 46% in dogs diagnosed with separation anxiety.

Few adult dogs perform responses categorized as exploration or play when home alone (Scaglia et al., 2013), and such behaviors are especially few in dogs reported with separation-related problems (Palestrini et al., 2010; Scaglia et al., 2013). Professionals report that behavioral depression with immobility or withdrawal is noted in dogs with separation-related problems (Borchelt & Voith, 1982a; Horowitz, 2001; Schwartz, 2003), as well as postures indicative of submission or fear (Schwartz, 2003).

Research on typical home-alone behavior in domestic dogs is sparse, but most dogs probably spend most of their home-alone time in passivity. In one study, 20 adult dogs with no record of separation-related problems were found to be lying down on average more 90%

of the time, whether home alone for half an hour, two, or four hours. (Rehn & Keeling, 2011). Even puppies have been observed to spend the majority of the time passively when left alone (Cannas et al., 2010; Frank et al., 2007). In terms of separation-related behavior, passive behavior is generally not considered a problem, but Rehn and Keeling (2011) note that inactivity is used as a negative welfare indicator in other captive animals and should be investigated further in dogs'home alone.

Temporal patterns of behavior

When it comes to the temporal pattern of behaviors during separation, several authors report a peak in activity shortly after the owner has left (Borchelt & Voith, 1982b; Lund & Jørgensen, 1999; Palestrini et al., 2010). Out of 15 dogs with separation-related behavior problems observed for four hours home alone, 14 were most active during the first hour (Lund & Jørgensen, 1999). Palestrini et al. (2010) found different temporal patterns for different responses: Vocalization and environmental orientation decreased over time, while whining and scratching tended to stay consistent and panting actually increased.

Some data contradict this pattern. Rehn and Keeling (2011) found equal activity levels across time periods of 30, 120 and 240 minutes in dogs without separation-related problems left home alone, and when Konok et al. (2011) investigated behavior during brief separations (1-5 minutes) in an unfamiliar environment they noted reduced activity over time in dogs without separation-related problems, but not in dogs with known separation issues. Konok et al.'s results may indicate that five minutes is too short a time period for the full pattern of activity to be seen if responding is intense, and that separation in unfamiliar environments evokes a brief peak in activity also in dogs not typically showing separation-related behaviors.

Observations of temporal patterns typically focus on motor responses such as vocalization and various types of locomotion. Physiological responding might show a different pattern, at least in dogs with separation-related problems. In Palestrini et al.'s (2010)

study, panting was the only response observed to increase over time in the sessions. Rehn and Keeling (2011) found heart rate to be steady across session time, but their dogs did not have any known home-alone problems.

Before and after separation

Dogs with separation-related behavior problems often respond to cues indicating an upcoming departure. The dog may follow its owners closely, pant, whine and pace (Horowitz, 2001; Podberscek et al., 1999b; Schwartz, 2003). Behavioral depression and shaking/shivering also occur (Podberscek et al., 1999b), and some observers even report pre-departure vomiting and defecation (Podberscek et al., 1999b). Preparation for departure can also occasion owner-directed aggression such as nipping or biting in some dogs (Borchelt & Voith, 1982b; Podberscek et al., 1999b; Storengen et al., 2014). In a study of the clinical records of 215 dogs diagnosed with separation anxiety, authors report that as many as 75% of the dogs emit behaviors indicative of distress or anxiety as the owner prepares to leave (Storengen et al., 2014).

When reunited with their owners, dogs with reported home-alone problems often show exaggerated and prolonged greeting behaviors which may include jumping up, vocalization, whining and running in circles (Borchelt & Voith, 1982b; Storengen et al., 2014). Greeting behavior is also affected by the duration of the separation, with four hour separations occasioning significantly more intense greetings than half hour separations, even in dogs without separation issues (Rehn & Keeling, 2011). However, in a study of brief separations, differences between one to five minutes did not affect the intensity of greeting behaviors (Konok et al., 2011).

Discussion

Dogs' behavior under separation condition show substantial individual variation. In many cases it includes patterns of responding that are generally considered problematic, such

as vocalization, destructiveness, elimination, stereotypic behavior and physiological stress responses. Pre-departure behavior such as following the owner, pacing and whining are also reported, as is intense and prolonged greeting upon homecoming. While confirming a high prevalence of behaviors deemed problematic, studies of dogs home alone behavior are highly variable in what data they collect, in their data collection methods, and in their inclusion criteria for what constitutes a dog with separation-related problems, which makes it difficult to draw conclusions across studies. In addition, only a few studies that have collected data through the video recordings (for example, Lund & Jørgensen, 1999; Palestrini et al., 210; Rehn & Keeling, 2011; Scaglia et al., 2013), and all information on dogs' normal behavior in the home environment outside of separation conditions comes from owner reports without assistance of video recordings. Further use of video technology and reliable observations of individual dogs' behavior under different conditions would facilitate comparisons across studies and further our understanding of behaviors labelled separation-related.

Causes – why do home-alone problem behaviors occur?

In this section I will explore what is known or hypothesized about the variables that influence dogs' home alone behavior problems.

The very notion of "separation related behavior problems" indicates a correlation and a possible causal relationship between the behaviors in question and the separation conditions. The same topographies of behavior may be observed in other contexts as well (Flannigan & Dodman, 2001; Storengen et al., 2014), but labels such as separation-related problems and separation anxiety are reserved for when they specifically occur under home-alone conditions (Jagoe & Serpell, 1996; Lund & Jørgensen, 1999).

A further narrowing of the subject can formed by a category where the departure and absence of a significant person or significant persons is the key variable influencing the behavior. In an influential paper on diagnostic criteria, McCrave (1991) suggested that the

term separation anxiety should be reserved for this narrower category, and although that differentiation in terminology does not always hold fast today (Ogata, 2016), the aspect of separation from significant person(s) definitely holds a special status in discussions on dogs separation-related behavior (DeMartini-Price, 2014; Miller, 2016; Sargisson, 2014). In the following, I will therefore begin by discussing the aspect of separation from significant person, and then review other factors believed to influence dogs' home-alone behavior.

Separation from significant person

The factor of separation from certain individual(s) is central in discussions about separation-related behavior problems (Borchelt & Voith, 1982b; McCrave, 1991; Ogata, 2016).

Separation distress. Responses described as separation distress are observed in infants of many species including dogs (Bowlby, 1969; Elliot & Scott, 1961). Vocalization and increased motor activity functions to reunite the puppy with its mother and littermates (Elliot & Scott, 1961; McCrave, 1991) and adult dogs' separation-related problems have been viewed as similar behavior patterns related to their human caregiver (Borchelt & Voith, 1982b; Overall, 1997).

Dogs' separation anxiety has been described as a serious emotional problem, paralleling human panic attacks, with intense physiological responses and behaviors indicating acute fear and discomfort (Schwartz, 2003). The behaviors observed are typically viewed as distress responses evoked by the separation from an attachment figure (Borchelt & Voith, 1982a; Ogata, 2016; Overall, 1997), or by stimuli associated with an upcoming separation (Horowitz, 2001; Podberscek et al., 1999; Schwartz, 2003; Storengen et al., 2014).

While referring to the separation as the condition where these distress responses occur, the literature on separation-related problems also frequently notes inner emotional states as causes of overt behavior. Examples are escape responses referred to as being

triggered by fear (Storengen et al., 2014), lip licking, yawning and vocalization being signs of anxiety (Blackwell, Casey, & Bradshaw, 2005), and repetitive or stereotypic responses being products of frustration (Overall et al., 2001). However, terms such as fear and anxiety do not refer to empirical events. Instead, the meaning of the terms can be found in the functional relationship between the responses and the environmental conditions under which they occur, as noted by Friman, Hayes, and Wilson (1998). For example, the category of fear consists of physiological stress responses and escape or avoidance behavior in response to danger while the category of anxiety includes the same physiology but in situations with an uncertain outcome (Friman et al., 1998). Similar notions can be found in the literature on dogs' separation-related behavior, with references to fear as responses to danger or threatening stimuli and anxiety as reactions to prospective danger or uncertainty, or anticipation or a negative outcome (Blackwell, Bradshaw, & Casey, 2013; Passalacqua, Marshall-Pescini, Merola, Palestrini, & Previde, 2013; Shaw, 2015). Mentioning emotional states implies hypotheses regarding environmental variables responsible for the occurrence of the observed responses. Rather than referring to emotional states as causes of behavior, investigations should focus on identifying those environmental variables.

Reinforcement. Vocalization and destructive behavior is sometimes described as attempts to reunite with the owner (Blackwell et al., 2006; Podberscek et al., 1999b; Tod, Brander, & Waran, 2005), but reinforcement is rarely directly discussed in the scientific literature on separation-related behavior. However, access to the owner has been shown to function as a reinforcer when teaching and maintaining a response in dogs in separation conditions (Feuerbacher & Wynne, 2014), and dog professionals remark that dogs can learn to get attention or human aid through barking (Association of Pet Dog Trainers, 2016; McConnell, 2000), and that scratching or jumping at doors and windows can be reinforced through successful escape (Tapper, 2009).

Attachment. The dog's relation to its owner can be described as an affectionate relationship, possibly meeting the criteria for an attachment bond as described by Bowlby (1969) (Palmer & Custance, 2008; Rehn, McGowan, & Keeling, 2013). Test situations confirm that dogs in general tend to keep proximity with their owner rather than with a stranger (Gacsi, Maros, Sernkvist, Farago, & Miklosi, 2013; Prato-Previde, Custance, Spiezo, & Sabatini, 2003), that separation from the owner tends to occasion whining and other vocalizations as well as orientation toward the exit point, often accompanied by scratching or jumping at the door, even in the presence of stranger (Prato-Previde et al., 2003), and that access to the owner can function as a reinforcer (Feuerbacher & Wynne, 2014). But if proximity is generally valuable to dogs, then why do some dogs but not others develop separation-related problems? One popular hypothesis is that separation distress might correlate with the level of attachment, with "hyper-attachment" leading to separation problems (Blackwell et al., 2006; Flannigan & Dodman, 2001; J. N. King et al., 2000; Konok et al., 2015; Takeuchi, Ogata, Houpt, & Scarlett, 2001). If such a correlation was to be found, the next step would be to investigate the conditions governing this hyper-attachment. However, outside of separation contexts, the behavior of dogs with separation-related behavior is generally similar to that of other dogs (Flannigan & Dodman, 2001; Parthasarathy & Crowell-Davis, 2006), which disconfirms the notion that behavior patterns categorized as hyper-attachment would predict separation-related behavior problems. One possible difference was indicated in a study by Flannigan and Dodman (2001), where dogs with separation-related problems were three times as likely to be reported to follow their owners around the house; but as Parthasarathy & Crowell-Davis (2006) note this could be an artifact of the comparison being made with dogs with other types of behavior problems.

