UNIVERSIDADE DE LISBOA
FACULDADE DE MEDICINA VETERINÁRIA

Human-Canine Dyads: Identifying dysfunctional relationships, a Portuguese Case Study

Rute Saraiva Canejo dos Santos Rodrigues Teixeira

Orientador(es): Professora Doutora Maria Manuela Grave Rodeia Espada Niza

Professor Doutor Luís Vicente Baptista

Tese especialmente elaborada para obtenção do grau de Doutor em Ciências Veterinárias na Especialidade de Clínica

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2019
Lisboa

In Remembrance of Professor Cristina L. Vilela

Those that touch our lives stay in our hearts forever.

"…Grant me the serenity to accept the things I cannot change,
Courage to change the things I can,
And wisdom to know the difference."

- Karl Paul Reinhold Niebuhr

Acknowledgments

This work is a result of a roll coaster ride that made me stronger as a scientist, veterinarian, mother, friend, wife and, above all, person. It taught me that, at times, the most twisted, dark and over grown path can lead to the most sun filled clearings. When life gives you lemons…make lemonade!

My most profound gratitude to Professor Cristina L. Vilela, who left us far too soon, and saw in me that which I only imagined. Greatly missed, greatly needed.

To my supervisor, Professor Maria Manuela Grave Rodeia Espada Niza whose unwavering attention to detail allowed me to move from quicksand to rock-solid ground.

To my co-supervisor, Professor Luís V. Baptista for being open to new ideas and viewpoints.

To Professor Pedro Armelim Almiro whose research and knowledge made much of this work possible. For all the support given right from our first meeting and for being a real interdisciplinary partner that I profoundly respect and will always be eternally grateful to.

To Professor Isabel Neto for taking the time and having the patience to be my lighthouse when I was adrift.

To Professor Helena Águeda Marujo whose willingness to accept interdisciplinary possibilities made them possible.

To Professor James A. Serpell for allowing me to tackle the C-BARQ and for the precious insight when I did.

To the FCT (grant SFRH/BD/91362/2012) and CIISA for the funding that allowed me to ask the questions, and then go find the answers.

To my colleagues Drª Marta Videira, Dr Carlos Semião de Sousa, Drª Maria João Nabais, Drª Liliana Carvalho, Drª Alexandra Pereira and their staff at the municipal kennels of Almada, Lisboa, Moita, Odivelas, Sesimbra, Setúbal and Sintra for allowing me to participate in municipal anti-rabies campaigns.

To the staff at the Clinics of the Liga Portuguesa dos Direitos dos Animais (LPDA), Clínica Veterinária AZEVET, Clínica Veterinária MVet, Clínica Veterinária de Corroios, Clínica VetHelp, Hospital Veterinário do Atlântico, Hospital Veterinário SOSVet, Hospital Veterinário VetOeiras and the Hospital Veterinário da Faculdade de Medicina Veterinária for helping recruit owner participation.

My heartfelt thanks to all the human partners of the dyads studied for their indispensable participation.

To everyone at the Hospital Veterinário da Faculdade de Medicina Veterinária for putting up with me and letting me do some of your work.

To my homies of the Fabulous Seven! Sandra Pires, Vanda Sequeira, Ana Paula Maceira, Paulo Maceira, António Fragoso and Jorge Vaz. You held me up, heard my complaints and kept me going…despite the fact that I swear like a sailor while sweating bullets!

To the homonymous Professor Rute M. Noiva, you know our affliction has a common source.

To Skye Jarvis my sister from another mother, now and forever. Your support and love make the "pond" meaningless.

To my family for their support, sometimes not of the most understanding kind, but always there.

To my rock, soulmate, and life partner, Gil. Nothing is possible without you, not breathing not waking and certainly not the kind of undertaking this work represents.

Most importantly to all my hopes and dreams for the future, to the best of me, to my most important legacy. My children Afonso and Dani (Daniela), I will always be your number one cheerleader. May you go further than I ever have.

Abstract

The human-dog dyad is thought to be the oldest existing domestic partnership and is generally mutually beneficial for both members of the partnership. Dysfunction in the human-dog dyad, however, produces serious consequences for each member of the partnership and also for society at large. Research into these relationships has addressed only the consequences of dysfunction, making prevention difficult. This project set out to evaluate the possibility of pre-emptively identifying dysfunction in such dyads by using dog health histories easily available in clinical contexts. To that end, the researcher developed a simple, one-page questionnaire that was disseminated in the greater metropolitan areas of Lisbon, Portugal, and was made available online. By identifying a dog's biting history, trauma, or involvement in a vehicular accident, the researcher was able to suggest the possibility of the dog's involvement in a dysfunctional dyad. To classify the canine behaviour traits essential for establishing the general characteristics of dysfunctional dyads, the researcher developed the European Portuguese Canine Behaviour Assessment and Research Questionnaire (C-BARQ). The psychometric properties were evaluated, and the instrument showed excellent to respectable consistency. The result was a canine behavioural questionnaire that established 13 different personality traits. A more extensive questionnaire was then administered to the same population in Lisbon, Portugal, aimed at identifying husbandry and noting dog and human characteristics within dysfunctional dyads. The results suggest that dogs housed on verandas or on plots of land, dogs that were fed diets purchased at agricultural cooperatives, dogs with C-BARQ scores showing high owner-directed aggression (ODA), dog-directed agressoion/fear (DAF) and dog rivalry (DR) were more likely to be part of dysfunctional dyads. Similarly, owners with high neuroticism scores and low lie/social desirability scores on the Eysenck Personality Questionnaire (EPQ-R) were also more likely to be part of these partnerships. These characteristics were then used to develop two predicative models – the Predicted Dysfunction with Dog and Owner Characteristics (PDDOC) and the Predicted Dysfunction with Dog Characteristics (PDDC) – that successfully predicted dysfunction in 79.7% and 80.1% of cases respectively. These findings reveal the feasibility of pre-emptively identifying dysfunctional human-dog dyads. As a result, this pre-emptive identification can be used to take preventative action – specifically the development of educational programs, the improvement of human-dog pairings, and the equipping of veterinarians to better prevent and/or correct dysfunction.

Keywords: Prevention, Dysfunctional dyad; C-BARQ; EPQ-R; Clinician; Personality; Models; Human-Dog dyad; Pre-emptive Identification

Resumo

A díade homem-cão é considerada a mais antiga parceria doméstica, sendo tida como mutualmente benéfica para ambos os membros. Quando estas díades se tornam disfuncionais pode haver sérias consequências, não apenas para os membros da díade, mas para a sociedade no seu todo. A disfuncionalidade de díades tem sido abordada em diversos estudos, contudo somente após se terem sentido as suas consequências nefastas, o que dificulta o processo de implementação de medidas preventivas. Este projecto teve como objetivo a sua identificação precoce, usando para isso, o historial de saúde do animal disponibilizado em contexto clínico. Foi desenvolvido um questionário sucinto de uma página, o qual foi distribuído a proprietários em Centros de Atendimento Médico-Veterinário (CAMV) na Área Metropolitana de Lisboa e também em formato *online*. A identificação de ocorrência de mordedura, trauma ou atropelamento foi associado a díade disfuncional. Foi desenvolvido o European Portuguese Canine Behaviour Assessment and Research Questionnaire – C-BARQ (Questionário de Investigação e Avaliação de Comportamento Canino) com o intuito de estabelecer bases gerais que permitissem classificar alguns aspetos do comportamento canino. Avaliaram-se as propriedades psicométricas e o instrumento mostrou um intervalo de consistência do respeitável ao excelente. O resultado final foi um questionário de comportamento canino que estabeleceu 13 traços de personalidade diferentes. Administrou-se seguidamente um questionário mais extenso à mesma população, mas agora com a finalidade de identificar características tanto do homem como do cão nestas díades disfuncionais. Observou-se que cães alojados em varandas ou em terrenos, alimentados com rações compradas em cooperativas agrícolas ou que apresentaram valores elevados nos scores de ODA, DAF e DR no C-BARQ, têm uma maior tendência de fazer parte de uma díade disfuncional. Proprietários que no questionário de personalidade humana, EPQ-R apresentaram um valor elevado em neuroticismo e baixo em mentira/desejabilidade social também partilham esta tendência. Estas características foram então usadas no desenvolvimento de dois modelos preditivos (PDDOC e PDDC), cujos resultados previram disfunções em 79,7% e 80,1% dos casos, respetivamente. Estes resultados, possibilitarão o desenvolvimento de programas educacionais, escolha mais informada na adoção de animais em abrigos, bem como dar aos médicos veterinários ferramentas para identificar e eventualmente prevenir e/ou corrigir algumas destas disfunções.

Palavras chave: Prevenção; Díade disfuncional; C-BARQ; EPQ-R; Clínico; Personalidade; Modelo; Díade homem-cão; Identificação antecipada

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List of Abbreviations

AAS – Attachment/Attention-seeking Behaviour

C-BARQ – Canine Behaviour Assessment and Research Questionnaire

CH – Chasing

DAF – Dog-directed Aggression/Fear

DDA – Dog-directed Aggression

DDF – Dog-directed Fear

DR – Dog Rivalry

EL – Energy Level

EPQ-R – Eysenck Personality Questionnaire - Revised

EX – Excitability

FFM – Five Factor Model

GNR – Guarda Nacional Republicana

MCA – Multiple Correspondence Analysis

NEO-PI – Neuroticism, Extraversion, Openness Personality Inventory

NEO-PI-R – Neuroticism, Extraversion, Openness Personality Inventory-Revised

NSF – Non-social Fear

ODA – Owner-directed Aggression

PDDC – Predictive Dysfunction Dog Characteristics

PDDOC – Predictive Dysfunction Dog and Owner Characteristics

ROC – Receiver Operating Characteristic

SA – Stranger-directed Aggression

SDF – Stranger-directed Fear

SRB – Separation-related Behaviour

TR – Trainability

TS – Touch Sensitivity

Chapter I: General Introduction

Humans and dogs have been partners for 33,000 years (Wang et al., 2015), with evidence indicating that as many as 14,000 years ago, dogs were buried with care, indicating their importance within human communities (Morey, 2006). The evolution of this relationship is defined by its mutually beneficial nature (King, Marston, & Bennett, 2012; Sterneberg-van der Maaten, Turner, Van Tilburg, & Vaarten, 2016). On the most basic level, both partners increase their chances of survival through cooperation (O'Haire, 2010), but the human-dog dyad has evolved far beyond such a simplistic interaction (Dotson & Hyatt, 2008; McGreevy, Starling, Branson, Cobb, & Calnon, 2012; Shaughnessy, 2008).

From the human point of view, dogs fulfilled a wide variety of functions, including protection, herding, and companionship (Black, 2012; Christian et al., 2014; Vizek Vidović, Vlahović Štetić, & Bratko, 1999; Wells, 2011). As the human-dog relationship evolved, man found many other ways to build the partnership. Today, dogs partner with humans in police work (Hart, Zaskasloff, Bryson, & Christensen, 2000), in search and rescue tasks (Greatbatch, Gosling, & Allen, 2015), in providing assist for the disabled and elderly (Davis, Nattrass, O'Brien, Patronek, & MacCollin, 2004; Endenburg & van Lith, 2011; Sanders, 2000; Zisselman, Rovner, Shmuely, & Ferrie, 1996), and even in determining medical diagnoses (Horvath, Andersson, & Nemes, 2013). Through it all, dogs have thrived as a species, with benefits from their partnerships with man to include companionship, food, shelter, and in many countries, access to life-saving medical treatment (Bennett & Rohlf, 2007; Pulczer, Jones-Bitton, Waltner-Toews, & Dewey, 2013; Rohlf, Bennett, Toukhasti, & Coleman, 2012).

This relationship however, does not always work well. Dysfunctional human-dog dyads create serious problems that affect individuals as well as society at large, often as a direct result of inappropriate canine behaviour (Lambert, Coe, Niel, Dewey, & Sargeant, 2015; O'Farrell, 1997). One of the most studied and visible examples of this dysfunction is seen in dog-on-human aggression (Casey, Loftus, Bolster, Richards, & Blackwell, 2014; King et al., 2012). The seriousness of this problems has prompted many countries to enact legislation that limits access to specific breeds considered to be "aggressive." However, such an approach ignores the dyadic nature of the human-dog relationship (Cornelissen & Hopster, 2010; Ledger, Orihel, Clarke, Murphy, & Sedlbauer, 2005; Rosado, García-Belenguer, León, & Palacio, 2007; Schalke, Ott, von Gaertner, Hackbarth, & Mittmann, 2008).

Many authors suggest that the lackadaisical natures of the humans in dog-human relationships cause the entire range of problematic dog behaviours. It is known that human partners within dysfunctional dyads frequently allow their dogs to roam (Dalla Villa et al., 2010; Fielding & Plumridge, 2005; Matthias, Templin, Jordan, & Stanek, 2015; Rohlf, Bennett, Toukhsati, &

Coleman, 2010; Voslárová & Passantino Annamaria, 2012), increasing the risk of dogs' involvement in vehicular accidents (Bruce, Brisson, & Gyselinck, 2011; Simpson, Syring, & Otto, 2009; Streeter, Rozanaski, Laforcade-buress, Freeman, & Rush, 2001) and increasing the likelihood that dogs will destroy private property (Bennett & Rohlf, 2007; Fatjó, Ruiz-de-la-Torre, & Manteca, 2006; Fielding, Gall, Green, & Eller, 2012). Dogs in dysfunctional pairings are often denied adequate medical care and may, therefore, pose a risk to public health (Mustiana et al., 2015; Slater, 2001). Of critical importance is the fact that, while dogs are not directly responsible for the development of these unwelcome and dangerous behaviours (Tiira & Lohi, 2015), they often suffer the most severe consequences from them (Bower, 2014; Rayment, De Groef, Peters, & Marston, 2015). Dogs in dysfunctional dyads are subject to harms including abandonment and overpopulation problems (Fielding, 2010; Ramón, Slater, & Ward, 2010; Weng, Kass, Hart, & Chomel, 2006), to convenience euthanasia (Houpt et al., 2007; Marston, Bennett, & Coleman, 2004; Siess, Marziliano, Sarma, Sikorski, & Moyer, 2015; Yeates & Main, 2011).

As part of a concentrated effort to minimize the negative effects of these partnerships on both humans and canines, attention has been focused in recent years on understanding why such dysfunction arises (Nicholas H. Dodman, Brown, & Serpell, 2018; Kuroshima, Hori, Inoue-Murayama, & Fujita, 2016; Payne, Bennett, & McGreevy, 2015; Siniscalchi, Stipo, & Quaranta, 2013; Van Herwijnen, Van Der Borg, Naguib, & Beerda, 2018). Various research groups have tried to establish patterns in dysfunctional dyads, examining issues ranging from husbandry practices to owner[1] personality. Researchers operate on the assumption that improving understanding of how and why dysfunctional dyads develop will enable the development of programs designed to prevent or minimize the negative impact of these dyads on the dyad members and on society at large.

Studies have shown that dogs left alone for longer periods of time (Col, Day, & Phillips, 2016; Ibáñez & Anzola, 2009; Rehn & Keeling, 2011; Tamimi, Jamshidi, Serpell, Mousavi, & Ghasempourabadi, 2015) and dogs that are not properly socialized (Van Herwijnen et al., 2018) are more prone to displaying problem behaviours arising from anxiety. Dogs that spend less time playing and exercising with their owners, as well as those housed in kennels, have been shown to be generally more aggressive (Tami, Barone, & Diverio, 2008). Canines

[1] Throughout this work the term "owner" will be used when referring to the human member of a dyad, responsible for the wellbeing of the dog and the functionality of the relationship. Although the terms "tutor"(eg. Rosa et al., 2017) and "caregiver"(eg. Siniscalchi et al., 2013) have both been suggested as more appropriate, no consensus exists within the literature regarding their use (Dotson & Hyatt, 2008).

acquired in pet shops also have demonstrated a wider variety of behaviour problems (McMillan, 2017; McMillan, Serpell, Duffy, Masaoud, & Dohoo, 2013; Pirrone, Pierantoni, Pastorino, & Albertini, 2016), suggesting that spur-of-the-moment decisions to acquire a dog can lead to dyadic dysfunction (Ghirlanda, Acerbi, Herzog, & Serpell, 2013).

The research focused on specific characteristics of human members of these partnerships has revealed the existence of some common traits. Ragatz, Fremouw, Thomas, and McCoy (2009) have shown that owners of high risk dogs have higher criminal conviction rates, suggesting that some dogs are acquired for the specific purpose of exhibiting certain attitudes that are considered problem behaviour, with aggression being the primary such trait (Jagoe & Serpell, 1996). Human personality within problem dyads (as measured by various psychological tests) influences the behaviour of dogs. Owners scoring higher on the psychoticism scale (Wells & Hepper, 2012) and scoring lower on the dimensions of agreeableness, emotional stability and extraversion (Dodman et al., 2018; Podberscek & Serpell, 1997) tend to partner with dogs that show aggression. Although it was suggested that owners' genders (Hsu & Sun, 2010; Kotrschal, Schöberl, Bauer, Thibeaut, & Wedl, 2009) and their socio-economic conditions (Calvo et al., 2016; Col et al., 2016; McCormack, Graham, Christian, Toohey, & Rock, 2016) can influence the appearance of problem dog behaviour, these associations have been contradicted by other studies (Matthias et al., 2015; Tzivian, Frigera, & Kushnir, 2015), leaving the role of these factors still undetermined.

Research indicates that certain traits can lead to dysfunction in human-dog dyads, with the human partner being primarily responsible for the dynamics (Houpt et al., 2007; Mongillo, Adamelli, Pitteri, & Marinelli, 2015). Human partners create the conditions in which dogs display problem behaviours (Bower, 2014; Overall, 2010). Because human behaviours are the hallmarks of dysfunction (Bennett & Rohlf, 2007; Coe et al., 2014), any attempt to prevent or correct dyadic function must first act upon owners. For this to take place effectively, the partnership dysfunction must be identified before the consequences of the dysfunction are felt (Christensen, Scarlett, Campagna, & Houpt, 2007; Houpt et al., 2007; Quirk, 2012). Unfortunately, however, existing studies have examined these pairings after the fact. Although Rohlf et al. (2012) suggested that dysfunction could be identified by searching human-dog dyads for characteristics opposite to those found in functional dyads, little scholarship has devoted to pre-emptively identifying these pairing.