Factors other than separation from significant person

Other factors, apart from the departure, absence and return of a significant person, can be partly or fully responsible for individual dogs' separation-related behavior problems.

Isolation and barriers. Some professionals differentiate between separation distress and isolation distress, suggesting that for some individuals the problem behaviors are evoked by separation from a particular individual or particular individuals, while for others they are occasioned by isolation from social companionship in general (DeMartini-Price, 2014; Wilde, 2010). Another possibility discussed by for example Horowitz (2001) and Schwartz (2003) is that the behavior may function to escape the confinement as such, rather than to reunite with the person. The specifics of confinement conditions can also affect responses, as observed in video analysis of dogs with separation-related behavior problems where dogs confined in crates emitted significantly more yawning and lip licking compared with dogs left out in the room (Palestrini et al., 2010).

Other aversive events. Another factor that can contribute to home-alone problems is if aversive events become associated with the home-alone situation, thus establishing the separation conditions as aversive. Supporting this hypothesis, some authors note that various sudden traumatic experiences (such as aversive noise or house intruders) while the dog is left alone can mark the onset of home-alone behavior problems (Blackwell, 2008; Horowitz, 2001).

Other behavior problems often coincide with separation-related problems, and may contribute to their development. In particular, several researchers have noted a correlation between separation anxiety and noise sensitivity with 40-50% of dogs diagnosed with separation anxiety also behaving fearfully when exposed to noise or thunderstorms (Flannigan & Dodman, 2001; Overall et al., 2001; Storengen et al., 2014a). Furthermore, McGreevy and

Masters (2008) found correlations between separation related distress and factors such as excitability, fear and anxiety, as measured by owner reports.

Absence of the owner's influence. The differentiation of separation-related problems from behavior problems that occur also in the owner's presence is emphasized in the literature (Borchelt & Voith, 1982b; Ogata, 2016). Destructiveness and vocalization are typical examples of behaviors where behavior specialists look for differential causations before concluding the behavior is separation-related. For example, Horowitz (2001) mentions that external stimuli can arouse the dog, and that scratching or digging at doors or windows may be parts of a territorial display occasioned by a passer-by. In addition, some active home-alone behaviors are categorized as exploration or play (Horowitz, 2001; Simpson et al., 2007) (Horowitz, 2001), and are supposedly not functionally related to the separation or confinement. If these behaviors occur more frequently under separation conditions although the factors responsible for the behavior are present also at other times, some have hypothesized that the dog may have learned to respond differently to them when the owner is home and provides different reinforcement contingencies (Voith & Borchelt, 1996). Similarly, Blackwell (2008) has speculated that when faced with aversive stimuli such as loud noises, some dogs may have learned coping strategies that involves the owner, thus responding more adversely to the noise when alone compared to if the owner is there.

Household routines. The activities and routines of the household may affect home-alone behavior. McGreevy and Masters (2008) found that dogs that frequently played games with their owners were less likely to have separation-related behavior problems, and in a study by Jagoe and Serpell (1996) obedience training correlated with lower incidence of home-alone problems. In addition, daily exercise was the factor that most clearly correlated with separation-related problems in a large survey of over 3200 family dogs, with the dogs

getting more daily exercise being less likely to be reported by their owners to have separation anxiety (Tiira & Lohi, 2015).

Changes in the daily routine are sometimes reported to trigger the onset of separation-related problems. McGreevy and Masters (2008) found that dogs living in households that had recently acquired a new human member, or where a person recently had changed jobs, were more likely to have separation-related problems, and in a study by Flannigan and Dodman (2001) 16% of owners recall change in routines just prior to the onset of home-alone problems.

Missed learning opportunities and other historical factors

Missed learning opportunities or lack of experience with being alone may contribute to separation-related behavior (Blackwell, 2008). In a recent review of the literature, Sargisson (2014) found that stable household routines including home-alone time correlated with a lower likelihood for home-alone problem behaviors and early home alone training in brief sessions has been recommended to prevent the development of separation-related problems (Case, 2010).

Historical factors potentially associated with separation-related problems have been investigated by several researchers. The data are inconclusive and often contradictory, but Sargisson's (2014) review summarizes that being a male dog, being adopted from a shelter, or being separated from the litter before the age of two months may be predictive factors for developing separation-related problems, while broad experiences with environments and people at age 5-10 months and absence of punishment coincided with lower incidence of home-alone problems. In addition, senior dogs (above age 7) have been reported to have a higher incidence of separation-related problems.

Discussion

In the literature on dogs' separation-related behavior, discussions of what causes the problems refer to factors of various types. A distinction can be made between predictive and manipulable factors, where predictive factors correlate with a behavior and can be used to foresee its occurrence, while manipulable factors can be shown to control the occurrence of behavior by functioning as independent variables in experimental investigations (Johnston & Pennypacker, 2008).

Many of the factors believed to be related to the occurrence of separation-related behavior problems are manipulable and could function as independent variables in an experimental investigation. However, to date only a handful of studies include manipulation of independent variables. Rehn and Keeling's (2011) investigation of the influence of home alone time on behavior during separation and reunion is one example, and Feuerbacher and Wynne's (2011) analysis of owner access as a reinforcer is another. In addition, experiments exploring the concept of attachment include comparisons of behavior across a variety of conditions including both presence and absence of the owner (Palmer & Custance, 2008; Rehn, McGowan, & Keeling, 2013; Topál, Miklósi, Csányi, & Dóka, 1998). Further focus on manipulable variables, with experimentation demonstrating how various factors variables influence the behavior of individual dog, would provide valuable contributions to the understanding of what causes dogs' separation-related behavior.

The field of applied behavior analysis, with its focus on identifying contextual variables which affect the behavior of individuals, offers promising additional directions of analysis. Especially, a functional analysis approach could be used to identify the contingencies responsible for the behavior seen in individual dogs. In a functional analysis, environmental variables hypothesized to affect responding are systematically manipulated one at a time (Iwata, 1994). With such an experimental design, the effect that each variable has on

the behavior can be measured. This approach has shown to be valuable for the understanding and treatment of a multitude of behavior problems in humans (Beavers & Iwata, 2013; (Hanley, Iwata, & McCord, 2003) as well as in non-human animals (Dorey, Rosales-Ruiz, Smith, Lovelace, & Roane, 2009; Dorey, Tobias, Udell, & Wynne, 2012; Hall, Protopopova, & Wynne, 2015)Dorey, Rosales-Ruiz, Smith and Lovelace, 2009). For example, in an investigation of stereotypic behavior in five dogs Hall et al. (2015) found that the responses of the individual dogs were dependent on specific consequences provided by the owner or by the environment. Feuerbacher and Wynne (2014) showed through functional analysis methodology that access to the owner indeed functioned as a reinforcer for responses in three individual dogs in a home alone setting. Further applications of the functional analysis research design can advance the understanding of the relationships between environmental variables and separation-related behaviors, and can identify the independent variables affecting the behavior of individual dogs.

Interventions for separation-related behavior problems

This third and last section of this paper reviews interventions that have been proposed for reducing separation-related behavior problems, ranging from behavioral interventions to pharmaceutical and alternative treatments.

Behavioral interventions

Behavioral interventions consist of treatment packages including various combinations of behavioral components, of which the most frequently mentioned will be discussed in this section. Few studies have focused on behavioral interventions specifically, but in a group of 56 dogs Blackwell et al. (2006) found that 56% of owners reported significant improvements while an additional 25% reported slight improvement after owner-implemented generic behavior modification plans. Butler, Sargisson, and Elliffe (2011) investigated fewer dogs but successfully reduced vocalization and destructive behavior in all

the eight dogs in their study through standardized behavioral treatment plans focusing primarily on graduated exposure, but implemented by owners with varying treatment fidelity, with six owners reporting a nearly complete elimination of problems in a three-month follow-up. As a group, 15 dogs receiving behavioral interventions and placebo medication improved significantly on all separation-related measures in a study by Podberscek, Hsu, and Serpell (1999a) paralleling the results observed with additional medical treatment, a result that will be discussed further in the section on pharmaceutical interventions.

Systematic desensitization. Graduated exposure techniques originate from human behavior treatment for anxieties, fears and phobia, where the graduated exposure is typically coupled with muscle relaxation techniques to replace the fear response with relaxed responding (Butler et al., 2011; J. O. Cooper, Heron, & Heward, 2007). Graduated exposure is instrumental in the treatment of separation-anxiety in humans children (Ehrenreich, Santucci, & Weiner, 2008), widely recommended by professionals for reducing separation-related problems (DeMartini-Price, 2014; McConnell, 2000; Wilde, 2010; Voith & Borchelt, 1982), and was identified as the key factor in the successful treatment of the eight dogs in Butler et al.'s (2011) study.

Adding food treats. The provision of edibles at departure may function as an equivalent to the relaxation techniques used with humans and can provide an alternative activity during the owner's departure and absence (Herron, Lord, & Husseini, 2014; Shaw & Lahrman, 2015). Such food activities are often included in treatment packages but their effect has not been evaluated separately (Blackwell et al., 2006; Butler et al., 2011). In addition, differential reinforcement can be provided through a remote controlled feeder as demonstrated in a study by Protopopova, Kisten, and Wynne (in press) where home-alone barking was reduced or eliminated in three out of five dogs through food being delivered contingent on the absence of barking.

Owner-initiated interactions only. Intervention packages for home-alone problems commonly include general alterations of the dog-human interaction pattern, suggesting that the owner should initiate all interactions and ignore the dog at other times (Blackwell, 2008; Horowitz, 2001; J. N. King et al., 2000; Shaw, 2015). This approach is seemingly influenced by the idea of hyper-attachment as a factor behind separation-related problems (J. N. King et al., 2000), but can also be seen as a way to get predictable interactions and teach the dog alternative ways of getting wants and needs met (Shaw, 2015). Blackwell et al. (2006) found that six weeks of such altered interactions had an effect comparable to those of a systematic desensitization program over the same time. However, this type of protocol is debated in professional communities (Sdao, 2012) and potential negative effects of its implementation as an intervention for separation-related problems have not been investigated.

No punishment. Another recommendation that is often part of treatment packages is to cease all punishment occurring in conjunction with separation or upon homecoming, with the intent of avoiding further distress in an already potentially aversive situation (Butler et al., 2011; Horowitz, 2001; J. N. King et al., 2000; Yin, 2012). Owners sometimes reprimand their dogs upon homecoming (Butler et al., 2011), and electronic collars that deliver an aversive consequence contingent on barking are widely sold, as indicated by an internet search on "anti-bark collar". Such devices have been demonstrated to effectively reduce barking, although variably across individuals (Juarbe-Diaz & Houpt, 1996; Sargisson et al., 2011), but aversive stimulation from electronic collars has been shown to occasion physiological stress responses as well as behavior indicative of fear and pain (J. J. Cooper, Cracknell, Hardiman, Wright, & Mills, 2014).

Downplay homecomings. Quiet homecomings, supposedly reducing the risk of inducing higher arousal during the separation, make up part of the behavioral intervention in several studies (J. N. King et al., 2000; Podberscek et al., 1999a; Takeuchi et al., 2000).

However, greetings with physical contact may be beneficial for the dog's welfare, as indicated by increases in oxytocin and decreases in saliva cortisol (Rehn & Keeling, 2011), and if and how the greeting style actually affects the behavior during separation has not yet been investigated.

Pharmaceutical interventions

Various medications used in the treatment of depression and anxiety in humans are also administered for reducing separation-related behavior problems in dogs, and two preparations, Clomicalm® (clomipramine, tricyclic antidepressant) and Prozac® (fluoxetine, selective serotonin reuptake inhibitor) are specifically approved for treatment of canine separation anxiety in the United States (Sherman & Mills, 2008).

According to data from video recordings of 23 dogs, the combination of behavioral advice and clomipramine was effective in increasing passive behavior and reducing scratching, pacing, whining and vocalizing according in a study by Cannas et al. (2014). How much the behavioral advice contributed to the results in this study is not known, but J. N. King et al. (2000) compared treatment groups and noted a faster reduction in destructive behavior and elimination problems and in owners' rating of overall behavior, but not in vocalization, in dogs treated with clomipramine in addition to behavioral treatment compared to the dogs receiving corresponding behavioral treatment but placebo medication. By contrast, Podberscek et al. (1999) found that the addition of clomipramine treatment to behavioral interventions reduced dogs' general activity and tendency to seek physical contact and provided an initial reduction in pre-departure shaking and shivering but did not contribute to the reduction of any other directly separation-related behaviors such as vocalization, destructiveness or pre-departure restlessness. Instead, the behavioral intervention component in itself significantly reduced the separation-related behavior problems in that study.

It is possible that effects of medication can be conditioned and thereby sustain after administration is withdrawn. Sümegi, Gácsi, and Topál (2014) found what they call a placebo effect under separation conditions after repetitive administration of a sedative, and Katz (n.d.) reports that after a successful pharmaceutical intervention, antecedent arrangements maintained a reduction in anxiety related behavior under separation conditions while cessation of the antecedent routine led to an instantaneous return of the problem behaviors.

Some undesired side effects, such as gastrointestinal problems and behavioral depression, have been noted when clomipramine is used for treatment of separation-related problems (J. N. King et al., 2000; Tod et al., 2005).

Alternative treatments

Pheromones. *Dog-appeasing pheromone* (DAP®/Adaptil®) mimicks the pheromones excreted by lactating female canines, and is described as having a calming effect in stressful situations also in adult dogs (Ceva Animal Health Ltd, 2016). In a study of typical separation-related behaviors in 43 dogs kenneled in a veterinary hospital (Kim et al., 2010), the use of DAP reduced pacing, licking and elimination, and the effect of DAP equaled that of clomipramine in a group study of 67 dogs with separation-related behavior problems who also received behavioral treatment (Gaultier, Bonnafous, Bougrat, Lafont, & Pageat, 2005).

Pressure techniques. Pressure equipment such as ThunderShirt™ resemble deep pressure therapy for humans (Grandin, 1992; Vasa et al., 2014). In a group experiment with 90 dogs diagnosed with separation anxiety or generalized anxiety disorder, C. King, Buffington, Smith, and Grandin (2014) found that a properly fitted Thunder Shirt ™ reduced heart rate and gave a slight reduction in tongue-flicking and drooling but did not affect other behavioral measures such as pacing, barking or whining in dogs left alone in kennels.

Discussion

Studies demonstrate that separation-related behavior problems can be successfully reduced through behavioral interventions, or through a combination of behavioral and pharmaceutical interventions. However, differences in inclusion criteria, data recorded, data collection methods, components included in treatment packages, how effects are measured, and in the fidelity to the treatment protocol (if that is reported at all) makes it profoundly difficult to identify the active ingredients responsible for improvement.

In addition, the components of an intervention ought to evaluated not only for their effectiveness in altering a particular behavior but also for potential negative side effects and ethical concerns (Bailey & Burch, 2005; Friedman, 2010; Wolf, 1978), an aspect notably missing especially in the behavioral parts of the interventions. Since behavioral aspects are included in most treatments, also in those including pharmaceutical interventions, a thorough examination of the effects of the various behavioral components included is highly needed.

As discussed in the section on causes, empirical evidence concerning the factors that contribute to separation-related problems are limited. This reduces the ability to link treatments to causes, and calls for further investigations on the functional relationships between behavior and environmental variables in individual dogs so that relevant environmental factors can be manipulated for effective treatment with minimal restrictiveness.

Summary and conclusion

Dogs' separation-related behavior problems are multi-faceted, including a variety of behaviors noted before, during and after separation. Vocalization, destructiveness and elimination are the most common complaints, and owners and professionals are concerned not only for the behaviors causing nuisance to caregivers and neighbors but also for situations threatening the welfare of the dog (Horowitz, 2001; Thompson, 2012). An increased use of video recording techniques and further studies of individual dogs' behavior across situations,

in combination with further agreements in inclusion criteria and behavioral definitions, would benefit the surveying of this category of behavior problems in family dogs.

Although separation conditions are the common denominator in dogs' home alone behavior problems, the specifics of the variables influencing the behavior are poorly understood and are likely to vary across individuals.

Several authors note the risk of presumptuous interpretations of what they refer to as the dog's motivation and suggest a symptom-based approach with focus on observable behavior (Blackwell et al., 2006; McCrave, 1991; McGreevy & Masters, 2008).

While avoidance of presumptuous interpretations is commendable, Ogata (2016) in a recent review rightfully notes that beyond clinical symptomology there has not been much progress in advancing the understanding, "little progress has been made to build a new understanding beyond the clinical symptomology" (p. 1), and calls for rigorous research designs and clearly defined research questions. Rather than relying on a symptom-based approach, the functional relations between an individual dog's behavior and manipulable components in its environment can be scientifically examined. A functional analysis approach has been successful in identifying variables controlling behavior problems in humans as well as in non-human animals, and could provide empirical data on the variables that influence the behavior of individual dogs. This approach has already been used to demonstrate that access to humans can function as a reinforcer for dogs behavior under separation conditions (Feuerbacher & Wynne, 2014), and should be explored further in order to advance the understanding of dogs' home-alone behavior.

Experimental investigations in how manipulable variables control separation-related behavior hold potential benefits also when it comes to designing effective interventions. Today, treatment packages often include a variety of behavioral components as well as additional pharmaceutical treatments. Systematic investigations on how various antecedent

and consequence variables influence dogs' behavior can lead to more precise interventions and should therefore be in focus in future research.

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An experimental analysis of variables influencing behavior in dogs *(Canis familiaris)* under separation conditions

Master Thesis

Article 2

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Abstract

This experiment examined how a response that led to escape from an enclosed room and access to an attentive person was influenced by different conditions in three family dogs (*Canis familiaris*). First, a target response was shaped using escape from the room and access to the person as a reinforcer. Then, a functional analysis was conducted over five conditions. The functional analysis revealed that escape from an enclosed room and access to an attentive person functioned as a reinforcer for the target response in all dogs, and that antecedent access to the person starkly reduced the frequency of responding. Two different feeding enrichments similarly reduced responding in all dogs, while access to toys had minimal effect for two of the dogs but led to some reduction in responding in the third dog. The experiment was a systematic replication of Feuerbacher and Wynne (2014a) and confirms that access to a person can be an effective reinforcer for the behavior of dogs home alone and that antecedent access to toy yields variable results. The present experiment adds that access to feeding enrichment can effectively reduce behavior that functions to let the dog out of an enclosed room and get access to an attentive person.

Key words: Animal welfare, Dog, Enrichment, Functional analysis, Reinforcement, Separation anxiety, Separation distress, Separation-related problem

An experimental analysis of variables influencing behavior in dogs *(Canis familiaris)* under separation conditions

Dogs' separation-related behavior problem are undesired behaviors that specifically occur when dogs are left alone or separated from significant person(s) (McCrave, 1991; Ogata, 2016). This includes behaviors of various types, most notably vocalization, destructive behavior and elimination (Konok et al., 2015; Palestrini, Minero, Cannas, Rossi, & Frank, 2010; Podberscek, Hsu, & Serpell, 1999b). Stereotypic locomotion, over-grooming, and behavioral depression can be observed, as well as physiological stress responses such as panting or shivering (Blackwell, Casey, & Bradshaw, 2006; Lund & Jorgensen, 1999). Some dogs cause severe damage to the house or inflict serious injuries on themselves (Borchelt & Voith, 1982; Gaultier, Bonnafous, Bougrat, Lafont, & Pageat, 2005; Schwartz, 2003).

As many as 50% of the dogs in the USA and Europe are estimated to show separation-related problems at some time during their lives ((Bradshaw, McPherson, Casey, & Larter, 2002)Karagiannis et al 2015). The societal importance (Baer, Wolf, & Risley, 1968) of dogs' separation-related behavior problems is noticeable since the behaviors are prevalent and negatively impact the lives of both caregivers and dogs (Dreschel, 2010; Horowitz, 2001; Shaw & Lahrman, 2015; Sherman & Mills, 2008; Thompson, 2012).

It is believed that dogs' evolutionary history as a social animal living closely with humans contributes to their susceptibility to form affectionate bonds with humans, and also to their susceptibility to develop separation-related behavior problems. In individual dogs, the problems have been hypothesized to stem from excessive attachment to the caregiver (Borchelt & Voith, 1982; McCrave, 1991) but this notion is debated since dogs with or without separation-related problems show few differences in their interactions with their caregivers outside of the separation context (Flannigan & Dodman, 2001; Mongillo et al., 2013; Ogata, 2016; Parthasarathy & Crowell-Davis, 2006).

Considering the universality of reinforcement principles (J. O. Cooper, Heron, & Heward, 2007; Schneider, 2012) it is likely that the behaviors seen in individual dogs reflect a history of reinforcement for those behaviors. Several authors on separation-related behavior problems note that vocalization, destructive behavior and escape may be attempts to reunite with the caregiver (Blackwell et al., 2006; Podberscek, Hsu, & Serpell, 1999a; Tod, Brander, & Waran, 2005), and although maintaining reinforcers must be determined individually it is quite possible that separation conditions could establish resumed contact as a valuable reinforcer and that various behaviors seen under separation conditions could serve that function.