Preventative methods implemented on a governmental or clinical level would need to have some way of pre-emptively identifying problem dyads and targeting them specifically (Flint, Minot, Perry, & Stafford, 2010; Rohlf et al., 2012; Van Herwijnen et al., 2018; Weng, Kass,

Hart, & Chomel, 2006). Kennels, for example, would greatly benefit from a tool allowing for the prediction of whether a given human-dog pairing would function well, thus reducing the numbers of dogs returned to shelters (Wells & Hepper, 2000). It is important to note that any attempt to pre-emptively identify dysfunctional dyads would rely on assistance and cooperation from human members of the partnerships.

Bennett and Rohlf (2007) suggest that human members of dysfunctional dyads may not cooperate with such in-depth research (Bennett & Rohlf, 2007). They may lack the motivation to participate, they may fear social stigma if they do cooperate, or they may be aware of their irresponsible handling of dog ownership and fear legal consequences (Assembleia da República, 2017). As such, any proactive identification of these partnerships must be done in a non-threatening way and must be accomplished quickly. It should be feasible to identify the demographic factors, the human/dog personality traits, and the husbandry practices that characterize dysfunctional dyads.

This project represents the first such attempt at pre-emptive classification and identification. Proving the feasibility of such an approach has profound implications for the prevention and correction of dysfunctional dyads are profound. The application of specific government programs, the early identification of dysfunction at the clinical level, and proper human-dog pairing in kennel and shelters could minimize the effects that dysfunctional dyads have on the dyad partners themselves and on society at large, improving significantly on the current legislation that focuses on specific breeds.

Chapter II: Literature Review

What do we know about the Human-dog dyad?

2.1 The human-dog dyad

The relationship between humans and canines is long and complex. It has been postulated that ancient wolves and dogs began diverging in Eastern Asia 33,000 years ago, migrating to Europe some 15,000 years ago (Wang et al., 2015). This divergence happened primarily as a result of the interaction between ancient canines and humans when both species occupied the same geographical space, possibly seeking refuge together during the last ice age (Clutton-Brock, 2016). The domestication of the ancient wolf into the modern-day dog is believed to have happened in three distinct stages. First came interactions between the canine ancestors and man, in the form of scavengers around human encampments (Archer, 1997). In the second stage, these animals went through a process of self-domestication (Hare, Wobber, & Wrangham, 2012), during which individuals with closer connections to humans increased their chances of survival (Buttner, 2016). The third and final stage occurred with the introduction of intense phenotypical selection by humans who bred those canines that were most suited to domestication (Jensen, 2014). Dogs then began to be valued as members of human society, with evidence of formal canine burials dating from as many as 14,000 years ago (Morey, 2006). Since then, human-dog dyads have flourished, with dogs now found in partnerships with humans worldwide.

At the end of the last century, the importance of human interactions with other species was elevated to its own field of study, spearheaded by the establishment of two scientific journals: Anthrozoös (1987) and Society & Animals (1993), called Anthrozoology (Harold Herzog, 2016). Within this academic field the study of the human-dog dyad has begun to receive ever more attention (Duranton & Gaunet, 2015; Gácsi, Maros, Sernkvist, Faragó, & Miklósi, 2013; Schilder, Vinke, & van der Borg, 2014), in part due to the realization that it mimics closely the parent-child bond (Archer, 1997). Studies have shown that the same processes may modulate the two relationships, both physiologically and biochemically.

On a psychological level, human-dog dyads show behavioural characteristics similar to those of parent-child relationships, particularly attachment and caregiving (Gácsi et al., 2013; Maclean & Hare, 2015; Siniscalchi et al., 2013; Van Herwijnen et al., 2018). The rationale behind attachment behaviour is set out within the context of attachment theory as the notions of a secure base, safe haven and proximity maintenance (Bowlby, 1969) from which an infant or child can learn and grow while safely exploring the environment. With attachment behaviour, individuals increase their own survival by depending on others. In contrast, caregiving behaviour is believed to be evolutionarily centred on the activation of neural

pathways known as the "care circuits," which involve the release of a series of biochemical mediators – oxytocin among them – that make the caregiving itself rewarding to the caregiver (Panksepp, Nelson, & Siviy, 1994). Within a human-dog dyad, the dog is the attached party and the human as caregiver is bonded to the canine (Rehn & Keeling, 2016).

The attachment theory model of the human-dog dyad aligns with the recent biochemical findings in anthrozoology. It has been postulated that the mediators oxytocin (Kis et al., 2014; Nagasawa et al., 2015) and cortisol (Rehn, Handlin, Uvnäs-Moberg, & Keeling, 2014; Roth, Faresjö, Theodorsson, & Jensen, 2016) have important roles within the human-dog dyad. Oxytocin is identified as the bonding hormone in mother-infant relationships (Sue Carter, 1998). Its levels mutually increase within human-dog partnerships during contact events (Handlin, Nilsson, Ejdebäck, Hydbring-Sandberg, & Uvnäs-Moberg, 2012). This effect is reinforced by the fact that the increase is more pronounced when the human is interacting with their own dog than with another individual's dog (Odendaal, 2000). There is also a notable decrease in the plasma cortisol levels of dogs and humans when they interact (Handlin et al., 2012). This effect is more evident in dogs that are considered securely "attached" to their human (Schöberl et al., 2016).

As a consequence of these findings, Diesel et al. (2010) postulated that dysfunctional dyads are a direct result of misunderstandings between a dog's attachment style and an owner's caregiving strategy. When placed in a stress-inducing environment or situation, dogs display behaviours in line with their attachment styles and which owners must correctly interpret and respond to, providing caregiving behaviours that will help dogs cope. If an owner does not respond to the attachment behaviours or if an owner misunderstands the cues, the dog will try other behaviours in the hopes of receiving the care it requires (Rehn & Keeling, 2016). This kind of failed attempt at communication can lead to the kind of problematic behaviours that are typical of dysfunctional human-dog dyads ((Rehn & Keeling, 2016)Figure 1).

The choices owners make when responding to their dogs' solicitations – their caregiving responses (Rehn & Keeling, 2016) – can be influenced by many factors, including demographic characteristics (Pirrone, Pierantoni, Mazzola, Vigo, & Albertini, 2015), personality (Dodman et al., 2018), and even previous ownership experiences (Harvey, Craigon, Blythe, England, & Asher, 2016). In the same way, dogs' attachment styles can be influenced by many of the same factors (Hoffman, Chen, Serpell, & Jacobson, 2008).

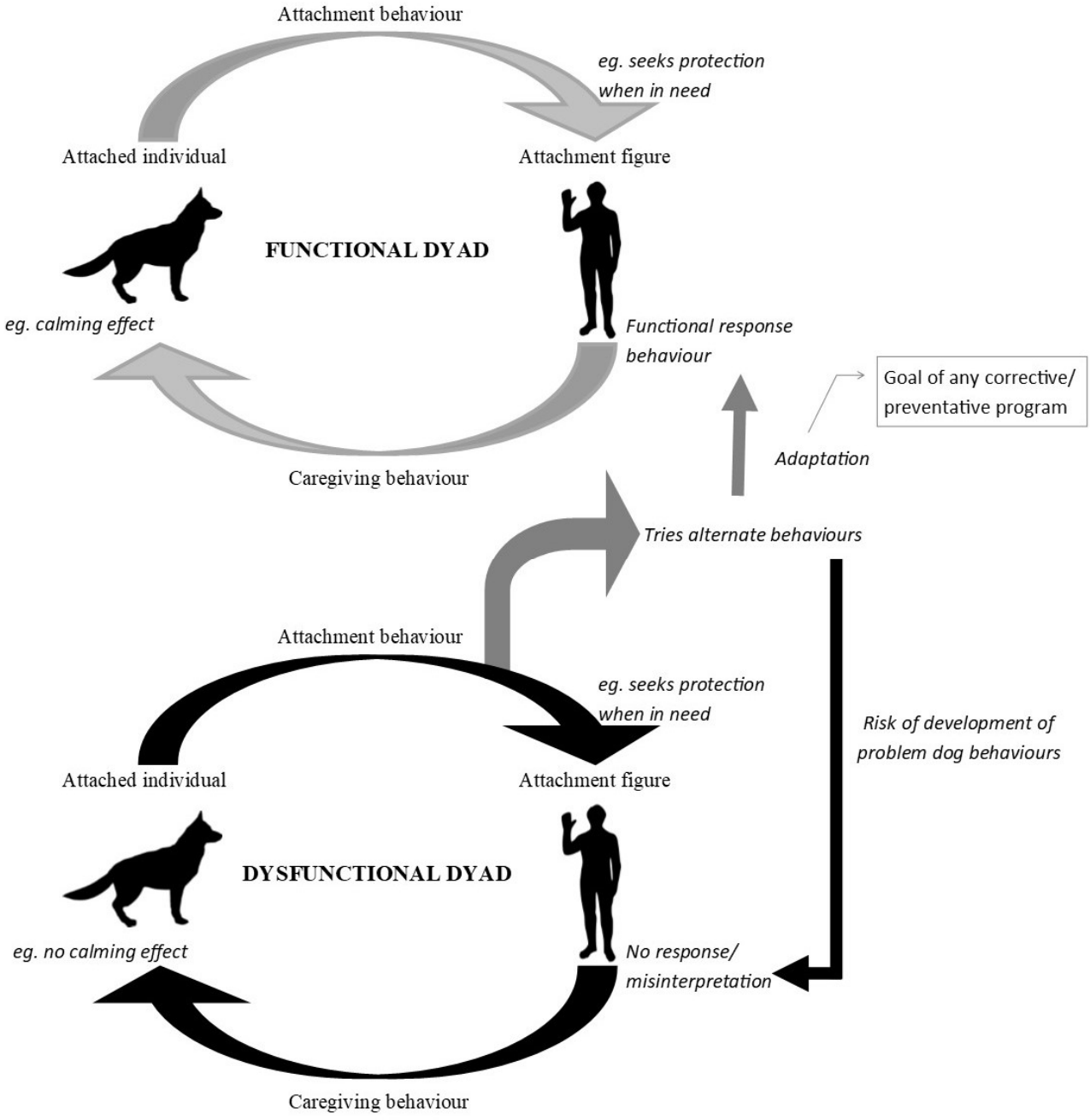

Figure 1: A schematic representation of human-canine attachment theory. When a dyad is functional the solicitations of the attached figure (the dog) are correctly responded to by the attachment figure (the owner). When a dyad is dysfunctional the dogs' solicitation is either misinterpreted or not responded too. The result is the display of alternative behaviours by the dog, trying to obtain the correct caregiving behaviour. It is here that the risk of the development of problem behaviour is high. (Rehn, T. and Keeling, L. (2016). Measuring dog-owner relationships: Crossing boundaries between animal behaviour and human psychology. App. Ani. Behav. Sci. 182: 1-9. Adapted with permission.)

2.2 Consequence of Dysfunctional Human-dog dyads

The natural evolution of the human-dog dyad has resulted in an increased proximity between the two partners (Jensen, 2014). It is now common to find a least one dog in most households, particularly in the western world (Serpell, 2003), with many of them housed indoors (Chung, Park, Kwon, & Yeon, 2016; González Ramírez & Landero Hernández, 2014; Hoffman et al., 2008). While it is this closeness that has maximized the benefits for both partners, it also exacerbates the consequences of dysfunction and makes them evident. The consequences of dysfunction can be far reaching, with studies showing that they can range from close contact events, such as dog bites (Le Brech, Amat, Camps, Temple, & Manteca, 2016), to public health risks (Fielding et al., 2012; Kisiel et al., 2016; Lopes Antunes et al., 2015; Mustiana et al., 2015; Pulczer et al., 2013; Rijks, Cito, Cunningham, Rantsios, & Giovannini, 2016; Rinzin, Tenzin, & Robertson, 2016; Voslárová & Passantino Annamaria, 2012) and to the financial costs associated with the destruction of private assets (Mongillo et al., 2015).

A hallmark of dysfunctional human-dog dyads is the development of undesirable and problematic behaviour in dogs (King et al., 2012), spanning a broad range of severity and outcome. Some undesirable behaviours may be considered a mere nuance, with examples being excessive barking (Boyd et al., 2004), chewing (Stephen & Ledger, 2007) or high energy (Marston, Bennett, & Coleman, 2010; Shabelansky & Dowling-Guyer, 2016). Other behaviours can have more serious implications, with examples of that category of problem behaviour being inappropriate elimination (Martínez, Santamarina Pernas, Diéguez Casalta, Suárez Rey, & De la Cruz Palomino, 2011), anxiety problems (Reisner, Houpt, & Shofer, 2005) and aggression (Flint, Coe, Serpell, Pearl, & Niel, 2017; Matthias et al., 2015). Dog bites are the most frequently studied problem behaviour and bits have the potential to result in significant collateral damage. (Sacks, Sinclair, Gilchrist, Golab, & Lockwood, 2000).

Research into the reasons that dogs bite humans has been ongoing for some time (T. de Keuster & Butcher, 2008; T. de Keuster & Overall, 2011; Sacks, Kresnow, & Houston, 1996; Weiss, Friedman, & Coben, 1998), with studies examining links between that behaviour and factors including a dog's breed (Gershman, Sacks, & Wright, 1994) and its environment (Hsu & Sun, 2010; Rezac, Rezac, & Slama, 2015). Although few dog bites have fatal consequences for humans (Horswell & Chahine, 2011; King et al., 2012), many bites do require in-hospital treatment and can leave permanent physical sequelae (Esposito, Picciolli, Semino, & Principi, 2013). Since children are the most frequent victims of dog bites (Horswell & Chahine, 2011; Lakestani, Donaldson, Verga, & Waran, 2011; Shen et al., 2013; Weiss et al., 1998), and

since these take place most often inside an owner's own home and with dogs that are familiar to him or her (Overall & Love, 2011), this consequence of dyadic dysfunction has a particular resonance for society.

Other consequences of this dysfunction are nuisance behaviours such as separation anxiety disorder, excessive vocalization, destructive behaviour, and inappropriate elimination. These behaviours diminish owners' satisfaction with their dogs (Hoffman et al., 2008; J. A. Serpell, 1996) and frequently lead to relinquishment (Diesel et al., 2010; Fatjó et al., 2015; Stephen & Ledger, 2007), to abandonment (Houpt et al., 2007), or even euthanasia of the animals (Siracusa, Provoost, & Reisner, 2017; Yeates & Main, 2011). Canine abandonment and relinquishment is a serious problem worldwide (Houpt et al., 2007), leading to the overpopulation of kennels in many countries (Avanzino, 1991; Cafazzo et al., 2014; Fielding, 2010) causing expenses and difficulties associated with the maintenance of feral dog populations in others (Fielding, 2010; Mustiana et al., 2015).

The existence of canines freely roaming public spaces is another consequence of dysfunctional dyads. Whether deliberately abandoned or allowed to "be free" and roam (Dalla Villa et al., 2010), these dogs represent a clear and present danger to public health and safety. In 2017, the National Authority for Road Safety in Portugal registered 118 vehicular accidents with 118 human injuries (Autoridade Nacional de Segurança Rodoviária, 2018), while in 2013 the Portuguese National Republican Guard (GNR) registered 1242 vehicular accidents involving companion animals (personal communication, GNR Road Safety and Transit Division). Roaming canines can also be a source for the spread of zoonotic diseases through contact with bodily fluids and through dog bites (Cito et al., 2016; Rijks et al., 2016).

2.3 Predisposing Factors Associated with Dysfunction

The theory that dysfunction within human-dog dyads is a direct result of a mismatch between attachment and caregiving behaviour suggests the existence of predisposing factors (Rehn & Keeling, 2016). If dysfunction is marked by undesirable behaviour in dogs, then consistent factors should be present when a canine displays such behaviours. Recent studies have shown that similarities can be found among the dogs that share similar types of behavioural displays. These similarities are not limited to canine characteristics, but also include owner behaviours as well (Dodman et al., 2018).

2.3.1 Dog Specific Characteristics

2.3.1.1 Canine Demographics

As expected, most existing studies investigated demographic characteristics common in dogs that show signs of aggression. Displays of aggression in dogs are varied and have different origins (Bollen & Horowitz, 2008). A dog may have an aggressive reaction based on fear, anxiety, or competition (Fatjo, Amat, Mariotti, de la Torre, & Manteca, 2007) or can show aggression as a result of protective instincts or training (Messam, Kass, Chomel, & Hart, 2008). Given this variety, aggression in dogs cannot be summarily lumped together with the hope of identifying owner and dog characteristics that are common to all cases.

When it comes to competition aggression (Bollen & Horowitz, 2008), some studies have suggested that specific breeds are more aggressive and therefore have a greater tendency to bite (Cattell, Bolz, & Korth, 1973; Rugbjerg, Proschowsky, Ersbøll, & Lund, 2003). This has led to the stigmatization of certain dog breeds such as Pit Bulls, Rottweilers and German Shepherd Dogs (Rosado et al., 2007; Sacks et al., 2000). However, this stigmatization has also been highly contested (Cornelissen & Hopster, 2010; Martínez et al., 2011; Overall, 2010; Overall & Love, 2011; Sacks et al., 2000). Since it seems clear that any dog will bite under the right circumstances, breed should not be considered a predisposing factor in competition aggression behavioural displays (Udell & Wynne, 2008). The exception to this would be cases of aggression with a confirmed genetic origin such as in the case of single- colour coated English Cocker Spaniels (Reisner et al., 2005) and a specific subfamily of Golden Retrievers (van den Berg, Schilder, de Vries, & Leeg, 2006).

Aside from breed, a few canine characteristics have been identified as being more common in dogs that show competition aggression. It has long been held that intact males show more competition aggression then dogs that have been gonadectomized (Neilson, Eckstein, & Hart, 1997), but even this categorization has recently been called into question (Farhoody et al., 2018). Dogs acquired from commercial breeders have been shown to be more prone to competition aggression (McMillan et al., 2013; Pirrone et al., 2016), although this association has been attributed to lack of appropriate socialization within this type of population (McMillan, 2017; Tiira & Lohi, 2015). Several studies have shown that small breeds demonstrate more signs of competition aggression (Guy et al., 2001b, 2001a; Pérez-Guisado & Muñoz-Serrano, 2009), although it has been suggested that this is due to the fact that large breeds tend to have formal obedience training, are corrected more, and are spoiled less than smaller breeds (Pérez-Guisado & Muñoz-Serrano, 2009), potentially skewing these findings.