That various responses can be shaped and maintained by "caregiver" proximity was demonstrated in a classical experiment with ducklings by Peterson (1960). In their natural environment, ducklings maintain proximity to their mother by following her around, but Patterson demonstrated that ducklings will readily learn to perform a different response if that is what keeps the mother-figure close. Peterson's experiment demonstrated two important facts: Both that the proximity of the mother-figure functioned as a reinforcer, and that the behavior of the ducklings altered depending on which response gave them access to that proximity.

In adult family dogs, a recent study by Feuerbacher and Wynne (2014a) similarly shows that access to the owner can function as a reinforcer for dogs' behavior under home alone conditions. In three dogs with no known separation-related behavior problems, the response of pressing a lever was readily shaped and maintained using escape from a closed room and access to the owner's attention as a reinforcer.

Feuerbacher and Wynne's study was inspired by functional analysis methodology, where a single-subject experimental design is used to identify how a problem behavior is affected by environmental variables, an approach that is well established in work with humans

(Hanley, Iwata, & McCord, 2003; Iwata, 1994) and has been utilized to identify the maintaining reinforcers of problem behaviors also for non-human clients. For example, Dorey, Rosales-Ruiz, Smith, Lovelace, and Roane (2009) found human attention to be maintaining reinforcer for self-injurious behavior in a captive olive baboon *(Papio hamadryas anubis)* and Martin, Bloomsmith, Kelley, Marr, & Maple (2011) similarly identified the feces throwing and spitting of a captive chimpanzee *(Pan troglodytes)* as attention-maintained, while Dorey, Tobias, Udell, & Wynne (2012) found three dogs' *(Canis familiaris)* jumping up behavior to be maintained by tangible reinforcers and attention, respectively.

If a certain behavior is found to be maintained by a certain consequence, altering the behavior-consequence contingency so that the relevant reinforcer is instead made available through alternative behaviors is a straight-forward and effective approach for altering that response (Ringdahl, Marcus, & Roane, 1997 (J. O. Cooper et al., 2007) (Dorey et al., 2009; Dorey et al., 2012; Martin et al., 2011) and has been suggested for interventions concerning dogs' home alone behavior (Feuerbacher & Wynne, 2014a; Yin, 2012).

Another possible approach is to influence the behavior through manipulations of the antecedent environment. Enriching the environment by giving access to preferred items or activities is a strategy often used to increase normal behavior and to decrease abnormal behavior in captive animals of various species including domestic dogs (Pullen, Merrill, & Bradshaw, 2010; Jenny & Schmid, 2002; Young & Lawrence, 2003), and examples from research with human children show that access to preferred items or activities can reduce behavior problems. One such example is given by Ingvarson, Hanley, and Welter (2009) who worked with three children with disruptive classroom behavior suggested to be maintained by escape from demand. Non-contingent access to preferred food items increased compliance increased in all the children and disruptive behavior decreased consistently in two of them, even though the escape contingency was left intact. Similarly, Ringdahl et al. (1997) showed

that antecedent access to preferred items reduced stereotypic self-injurious behavior believed to be maintained by automatic reinforcement in three children with developmental disabilities. In the test situation the environmental enrichment eliminated problem behaviors in two of the children and reduced it in the third child, again indicating that such antecedent arrangements can be helpful although not always enough for reducing a problem behavior. Antecedent arrangements can be a preferable approach compared to differential reinforcement since it avoids the potential negative side effects of extinction (Ingvarson et al., 2009), and it can be effective also when the function of the behavior is unknown (Ringdahl et al., 1997).

In dogs home alone it is possible that enrichment can reduce behavior that functions to escape the closed quarters and gain access to the human. In the study where Feuerbacher and Wynne (2014a) found that a response could be shaped and maintained with access to the owner as the reinforcer, they also tested how antecedent access to preferred toys or a familiar dog bed affected responding. The results were variable across the three dogs they tested, and responding was eliminated only in one dog in one of the conditions (access to bed). However, the notion of using enrichment as a means to reduce separation-related behavior problems offers a promising area for continued investigation. Specifically, enrichment involving food should be investigated further. In modern animal care, foraging enrichment is common practice (Young, 2003), and long-lasting food items are often suggested both as activities to keep a dog occupied and as aids in evoking calm and relaxed responses in the home-alone situation (Appleby & Pluijmakers, 2004; Butler, Sargisson, & Elliffe, 2011; Case, 2010; DeMartini-Price, 2014; Herron, Lord, & Husseini, 2014; Shaw, 2015).

Feuerbacher and Wynne's (2014a) study utilized a functional analysis methodology and confirmed that access to the caregiver can function as a reinforcer for behavior in a home-alone setting. That study was limited to three individuals, and thus a replication would be valuable in order to investigate the generality of the results. In addition, while antecedent

access to toys was included in the study and was shown to give some reduction in responding, access to food as an antecedent variable was not included in that study. Since edible items are preferred reinforcers for many dogs (Feuerbacher & Wynne, 2012, 2014b) and since food enrichment is a common recommendation in separation training protocols (Butler et al., 2011; DeMartini-Price, 2014; Herron et al., 2014) it can be hypothesized that food access could be effective in reducing responding. Therefore it would be valuable to test the effect of antecedent access to food items.

The present study is a systematic replication of Feuerbacher and Wynne's (2014a) study, investigating whether access to a person would function as a reinforcer for the behavior of three family dogs, and how different antecedent conditions would affect such behavior. Specifically, the study investigated how access to toys, long-lasting food items or frequently delivered small food items respectively influenced the behavior. Similarly to Feuerbacher and Wynne, this study also examined the usefulness of a functional analysis approach as a tool for investigating the behavior of dogs left alone, and whether an arbitrary response can be useful as a stand-in for problem behaviors in research on dogs' separation-related behavior.

Method

Participants and setting

Three dogs participated in the study: Gizmo, mixed breed, 12 years old; Pixl, Pyrenean shepherd, 8 years old; and Imse, Pyrenean shepherd, 2 years old. All the dogs lived in the same household, at the property where the testing was done, and were familiar with the experimenter. During a pre-test phase each dog interacted with the experimenter, readily accepted food treats and settled in the test building.

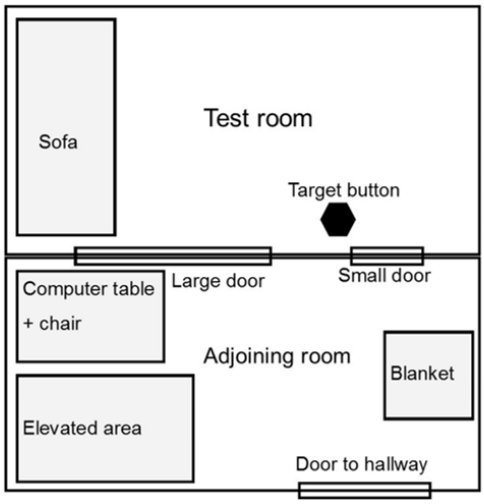

Figure 1. The experiment area. This figure illustrates the setup, with the test room containing the target button and the adjoining room used for the one minute consequence periods. The illustration is not to scale.

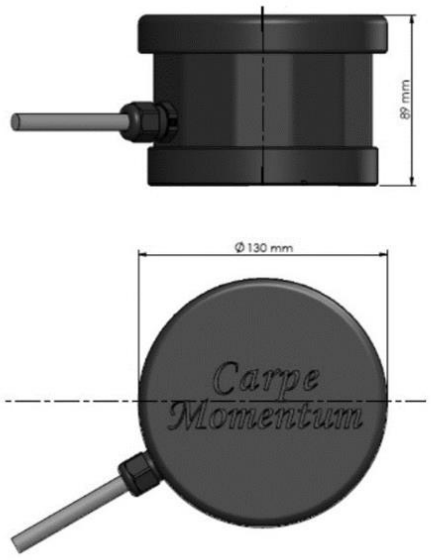

Figure 2. The target button. This figure illustrates the target button used in the experiment.

The experiment was carried out in an empty boarding kennel building at the property where the dogs lived. The layout of the experiment rooms is illustrated in Figure 1. The area of the test room was 180 x 260 centimeters and it was empty except for a sofa with a blanket and a full water bowl. One small and one large door opened into an adjoining room, which

held an elevated resting area with a blanket, a full water bowl, a blanket on the floor, a small table with a computer, and a chair. The adjoining room also had a door to the hallway of the building. The wall between the test room and the adjoining room was 165 cm high, and the experimenter was always positioned so that the dog could not make visual contact when in the other room. There was one full water bowl in the test room and one in the adjoining room.

During sessions, a custom designed target button (illustrated in Figure 2) was placed on the floor 10 cm from the wall, next to where the door opened in the test room. The target button was 9 cm high, 13 cm in diameter, and had a wire connection to a speaker which made a beeping sound when the target's surface was pressed down with a force of 1.7 Newton. The criteria for a response was that the target button was depressed so that it made a sound. The consequence was delivered immediately when the experimenter heard the sound.

Testing was carried out by the author, a person familiar to the dogs but not their owner. The dog entered the building with the experimenter a few minutes prior to each session, and no other person was in the building during the sessions.

Ethical considerations

The study was conducted in Sweden while administered from a university in Norway. The dogs were privately owned, and consent to their participation was given by the owners. The experiment was conducted on the property where the dogs lived. In accordance with instructions from Swedish authorities and with reference to "Statens jordbruksverks föreskrifter och allmäna råd SJVFS 2012:26 2 kap 16§", the study was not subject for ethical approval for animal research in Sweden. Similarly, in accordance with instructions from Norwegian authorities and with reference to "Forskrift om bruk av dyr i forsook, FOR-2015-06-18-761 2-4§", it would not have been subject for ethical approval if it had been conducted in Norway.

The details of the procedure were planned to minimize restrictions and avoid force, and the dogs' general behavior and health was continually monitored and evaluated by the experimenter and the owners to ensure the dogs' wellbeing.

Research design

The study was conducted in a within-subject design using a functional analysis approach inspired by Iwata (1994). Briefly described, the setup was as follows: Each dog was placed in test room containing a target button, and was let out of that room and into an adjoining area upon pressing the button. The behavior of button-pressing was shaped with being let out of the test room and receiving attention from a familiar person in the adjoining room as the consequence, thereby investigating whether this consequence functioned as a reinforcer. Five different antecedent/consequence conditions were then introduced in a multielement phase, investigating how the response was affected by each condition.

The independent variables were the conditions in the test room and in the antecedent room, and the dependent variable was the number of button-pressing responses emitted during each 15-minute session.

Measures

For every session, all responses were scored from video by the experimenter, and the number of responses per sessions were calculated. In addition, the time for each target response and the time when the first paw touch the test room floor upon entering it were scored, and actual "1-minute" consequence times were calculated for scoring treatment fidelity.

A randomly sampled 10 % of the videos were scored also by an independent second observer for interobserver agreement (IOA). Scores were considered to be in agreement if they occurred within 1 second of each other.

Procedure

The session structure. Each trial started with the experimenter and the dog in the adjoining room. The experimenter opened the door, called the dog, and sent it into the test room while tossing a treat on the floor. The reason for giving a treat upon entering the room was to maintain the behavior of coming when called and voluntarily entering the room. The trial was considered started when the first paw touched the floor in the test room. At the start of the first trial in each session, a timer was set on 15 minutes to indicate the end of the session.

Upon a response that met criteria (successive approximations in the acquisition phase, button-press response in the baseline and multielement phases), the experimenter set timer to start the 1-minute consequence period and opened the door that gave the dog access to the adjoining room.

In all sessions of all phases, the consequence consisted of the experimenter opening the door and letting the dog out into the adjoining room for 1 minute. During the acquisition of the response, in all baseline sessions and in all multielement sessions except in attention condition, the experimenter was in the adjoining room during the consequence period. The door was closed behind the dog and the experimenter sat down on the elevated resting area. Throughout the 1-minute consequence period the experimenter gave the dog attention in the form of gaze, praise, small talk and petting, striving to provide reinforcing and non-aversive types of attention and maintaining a naturalistic communication with the dog. In the attention condition, the experimenter was instead in the test room when the dog pressed the button and stayed there while letting the dog out into the adjoining room for the 1-minute consequence period.

After 55 seconds of the 1-minute consequence period, the timer made a warning beep which prompted the experimenter to get up and let the dog into the test room again. The time

it took to let the dog into the test room was estimated to vary between 5-13 seconds (based upon test trials with other dogs, with the time variations depending on the dog's latency and speed of entering the test room), giving an effective consequence time of 60-68 seconds.

The session ended after 15 minutes. If the session ended during a 1-minute consequence period, the experimenter continued with the consequence until that minute was over. If the session ended at a time when the dog was in the test room, the large door was opened and the dog was let out without any response requirement. The experimenter then sat down at the chair by the desk and ignored the dog for 1 minute, thus delivering a presumably less reinforcing consequence compared to the consequence that followed the target response. Letting the dog out through the large door, instead of the usual small one, also differentiated this scenario from the consequence on the target behavior.

Acquisition - teaching the response. The target button was novel for all dogs and pressing it was shaped in successive approximations, combining shaping and stimulus fading with inspiration from errorless learning techniques (Jones, Clare, MacPartlin, & Murphy, 2010). Access to the person and the person's attention was the only reinforcer used throughout the acquisition trials. The shaping process started with the dog stepping on a wooden board placed in the slightly open doorway of the larger door (which was the easiest door to manipulate at this stage). The setting was gradually shifted, through smaller boards in varied positions, to the actual target and the door fully closed. Once the response was established, the target button was moved to its designated spot on the floor, 10 cm from the smaller door, and from then on that door was used to let the dog out when it pressed the target.

Acquisition trials continued until the dog had emitted the target response in three consecutive sessions with the target button placed in its designated spot and the door closed.

Baseline phase. Baseline sessions were conducted in the same way as the final acquisition sessions: The door was closed, the target button was in its designated spot, and only target responses which sounded the target button earned the 1-minute consequence period.

Baseline sessions were conducted three times per day, starting in the same hour each day, and with 45-90 minute pauses between sessions. Between sessions the dog and the experimenter left the building and the dog joined the regular household routines.

Baseline days continued until stability and lack of trend was achieved, as judged by visual inspection over minimally two days. Then the multielement phase begun.

Multielement phase. The multielement phase was arranged according to functional analysis methodology (Iwata, 1994) and contained five conditions. The name of each condition refers to the antecedent situation in the test room. When the dog emitted a target response in the test room, he was let out into the adjoining room for 1 minute, following the same structure as in the baseline phase. Table 1 shows the setup in the test room and in the adjoining room for each condition.

Table 1.

Setup for the five conditions in the multielement phase.

Condition	Test room (antecedent)	Adjoining room (consequence)
Alone condition	Empty room	Person and attention
Attention condition	Person and attention	Empty room
Toy condition	Toys	Person and attention
Treat dispenser condition	Treat dispenser FT7s	Person and attention
Stuffed toy condition	Treat-stuffed rubber toys	Person and attention

For each dog, all conditions were run each day for five days. Sessions started within the same hour each day, each session ran for 15 minutes, and there were pauses of 45-90

minutes between the sessions. The sequence of the conditions was randomized for each day, with the limitation that each condition could only occur once in each position in order to minimize correlations between the conditions and the time of the day. The time of the day could otherwise have affected responding due to the dogs' normal daily schedule for eating, sleeping, and other activities, or though potentially disturbing noises or activities from wildlife, other pets, or human activities outside the building that might be more or less likely at different times of the day.

Gizmo and Imse conducted all the planned sessions while Pixl's participation was terminated after the fourth session of his fourth day, due to medical and dietary considerations.

Alone condition. The alone condition was the same as the baseline. The test room was empty, and as a consequence of responding the dog was let out into the adjacent room where he had access to the person and attention. This condition measured whether being let out of the test room and getting attention from the experimenter functioned as reinforcement for the target response.

***Attention condition*.** This condition reversed the antecedent and the consequent situations from baseline. The dog got attention from the person in the test room, and as a consequence of responding he was let out into the adjoining room which was empty.

When each trial started, the experimenter entered the room together with the dog and sat down on the elevated area. The experimenter paid attention to the dog through gaze, praise, small talk, and petting in the same way as she had done during the baseline consequence.

If the dog made a target response the experimenter opened the door, let the dog out and closed the door behind it. The dog thus had access to the adjoining room while the experimenter stayed in the test room for the one-minute consequence period. Once the minute

had passed the experimenter opened the door, called the dog and let it into the test room again. As in the other conditions, the dog got a treat upon entering the room.

This condition was included in order to measure whether the presence and attention of the experimenter in the antecedent condition, instead of in the consequent condition, affected the target response. The results from this condition were used to validate whether responses in the baseline and alone conditions were indeed functioning to attain the company of the person, rather than escaping the test room and getting access to the pause room as such.

Toy condition. This condition was the same as the baseline and alone conditions, with the addition of five toys placed in a semi-circle 0.8 meters from the target button. The toys were familiar to the dog which had played with them prior to the experiment, but it had not had access to them since at least one day before the multielement phase begun. During the experiment the dog did not have access to these toys outside this condition.

Responding gave access to the adjoining room and the person's attention. If the dog did not immediately leave the toys and exit the test room, a treat lure was used to prompt the dog to give up the toy and exit the test room.

This condition measured weather the presence of toys in the test room reduced the target response.

Treat dispenser condition. This condition was the same as the baseline and alone conditions, with the addition of an automatic Treat & Train™ treat dispenser placed by the wall, one meter from the door and the target button. The treat dispenser delivered kibble on an FT 7s schedule as long as the dog was in the room. A target response gave access to the adjoining room and the person's attention and simultaneously aborted the dispensing of treats.

Similarly to the toy condition, this condition measured weather the presence of a treat dispenser and the delivery of kibble every 7 seconds in the test room reduced the target response.

Stuffed toy condition. This condition was the same as the baseline and alone conditions, with the addition of three Kong ™ rubber toys stuffed with frozen raw meat mix placed in the test room.

On the basis of prior informal observations, the food in the stuffed toys were was estimated to last for at least 20 minutes of continuous licking and gnawing.

Responding gave access to the adjoining room and the person's attention. If the dog did not immediately leave the stuffed toy and exit the room without it, a visible treat lure l was used to prompt the dog to give up the toy and exit the test room.

Similarly to the toy and treat dispenser conditions, this condition measured whether the presence of treat-stuffed toys in the test room reduced the target response.

The positioning of the stuffed toys was altered during the experiment: For the entirety of Imse's experiment and for Pixl's first day, the stuffed toys were placed freely on the floor by the wall, one meter from the door and the target button. For the remaining days of Pixl's experiment and for the entirety of Gizmo's experiment, the stuffed toys were instead tied to the far wall by a rope. This alteration was made to minimize contact between the stuffed toys and the target button, and will be discussed further in the discussion section.

Results

Initial training

Through the combination of shaping and stimulus fading, and with access to the adjoining room and attention from the person as reinforcer, all three dogs acquired the target response. The initial training was completed in 27 sessions for Gizmo, 10 sessions for Pixl and 7 sessions for Imse.

The baseline phase

In the baseline phase, the response rate was consistently high in all dogs: 13-14 responses per session for Gizmo, 11-13 responses per session for Pixl and 12-14 responses per

session for Imse. Due to a mistake in the preliminary data recordings for Pixl's first day I ran an extra day of baseline trials with him, totally 9 trials, while Imse and Gizmo did 6 baseline trials each.

The multielement phase

The multielement phase was conducted as planned for five days for Imse and Gizmo, while Pixl's participation was ended after four days due to medical and dietary reasons. For the same reasons, the treat dispenser condition was not included for Pixl on the fourth day.

The number of responses per session for each dog under each condition can be seen in Figure 3. For the multielement phase, the x-axis shows one day per step in order to facilitate visual inspection of the results for each day and each condition.