It has been shown that dogs acquired from commercial breeds are disproportionally represented among dogs showing fear and anxiety (McMillan, 2017; Tiira & Lohi, 2015) and that dogs with adoption or shelter backgrounds are more likely to show anxiety behaviours (Kobelt, Hemsworth, Barnett, & Coleman, 2003; Martínez et al., 2011) that could lead, in turn, to aggressive behaviours (O'Sullivan, Jones, O'Sullivan, & Hanlon, 2008). Toy breeds and female dogs have been shown to be more fearful (Temesi, Turcsán, & Miklósi, 2014), particularly in comparison with male dogs and with dogs that are less than 2 years of age (Döring, Roscher, Scheipl, Küchenhoff, & Erhard, 2009). Since aggression can be motivated by fear, these are important findings. Not surprisingly, younger dogs show more problem behaviours related to excess energy than mature canines do (Shabelansky & Dowling-Guyer, 2016).

2.3.1.2 Canine Personality

Some effort has been made to understand how dogs' personalities can influence their behavioural displays. While the foundations of individual canine personality are complex (Temesi et al., 2014) and can be impacted by factors including genotypic determination and upbringing (Fratkin, Sinn, Patall, & Gosling, 2013), dogs do have defined and identifiable personality traits. A full discussion of the foundations of canine personality can be found elsewhere (Jones & Gosling, 2005), but for the purpose of this thesis, personality is defined as those traits or characteristics that are unique, relatively stable, and influence a spectrum of areas from behaviour to cognition (Jones, 2007; Jones & Gosling, 2005).

The identification of a dog's personality traits can be accomplished through the application of a variety of methods, including test batteries and direct observation by trained professionals (Fratkin et al., 2015; Jones & Gosling, 2005). However the use of these tests is somewhat controversial (Rayment et al., 2015), as results may depend on the experimental conditions (Christensen et al., 2007; Rayment et al., 2015) and can require specific settings (Klausz, Kis, Persa, Miklósi, & Gácsi, 2014). This makes them difficult to conduct on large populations and makes results difficult to compare (Jones & Gosling, 2005).

Without the ability to compare results among studies, it is difficult to identify personality traits that can be linked to specific problem behaviours. For this type of evaluation to be made, a common tool must be found. The Canine Behaviour Assessment and Research Questionnaire (C-BARQ), a 100-item, 14-factor instrument originally developed in the United States of America (Hsu & Serpell, 2003; Duffy and Serpell, 2012), uses an owner's knowledge (Kobelt et al., 2003) to evaluate an individual dog's personality traits (Svartberg, 2005). The psychometric properties of the C-BARQ have been studied in a variety of

countries and the instrument has been validated for use multiple language, including Mandarin (Hsu & Sun, 2010) Japanese (Nagasawa et al., 2011), Dutch (van den Berg et al., 2006), Swedish (Svartberg, 2005), Italian (Marshall-Pescini, Valsecchi, Petak, Accorsi, & Previde, 2008), Farsi (Tamimi et al., 2015), Latin American Spanish (González-Ramírez, Quezada-Berumen, & Landero-Hernández, 2017) and Brazilian Portuguese (Rosa, Jarrel, Soares, & Paixão, 2017). The questionnaire classifies dogs according to various personality traits; stranger-directed aggression (SA), dog-directed aggression (DDA), dog-directed fear (DDF), owner-directed aggression (ODA), excitability (EX), stranger-directed fear (SDF), separation-related behaviour (SRB), non-social fear (NSF), dog rivalry (DR), chasing (CH), trainability (TR), attachment/attention-seeking behaviour (AAS), energy level (EL), and touch sensitivity (TS). It is the ideal tool to uncover the personality traits that are shared among dogs displaying problem behaviours.

C-BARQ subscales (personality traits) can be associated with the display of problem behaviours seen in dysfunctional dyads as follows: competition aggression is associated with SA, DDA and ODA subscales (Eken Asp, Fikse, Nilsson, & Strandberg, 2015; van den Berg et al., 2006), aggression motivated by fear is associated with SDF, DDF, NSF and TS subscales (Rayment, Peters, Marston, & Groef, 2016), and nuance behaviour is associated with EX, SRB, AAS and EL subscales (Harvey et al., 2016). It follows that dogs with high scores on these subscales would have a greater propensity for falling back on inappropriate behaviours as alternate pathways for securing appropriate care from attachment figures (Figure 1).

2.3.2 Owner Specific Characteristics

2.3.2.1 Owner Characteristics

Research has identified characteristics of those owners whose dogs show problem behaviours. For example, Kubinyi, Turcsán, & Miklósi (2009) found that less educated owners are in dyads with less social dogs, that men tend to have more excitable dogs, and that households with more people tend to have dogs considered to be less trainable but calmer. Other studies have shown that men are more likely to be in dyadic relationships with dogs that are considered aggressive (Pirrone et al., 2015) and disobedient (Bennett & Rohlf, 2007).

2.3.2.2 Husbandry Choices

Husbandry choices made by the human member of a dyad can be a significant factor in the presence of problem canine behaviour. Research suggests more problematic behaviour is shown by dogs left alone for long periods of time (Col et al., 2016), by ones with infrequent interaction, and by those housed outside (Chung et al., 2016; Kobelt et al., 2003), suggesting that ignoring a dog's caregiving solicitations may be to blame for problematic behaviour. Tami et al. (2014) found that dogs housed in kennels showed more aggression than those housed in homes and that canines that were played with frequently were less fearful than those that were only taken for short walks. Similarly, dogs housed in apartments tended to show more anxiety type behaviours (Takeuchi, Ogata, Houpt, & Scarlett, 2001). Resorting to positive punishment or negative reinforcement while training a dog has been linked to a wide variety of undesirable behaviours (Arhant, Bubna-Littitz, Bartels, Futschik, & Troxler, 2010; Casey et al., 2014; Nicola Jane Rooney & Cowan, 2011), although participation in obedience classes tends to minimize those behaviours (Casey et al., 2014; Kutsumi, Nagasawa, Ohta, & Ohtani, 2013).

2.3.2.3 Owner Personality

In the same way that canine personality traits can predispose dysfunction, owner personality dimensions also can (Payne et al., 2015). Assigning personality characteristic to humans is challenging, however. Most attempts to evaluate human personality quantitatively are based on two different models of the human psyche. The first is the Five Factor Model (FFM) of personality, an empirical framework (Poropat, 2011) that classifies personality into five dimensions: extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience (McCrae & John, 1992). The second model for evaluating human psyches is the Eysenck Personality Questionnaire - Revised (EPQ-R), a theoretical framework (Poropat, 2011) that classifies personality according to three dimensions. The EPQ-R identifies personality dimensions of: (a) neuroticism, or the response of the reticulo-limbic system to emotional stimuli, (b) extraversion, or the measure of reticulo-cortical arousal (Poropat, 2011), and (c) psychoticism and a lie/social desirability scale (Jackson & Francis, 1998).

Some authors ask owners open-ended questions and use responses to classify owner personality along broad linguistic lines (Flint et al., 2010), while others use accepted psychological instruments. These instruments the FFM (Cattell & Mead, 2008) such as the Cattell 16 Personality Factor Questionnaire (Podberscek & Serpell, 1997), based on the FFM like the Neuroticism – Extraversion – Openness Personality Inventory, or the NEO-PI

(Cimarelli, Turcsán, Bánlaki, Range, & Virányi, 2016), for example. They can also be based on the theoretical models, with the Eysenck Personality Questionnaire – Revised (EPR-Q) being an example (Wells & Hepper, 2012).

Regardless of the way owner personalities are evaluated, it has been shown that they clearly influence canine behaviour within human-dog dyads. Individuals that are more independent and confident pair with dogs less likely to show problem behaviour (Dodman, Patronek, Dodman, Zelin, & Cottam, 2004). It has been suggested that more extroverted owners have more extroverted dogs (Turcsán, Kubinyi, Virányi, & Range, 2011) and less aggressive ones (Kuroshima et al., 2016). Houmandy et al. (2016) concluded that the dogs of owners with higher extroversion, conscientiousness, and agreeableness scores on the NEO-PI-R had more success when performing certain tasks.

Studies have shown that higher FFM-based openness scores in owners are related to higher trainability in dogs (Kuroshima et al., 2016). Owners classified as tense, emotionally unstable, and undisciplined by the Cattell 16 tend to pair with more aggressive dogs (Podberscek & Serpell, 1997), while those with low FFM-based conscience and extraversion scores paired with dogs that had high SDF scores on the C-BARQ (Dodman et al., 2018). High neuroticism scores on both personality models were shown to be a common personality dimension in owners whose dogs display a variety of undesired behaviours such as aggression (Dodman et al., 2018; Wells & Hepper, 2012), are less trainable (Kis, Turcsán, Miklósi, & Gácsi, 2012), have difficulty improving on tasks (Houmady et al., 2016), and are more susceptible to separation anxiety disorders (Konok et al., 2015). Owners who scored higher on the EPQ-R psychotic scale tended to partner with dogs of breeds considered “aggressive” (Wells & Hepper, 2012). Owners with criminal histories or who admit to criminal wrong doing were also more likely to partner with such breeds (Ragatz et al., 2009).

Regardless of the model used to identify owner personality dimensions, the neuroticism scale, in particular, appeared to impact problematic dog behaviour within a dyad. According to attachment models of human-dog relationships (Payne et al., 2015), owner personality may be a significant predisposing factor in owner response to canine solicitation, shaping responses in ways that elicit alternate undesirable behaviours from their dogs.

2.4 Preventing or Correcting Dysfunctional Dyads

Growing concern regarding the consequences of dysfunctional dyads has prompted efforts to prevent or correct such pairings. These efforts range from legislative endeavours (Assembleia da República, 2012; Cassia, Garcia, & Calderón, 2012; Dias Costa et al., 2017; Gazzano, Zilocchi, Massoni, & Mariti, 2013; Miller & Howell, 2008; Rosado et al., 2007; Voslárová & Passantino Annamaria, 2012) to owner educational programs (Schwebel, Morrongiello, Davis, Stewart, & Bell, 2012; Shen et al., 2013; Spiegel, 2000). Efforts use resources from web-based platforms (Schwebel, McClure, & Severson, 2015) to demands for intervention from veterinary professionals (Christiansen & Forkman, 2007; T. de Keuster & Overall, 2011; Herron, Lord, & Husseini, 2014; Houpt et al., 2007; Roshier & McBride, 2013; Voith, 2009; Wickens, 2007).

2.4.1 Legislation

Legislative undertakings to curb the creation of dysfunctional dyads have largely focused on controlling access to specific breeds considered to be "aggressive" (Assembleia da República, 2012; Cornelissen & Hopster, 2010; Ledger et al., 2005; Rosado et al., 2007; Schalke et al., 2008). In general, these laws concentrate on eliminating dog-on-human aggression but do not consider other problematic behaviours (Overall, 2010). Such efforts ignore contributions of the human member of dysfunctional dyads, focusing on classifying particular dogs as "aggressive" rather than looking for the root of the aggression.

In order to be able to claim breed-specific risk, one would need to know the exact number of each dog breed within the study population, data that is not available with any degree of certainty (Cornelissen & Hopster, 2010; Overall & Love, 2011; Sacks et al., 2000). There is also the problem as to how breeds are identified. Frequently dogs are identified as Pit Bulls or German Shepherd Dog, when the animals in question are actually mongrel or mixed breeds with isolated or passing similarities to the actual cited breeds (Cornelissen & Hopster, 2010; Overall, 2010; Overall & Love, 2011; Ozanne-Smith, Ashby, & Stathakis, 2001). There is also a bias that exists in terms of the reporting of dog bites, since those caused by small breeds are less likely to be reported and studied than those caused by large breeds (Arhant et al., 2010; Overall & Love, 2011; Rezac et al., 2015; Temesi et al., 2014), which serves to remove small breeds from most suggestions of breed predisposition. Lastly, it has been well established that the development of dog aggression is primarily a question of environment

(Blackwell, Twells, Seawright, & Casey, 2008; Ozanne-Smith et al., 2001; Pirrone et al., 2016). It has been shown that a dogs' reactions to specific situations result more from the environments in which they were reared than their breeds (Pérez-Guisado & Muñoz-Serrano, 2009). Any dog, regardless of breed and given the right context, can become aggressive and bite. This is borne out by the fact that most studies done on the success of dog breed legislation have shown that such legislation does not decrease the incidences of dog bites (Cornelissen & Hopster, 2010; Ledger et al., 2005; Mora, Fonseca, Navarro, Castaño, & Lucena, 2018; Rosado et al., 2007; Schalke et al., 2008; Súilleabháin, 2015).

2.3.2 Education

Authors studying dyadic dysfunction have stressed the importance of educational programs to combat the problem (Coe et al., 2014; T. de Keuster & Overall, 2011; Schurer et al., 2015). Since children are often the victims of dog-on-human aggression, the use of educational strategies specifically directed at children has been proposed as one method for reducing such occurrences (Sacks et al., 1996). Programs such as The Blue Dog (Schwebel et al., 2012) and BARK (Spiegel, 2000) use interactive techniques and didactic approaches to teach young children how to interact with dogs. These programs are often implemented within school settings (Shen et al., 2013; Weng et al., 2006), based on expectations that children will take their knowledge home to help educate their parents.

Efforts are also being made to educate the public on responsible dog care in order to mitigate the effects of dysfunctional human-dog dyads. In Brazil (Dias Costa et al., 2017), in Taiwan (Weng et al., 2006), in China (Shen et al., 2013) and in the United States of America (Avanzino, 1991), specific public educational programs have been designed to help people understand how to care for their dogs and how to read canine behaviour. Such programs have been very effective at conveying the importance of neutering dogs (Avanzino, 1991; Dias Costa et al., 2017), which suggests that some level of success should be expected from large-scale, owner-education efforts implemented in other areas of canine care and human-dog relationships (Cimarelli et al., 2016).

2.3.3 Expectations of the Veterinary Professional

There are general expectations that veterinary professionals, particularly at the clinical level, have a responsibility to help minimize the effect of dyadic dysfunction on society (Coe et al., 2014). The public expects veterinarians in clinical settings to help prevent or correct

problematic human-dog dyads through owner education (Voith, 2009). The rationale behind this sentiment seems to be based on the close contact that veterinarians have with owners and their dogs, ideally situating them for identifying dysfunction and formulating plans to combat it (Roshier & McBride, 2013).

Although it is true that veterinarians in clinical setting are in privileged positions for identifying problem partnerships with the intent of helping to prevent or correct dyadic dysfunction, accomplishing such goals is easier said than done. Scholars acknowledge the existing deficit within veterinary curricula when it comes to teaching animal behaviour and ethology (Christiansen & Forkman, 2007; Wickens, 2007). In addition, the development of problem dog behaviour is a complex issue involving both canine and human characteristics, some of which (husbandry conditions, for example) might be easy for veterinarians to identify, but others of which (human personality determination, for example) would be well outside the scope of a veterinary consult. To date, there is no formula for pre-emptive identification of such dyads within a clinical context.

Chapter III: Thesis Objectives

The existence of dysfunction human-dog dyads presents a danger to each member of the partnership and to society. To minimize the negative effects of this partnership, it must be clearly understood. Only recently, has this issue been recognized and begun to be studied. To the authors knowledge, pre-emptive identification of such dyads has never been attempted, nor have problem dyads that do not give rise to clear social consequences been studied. As such, this project had several main objectives:

- To evaluate the possibility of identifying potential problem dyads through the study of dog health care histories provided by owners (Chapter IV)

- Validate a Portuguese European Version of the C-BARQ (Chapter V)

- Identify specific differences within potentially dysfunctional dyads in terms of husbandry choices, dog and human personalities (using translated and validated questionnaires C-BARQ and EPQ-R) (Chapter VI)

- Evaluate the possibility of identifying characteristics within a given population that would allow for the pre-emptive classification of any given human-dog dyad as dysfunctional (Chapter VI)

Chapter IV: Identification of Dysfunctional human-dog dyads through Dog Ownership Histories

Identification of Dysfunctional human-dog dyads through Dog Ownership Histories

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Published in: Open Veterinary Journal, 2019, 9(2): 140-146

4.1 Abstract

The human-dog relationship goes back at least 16,000 years, with the human as the responsible member in the dyad, insuring that it is beneficial to each partner and to society. However dysfunctional dyads are normally only identified after consequences have been felt (e.g. dog-human aggression) which limits the action that can be taken to prevent such occurrences. To evaluate whether these dysfunctional dyads could be preemptively identified, a questionnaire was administered, analyzing the owners' dog health care histories. Multiple Correspondence Analysis (n=1385) was conducted identifying three clusters accounting for 37.1% of the total variance, while four moderate positive correlations where found: "unspecified trauma" with "vehicular trauma" ($r = 0.303$, $p < 0.001$), "bitten" with "bit other animal" ($r = 0.345$, $p < 0.001$), "bit a person" with "bit other animal" ($r = 0.369$, $p < 0.001$) and "chronic illness" with "hospitalized" ($r = 0.297$, $p < 0.001$). These results suggest that a simple questionnaire can identify potential characteristics of functional and dysfunctional dyads. In functional dyads, humans tend to be responsible for their dogs' well-being, while dysfunctional dyads show the opposite characteristics, reporting experience with trauma and dog aggression.

Keywords: dysfunctional dyads; human-dog bond; MCA; questionnaire; ownership characteristics

4.2 Introduction

The human-dog relationship is believed to be at least 16,000 years old and evolved due to its mutually beneficial nature (Wang et al., 2015). In a functional human-dog dyad the human partner benefits in a variety of ways, from using dogs capacity to work (Sanders, 2000 Greatbatch, Gosling, & Allen, 2015, Christensen, 2000) through to its value as a companion animal (Davis, Nattrass, O'Brien, Patronek, & MacCollin, 2004; Nimer, Lundahl, Nimer, & Lundahl, 2016 Wood, Giles-Corti, & Bulsara, 2005 Kuban, Królikowski, & Nowicki, 2016). The human, in turn, provides for the dogs basic needs (food, shelter, veterinary care, etc.), and is considered the responsible member of the dyad (Houpt et al., 2007). As such the human must insure that the relationship is beneficial not only to its´ two members, but to society at large (Wood, Giles-Corti, & Bulsara, 2005), because when these human-dog dyads become dysfunctional, they can present a risk to each member as well as to the general public (Lambert et al., 2015; Mongillo et al., 2015). This aspect of the human-dog relationship has received much attention in recent years (O'Haire, 2010; Rehn & Keeling, 2016) in an attempt to correct or at least minimize the effect of these problem dyads.