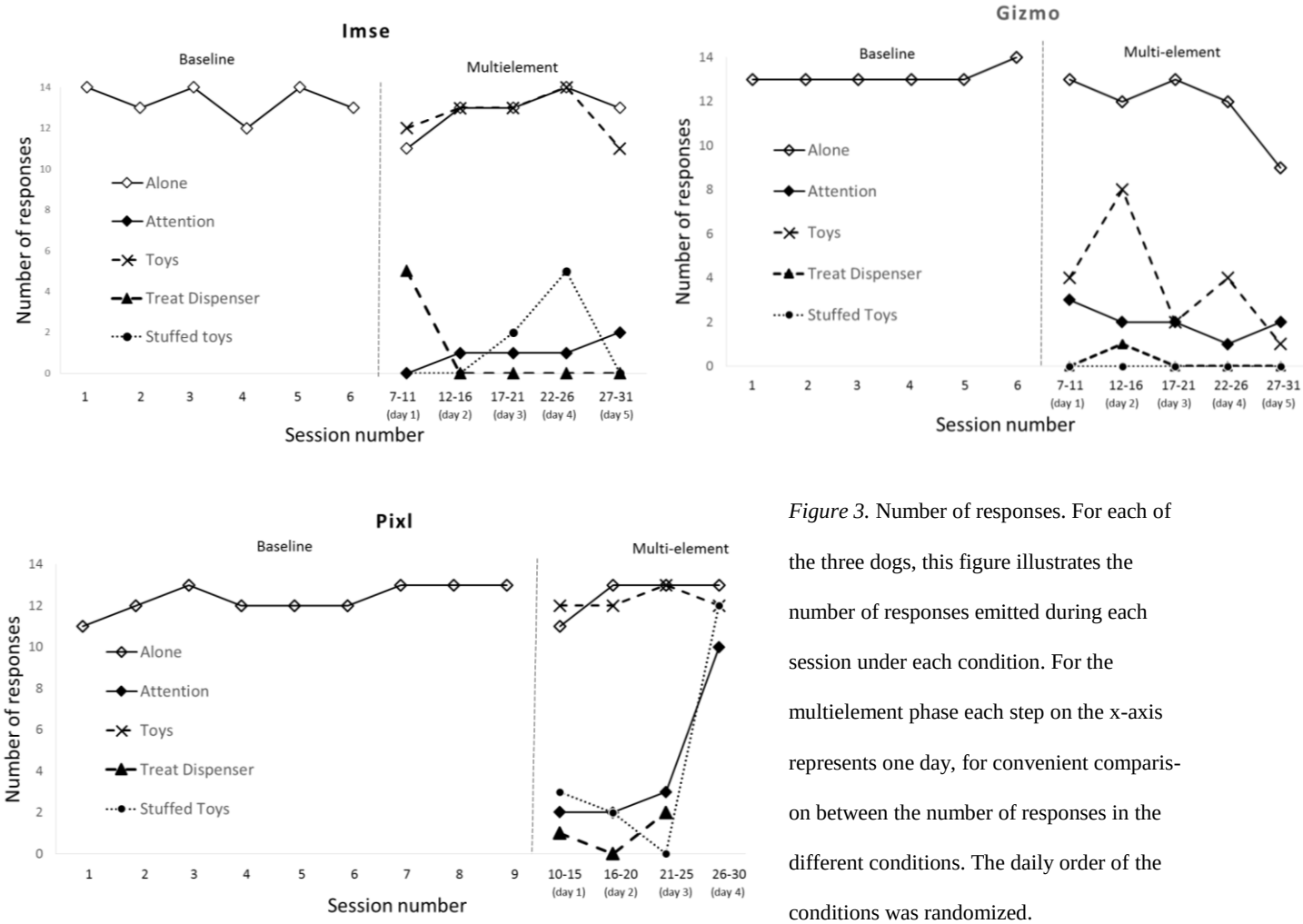

Figure 3. Number of responses. For each of the three dogs, this figure illustrates the number of responses emitted during each session under each condition. For the multielement phase each step on the x-axis represents one day, for convenient comparison between the number of responses in the different conditions. The daily order of the conditions was randomized.

In the alone condition, which was a continuation of the baseline phase, responding was continuously high: 10-13 responses per session for Gizmo, 11-13 responses per sessions for Pixl and 11-14 responses per sessions for Imse.

In the attention condition, where the person went into the test room with the dog and where the dog was alone in the adjoining room during the 1-minute consequence pause, responding was generally low: 1-3 responses per session for Gizmo, 0-2 responses per session for Imse, and 2-3 per session for Pixl expect for on his last day, day four, when his responding in the attention condition went up to 10 responses.

In the treat dispenser condition, responding was generally low. Gizmo emitted no responses at all except in the second day, when he emitted one response following machine malfunction where the dispenser stopped dispensing treats. Imse responded 5 times during the treat dispenser condition the first day, and then 0 times per session on the following days. Pixl responded 0-2 times per sessions, totally 3 responses, of which 2 occurred following machine malfunctioning. On Pixl's fourth and last day the treat dispenser condition was not included.

In the stuffed rubber toy condition responding was also generally low: 0 responses per day for Gizmo, 0-5 responses per session for Imse, and 0-3 responses per session for Pixl expect for on his fourth and last day when he performed 12 responses.

Imse performed a total of 7 responses in the stuffed rubber toy condition. The video recordings showed that in 6 of these responses it was the rubber toy that touched the target and caused it to sound, and in the 7th Imse touched the target with his paw while holding the stuffed toy in his mouth.

In the toy condition, responding was similar to baseline/alone conditions for Imse and Pixl: 11-14 responses per session for Imse and 12-13 responses per session for Pixl. Gizmo's responding in the toy condition varied between 1-8 responses per session.

Data reliability and treatment fidelity

Interobserver agreement (IOA) was 99%.

The number of responses in a session showed no correlation neither with the session's order number in the day nor with which condition the session followed, according to visual inspections of the data.

97% of the nominal 1 minute consequence time intervals fell between the planned 60 and 68 seconds. The consequence times showed a weak negative correlation with the number of responses in the session where they occurred (r -.14, p<.001). The attention and treat dispenser conditions generally had the shortest average consequence times, as illustrated in Figure 4. Inspection of data in each session showed that variations in the length of the consequence times can never directly have accounted for a fault of more than 1 response in any given session.

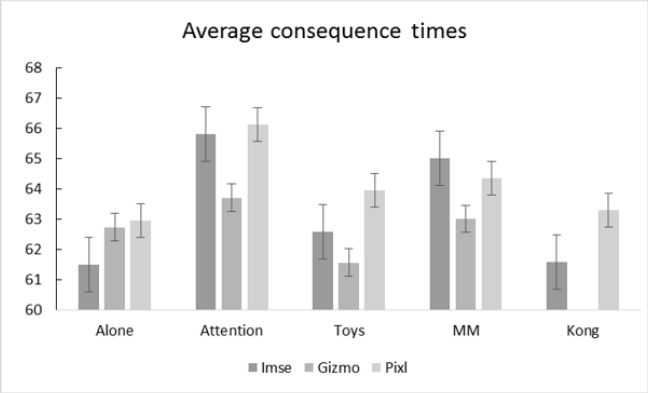

Figure 4. Average consequence times. This figure shows the average actual durations of the 1-minute consequence time periods under the different conditions in the multielement phase. Standard errors are indicated by error bars. Note that the x-axis starts at 60 seconds.

Discussion

In this study I found that access to a person and the person's attention functioned as a reinforcer for a target response in three family dogs, and that access to food drastically reduced responding in all three dogs. Non-food toys somewhat reduced responding in one individual and had no effect on the responding of the other two individuals. The functional

analysis approach, where environmental variables were manipulated using a multielement design (Iwata, 1994), proved to be useful since it revealed that responding clearly and consistently differed under different conditions, and use of an arbitrary response made it possible to do the investigation without relying on typical "problem" behaviors such as vocalizing or scratching to occur.

No order effects or effects of time of day were observed, which further strengthens the conclusion that the number of responses in a session was a function of the condition in that session. Inconsistencies in the length of the 1-minute time consequences were a weakness in the procedure but this does not alter the interpretation of the overall results. In my best judgement, the small negative correlation seen between the length of the consequence times and the number of responses in a session occurred due to human mechanics being slower when letting the dog back into the test room in the attention condition (opening the door from the inside) and in the treat dispenser condition (simultaneously starting the treat dispenser), both conditions where few responses occurred.

The current study was limited in scope, covering only three dogs and five different conditions. It confirms the reinforcing effect of access to an attentive human observed in Feuerbacher and Wynne's (2014a) study and demonstrates that food enrichment can effectively reduce responding maintained by such access, but further research is needed to investigate the generality of the results across individuals and across situations.

For the individual dogs that participated in this study, the generality of the results across situations remains to be explored. However, the results indicate that access to a person is a valuable asset for these dogs and can function as a reinforcer even if the person is not a family member. The results also suggest that feeding enrichment through stuffed toys or frequently dispensed treats are preferred activities that can ameliorate home-alone time, and that for Gizmo also access to toys may be worth exploring further.

Access to person functioned as a reinforcer

Access to the person and the person's attention functioned as a reinforcer for the button-pressing behavior of all the dogs in the study, confirming the results of Feuerbacher and Wynne (2014a). This can be concluded from the evidence that the target response was shaped with access to the person and attention as a reinforcer, that responding was close to maximal in the baseline and alone conditions, and that responding dropped to near zero in the attention condition where the person was with the dog in the antecedent condition and responding only gave access to an empty room. The dogs thus allocated their behavior so that they could be in the same room as the person, regardless of which room that was.

These results were consistent across this study and Feuerbacher and Wynne (2014a), despite the differences in experimenter (familiar person in my study, vs. owner in Feuerbacher and Wynne's) and facility (a kennel building on the home property in my study, vs. the family's house in Feuerbacher and Wynne's), and despite the procedural difference that the dogs in my study were given a treat each time they entered the test room. Test room entries were fully trained and maintained with that treat delivery as a reinforcer, ensuring a positive reinforcement contingency for that part of the experiment, but hypothetically a dog might learn to press the target to get out into the pause room from where he will be allowed to enter the test room and get a treat 1 minute later. However, the treat-upon-entry condition was the same in both alone and attention condition but responding was still allocated to maximize access to the person rather than to maximize access to treats-upon-entry, and Feuerbacher and Wynne (2014a) got similar results with a procedure where the dogs were led into the experiment room by the collar and not given any food reinforcers. The treat upon entry does thereby not seem to have influenced the results.

Pixl's responding on his fourth and last day in the experiment was the only exception from the pattern of access to the person clearly functioning as a reinforcer. On that day, his

responding was high also in the attention condition which indicates that access to the adjoining room, rather than access to the person, may have been the maintaining reinforcer. Incidentally his responding in the stuffed toy condition was also deviant that day compared to the other days, with a high rate of responding also in that condition. Later that day he vomited, and was withdrawn from the experiment due to health and dietary concerns. I can only speculate that his medical condition affected his behavior on that day, possibly through increasing the relative value of access to the adjoining room with its exit to the hallway and the door out of the building. The possibility that medical conditions may influence separation-related behavior is reflected in the recommendation by behavior specialists to exclude medical issues as a contributing factor (Horowitz, 2001; Overall, 1997), and merits systematic investigations in future research.

Overall, this study contributes to the current understanding of dogs' behavior under separation conditions though demonstrating the potential role of reinforcement contingencies, and through verifying the value that human company has for dogs - also for those not showing separation-related behavior problems.

To date, the literature on dogs' separation-related behavior has predominantly focused on the antecedent conditions where the behaviors occurs, rather than on potentially reinforcing consequences. However, several authors have remarked that behaviors such as vocalization, scratching or jumping at the door may be attempts to resume contact with the person (Blackwell, 2008; Podberscek et al., 1999b; Tod et al., 2005) and some have directly noted that various responses can be reinforced through contact or reunion with the owner (Association of Pet Dog Trainers, 2016; Blackwell, 2008; McConnell, 2000; Tapper, 2009). That an arbitrary response such as button pressing can be readily established and maintained using access to a person as a reinforcer, as demonstrated in my experiment and in that of Feuerbacher and Wynne (2014a), supports the notion of human access as a potent reinforcer

for the behavior of dogs under separation conditions. Further research is needed to investigate whether human access is indeed the maintaining reinforcer for individual dogs' separation-related behavior problems. The functional analysis approach used in this study provides a valuable tool for such investigations, and has been successfully used for identifying the maintaining reinforcers for numerous other behavior problems in non-human individuals as well as in humans (Beavers, Iwata, & Lerman, 2013; Dorey et al., 2009; Dorey et al., 2012; Hall, Protopopova, & Wynne, 2015; Hanley et al., 2003).

The demonstration of human access as a reinforcer under separation conditions indicates that the dogs could readily learn to perform also other behaviors, including behaviors categorized as problems, through similar contingencies. This highlights the potential in using such access as a reinforcer for desired behavior in home-alone training, as suggested by some authors on separation-related behavior problems (Feuerbacher & Wynne, 2014a; Tapper, 2009; Yin, 2012).

Notably, the current results demonstrate that even dogs not labelled as having separation-related behavior problems may act to gain access to human company when given the opportunity. This supports the view that proximity to a human companion is a preferred condition for domestic dogs, also for dogs not showing behavior problems when left alone. In line with this view, dogs with and without known separation-related problems spent similar amounts of time near their owner in a test situation (Parthasarathy & Crowell-Davis, 2006), and when left home alone dogs without reported separation-related problems have been found to spend most of the time in the entrance area (Rehn & Keeling, 2011). A majority of dogs is also reported to follow their caregivers from room to room under at-home conditions (Parthasarathy & Crowell-Davis, 2006), and according to one study this behavior was equally reported in dogs with and without separation-related problems (Parthasarathy & Crowell-

Davis, 2006) although others have found it to be even more prevalent in dogs with separation-related problems (Flannigan & Dodman, 2001).

In animal welfare research, the reinforcing effect of a stimulus is used as a measure of how important that stimulus is to the animal (J. J. Cooper & Mason, 2001; Dawkins, 1990, 2003; Fraser, 2008; Hughes & Black, 1973). Rehn and Keeling (2011) have previously noted that the generally passive behavior seen in dogs without separation-related problems may be a welfare concern. From an animal welfare perspective the unison results from the current study and that of Feuerbacher and Wynne (2014a) point to the to the value that access to the person has for the dogs and thereby indicate that separation may pose a welfare also for dogs that do not show obvious behavior problems. To quantify how important human companionship is for a dog, future studies could manipulate the amount of "work" required for reinforcement and thus test how much the dogs are willing to "pay" for the human company in accordance to a methodology adapted from behavior economics consumer demand theory by animal welfare scientists such as Dawkins (1983). The setup of the present study, where the dog gets access to the person through a target response, could conveniently be adapted to such an investigation through increasing for example the force, the ratio or the duration of the required response.

The food conditions reduced responding

Antecedent access to food, whether food-stuffed rubber toys or kibble dispensed at an FT 7s schedule, markedly reduced responding in all three dogs in my study. Furthermore, several of the responses that did occur coincided with technical issues: Mechanical malfunctioning where the treat dispenser seized dispensing treats preceded Gizmo's only response as well as two the three responses emitted by Pixl, and in the stuffed toy condition all but one of Imse's responses and all of Pixl's responses on the first day occurred through

the toy touching the target button. Without these technical issues, responding under food conditions would likely have been even lower.

The current study is the first to specifically investigate how access to food activities affect the behavior of dogs under separation conditions. The fact that both the food activities effectively decreased responses maintained by access to the person confirms the notion that food items can be an effective tool for facilitating desirable home-alone behavior in dogs, as is often suggested (Appleby & Pluijmakers, 2004; Butler et al., 2011; Case, 2010; DeMartini-Price, 2014; Herron et al., 2014; Shaw, 2015). Enriching the environment with food-stuffed toys has been shown to increase behavioral variability while decreasing barking in kenneled dogs (Schipper, Vinke, Schilder, & Spruijt, 2008), and leaving the dog with a food stuffed toy has also been shown to be advice that new dog owners readily comply with, which further supports its usefulness (Herron et al., 2014).

Presumably, a familiar person is less valuable for dogs than their owner. It is therefore possible the reduction in responding would be less marked if the owner was the experimenter, which may limit the generality of the study. It should also be noted that the current study did not include any dogs with evident home-alone behavior problems. Separation-related behavior problems have been noted to coincide with reduced eating under separation conditions (DeMartini-Price, 2014; Flannigan & Dodman, 2001; Horowitz, 2001), and I therefore hypothesize that access to food would be less effective in reducing responding for dogs with severe separation-related behavior problems.

For practical use, the type and amount of food used needs to be moderated to accommodate the dog's dietary needs and possibly to avoid satiation, especially if implemented for longer time periods. This could for example be accomplished through gradual thinning the time schedule, a well-established procedure that may be implemented using either a fixed or a variable time schedule (Van Camp, Lerman, Kelley, Contrucci, &

Vorndran, 2000). With an automated treat dispenser this is easily facilitated, but other food or enrichment items can also be presented using time-scheduled mechanisms (Jenny & Schmid, 2002). The use of a treat dispenser delivering small, quickly consumed food deserves a note of caution due to the risk that schedule-induced behavior such as polydipsia (excessive drinking) or other types of abnormal behavior might develop (Mason, 1991; Young, 2003), and from that perspective, alternative food activities such as the stuffed toys may be preferred. In future studies, the setup of the current experiment can be useful for examining the effects of gradually thinner time schedules and other endeavors aimed at reducing the amount of food used while maintaining low rates of responses functioning to get access to the person.

The toy condition gave variable results

The toy condition gave very different results compared with the food conditions. Imse's and Pixl's responding in the toy condition was as high as in the alone condition, showing no effect from the presence of the toys. By contrast, Gizmo's responding was clearly lower in the toy condition than in the alone condition although not as low as in the attention condition.

Gizmo's behavior in the toy condition held much variation. Besides being the only dog whose target responding was markedly different in the toy condition compared to the alone condition, with the toys somewhat functioning as abolishing operations for the target response, the video recordings show that apart from interacting with the toys he also spent some of the time lying down. In addition, on several occasions he faced the door and barked. Further experimentation would be needed to investigate the environmental events responsible for the lying down and the barking, but the presence of these responses indicates that contingencies not accounted for in the experimental setup may have influenced Gizmo's reduced responding in the toy condition.

In sum, for two out of three dogs in this study the presence toys did not affect responding at all. For the third dog responding was somewhat decreased, which resembles the results in Feuerbacher and Wynne's study where the toy condition gave a slight reduction in responding in all three dogs. Access to toys thus seems to have a limited effect, especially when compared with the food condition.

Since dietary restraints can limit the use of food items, and since owners of dogs kept in groups may be hesitant to provide food when the dogs are left alone due to potential resource guarding behavior, further efforts should be made to find non-food items that can complement or replace to food activities in home-alone situations. In video recordings of dogs home alone, behavior categorized as play has been noted only sparingly and for brief periods of time (Cannas, Frank, Minero, Godbout, & Palestrini, 2010; Scaglia et al., 2013), and play is generally referred to as a social activity in dogs (Bekoff, 1974). Other types of enrichment may be more likely to evoke interaction under separation conditions. For example, Feuerbacher and Wynne's (2014a) study included a condition where the dog's own bed was placed in the test room. This diminished responding functioning to gain access to the owner in one of the dogs, suggesting it can be effective for certain individuals. The behavior seen in a study by (Konok, Dóka, & Miklósi, 2011), where dogs spent much time in proximity with items their owners had left and the chair their owners had sat, also points to the potential usefulness of familiar items. The literature on environmental enrichment for captive animals can provide further ideas. For example, non-food enrichment may also include other scents, sounds and/or visual stimuli, and could be enhanced by the inclusion of novel items and variation across sessions (Young, 2003). The effects of such interventions on dogs separation-related behavior, including their ability to reduce responses functioning to resume contact with the person, remains to be investigated.

The arbitrary response

The arbitrary response used in this experiment proved to be a valuable tool for investigating the effects of antecedent and consequence variables without relying on "problem" behaviors. Further exploration of antecedent events that can reduce responding may include various enrichment activities in the separation setting, but can also encompass other features. For example, interventions targeting self-injurious behavior in children have shown that a less preferred reinforcer may substitute for a more preferred one if response cost for the more preferred reinforcer is increased (Zhou & Goff, 2000), which indicates that an increase in the effort required to obtain access to the person might increase the likelihood that the dog instead chooses to engage in the enrichment available, a hypothesis that can be tested using an arbitrary response. Providing non-contingent access to the person on a gradually increased time schedule, consistent with a systematic desensitization approach (Butler et al., 2011), is another example of antecedent intervention that can be tested. In addition, the setup with an arbitrary response can of course also be used to investigate the effect of various consequence variables.

The use of an arbitrary response may also have practical applications. Providing the dog with a response that functions to "opt out" of the alone setting and reunite with the person offers a new paradigm in dogs' home alone training. Functional communication training, where the client is taught an alternate, socially appropriate, response which renders the same reinforcer as the problem behavior, reduces behavior problems in human subjects (Tiger, Hanley, & Bruzek, 2008) but remains to be scientifically investigated for non-human animals. However, a similar approach is used for example when pet owners teach their dogs or cats to ring a doorbell to be let out (Bindoff, 2007). In home alone training, a setup where the dog is given the option to abort the session and reunite with the person provides a novel approach that remains to be explored.

Conclusion

The present study showed that access to a person functioned as a reinforcer for behavior in dogs under separation conditions, and that environmental enrichment in form of feeding activities reduced such responding.

The demonstration of access to human company functioning as a reinforcer for the behavior of family dogs contributes to a more thorough understanding of dogs' separation-related behavior through enhancing the impact of reinforcement contingencies. Future studies should continue examining the effect of human company and attention, both as a potent reinforcer for desirable as well as undesirable behavior under separation conditions and as a factor of relevance for the welfare of family dogs.

The results of this study also indicates that enrichment activities, especially the provision of food items, can reduce behavior functioning to gain access to human company and may be effective as reinforcers for desired home alone behavior. Future studies should further explore the impact of enrichment activities and their usefulness in home alone training.