One of the hallmarks of dysfunctional human-dog dyads is the tendency for the dog to develop problem behaviors (Bennett & Rohlf, 2007; Meyer & Forkman, 2014), the most obvious of which is dog on human aggression (Fatjo et al., 2007). Often these dogs are also allowed to roam (Mustiana et al., 2015), making them more prone to becoming involved in a vehicular accident, harming other non-human animals and could be responsible for the destruction of property. In all of these cases the final outcome for many dogs is frequently euthanasia (Galvis et al., 2015). Additionally, some dogs are submitted to euthanasia due to factors related to owner convenience (Coe et al., 2014; Overall, 2010). For these reasons, it is very important to identify these problematic dyads. However, these dyads are notoriously difficult to identify and study, since the human partner is unlikely to easily volunteer personal information (Bennett & Rohlf, 2007; Rohlf et al., 2010).

Identification of a dysfunctional dyad has mostly been conducted after a dog has manifested a behavioral problem (Guy et al., 2001a), mainly dog-human aggression (Keuster, Lamoureux, & Kahn, 2006 Le Brech, Amat, Camps, Temple, & Manteca, 2016). Indeed, some authors have shown that criminal conviction rates seem to be higher in owners of high risk dogs (Barnes, Boat, Putnam, Dates, & Mahlman, 2006; Ragatz et al., 2009). The concern with this approach is that it takes place after the fact, making preventive measures impossible to implement. Theoretically it should be possible to identify the quality of the human-dog relationship through the knowledge of owners' dog health care histories, willingness to abide by animal welfare laws and the provision of necessary veterinary care (Rohlf et al., 2010).

The aim of this study was to evaluate whether dysfunctional human-dog dyads could be identified by analyzing each owner´ dog health care histories, to find patterns or groupings that may occur, through the use of a simple yes/no questionnaire administered to dog owners in an urban setting. To our knowledge, this is the first time that ownership history has been studied in this light and it could lead to the early detection of dysfunctional dyads, which, in turn, may help regulatory agencies to detect the presence of dysfunctional human-dog dyads, thereby justifying the implementation of specific preventive programs (Lakestani & Donaldson, 2015).

4.3 Materials and Methods

A simple, one-page questionnaire was developed with three distinct question categories. The first section consisted of a single question regarding the number of dogs the respondent has cared for in his or her life up until the moment they filled out the questionnaire. The second involved a series of yes/no questions regarding their experiences with different medical occurrences in their dogs or dogs' lives. The final and third section asked the district and parish of their residence.

The questionnaire was administered first to a small sample of dog owners at the Teaching Hospital at the Faculty of Veterinary Medicine/ University of Lisbon. This test group was questioned regarding ease of understanding and clarity of the questions, and appropriate changes were made where necessary.

Questionnaires were then distributed throughout the Greater Lisbon Metropolitan Area to various small animal hospitals, clinics and during municipal anti-rabies vaccination programs for a period of 8 months. Dog owners were asked to complete the questionnaire whilst in the waiting room. Care was taken in trying to include at least one clinic, hospital or municipal kennel from each of the 18 different districts within the Greater Lisbon Metropolitan Area so as to obtain as representative a sample as possible. Questionnaires were also made available online using Google Forms™ during the same period, and its existence publicized through the use of the Teaching Hospital at the Faculty of Veterinary Medicine/University of Lisbon website and social media.

Since the data obtained from the questionnaires was nominal in nature, an initial exploratory analysis was conducted using multiple correspondence analysis. The data was further analyzed using 2-way, and where appropriate, 3-way chi-square analyses. IBM SPSS Statistics for Windows, version 22.0 was used for all statistical analysis.

4.4 Results

4.4.1 Descriptive Statistics

A total of 1385 questionnaires were completed at the end of the 8-month period, 733 (52.9%) online and 653 (47.1%) at the various hospitals, clinics, and municipal anti-rabies campaigns which agreed to participate. For the first section of the questionnaire, regarding the number of dogs each individual person has cared for, 1371 valid answers were obtained. All 1385 individuals completed the middle section, and every individual had at least one medical occurrence to report. The last section obtained 1242 valid answers and was excluded from this analysis since more than 10% of the responses obtained were invalid. A summary of the

individual responses to the first section can be found in figure 2 and second section in figure 3.

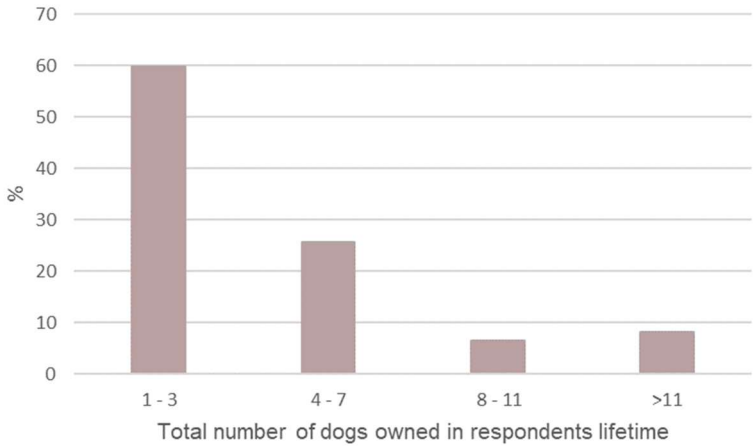

Figure 2: Breakdown of respondent population by number of dogs each individual reports having cared for in their life-time (N=1371).

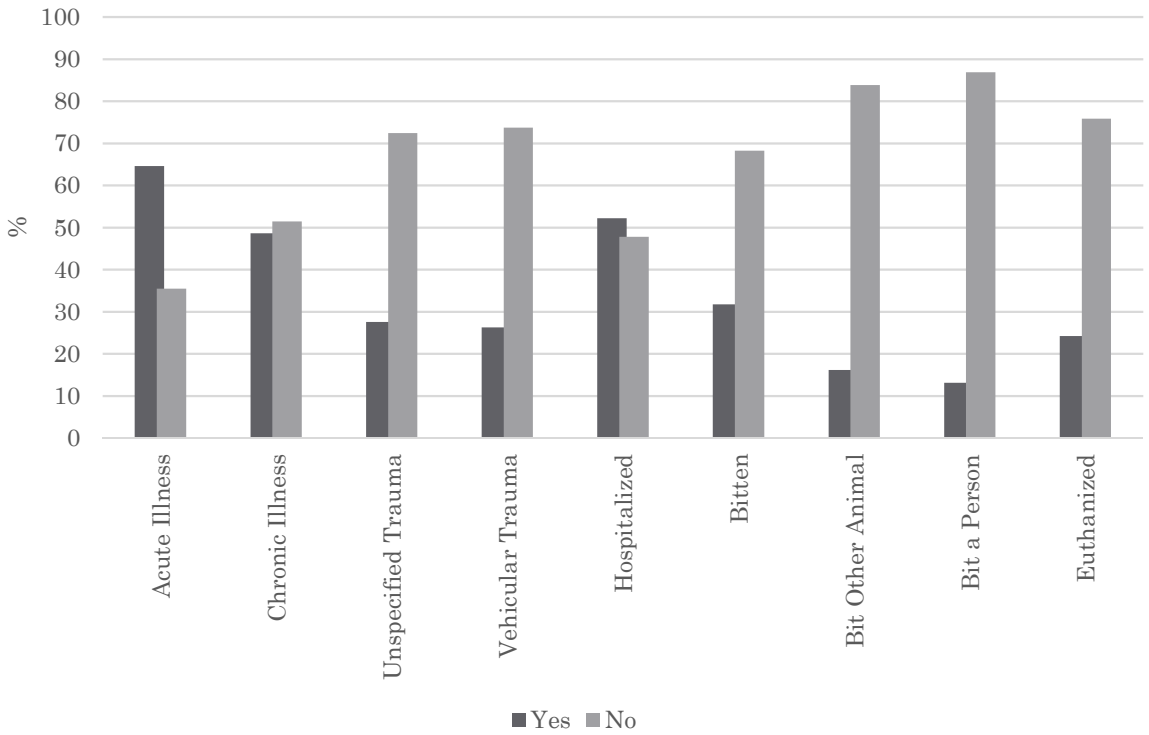

Figure 3: Breakdown of responses to the second section of the questionnaire regarding medical occurrences experienced while caring for one or more dogs (N= 1385).

4.4.2 Multiple Correspondence Analyses (MCA)

For this analysis the two dimensions selected, which together accounted for 37.1% of the variance observed in the samples (table 1) showed three clear clusters (figure 4). In line with other research, exploratory in nature (Costa, Santos, Cunha, Cotter, & Sousa, 2013) , a Cronbach´s alpha lower than 0.7 is accepted due to the heterogeneous nature of the data as well as the reduced number of questions in the questionnaire (Tavakol & Dennick, 2011).

Table 1: MCA Model Summary

		Variance Accounted For	
Dimension	Cronbach's Alpha	Total (Eigenvalue)	Inertia
1	.662	2.473	.247
2	.211	1.234	.123
Total		3.706	.371
Mean	.512[a]	1.853	.185

a. Mean Cronbach's Alpha is based on the mean Eigenvalue.

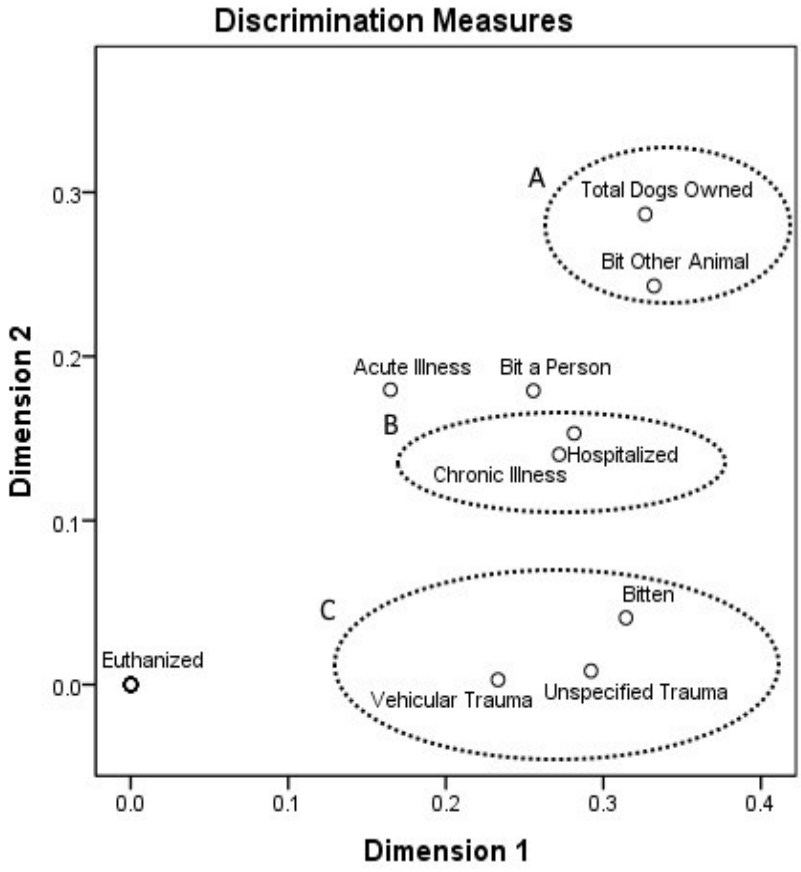

Figure 4: MCA dimensions discrimination measures. Three clear groupings have been circled; A - Total dogs owned and bit other animal, B - Hospitalized and Chronic illness, C - Vehicular trauma, unspecified trauma and bitten.

Although none of the discrimination measures were >0.5, three clusters can be observed to have similar discrimination measures (table 2). The first cluster, furthest from the origin in dimension 2, groups owners reporting the variable “bit another animal” with the total number of dogs the individual reported having cared for in their lifetime. The second cluster, furthest from the origin in dimension 1, groups owners reporting the variables “vehicular trauma”, “unspecified trauma”, and “bitten”. Finally, the last cluster, groups owners reporting both the variables “chronic illness” and “hospitalized”. Further observation of the MCA analysis allows for the observation that the variable “euthanized” has been placed at the origin of both dimensions, suggesting that it represents the variable with the least deviation form independence in the sample.

Table 2: MCA dimensions discrimination measures.

	Dimension		
	1	2	Mean
Total Dogs Owned	.327	.287	.307
Acute Illness	.165	.180	.172
Chronic Illness	.272	.140	.206
Unspecified Trauma	.292	.008	.150
Vehicular Trauma	.233	.003	.118
Bitten	.314	.041	.178
Hospitalized	.281	.153	.217
Bit Other Animal	.332	.243	.288
Bit a Person	.256	.179	.217
Euthanized	.000	.000	.000
Active Total	2.473	1.234	1.853

Bivariate correlations between variables in dimension 1 were identified (transformed variables) and found to be the same as those in dimension 2. Only correlations ≥ 0.3 were considered to be relevant (Costa et al., 2013), and as presented in table 3 the variable “unspecified trauma” correlated significantly with “vehicular trauma”, “bitten” correlated with “bit other animal”, “bit a person” correlated with “bit other animal” and the variable “chronic illness” correlated with “hospitalized”.

Table 3:Correlation matrix of the transformed (optimally scaled) variables.

Dimension: 1

	Total Dogs Owned	Acute Illness	Chronic Illness	Unspecified Trauma	Run Over by Vehicle	Bitten	Admitted to ICU	Bit Other Animal	Bit a Person	Euthanized
Total Dogs Owned	1.000									
Acute Illness	.130	1.000								
Cronic Illness	.217	.216	1.000							
Unspecified Trauma	.141	.170	.176	1.000						
Run Over by Vehicle	.259	.093	.125	**.303**[a]	1.000					
Bitten	.214	.143	.162	.214	.132	1.000				
Admitted to ICU	.205	.212	**.297**[a]	.202	.135	.203	1.000			
Bit Other Animal	.241	.075	.142	.155	.152	**.345**[a]	.130	1.000		
Bit a Person	.223	.078	.139	.181	.122	.148	.115	**.369**[a]	1.000	
Euthanized	.030	-.026	.038	-.028	.007	.027	.024	-.028	.000	1.000
Dimension	1	2	3	4	5	6	7	8	9	10
Eigenvalue	2.473	1.167	1.030	.998	.866	.821	.785	.695	.628	.536

a. $p < 0.001$.

It is important to note that this information arises from self-reporting data and as such correlation does not equal causation.

4.4.3 Chi-Square Analysis of Cluster Variables

Variables identified as having potential significant deviation from independence with MCA were further explored though the use of chi-square analyses. The potential association between owners reporting chronic illness and those who reported hospitalization was significant, with 67.5% of those having experienced chronic illness with one or more dogs also referring hospitalization (χ^2=122.131, df=1, p<0.001). In the case of owners reporting have had at least one dog suffering vehicular trauma, 50.3% also reported unspecified trauma significantly more than expected (χ^2=127.310, df=1, p<0.001). Individuals who report having cared for more than 11 dogs in their life-time report having had at least one dog that bit another animal significantly more than expected (χ^2=85.236, df=3, p<0.001, standard residual 6.8). In cases where the owner reports one or more biting occurrence, 34.8% of those reporting a dog having been bitten also report more dog(s) that bit other animals (χ^2=164.547, df=1, p<0.001), and of those reporting dog(s) that have bitten a person 51.1% also cite having one or more dogs that also bit other animals (χ^2=188.522, df=1, p<0.001).

As a result of this last finding a three-way contingency table was calculated and although individuals who report having cared for at least one dog which was bitten also report having at least one dog that had bitten other animals, independently of whether or not they also report a dog that bit a person (χ^2=46.578, df=1, p<0.001 and χ^2=87.436, df=1, p<0.001 respectively), the association is much stronger in the population that reports having had at least one dog that bit a person (Cramer´s V=0.506, p<0.001 versus Cramer´s V =0.270, p<0.001).

Analysis of the second cluster identified by MCA shows that individuals who have not cared for dogs that suffered unspecified trauma also report less experience with dogs bitten and suffering vehicular trauma (χ^2=21.445, df=1, p<0.001).

It is interesting to note that in the sample of dog owners in study there was no single or group of medical occurrences that would make each individual more likely to choose to euthanize their dog or dogs.

4.5 Discussion

When the relationship between human and dog works well, the two individuals form a functional human-dog dyad that has been shown to be mutually beneficial (O'Haire, 2010; Wang et al., 2015). When these dyads are dysfunctional however, they can pose a risk to humans, animals and the community itself (Lambert et al., 2015; Mongillo et al., 2015). The most studied problem is aggressive canine behavior, namely dog bites (Fatjo et al., 2007). However, this is not the only concern. Dogs that are not provided with adequate veterinary care can represent a risk to public health (Lambert et al., 2015; Sterneberg-van der Maaten et al., 2016), those that are allowed to roam present a clear risk to public safety (Mustiana et al., 2015) and dogs that develop behavior problems are at risk of euthanasia (Bower, 2014), abandonment (Diesel et al., 2010) and can be difficult to re-home (Coe et al., 2014). In order to develop strategies to correct these issues, the human-dog dyad requires further study to understand the underlying causes that can be at the heart of the dysfunction (Meyer & Forkman, 2014). The main problem is that the human partner at the core of a dysfunctional dyad has proven difficult to study since these owners are less likely to participate in studies that require the provision of personal information (Bennett & Rohlf, 2007; Rohlf et al., 2010). They may feel that such information could bring into question their moral and ethical principles, that they will be judged negatively in other aspects of their lives, or they may be reluctant to have their fears of poor dog ownership confirmed. Taking all these facts into consideration, a different approach was implemented, through the application of a simple questionnaire to dog owners, both in person and online, about dog ownership history. This study aimed to evaluate dog health care histories (chronic disease, trauma and euthanasia) with the intent to find patterns that may help typify these relationships, and possibly contribute to the identification of dysfunctional dyads.

It has been suggested that the most visible sign of functional human-dog dyads, especially to veterinary professionals, is the willingness of an owner, as caregiver, to provide adequate medical care to their dog (Mariti et al., 2012; Rohlf et al., 2012). To assess this issue, the questionnaire focused in diseases and hospitalization of each individual dog, as opposed to asking questions that owners may find too personal or invasive. As suggested by Wiseman-Orr et al., 2004, the vast gambit of possible disease processes that can occur in a dog´s lifetime were condensed into simple categories, using simple familiar terms that owners would easily understand and incidents they would most likely remember (Robinson, Dean, Cobb, & Brennan, 2015, 2016). Since dog health care issues that can be time consuming and/or costly are very likely to be remembered, owners were asked whether they had owned a

dog which had suffered acute illness, chronic illness, unspecified or vehicular trauma or been hospitalized. These five health occurrences can be common within a normal canine life span and by using simplified, non-medical terminology (by asking about chronic illness in general as opposed to renal insufficiency, for example), the owner will be more likely to correctly identify the occurrence. Situations involving dog bites, whether the dog in question is the victim or the aggressor, are very likely to be remembered since these situations can be quite traumatic occurrences. As such, owners were asked if their dog had been bitten, had bitten another animal or a person. It was important to assess if experience with euthanasia could be used to identify potential problem dyads, since it is not uncommon for veterinarians to come across requests for medically unjustified euthanasia (Yeates & Main, 2011) , so owners were asked if they had ever had a dog euthanized to evaluate this possibility.

In this study 67.5% of owners who reported having a dog that suffered from a chronic illness also reported significantly more experience with hospitalization. Most chronic illnesses in dogs require some period of hospitalization during the disease process (Polzin, 2013; Pouchelon et al., 2015). So, it makes sense that these owners represent functional human-dog dyads, since they are conscientious of their responsibility to provide adequate medical care. This may not be the case with less motivated owners.

In the population in study, 77.7% of owners who did not report experience with a dog suffering unspecified trauma also failed to report experience with a dog victim of vehicular trauma or being bitten. This would suggest that responsible members of human-dog dyads avoid situations of risk by keeping their dog(s) under control. In contrast, 50.3% of owners who reported having had a dog suffer vehicular trauma also reported significantly more unspecified trauma. These owners may represent the type of people that are the hardest to identify; because they could believe that by giving their dog “freedom” they are being more humane. Assuming this to be true, they represent the human half of a dysfunctional dyad, where a lack of responsibility results in an increase experience with both unspecified trauma and vehicular trauma in their dog ownership history.

In this study, among owners who reported having had a dog that bit another animal they also reported significantly more experience with a dog that bit a person (51.1%) and a dog that was bitten (34.8%). It is interesting to note that the association between having had a dog that bites and a dog that was bitten is stronger within the group of owners that also reported experience with a least one dog that bit a person. This would seem to support the idea that individuals who have dog ownership histories that include experience with various types of dog aggression (dog-dog and/or dog-human) represent a dysfunctional dyad (Cornelissen & Hopster, 2010; Tami et al., 2008). In such cases, owners may not understand the importance

of dog training and socialization or be aware that they are part of a potentially dysfunctional partnership. As with the previous owner type, some of these individuals believe that they are providing adequate dog care, and it is here that educational programs maybe the most effective (Lakestani & Donaldson, 2015; Schwebel et al., 2015). Through education the owner can be made to understand how they are contributing to the problem within the dyad and given the tools to make relevant and lasting changes.

By asking owners to report on how many dogs they had cared for up until the moment they filled out the questionnaire, the intention was to evaluate, albeit in a preliminary fashion, if experience with owning a larger number of dogs changed the type of dog health histories reported. It has been suggested that the more experience with individual animals a person has, the more knowledgeable this person will be (Bennett & Rohlf, 2007; O'Connor, Coe, Niel, & Jones-Bitton, 2016). However, at least when it comes to dog on dog aggression, the results of this study are not in agreement with this statement. The people who report having owned more than 11 dogs also report more experience with having had at least one dog that bit another animal. This could be due to more experience with dog ownership making individuals more lackadaisical when it comes to intra-species aggression (Kubinyi et al., 2009). On the other hand, this study did not identify how many dogs were being cared for simultaneously, it could be that this raise in intra-species aggression results from situations of overcrowding (Tami et al., 2008). In the latter case these may represent dysfunctional dyads since there is a limit to how many dogs one individual can safely and legally care for (Assembleia da República, 2003).

In the sample studied there was no evidence of association between euthanasia and any other variable. Although it has been suggested that owners may use medically unjustified euthanasia as a simple solution to their particular "problem pet" (Coe et al., 2014; Houpt et al., 2007), and so be a marker of dysfunctional dyads, this may not be the case here. This could be due to cultural reasons which make euthanasia a non-option, since many individuals wish their pet to have a natural death in the family home. As such, owner experience with euthanasia within this population was not helpful in anticipating the existence of dysfunctional dyads.

As the human-dog bond becomes increasingly relevant, the problem of dysfunctional human-dog dyads has been receiving increased attention. These dyads not only represent a problem to society but also place the individuals within the dyad, both human and canine, at risk (Lambert et al., 2015; Mongillo et al., 2015). As previously stated, since the human members of dysfunctional dyads are difficult to study, these relationships are normally only visible after the negative impact has been felt (Drobatz & Smith, 2003; Kahn, Bauche, & Lamoureux,

2003; Matthias et al., 2015; Rosado, García-Belenguer, León, & Palacio, 2009). This study has shown that it was possible to identify potential characteristics both of functional and dysfunctional dyads by using data from a simple one page yes/no questionnaire. Human members of functional dyads tend to be responsible for their dogs' wellbeing, providing the necessary veterinary care and avoiding situations of risk. On the other hand, owners that maybe part of dysfunctional dyads show the opposite characteristics, reporting experience with various kinds of trauma and dog aggression.

More studies are required to understand whether these findings can be applied to other populations, namely ones that are not urban in nature. By identifying these dyads, it will be possible to develop strategies and tools to limit the negative effect these dyads on each member and on society.

Chapter V: Evaluation of the factor structure of the Canine Behavioural Assessment and Research Questionnaire (C-BARQ) in Europe

Evaluation of the factor structure of the Canine Behavioural Assessment and Research Questionnaire (C-BARQ) in European Portuguese

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Published in: PLoS One. 2018 Dec 27;13(12):e0209852

5.1 Abstract

The human-dog relationship is thought to be the oldest domestic animal partnership. These relationships are complex and can become problematic when they become dysfunctional. The most common signs of dysfunctional human-dog partnerships are behaviour problems that, when unidentified and uncorrected, can be a clear danger to both species and the public. The Canine Behavioural Assessment and Research Questionnaire (C-BARQ) is a widely implemented instrument to evaluate dog behaviour proven to be useful across various cultures. A European Portuguese 78-item version based on the 100-item C-BARQ was developed and its psychometric properties evaluated. The resulting questionnaire has a 13-factor structure accounting for 58.42% of the total variance with Cronbach's alpha values ranging from 0.902 and 0.721, showing excellent to respectable consistency. The original factors, Dog-Directed Aggression and Dog-Directed Fear, both loaded strongly onto a joint factor renamed Dog Associated Fear/Aggression, explaining the 13-factor structure compared to the previously found 14-factor structure. In the European Portuguese C-BARQ only two items did not load onto their expected factor. Results show that the questionnaire measures universal dog behaviours that are evident to most owners. Our results suggest that the European Portuguese version of the C-BARQ can be used to characterize the behaviour of dog populations and is adequate for use in animal shelters to help match dogs with new owners and in clinical settings to identify behaviour problems in veterinary patients before they become unmanageable. The European Portuguese C-BARQ could be of vital importance in helping to resolve behavioural problems in owned dogs before they become so serious as to lead to abandonment or euthanasia, diminishing the pressure on municipal kennels and greatly improving canine welfare.

5.2 Introduction

The human-dog relationship is thought to be the oldest domestic animal partnership (Wang et al., 2015), serving the needs of both the human and the dog in a wide variety of ways (Houpt et al., 2007). However, these relationships are complex and can become problematic for humans and dogs when they become dysfunctional. One of the most common signs of dysfunctional human-dog partnerships are behaviour problems that, when unidentified and uncorrected, can present a clear and present danger to both species. Dogs with unidentified behavioural problems tend to be the ones that bite humans and other animals (O'Sullivan et al., 2008), that are returned more frequently after adoption (Diesel et al., 2010; Luescher &

Tyson Medlock, 2009) and are most likely to be euthanized at the owners' request. In fact, it has been suggested that behaviour problems represent the single most cited reason for the relinquishing and euthanasia of dogs (Diesel et al., 2010; Fatjó et al., 2015; Lambert et al., 2015). As such, identifying behaviour problems before they become larger issues is important in guaranteeing both dog and human health and safety. Once identified, most of these problems can be corrected, helping to change dysfunctional human-dog dyads into functional ones.

To identify problem behaviours and understand their origin, the dog's behaviour must be evaluated. In general, direct behavioural observation by trained behaviourists is the preferred form of assessing and classifying dog behaviour. Various tests have been developed to do so, mainly in the form of test batteries, ratings of individual dogs, expert ratings of breed prototypes, and observational tests (Jones & Gosling, 2005). These tests are often time consuming, require specific settings (Klausz et al., 2014), their results may depend on the experimental conditions (Christensen et al., 2007), and they may be difficult to conduct on a larger and more varied population, making generalization across populations difficult (Jones & Gosling, 2005). One way around these issues is by using the knowledge an owner possesses about the dog to evaluate an individual dog's behaviour and temperament (Svartberg, 2005). Although not specifically trained to observe canine behaviour, simply by virtue of their co-habitation, an owner may be knowledgeable about their pet's behaviour. As such, owners may represent a reliable source of information regarding their dog's behaviour.

One way to quantify owner knowledge is through questionnaires such as the widely-used Canine Behavioural Assessment and Research Questionnaire (C-BARQ), a 100-item instrument originally developed in the USA (Duffy & Serpell, 2012; Hsu & Serpell, 2003). So far, the C-BARQ has been used to evaluate canine behaviour and screen for appropriate temperament in dogs in guide dog programs (Duffy & Serpell, 2008; Kutsumi et al., 2013), to identify specific behaviours related to the dogs' hormonal response to human contact (Roth et al., 2016), and even to classify behaviour phenotypes in morphological and genetic studies (McGreevy et al., 2013; Tonoike et al., 2015). The psychometric properties of the C-BARQ have been studied in a variety of countries and validated for use in Mandarin (Hsu & Sun, 2010), Japanese (Nagasawa et al., 2011), Dutch (van den Berg et al., 2006), Swedish (Svartberg, 2005), Italian (Marshall-Pescini et al., 2008), Farsi (Tamimi et al., 2015), Latin American Spanish (González-Ramírez et al., 2017), and Brazilian Portuguese (Rosa et al., 2017), making it a tool that has shown consistency and validity in assessing dog behaviour in a wide variety of cultures. Common canine behavioural problems in various populations

may have common origins, or they may be unique to specific cultures; using the same validated instrument makes such comparisons possible (Wan, Kubinyi, Miklósi, & Champagne, 2009) . By identifying behaviour problems present in a given population, it becomes possible to develop educational programs for owners which would focus on prevention of these issues. Through owner education, it should be possible to reduce problem behaviour, leading to a reduction in the relinquishment and euthanasia of dogs, as well as human-directed aggression (Freiwald, Litster, & Weng, 2014; Overall, 2010).

In Portugal, dog ownership has gone through many changes in the past 20 to 30 years, since the revolution of 1974, when dogs started to become more common inside the home. It has only been very recently that dog training classes have been made available to the public which, along with the increased availability of pet insurance, demonstrates a gradual cultural shift in how the Portuguese view the family dog. Despite this shift, Portugal continues to have a dog abandonment problem, with official numbers from 2017 citing 24,079 dogs accepted in municipal kennels, of which 31% were euthanized (personal communication, National Authority for Animal Health, Government of Portugal). With the approval of the new Animal Welfare Act of 2016 (Assembleia da República, 2017), in which the euthanasia of healthy dogs under municipal care has been prohibited, it is likely that the importance of correct rehoming of relinquished dogs will become even more important. As such, having a reliable and valid tool, such as the C-BARQ, to assess and correctly classify a particular dog's behavioural characteristics in a quick, easy, and consistent way could greatly benefit municipal kennels. The C-BARQ could also serve to help clarify the behavioural characteristics of the Portuguese dog population, thereby helping to direct public education campaigns that may contribute to more responsible dog ownership. In a clinical setting, the use of the C-BARQ could help veterinarians to clearly identify problems and, as such, better help owners when behaviour issues begin to appear.

The present study aims to establish the psychometric properties of an adapted and shortened 78-item European Portuguese version of the C-BARQ. Such a questionnaire may be useful in classifying dogs for rehoming as well as identifying possible behavioural problems in owned dogs before they become so serious as to lead to abandonment or euthanasia.

5.3 Materials and Methods

5.3.1 Participants

All participants in this study were over 18 years of age and residents and/or citizens of Portugal. Each individual that participated was required to have owned at least one dog in his or her lifetime.

5.3.2 Instrument

The version of the C-BARQ used in the current study was based on the 100-item version used in the study by Duffy and Serpell (2012), itself an updated version of the original C-BARQ (Hsu & Serpell, 2003). The questionnaire's 100 items ask owners to assess their dog's reactions in everyday situations and score them on a Likert-type 5-point scale of frequency (0 representing "never", 4 representing "always") and of severity (0 indicating "no sign of the behaviour" and 4 indicating "severe demonstrations of the behaviour"). The questionnaire was translated from English to Portuguese, corrected by three university professors, and back translated by a native English speaker (Canadian citizen). The questionnaire was then administered to a small test population of owners (N=50) and, after frequent comments regarding the perceived excessive length, items labelled as "miscellaneous" (items 77 to 90), were removed to shorten the questionnaire. The result was a European Portuguese version of the C-BARQ containing 78 items (Table 4), maintaining the 7 sections of the original, but excluding 22 Miscellaneous items.

Participants were invited to complete the C-BARQ online using Google Forms TM or in person through paper questionnaires distributed throughout the Greater Lisbon Metropolitan Area to various small animal hospitals, clinics and anti-rabies vaccination programs. Owners were instructed to complete the questionnaire as thoroughly as possible, however if they had no experience with the behaviour described, they were given the option to select "non-applicable" or "not observed"; these responses were treated as missing values in statistical analyses. Questionnaires were made available for a period of 8 months, resulting in 344 completed questionnaires.

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Table 4:CBARQ sections and items translated into European Portuguese.

Section 1: Training difficulty (frequency)
1. When off the leash, returns immediately when called.
2. Obeys the “sit” command immediately.
3. Obeys the “stay” command immediately.
4. Seems to attend/listen closely to everything you say or do.
5. Slow to respond to correction or punishment; ‘thick-skinned’.
6. Slow to learn new tricks or tasks.
7. Easily distracted by interesting sights, sounds or smells.
8. Will ‘fetch’ or attempt to fetch sticks, balls, or objects.
Section 2: Aggression (severity)
9. When verbally corrected or punished (scolded, shouted at, etc.) by you or a household member.
10. When approached directly by an unfamiliar adult while being walked/exercised on a leash.
11. When approached directly by an unfamiliar child while being walked/exercised on a leash.
12. Toward unfamiliar persons approaching the dog while s/he is in your car (at the gas station for example).
13. When toys, bones or other objects are taken away by a household member.
14. When bathed or groomed by a household member.
15. When an unfamiliar person approaches you or another member of your family at home.
16. When unfamiliar persons approach you or another member of your family away from your home.
17. When approached directly by a household member while s/he (the dog) is eating.
18. When mailmen or other delivery workers approach your home.
19. When his/her food is taken away by a household member.
20. When strangers walk past your home while your dog is outside or in the yard.
21. When an unfamiliar person tries to touch or pet the dog.
22. When joggers, cyclists, rollerbladers or skateboarders pass your home while your dog is outside or in the yard.
23. When approached directly by an unfamiliar male dog while being walked/exercised on a leash.

24. When approached directly by an unfamiliar female dog while being walked/exercised on a leash.

25. When stared at directly by a member of the household.

26. Toward unfamiliar dogs visiting your home.

27. Toward cats, squirrels or other small animals entering your yard.

28. Toward unfamiliar persons visiting your home.

29. When barked, growled, or lunged at by another (unfamiliar) dog.

30. When stepped over by a member of the household.

31. When you or a household member retrieves food or objects stolen by the dog.

32. Towards another (familiar) dog in your household (leave blank if no other dogs).

34. When approached while eating by another (familiar) household dog (leave blank if no other dogs).

35. When approached while playing with/chewing a favorite toy, bone, object, etc., by another (familiar) household dog (leave blank if no other dogs).

Section 3: Fear and anxiety (severity)

36. When approached directly by an unfamiliar adult while away from your home.

37. When approached directly by an unfamiliar child while away from your home.

38. In response to sudden or loud noises (e.g. vacuum cleaner, car backfire, road drills, objects being dropped, etc.).

39. When unfamiliar persons visit your home.

40. When an unfamiliar person tries to touch or pet the dog.

41. In heavy traffic

42. In response to strange or unfamiliar objects on or near the sidewalk (e.g. plastic trash bags, leaves, litter, flags flapping, etc.

43. When examined/treated by a veterinarian.

44. During thunderstorms, firework displays, or similar events.

45. When approached directly by an unfamiliar dog of the same or larger size.

46. When approached directly by an unfamiliar dog of a smaller size.

47. When first exposed to unfamiliar situations (e.g. first car trip, first time in elevator, first visit to veterinarian, etc.)

48. In response to wind or wind-blown objects.

49. When having nails clipped by a household member.

50. When groomed or bathed by a household member.

51. When having his/her feet toweled by a member of the household.

52. When unfamiliar dogs visit your home.

53. When barked, growled, or lunged at by an unfamiliar dog.

Section 4: Separation-related behaviour (frequency)

54. Shaking, shivering or trembling.

55. Excessive salivation.

56. Restlessness/agitation/pacing.

57. Whining.

58. Barking.

59. Howling.

60. Chewing/scratching at doors, floor, windows, curtains, etc.

61. Loss of appetite.

Section 5: Excitability (severity)

62. When you or other members of the household come home after a brief absence.

63. When playing with you or other members of your household.

64. When doorbell rings.

65. Just before being taken for a walk.

66. Just before being taken on a car trip.

67. When visitors arrive at your home.

Section 6: Attachment and Attention-seeking. (frequency)

68. Displays a strong attachment for one particular member of the household.

69. Tends to follow you (or other members of household) about the house, from room to room.

70. Tends to sit close to, or in contact with, you (or others) when you are sitting down.

71.Tends to nudge, nuzzle or paw you (or others) for attention when you are sitting down.