In the current experiment, the functional analysis approach was utilized to investigate the effect of various antecedent and consequence conditions on an arbitrary response under separation conditions. The study was limited to three dogs and did not target actual problem behaviors. For home-alone behavior problems in individual dogs, functional analysis methodology can be used to reveal the environmental variables responsible for the behavior. This would aid the design of precise interventions for the individuals, as well as improve our general understanding of the behaviors labelled separation related problems.

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Table 1.

Setup for the five conditions in the multielement phase.

Condition	Test room (antecedent)	Adjoining room (consequence)
Alone condition	Empty room	Person and attention
Attention condition	Person and attention	Empty room
Toy condition	Toys	Person and attention
Treat dispenser condition	Treat dispenser FT7s	Person and attention
Stuffed toy condition	Treat-stuffed rubber toys	Person and attention

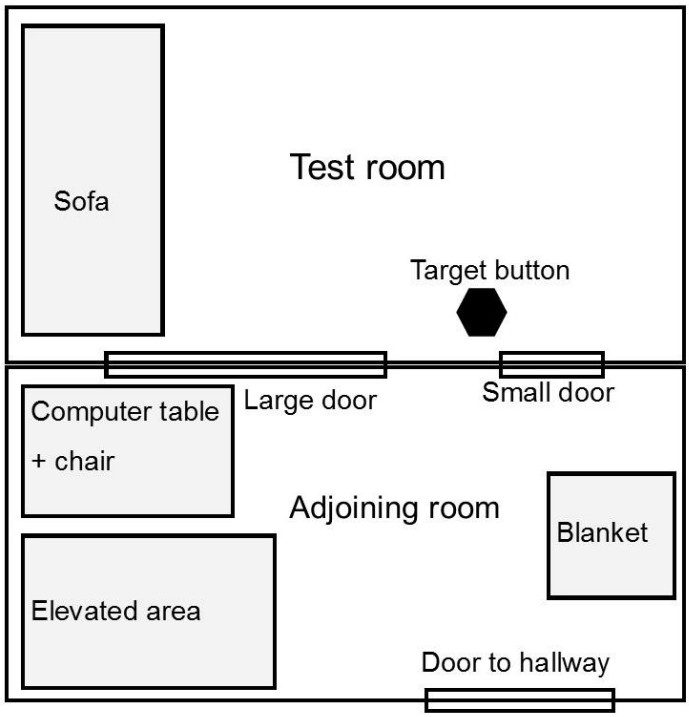

Figure 1. The experiment area. This figure illustrates the setup, with the test room containing the target button and the adjoining room used for the one minute consequence periods. The illustration is not to scale.

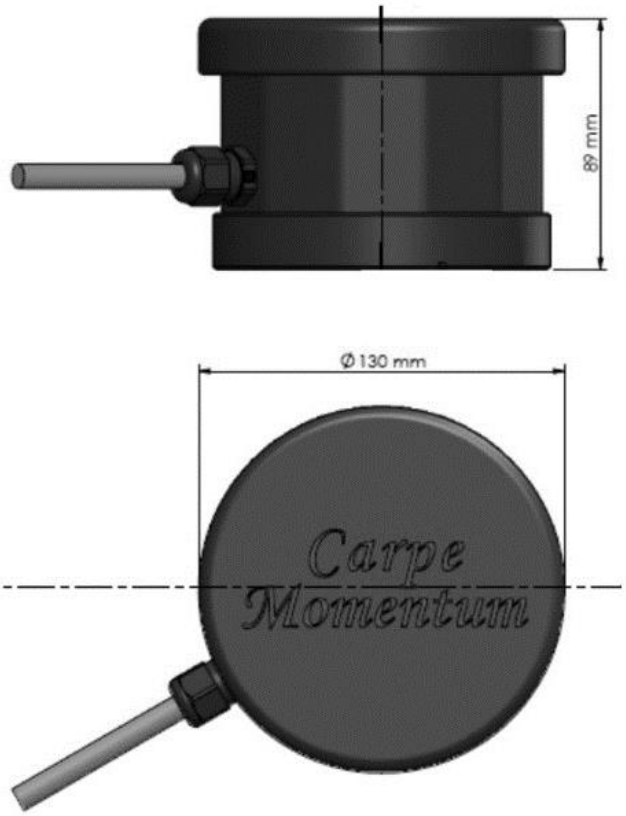

Figure 2. The target button. This figure illustrates the target button used in the experiment.

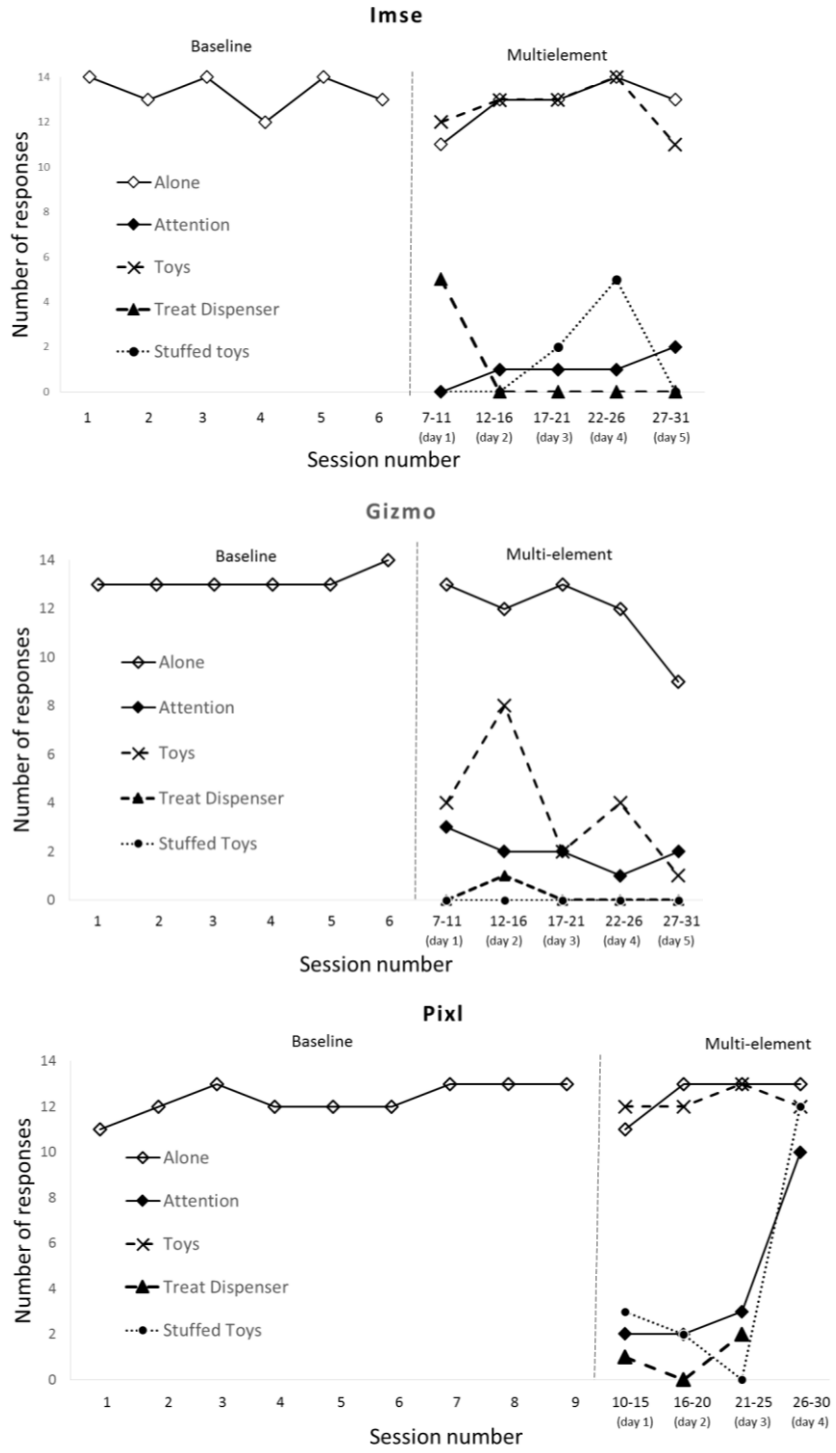

Figure 3. Number of responses. For each of the three dogs, this figure illustrates the number of responses emitted during each session under each condition. For the multielement phase each step on the x-axis represents one day, for convenient comparison between the number of responses in the different conditions. The daily order of the conditions was randomized.

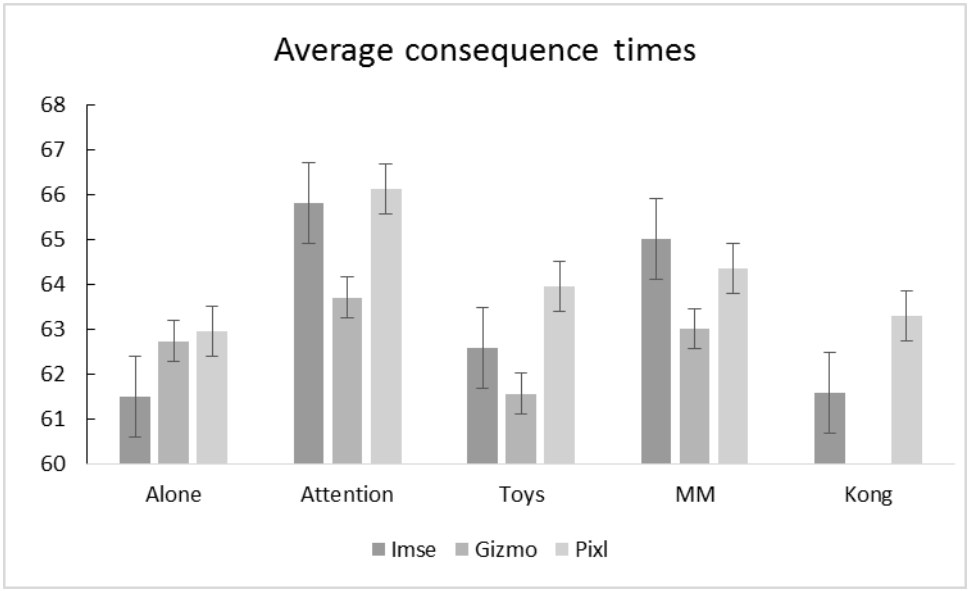

Figure 4. Average consequence times. This figure shows the average actual durations of the 1-minute consequence time periods under the different conditions in the multielement phase. Standard errors are indicated by error bars. Note that the x-axis starts at 60 seconds.