72. Becomes agitated (whines, jumps up, tries to intervene) when you (or others) show affection for another person.

73. Becomes agitated (whines, jumps up, tries to intervene) when you show affection for another dog or animal.

Section 7: Miscellaneous (frequency)

74. Chases or would chase cats given the opportunity.

75. Chases or would chase birds given the opportunity.

76. Chases or would chase squirrels, rabbits and other small animals given the opportunity.

77. Playful, puppyish, boisterous.

78. Active, energetic, always on the go.

5.3.4 Statistical Analysis

To assess the construct validity of the European Portuguese version of the C-BARQ, data obtained was subjected to principle components analysis using IBM SPSS™ Statistics version 20.0 (IBM Corp., Armonk, NY). To evaluate the reliability and to examine the internal consistency, the Cronbach's alpha was used and interpreted according to DeVellis' (2017) criteria. To determine the number of interpretable factors that could be extracted through principal components analysis and varimax rotation, the Kaiser-Guttman eigenvalue method (eigenvalues greater than 1.0) and the Scree test were used. Loading values of 0.40 and greater were considered significant (Nunnally and Bernstein, 1994). To study the internal validity of the C-BARQ, as relates to its construct validity, correlations between C-BARQ factors were calculated and item-factor correlations (point-biserial correlations) were examined to analyse the convergence of each item in the factor as well as its discrimination index (Nunnally and Bernstein, 1994). Correlations were analysed through the Pearson´s r coefficient. Missing values were treated as recommended by the original C-BARQ authors: if less than 25% of the items in a subscale were missing, the mean value of the subscale score was used throughout the data analysis (13).

5.4 Results

5.4.1 Population and Response Rates

The canine population under study was varied and is detailed in Table 5, while participants scores can be found in Table 6. The response rate for items relating to "Owner Directed aggression" (ODA) were the highest, 100%, with no missing values found, while those relating to "Dog Rivalry" (DR) were the lowest, 91%, with 31 missing values. For all other items the response rate ranged from 97.1% for "Non-social Fear" (NSF) to 99.7% for "Stranger-directed Fear" (SDF), "Trainability" (TR) and "Stranger-directed Aggression" (SDA).

Table 5:Demographic characteristics of canine population in study (N=345).

Age (years)	N (%)
<1	18(5)
1 - 5	132(38)
>5 -10	96(28)
>10 – 15	80(23)
>15	19(6)
Sex	
Male	120(35)
Castrated Male	47(14)
Female	81(23)
Spayed Female	97(28)
Breed	
Specific breed cited	185(10)
Cross-breed	34(31)
Mutt	106(54)
No response	20(6)
Weight (kilograms)	
0 – 10	93(27)
11– 25	146(42)
26 -44	94(27)
>44	12(3)

Table 6: C-BARQ descriptive statistics.

Factors	M	SD	Min.	Max.	Skewness	Kurtosis
SA (10 items)	5.57	6.42	0	32	1.58	2.49
DAF (8 items)	7.95	6.17	0	32	1.01	0.99
ODA (8 items)	1.30	2.89	0	19	3.47	13.70
Ex (6 items)	14.08	5.26	0	24	-0.18	-0.56
SDF (4 items)	2.12	3.09	0	15	1.86	3.26
SRB (8 items)	4.88	4.63	0	26	1.21	1.56
NSF (7 items)	6.31	4.86	0	23	0.83	0.09
DR (4 items)	1.79	2.79	0	16	2.51	7.50
Ch (4 items)	7.27	4.79	0	16	0.20	-1.02
TR (7 items)	18.10	4.30	7	28	-0.19	-0.26
AAS (6 items)	14.16	4.37	1	24	-0.05	-0.17
EL (3 items)	8.10	3.08	0	12	-0.59	-0.48
TS (3 items)	1.95	2.25	0	12	1.52	2.65

Note: SA=Stranger-Directed Aggression, DAF=Dog-Directed Aggression/Fear, ODA=Owner-Directed Aggression, Ex=Excitability, SDF=Stranger-Directed Fear, SRB=Separation-Related Behavior, NSF=Nonsocial Fear, DR=Dog Rivalry, CH=Chasing, TR=Trainability, AAS=Attachment/Attention-Seeking Behavior, EL=Energy Level, TS=Touch Sensitivity. M (mean), SD (standard-deviation).

5.4.2 Factor Analysis

Through analysis of the correlation matrix using the Kaiser-Meyer-Olkin measure of sampling adequacy, a value of 0.812 was obtained (Kaiser, 1974), and a significant Bartlett`s test of sphericity ($\chi 2=12071.958$; df=3003; $p<0.001$) confirmed that the sample size is adequate for analyses using principal components analysis (Field, 2018; Marôco, 2011).

The scree plot and eigenvalues suggested a 13-factor structure, which were extracted with item loadings presented in Table 3. This structure explained 58.42% of the total variance. Most of the items loaded onto the same factors as the original study (Duffy & Serpell, 2012), with the exception of two factors and two items (as shown in Table 7). In Duffy and Serpell´s (2012) study "Dog-directed Aggression" (DDA) and "Dog-directed Fear" (DDF) had 4 items loading onto two different factors, whereas in the current study all 8 items loaded onto a single factor renamed "Dog-directed Fear/Aggression" (Hsu & Serpell, 2003). Duffy and Serpell (2012) loaded item 8 onto the factor TR (factor 10) whereas in the current study the item loaded onto the factor "Energy" (EL). Item 43 in the Duffy and Serpell (2012) study

loaded onto the "Touch Sensitivity" (TS) factor, whereas in the current study the item loaded onto the NSF factor.

Table 7: Results of factor analysis on the European Portuguese CBARQ.

Factors	α	eigenvalue	% variance	loadings
Factor 1 – Stranger directed aggression (SA)	0.90	6.33	8.12	
10. When approached directly by an unfamiliar adult while being walked/exercised on a leash				0.810
16. When unfamiliar persons approach you or another member of our family away from your home.				0.775
21. When an unfamiliar person tires to touch or pet the dog.				0.765
28. Toward unfamiliar persons visiting your home.				0.760
12. Toward unfamiliar persons approaching the dog while s/he is in your car (at the gas station for example).				0.693
15. When an unfamiliar person approaches you or another member of our family at home.				0.691
20. When strangers walk past your home while your dog is outside or in the yard.				0.685
18. When mailmen or other delivery workers approach your home.				0.633
22.When joggers, cyclists, rollerbladers or skateboarders pass your home while your dog is outside or in the yard.				0.611
11. When approached directly by and unfamiliar child while being walked/exercised on a leash.				0.568
Factor 2 – Dog-directed aggression/fear (DAF)	0.86	3.98	5.11	
45. When approached directly by and unfamiliar dog of the same or larger size.				0.782
46. When approached directly by and unfamiliar dog of a smaller size.				0.777
53. When barked, growled, or lunged at by an unfamiliar dog.				0.698
52. When unfamiliar dogs visit your home.				0.663

23. When approached directly by an unfamiliar male dog while being walked/exercised on a leash.				0.623
24. When approached directly by and unfamiliar female dog while being walked/exercised on a leash.				0.571
2. Toward unfamiliar dogs visiting your home.				0.536
29. When barked, growled, or lunged at by another (unfamiliar) dog.				0.461
Factor 3 – Owner-directed aggression (ODA)	0.82	3.76	4.82	
19. When his/her food is taken away by a household member.				0.816
13. When toys, bones or other objects are taken away by a household member.				0.773
17. When approached directly by a household member while s/he (the dog) is eating.				0.771
31. When you or a household member retrieves food or objects stolen by the dogs.				0.674
9. When verbally corrected or punished (scolded, shouted at, etc.) by you or a household member.				0.489
25. When stared at directly by a member of the household.				0.452
14. When bathed or groomed by a household member.				0.434
30. When stepped over by a member of the household.				0.366
Factor 4 – Excitability (EX)	0.84	3.65	4.69	
6. Just before being taken for a walk.				0.789
66. Just before being taken on a car trip.				0.771
62. When you or other members of the household come home after a brief absence.				0.689
63. When playing with you or other members of your household.				0.667
67. When visitors arrive at your home.				0.614
64. When the doorbell rings.				0.535
Factor 5 – Stranger-directed fear (SDF)	0.90	3.44	4.40	
40. When an unfamiliar person tries to touch or pet the dog.				0.841

36. When approached directly by and unfamiliar adult while away from your home.				0.790
39. When unfamiliar persons visit your home.				0.785
37. When approached directly by an unfamiliar child while away from your home.				0.767
Factor 6 – Separation-related behaviour (SRB)	0.76	3.38	4.34	
57. Whinning.				0.699
59. Howling.				0.647
58. Barking.				0.633
54. Shaking, shivering or trembling.				0.623
56. Restlessness/agitation/pacing.				0.597
60. Chewing/scratching at doors, floors, windows, curtains, etc.				0.521
55. Excessive salivation.				0.477
61. Loss of appetite.				0.442
Factor 7 – Non-social fear (NSF)	0.78	3.26	4.17	
48. In response to wind or wind-blown objects.				0.705
38. In response to sudden or loud noises (e.g. vacuum cleaner, car backfire, road drills, objects being dropped, etc.).				0.641
44. During thunderstorms, firework displays, or similar events.				0.633
42. In response to strange or unfamiliar objects on or near the sidewalk (e.g. plastic trash bags, leaves, litter, flags flapping, etc.).				0.614
47. When first exposed to unfamiliar situations (e.g. first car trip, first time in elevator, first visit to veterinarian, etc.).				0.491
43. When examined/treated by a veterinarian.				0.479
41. In heavy traffic.				0.412
Factor 8 – Dog rivalry/familiar dog aggression (DR)	0.87	3.24	4.15	
33. When approached at a favourite resting/sleeping place by another (familiar) household dog.				0.802

34. When approached while eating by another (familiar) household dog.				0.763
35. When approached while playing with/chewing a favorite toy, bone, object, etc., by another (familiar) household dog.				0.757
32. Towards another (familiar) dog in your household.				0.734
Factor 9 – Chasing (CH)	0.87	3.20	4.10	
76. Chases or would chase squirrels, rabbits and other small animals given the opportunity.				0.880
75. Chases or would chase birds give the opportunity.				0.844
74. Chases or would chase cats given the opportunity.				0.812
27. Towards casts, squirrels or other small animals entering your yard.				0.604
Factor 10 – Trainability (TR)	0.72	3.06	3.93	
1. When off the leash, returns immediately when called				0.607
3. Obeys the "stay" command immediately.				0.597
4. Seems to attend/listen closely to everything you say or do.				0.580
2. Obeys the "sit" command immediately.				0.579
7. Easily distracted by interesting sights, sounds or smells.				0.544
5. Slow to respond to correction or punishment; "thick-skinned".				0.531
6. Slow to learn new tricks or tasks				0.516
Factor 11 – Attachment/attention-seeking behaviour (AAS)	0.75	2.88	3.69	
71. Tends to nudge, nuzzle or paw you (or others) for attention when you are sitting down.				0.661
70. Tends to sit close to, or in contact with, you (or others) when you are sitting down.				0.605
69. Tends to follow you (or other members of the household) about the house, from room to room.				0.601
68. Displays a strong attachment for one particular member of the household.				0.586

72. Becomes agitated (whines, jumps up, tries to intervene) when you (or others) show affection for another person.				0.538
73. Becomes agitated (whines, jumps up, tires to intervene) when you show affection for anther dog or animal.				0.506
Factor 12 – Energy level (EL)	0.81	2.75	3.53	
77. Playful, puppyish, boisterous.				0.806
78. Active, energetic, always on the go.				0.734
8. Will "fetch" or attempt to fetch sticks, balls, or objects.				0.696
Factor 13 – Touch sensitivity (TS)	0.73	2.64	3.38	
51. When having his/her feet towelled by a member of the household.				0.745
50. When groomed or bathed by a household member.				0.724
49. When having nails clipped by a household member.				0.682

In all cases, items loading values were above 0.412, with the exception of item 30 (loading 0.366). Despite this lower value, the item represented at least 9% of the variance accounted for in the factor (Kline, 1994) and as such was maintained.

5.4.3 Internal Consistency and Internal Validity

The internal consistency of extracted factors was analysed using Cronbach's alpha, with values above 0.70 considered to have adequate reliability. The Cronbach's alpha values ranged from 0.902 and 0.721 (table 4), showing excellent to respectable consistency (DeVellis, 2017).

To study the internal validity of the C-BARQ, as relates to its construct validity, correlations between C-BARQ factors were calculated and item-factor correlations excluding the item (point-biserial correlation) were examined to analyse the convergence of each item in the factor as well as its discrimination index (Nunnally & Bernstein, 1994).

Significant correlations ($p<0.01$, $p<0.05$) were found between the 13 factors within the C-BARQ, the coefficients of which varied between 0.454 and 0.108, denoting mostly moderate

or weak correlations (Cohen, 1988). However, some negative coefficients (in a few weak associations) and null associations were also detected.

Item-factor correlations can be found in Table 8 and indicate that factors SA, DAF, EX, SDF, DR, CH, EL and TS show strong correlations, while factors ODA, SRB, ASF, and AAS demonstrate strong to moderate correlations, with the TR factor presenting moderate correlations (Cohen, 1988).

Table 8: Item-factor correlation summary

Factor	α - Coefficient Variation	M
SA	0.74 - 0.52	0.65*
DAF	0.68 –0.52	0.60*
ODA	0.71 – 0.42	0.56†
EX	0.61 –0.53	0.63*
SDF	0.83 –0.75	0.79*
SRB	0.55 –0.37	0.47†
NSF	0.61 –0.37	0.51†
DR	0.76 –0.63	0.72*
CH	0.81 –0.57	0.73*
TR	0.49 –0.36	0.43‡
AAS	0.55 –0.41	0.49†
EL	0.74 –0.56	0.67*
TS	0.67 –0.52	0.58*

M=mean, *strong, †strong to moderate, ‡ moderate Note: SA=Stranger-Directed Aggression, DAF=Dog-Directed Aggression/Fear, ODA=Owner-Directed Aggression, Ex=Excitability, SDF=Stranger-Directed Fear, SRB=Separation-Related Behavior, NSF=Nonsocial Fear, DR=Dog Rivalry, CH=Chasing, TR=Trainability, AAS=Attachment/Attention-Seeking Behavior, EL=Energy Level, TS=Touch Sensitivity.

5.5 Discussion

This paper set out to study the psychometric properties of the European Portuguese version of the C-BARQ to establish its validity for use in a European Portuguese context. The obtained results for this instrument suggest good validity and reliability indices, with a robust 13-item factor structure accounting for 58.42% of the total variance of the results (annex I). These

findings reveal the important psychometric qualities of the instrument and highlight specific differences found in the current population compared to others studied.

The European Portuguese version of the C-BARQ very closely followed the structure of the original (Duffy & Serpell, 2012), with the extraction of almost all of the same subscales. The exception was the two subscales, DDA and DDF, each with 4 items loading strongly onto one factor that we renamed Dog Associated Fear/Aggression (Table 4). Although this result was similar to the results obtained by Svartberg (2005), it contrasts clearly with studies carried out in other countries (Hsu & Sun, 2010; Nagasawa et al., 2011; van den Berg et al., 2006). Portugal has only recently started to see the dog as a family member, and many dogs are still kept in yards. The importance of socializing dogs (Blackwell et al., 2008) is not widely acknowledged by Portuguese owners and, as a result, some dogs may show inappropriate behaviour when meeting an unfamiliar animal making the line between aggression and fear difficult to draw. This inexperience with dog behaviour could account for the grouping of DAF and DAA into a single factor.

When considering individual items on the European Portuguese C-BARQ, each loaded strongly on its expected subscale, except for two: items 8 and 43. The former, "will fetch or attempt to fetch sticks, balls, or objects" loaded onto the subscale EL instead of the original TR (Duffy & Serpell, 2012) as it did in a recent Mexican study (González-Ramírez et al., 2017). In Portugal, dog training classes have only recently started to be regularly offered and, as in other countries, few owners attend (Bennett & Rohlf, 2007). It is possible that fetching is not considered to be an act of training but of playing. Dogs scoring high on the EL factor may tend towards a more extroverted personality (Ley, Bennett, & Coleman, 2008) and may readily display fetch-like behaviours, but may not have been receptive to basic obedience commands such as "sit" and "stay", items included in the TR factor. Item 8 is also the only TR subscale item that can be demonstrated by the dog when alone, making it more likely to be displayed by extroverted, high energy dogs.

The only other item that differed from the English C-BARQ was "when examined/treated by a veterinarian" (item 43), which loaded onto the subscale NSF instead of the original TS subscale (Duffy & Serpell, 2012). As previously suggested (Hsu & Sun, 2010), the reaction of a dog when examined by a veterinarian may not be an accurate measurement of touch sensitivity, but rather of fear, as the dog could be reacting as a result of a previous negative experience with veterinarians. It is the only item in the TS subscale that involves a potentially

unfamiliar person, and the dog could be effectively reacting to fear of a novel person. This may be even more true in Portugal, where visits to veterinarians have traditionally been exclusively for obligatory rabies vaccinations instead of regular health care checks during the dog's entire lifetime.

While great care was taken to try and obtain the most representative dog owner population possible by distributing the questionnaire in every parish in the Greater Lisbon Metropolitan Area, spanning a wide variety of socioeconomic classes, it must be noted that the experimental design required that owners volunteer to participate. As stated by various authors (Bennett & Rohlf, 2007; Hsu & Sun, 2010; Rohlf et al., 2012) these owners may be naturally more connected with their dogs, making them more observant than the general population. Although this effect can never be completely accounted for, the fact that almost identical factor structures where extracted from data in different countries (González-Ramírez et al., 2017; Hsu & Sun, 2010; Nagasawa et al., 2011; Svartberg, Tapper, Temrin, Radesäter, & Thorman, 2005; van den Berg et al., 2006) gives weight to the notion that the questionnaire does measure universal dog behaviours that are evident to most owners, regardless of individual characteristics, such as culture or attachment level.

5.6 Conclusion

The C-BARQ has been shown to be an effective instrument, both valid and reliable, that can be used cross culturally. Small differences that may arise between countries can be identified by validating new translated versions of the questionnaire before they are widely used (Hsu & Sun, 2010). This study has demonstrated that the European Portuguese version of the C-BARQ can confidently be used to help characterize the behaviour of the Portuguese dog population and, as such, direct any future public education endeavours. This is borne out by the excellent psychometric properties demonstrated both in terms of reliability and validity. The instrument is adequate for use in animal shelters to better match dogs with potential new owners and in clinical settings to identify behaviour problems in veterinary patients before they become unmanageable. The European Portuguese C-BARQ could be of vital importance to help resolve behavioural problems in owned dogs before they become so serious as to lead to abandonment or euthanasia, diminishing the pressure on municipal kennels and greatly improving canine welfare in Portugal.

Chapter VI:

Predicting Dysfunctional Human-Dog Dyads

Predicting Dysfunctional Human-Dog Dyads

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Paper Submitted to Anthrozoös,

Status: under review

6.1 Abstract

Human-dog dyads represent a mutually beneficial partnership with a 16,000-year-old history. However, when this relationship becomes dysfunctional the consequences for human, dog and society at large can be severe. Canine members of dysfunctional dyads often display problem behaviours, such as aggression, and are frequently allowed to roam becoming a public health concern. The cause of this dysfunction is multifactorial and includes human and canine personality factors as well as husbandry choices. By using our knowledge of these factors, the possibility exists of pre-emptively identifying such pairings so that they can be corrected, or even prevented. This study evaluates the possibility of such pre-emptive identification by comparing factors that can contribute to failed partnerships between functional and dysfunctional dyads. Owners were asked to fill out questionnaires regarding their dog (general characteristics and the C-BARQ) and themselves (general characteristics, education, family make-up, husbandry choices and the EPQ-R). A total of 255 responses where obtained and differences between the two dyad types where found both in husbandry choices and both human and dog personalities. Using these factors logistic regression was performed and two models where obtained that could allow for the pre-emptive identification of dysfunctional dyads. These models could be used to developed targeted educational programs, to better match dogs to new owners within the context of shelter medicine and help better tailor patient care in a clinical context.

6.2 Introduction

The human-canine relationship is one of the oldest, most studied and complex domestic partnerships. For over 16,000 years human and dog have cooperated through the establishment human-dog dyads (Wang et al., 2015), that when functional, are mutually beneficial. The benefits to humans are numerous, from simple companionship to using the dogs' capacity to work (Barker, Rogers, Turner, Karpf, & Suthers-McCabe, 2003), while the dog has its basic needs (eg. food, shelter, veterinary care, etc) provided for. However, when these human-dogs dyads become dysfunctional they can represent a clear danger, not only to each individual member, but to society at large (Rohlf et al., 2012).

One of the most visible consequences of dysfunctional human-dog dyads is the development of problem canine behaviour, of which dog aggression receives the most attention (Casey et al., 2014), but it is not the only one. Vehicular accidents (Simpson et al., 2009) or intra-animal

aggressions caused by canine allowed to roam (Dalla Villa et al., 2010; Slater, 2001) present a serious risk to public health (Cito et al., 2016; Rijks et al., 2016). It has been shown that these dogs may be more prone to suffer abandonment, relinquishment to shelters (Houpt et al., 2007) and even convenience euthanasia (Marston et al., 2004; Yeates & Main, 2011).

Recently there has been increasing interest in understanding how dysfunctional dyads arise (Payne et al., 2015) and it has been demonstrated that husbandry choices (Kobelt et al., 2003; Tami et al., 2008) as well as the personality characteristics of both human (Dodman et al., 2018; Kis et al., 2012; Podberscek & Serpell, 1997) and dog (Eken Asp et al., 2015) play an important role.

A consensus exists in the literature regarding associations between husbandry decisions, such as housing conditions (Col et al., 2016; Hsu & Sun, 2010; Marinelli, Adamelli, Normando, & Bono, 2007; Otto et al., 1994; Pérez-Guisado & Muñoz-Serrano, 2009; Takeuchi et al., 2001; Tami & Gallagher, 2009), training (Bennett & Rohlf, 2007; Deldalle & Gaunet, 2014), origin (McMillan et al., 2013; Pirrone et al., 2016; Tiira & Lohi, 2015) and the appearance of undesirable behaviour in dogs.

The influence of personality - defined as traits or characteristics that are unique, relatively stable and influence areas from behaviour to cognition (Jones, 2007; Jones & Gosling, 2005) - has also been considered as having an important role in the development of problem behaviours in the dog (Eken Asp et al., 2015; Farhoody et al., 2018; Hsu & Sun, 2010). Research exploring this association use dog personality questionnaires (Posluns, Anderson, & Walsh, 2017; Temesi et al., 2014), such as the Canine Behavioural Assessment & Research Questionnaire (C-BARQ) (Duffy & Serpell, 2012). The C-BARQ is divided into various subscales, based on evaluation of canine behavioural dimensions, such as aggression, fear, trainability among others. Its use has allowed the identification of some dog personality traits that may compromise dyadic functionality (González-Ramírez et al., 2017; Marshall-Pescini et al., 2008). Accurate across a wide variety of populations and cultures (González-Ramírez et al., 2017; Hsu & Sun, 2010; Marshall-Pescini et al., 2008; Nagasawa et al., 2011; Rosa et al., 2017; Svartberg, 2005; Tamimi et al., 2015; van den Berg et al., 2006) the C-BARQ can be widely used to help identify such pairings.

Studies in human personality have shown that individuals with high scores in the psychoticism scale, tended to integrate a dyad with a dog whose breed is considered "aggressive" (Wells & Hepper, 2012). Similarly, those scoring low on the dimension of Agreeableness, Emotional stability, Extraversion and Conscientiousness tended to be paired with dogs that had higher scores in C-BARQ subscales associated with aggression (Dodman et al., 2018; Podberscek & Serpell, 1997). In the same way as the C-BARQ, the Eysenck

Personality Questionnaire – Revised (EPQ-R) is used to evaluate the three fundamental human personality dimensions: Neuroticism, Extraversion, Psychoticism and includes a Lie/social desirability scale (Almiro, Marques-Costa, & Simões, 2014). It can also be used to define the personality of human members of suspected problem dyads.

Recently our research group conducted an exploratory study on a sample population of 1385 dog owners to evaluate the possibility of pre-emptively identifying dysfunctional dyads. Each owner was asked simple questions regarding their experience with caring for dogs. Multiple Correspondence Analyse (MCA) of the data suggested that such identification is possible. Owners reporting having had at least one dog involved in a vehicular accident, that had suffered a trauma or was bitten, suggests the presence of a dysfunctional dyad (Canejo-Teixeira, Neto, Baptista, & Niza, 2017). It follows that identifying dogs with these occurrences in their health histories may be a way to identify, and therefor study, dysfunctional human-dog dyads within a wider population before the consequences of the dysfunction are felt.

This study set out to explore the possibility that knowledge of specific dyadic characteristics can predict whether it may be, or may become, dysfunctional. To our knowledge this is the first time that pre-emptive identification of dysfunctional dyads has been attempted. Such an approach would allow for a reduction of dog related problems (bites, relinquishment, etc.) through the implementation of appropriate educational protocols both at the clinical and governmental level, while being a useful tool for use in matching human and dog within adoption contexts.

6.3 Materials and Methods

6.3.1 Participants

All human participants in this study where over 18 years of age and residents and/or citizens of Portugal and was required to have owned a minimum of one dog. Individuals were invited to participate in this study after having demonstrating interest in continuing to collaborate with the authors after an earlier study (Canejo-Teixeira et al., 2017).

6.3.2 Instruments

An extensive questionnaire was created and divided into two distinct sections. In the first section participants were asked about a dog that they had cared for to which they felt particularly attached. The questions referred exclusively to that dog (sex, age, size and breed), husbandry practices (diet and place of purchase, housing conditions, etc) and simple health care history (last veterinary visit, correct vaccination, deworming, etc). Owners were also asked whether the dog suffered acute illness, chronic illness or unspecified trauma; if the dog

had been in a motor vehicle accident, been bitten, had bitten another animal or person, and if the dog had been submitted to euthanasia. If any such occurrence was identified, further questions regarding the incident were asked, such as frequency and location. Subsequently, owners were asked to complete the European Portuguese C-BARQ (article submitted, psychometric properties available), a 78-item and 13-factor instrument based on the original Duffy and Serpell (2012). The questionnaires´ 78 items ask owners to assess their dogs' reactions in everyday situations and score them on a Likert-type 5-point scale in terms of frequency (0 representing "never", 4 representing "always") and in terms of severity (0 indicating "no sign of the behaviour" and 4 "indicating severe demonstrations of the behaviour").

The second section concerning the owners probed sociodemographic (sex and age), educational and economical condition (employment status), family make up (presence of children/seniors in the household), as well experience with dog ownership. Lastly, participants were asked to complete the Portuguese EPQ-R, which evaluates personality dimensions. The instrument consists of 70 items on a dichotomous scale, distributed in 4 dimensions: Neuroticism (23 items), Extroversion (20 items), Psychoticism (9 items) and includes a Lie/Social Desirability scale (18 items) (Almiro et al., 2014).

6.3.2 Procedure

Participants were invited to complete the questionnaire online, using Google Forms ™, or by telephone, during an 8-month period. All data was collected following the principles of confidentiality and included a valid consent statement. It was possible to withdraw from completing the questionnaire at any time (British Psycholgical Society, 2017). Owners were instructed to fill out the questionnaire as completely as possible.

6.3.3 Statistical Analysis

Data was analysed using inferential statistics using the Qui-Squared test of independence, Fisher Exact test, Manova and logistic regression. The qui-square assumption of never having more than 20% of cells with expected frequencies less than 5 was analysed and in cases where the assumption was not met, the Monte Carlo simulation was used. Differences were analysed using adjusted standard residuals. All statistical analysis was carried out using IBM SPSS® Statistics version 24 (IBM Corp., Armonk, NY).

6.4 Results

6.4.1 Population and Response Rates

The canine population in this study was diverse and is detailed in table 1 while the husbandry conditions are shown in figure 5 and 6. The human population is categorized in table 9. Relevant response rates for each section are detailed in table 10, the sections pertaining to deworming, ectoparasite prevention, last veterinary visit and vaccination history had the lowest response rates with 79.2%, 78.4%, 76.9% and 75.7% respectively. Response rates for each C-BARQ factor were excellent with Dog Rivalry (DR) having the lowest response rate (89%) and Owner-directed aggression (ODA), Dog-directed fear (DAF) and Energy Level (EL) the highest (99.6%).

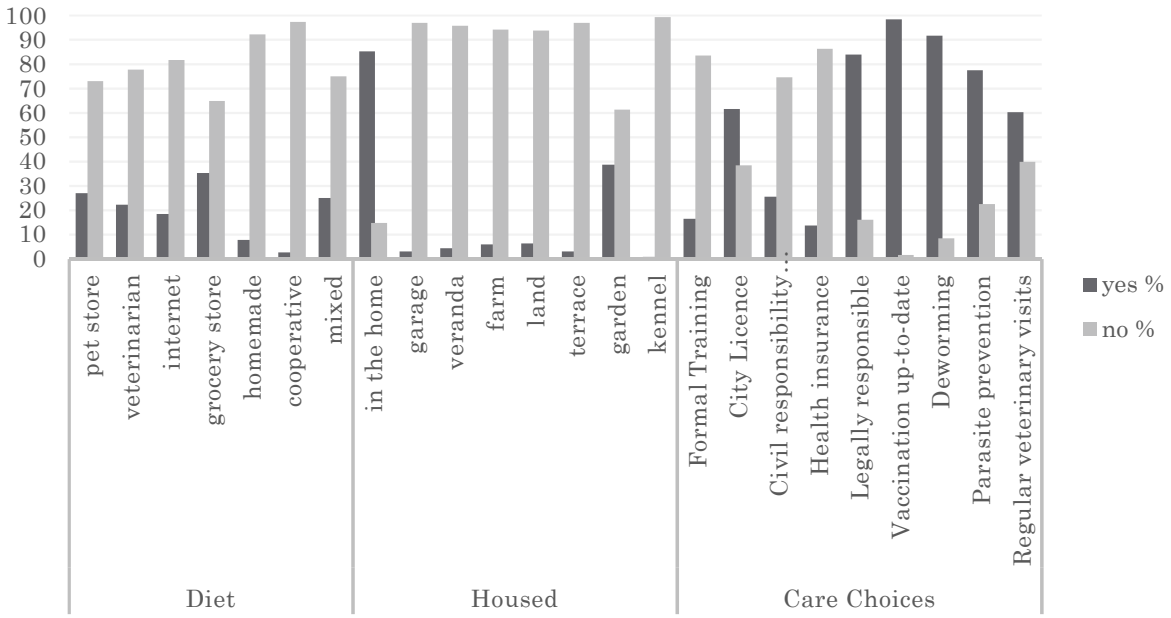

Figure 5: Husbandry and health care conditions reported for the canine populations in study (N=255).

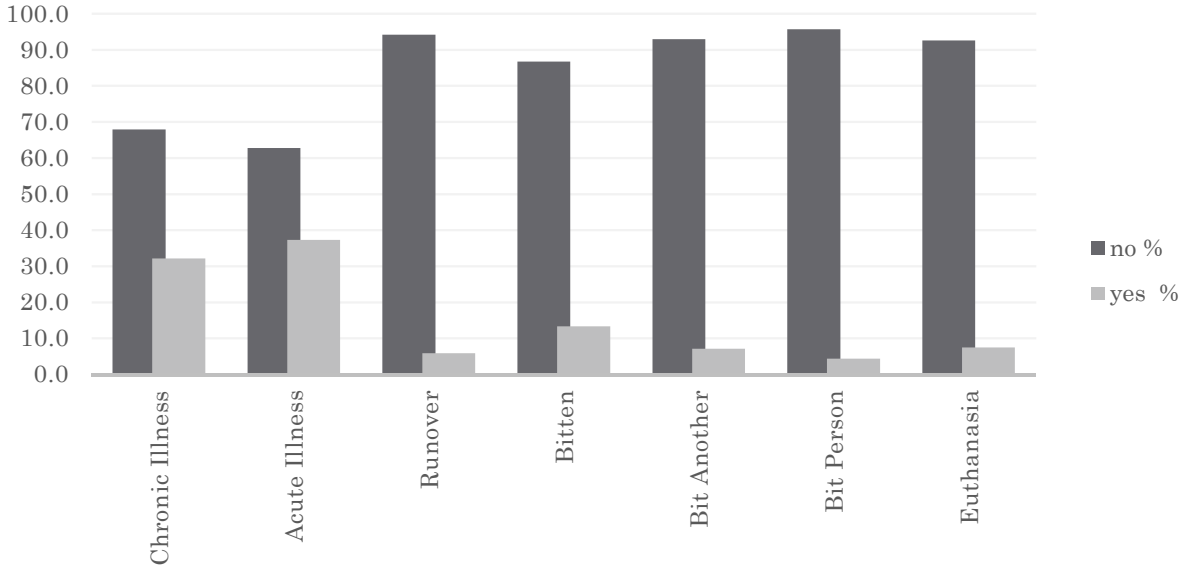

Figure 6: Owner reported canine health occurrences (N=255).

Table 9: Demographic characteristics for the canine population (N=255).

		N	%
Sex	Female	59	23.1
	Male	94	36.9
	Sterilized Female	67	26.3
	Sterilized Male	35	13.7
Age	<1 yr	15	5.9
	1 - 5 yr	100	39.2
	>5 - 10 yr	63	24.7
	>10 - 13 yr	62	24.3
	> 14 yr	15	5.9
Size	0 -10 kg	69	27.1
	11 -25 kg	109	42.7
	26 - 44 kg	68	26.7
	> 44 kg	9	3.5
Breed Category	mixed breed	120	49.6
	sporting	36	14.9
	hound	13	5.4
	pastoral	13	5.4
	Terrier	7	2.9
	Toy	17	7.0
	Utility	19	7.9
	working	17	7.0
Origen	Foundation	23	9.0
	Municipal Kennel	12	4.7
	Breeder	76	29.8
	Third party	83	32.5
	Found	50	19.6
	Pet Store	5	2.0
	Born at home	6	2.4

Table 10: Response rates for each section of the full questionnaire.

		Response Rate (%)	Missing (N)
Dog	Sex	100	0
	Age	100	0
	Weight	100	0
	Breed	94.5	14
	Vaccination	75.7	62
	Deworming	79.2	53
	Parasite prevention	78.4	55
	Regular veterinary visits	76.9	59
C-BARQ	SDA	98.4	5
	ODA	99.6	2
	DDF	99.6	2
	DR	89	29
	TR	98	6
	CH	97.6	7
	SDF	99.2	3
	NSF	98.4	5
	SRP	98	6
	TS	91.4	23
	EX	98.8	4
	AAS	98.8	4
	EL	99.6	2
Tutor	Sex	100	0
	Age	100	0
	Education	100	0
	Employment Status	100	0
	Children*	100	0
	Seniors*	100	0
Dog health issue	Chronic illness	100	0
	Acute illness	100	0
	Vehicular accident	100	0
	Bitten	100	0
	Bit Another	100	0
	Bit Person	100	0
	Euthanasia	100	0

*if children (<18 years of age) or seniors (>65 years of age) are present within the nuclear family

6.4.2 C-BARQ and EPQ-R

Descriptive statistics for the C-BARQ are detailed in table 11. The highest scores mean scores were obtained in Energy level (2.7), Trainability (2.6), Attachment/Attention seeking (2.4) and Excitability (2.3) subscales, while the lowest mean scores were seen in Dog rivalry (0.4), Stranger-directed fear (0.5) and Stranger-directed aggression (0.5) subscales. Descriptive statistics for the EPQ-R can be found in table 12, with the highest mean score in the Extraversion/Introversion personality dimension (12.00) and the lowest mean score in the Psychoticism/Socialisation personality dimension (0.73).

Table 11: C-BARQ descriptive statistics.

Subscales	*N*	Min	Max	*M*	*SD*	Skewness	Kurtosis
Stranger-directed aggression (SDA)	251	0.00	3.10	0.55	0.65	1.57	2.52
Owner-directed aggression (ODA)	254	0.00	2.67	0.18	0.39	3.63	15.47
Dog-directed fear (DAF)	254	0.00	4.00	1.00	0.80	1.06	1.01
Dog rivalry (DR)	227	0.00	4.00	0.43	0.74	2.50	6.90
Trainability (TR)	250	1.14	4.00	2.58	0.59	-0.29	-0.33
Chasing (CH)	249	0.00	4.00	1.70	1.20	0.30	-1.02
Stranger-directed fear (SDF)	253	0.00	3.75	0.49	0.72	2.00	4.42
Non-social fear (NSF)	251	0.00	3.29	0.88	0.70	0.92	0.24
Separation-related problems (SRP)	250	0.00	3.25	0.61	0.58	1.28	2.05
Touch sensibility (TS)	233	0.00	4.00	0.69	0.77	1.38	2.03
Excitability (EX)	252	0.00	4.00	2.30	0.87	-0.21	-0.53
Attachment/Attention Seeking (AAS)	252	0.33	4.00	2.36	0.71	0.15	-0.29
Energy level (EL)	254	0.00	4.00	2.72	1.01	-0.57	-0.47

Table 12: EPQ-R descriptive statistics (N=255).

Personality Dimensions	*M*	*SD*	Min.	Max.	Skewness	Kurtosis
Neuroticism (23 items)	9.78	5.686	0	23	0.305	-0.851
Extraversion (20 items)	12.00	4.193	0	20	-0.341	-0.455
Psychoticism (9 items)	0.73	1.025	0	7	1.943	5.992
lie/social desirability (18 items)	10.30	3.305	1	18	-0.044	-0.631

6.4.3 Classification of Dysfunctional Dyads

Based on previous research, dysfunctional dyads where found by identifying owners who signalled their dog had had at least one of the following health issues: vehicular trauma, been bitten, bit another animal or bit a person (table 13). The resulting new nominal variable, named dysfunctional dyad, resulted in a total of 59 dysfunctional dyads (23.1% of the population) and 196 functional dyads (76.9% of the population).

Table 13: Breakdown of the total number of dog health occurrences reported grouped by quantity (N=255).

nº of dog health occurrences reported	*N*	%
0	196	76.86
1	43	16.86
2	14	5.49
3	1	0.39
4	1	0.39

6.4.4 Dysfunctional Dyads

There were statistically significant different distributions between owners in functional and dysfunctional dyads when considering general husbandry practices. Owners classified as being a part of dysfunctional dyads reported feeding diets purchased at agriculture cooperatives significantly more than those in functional dyads (8.5% vs 0.5%, Fisher´s exact test, p=0.003). The same is true for the housing conditions Veranda (10.2% vs 2.6%, Fisher´s exact test, p=0.021) and Land (13.6% vs 4.1%, Fisher´s exact test, p=0.014). No other husbandry practices were found to be significantly different between the two groups (table 14).

Table 14: Differences between owners in functional and dysfunctional dyads when considering general husbandry practices (Fisher´s Exact Test).

		Functional Dyad		Dysfunctional Dyad		
		N	%	N	%	Sig.
Diet	pet store	55.00	28.10	14.00	23.70	0.62
	veterinarian	47.00	24.00	10.00	16.90	0.29
	internet	36.00	18.40	11.00	18.60	1.00
	grocery store	68.00	34.70	22.00	37.30	0.76
	homemade	14.00	7.10	6.00	10.20	0.42
	cooperative	1.00	0.50	5.00	8.50	.003**
	mixed	50.00	25.50	13.00	22.00	0.73
Housed	in the home	172.00	0.88	46.00	0.78	0.09
	garage	5.00	0.03	3.00	0.05	0.39
	veranda	5.00	0.03	6.00	0.10	.021*
	farm	8.00	0.04	7.00	0.12	0.05
	land	8.00	0.04	8.00	0.14	.014*
	terrace	5.00	0.03	3.00	0.05	0.39
	garden	75.00	0.38	24.00	0.41	0.76
	kennel	2.00	0.01	0.00	0.00	1.00

* p < .05 ** p < .01 *** p < .001

When considering each individual dogs characteristics (sex, age, breed category and origin), individual owner socio-economic condition and dog care choices (such as deworming) no significant differences were found between dysfunctional and functional dyads.

Multivariate MANOVA analysis of dyad type and C-BARQ subscales was marginally significant ($F(13, 185) = 1{,}671$, $p = 0.070$), with significant differences between functional and dysfunctional dyads. When it came to the ODA, DAF, DR and EL subscales, dogs classified as belonging to dysfunctional dyads had significantly higher scores on the ODA ($F(1, 197) = 5.575$, $p = 0.019$), DAF ($F(1, 197) = 5.137$, $p = 0.025$), and DR ($F(1, 197) = 10.039$, $p = 0.002$) subscales while having significantly lower EL scores ($F(1, 197) = 5.199$, $p = 0.024$).

Analysis of dyad type and EPQ-R score via multivariate MANOVA revealed that at least one owner personality dimension was significantly different between the two groups of owners ($F(4, 250) = 6.292$, $p = 0.001$). Individuals classified as belonging to dysfunctional dyads presented significantly higher levels of neuroticism ($F(1, 253) = -2.096$, $p = 0.037$) and lower levels of lie/social desirability ($F(1, 253) = 4.767$, $p = 0.037$).

6.4.5 Logistical Regression Analyses

Two models where tested, the first aimed to evaluate the predictive value of all significant findings while the second only considered those variables that would be accessible to a veterinarian in a clinical setting. As such, the first model (Predictive Dysfunction with Dog and Owner Characteristic - PDDOC) considered significant husbandry variables relating to housing choices (Home, Veranda, Farm and Land) and one relating to diet place of purchase (cooperative). It also contemplated owner personality dimensions (neuroticism and lie/social desirability) and subscales within the C-BARQ found to be significant (ODA, DAF, DR and EL). Since it is highly unlikely that most owners would be willing to complete the EPQ-R in a veterinary clinic or hospital setting it was important to test how the inclusion of only dog centred variables would change the first model. As a result, the second model arose (Predictive Dysfunction with dog characteristics - PDDC) including only those husbandry and C-BARQ variables found to be significant.

The PDDOC model correctly classified 79.7% of the dysfunctional dyads, superior to 78% when the null model was used ($x^2=46.423$, $df= 5$, $p<0.001$). This model shows that within the study population, those dogs whose diet is purchased in agricultural cooperatives, housed on a plot of land, with higher values within the DAF but lower values on the EL C-BARQ subscales and owners with low lie/social desirability EPQ-R scores have an increased probability of being part of a dysfunctional dyad (table 15 and 16).

Table 15: Logistic Regression Analysis to evaluate Predictive Dysfunction with dog and owner characteristic in the model.

Predictor	β	S.E.	Wald	df	*p*	odds ratio	95% C.I. for EXP(B) Lower	Upper
Diet: Cooperative	2.160	1.210	3.185	1	0.074	8.669	0.809	92.899
Housed: Land	1.353	0.641	4.456	1	0.035	3.870	1.102	13.595
DAF	0.578	0.210	7.590	1	0.006	1.783	1.182	2.690
EL	-0.482	0.176	7.483	1	0.006	0.618	0.437	0.872
lie/social desirability	-0.258	0.062	17.559	1	0.000	0.772	0.684	0.871

Note: DDF=Dog-directed Fear, EL=Energy Level. Cox and Snell R^2=0.185. Nagelkerke R2=0.284. Hosmer & Lemeshow goodness of fit x2=6.900, df=8, p=0.547

Table 16: The Observed and the Predicted Frequencies for Dysfunctional Dyads in the Predictive Dysfunction with dog and owner characteristic model (cutoff=0.50).

Observed		Predicted Dysfunctional Dyad: Functional	Predicted Dysfunctional Dyad: Dysfunctional	Percentage Correct
Dysfunctional Dyad	Functional	171	6	96.6
	Dysfunctional	40	10	20.0
Overall Percentage				79.7

The PDDC model was able to correctly classify 80.2% of the dysfunctional dyads, slightly superior both to PDDOC model (79.7%) and to the null model (x^2=25.753, df= 4, p<0.001). In this model those dogs whose diet is purchased in agricultural cooperatives, with higher scores on DAF and DR but lower scores on EL subscale have an increased probability of being part of a dysfunctional dyad (table 17 and 18).

Table 17: Logistic Regression Analysis to evaluate Predictive Dysfunction with dog characteristics in the model.

Predictor	β	S.E.	Wald	df	*p*	odds ratio	95% C.I. for EXP(B) Lower	Upper
Diet: Cooperative	3.032	1.165	6.771	1	0.009	20.736	2.113	203.490
DAF	0.463	0.209	4.891	1	0.027	1.589	1.054	2.395
DR	0.394	0.211	3.487	1	0.062	1.484	0.981	2.244
EL	-0.346	0.164	4.434	1	0.035	0.708	0.513	0.976

Note: DDF=Dog-directed Fear, DR=Dog rivarly, EL=Energy Level. Cox and Snell R2=0.107. Nagelkerke R2=0.165. Hosmer & Lemeshow goodness of fit x2=8.693, df=8, p=0.369.

Table 18: The Observed and the Predicted Frequencies for Dysfunctional Dyads in the evaluate Predictive Dysfunction with dog characteristics model (cutoff=0.50).

Observed		Predicted Dysfunctional Dyad Functional	Dysfunctional	Percentage Correct
Dysfunctional Dyad	Functional	173	4	97.7
	Dysfunctional	41	9	18.0
Overall Percentage				80.2

To evaluate each of the models goodness of fit, ROC curves where obtained (figure 7 and table 19). Both models can be considered fair having AUC >0.700 (Anderson, Jin, & Grunkemeier, 2003; Park, 2013; Stoltzfus, 2011) suggesting that both models can be used to predict which dyads maybe dysfunctional in a given population.

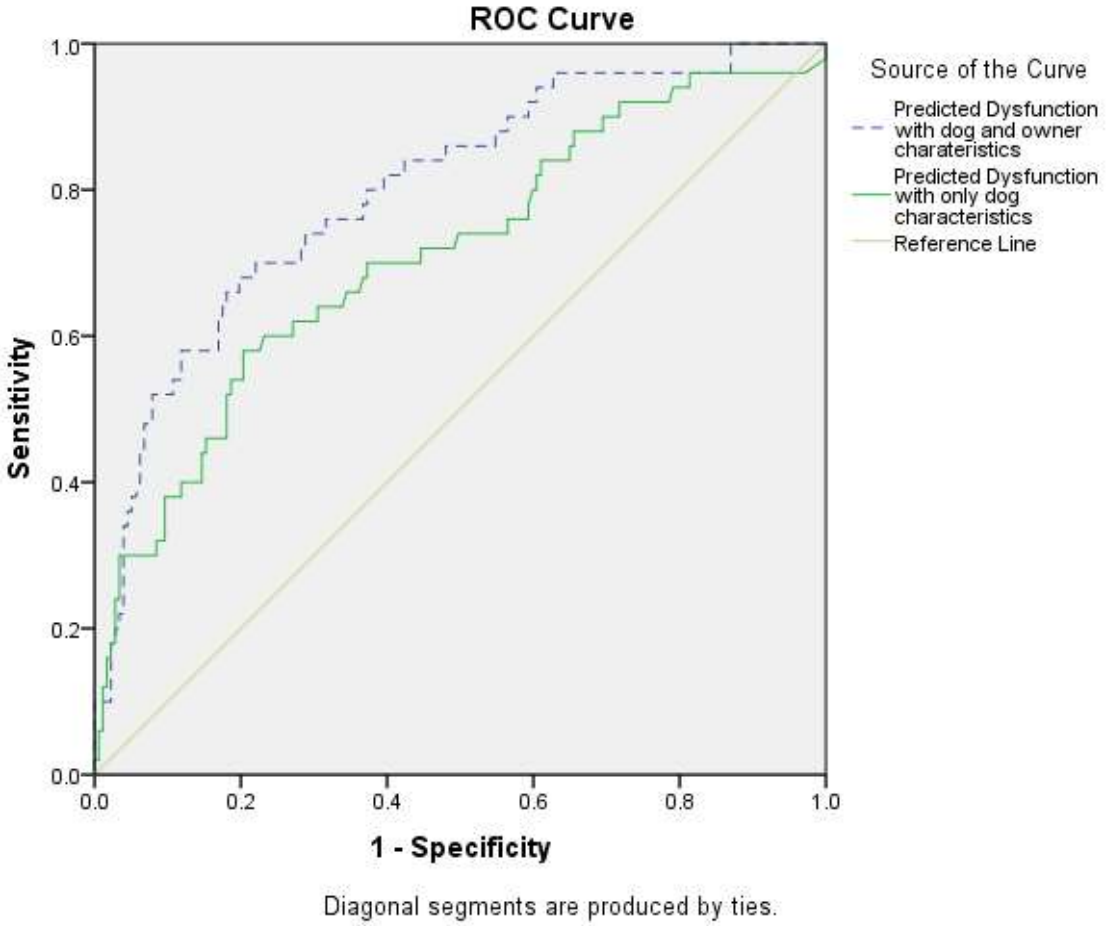

Figure 7: Comparison of ROC curves generated for both predictive models in study.

Table 19: Receiving Operating Characteristic (ROC) curve results comparing predictive value of the two models in analysis.

				95% Confidence Interval	
	AUC	*SD*	*p*	Lower	Upper
PDDOC model	0.799	0.036	0.000	0.729	0.870
PDDC model	0.711	0.044	0.000	0.625	0.797

Note: PDDOC= Predicted Dysfunction with dog and owner characteristics,
PDDC= Predicted Dysfunction with only dog characteristics.

6.5 Discussion

Functional human-dog dyads can be extremely beneficial to each member of the partnership (Bennett & Rohlf, 2007; Black, 2012; Christian et al., 2014; D. Wells, 2011) and to society as a whole (Davis et al., 2004; Endenburg & van Lith, 2011; Greatbatch et al., 2015; Hart et al., 2000), but when these dyads become dysfunctional dog-related problems can occur. It is clear that various factors can influence the development of canine behavioural problems (Payne et al., 2015), such as husbandry choices (Kobelt et al., 2003; Tami et al., 2008) and personality types of both partners (Dodman et al., 2018; Harvey et al., 2016; Kuroshima et al., 2016; van den Berg et al., 2006). Since these behavioural problems are often hallmarks of dysfunctional dyads, it makes sense to think that certain characteristics may be more prevalent in these dyads. This study set out to evaluate how the knowledge of these variables can help predict the functionality of human-dog dyads to pre-emptively identify and prevent or correct them before their negative impact can be felt.

Previous work conducted by our study group suggested that dogs with involvement in vehicular accidents, unspecified trauma or biting incidences in their healthcare histories may be part of dysfunctional dyads, whereby the current study population was divided in two groups: those that had these experiences and those that had not. The significant differences found here between the two groups give credence to the possibility of pre-emptive identification of dysfunctional human-dog dyads.

Owners belonging to dysfunctional dyads reported feeding diets purchased at agricultural cooperatives, generally considered less expensive, significantly more than functional ones. It has been reported that the more bonded a human is to their dog, the more money they are willing to spend on its care (Brockman, Taylor, & Brockman, 2008; Cote, 2008; Hsee & Kunreuther, 2000). It is then probable that the choice of diet quality reflects on the connection between the two dyadic members

Similarly, canine housing choices where different between functional and non-functional dyads. In fact, in dysfunctional dyads dogs are significantly more likely to be housed in places that do not require special preparation or investment, namely verandas and plots of land, which once more may translate into poor bonding between owner and dog. Although it has been suggested that housing dogs in kennels is a sign of weak human-dog bonds (Denham, Bradshaw, & Rooney, 2014; Fielding & Plumridge, 2005; Marston & Bennett, 2003), the results of this study do not bear this out, since there was no significant difference between the two dyadic groups. While housing dogs in kennels can create physical distance between the two dyadic partners, a contributor to dysfunction (Chung et al., 2016; Kobelt et al., 2003), it

often implicates a great deal of time, energy and money spent in their care, factors associated with strong bonds (Diverio, Boccini, Menchetti, & Bennett, 2016; Dotson & Hyatt, 2008). These owners may increase their bond in other ways, such as spending more time with their dogs (Rooney & Bradshaw, 2003; Sommerville, O'Connor, & Asher, 2017; Tami et al., 2008).

This study found that in dysfunctional dyads owners had lower lie/social desirability scores. Previous studies have suggested that owners with characteristics associated with this personality dimension have dogs that manifest aggressive owner and stranger directed behaviour (Dodman et al., 2018; Podberscek & Serpell, 1997; Ragatz et al., 2009). Since one if the parameters used in our study to classify dysfunctional dyads was the presence of various kinds of aggressive canine behaviour, these findings are not surprising. The present study also found that owners of dysfunctional dyads had higher neuroticism scores, which corroborates earlier findings (Dodman et al., 2018; Wells & Hepper, 2012). The current study reinforces the fact that owner personality has an important role in dog behaviour (Payne et al., 2015).

In literature the emergence of behaviour problems is associated with excess energy, are a common reason for relinquishment, abandonment and even euthanasia of dogs (Col et al., 2016; Diesel et al., 2010; Khoshnegah, Azizzadeh, & Mahmoodi Gharaie, 2011; New et al., 2000), negative consequences associated with dysfunctional dyads. Unexpectedly, our results are not in line with these findings, since dogs in these dyads presented lower scores. However, it must be considered that in order to adequately respond to three items on the EL C-BARQ subscale, frequent owner interaction with their dog is required (for example one of the items is "will fetch or attempt to fetch sticks, balls, or objects") and, as previously discussed, we have related separate housing conditions to dysfunctional dyads.

We observed that dogs in dysfunctional dyads had higher scores on ODA, DAF and DR subscales. These results were expected, since occurrences that allowed for the grouping of dyads were precisely incidences involving aggressive behaviour. Nevertheless, it is important to keep in mind that dog aggressive behaviour may be influenced by the personality of the owner.

The common characteristics we found in dysfunctional dyads became more relevant if they show predictive capacity. In order to evaluate this possibility, we conducted logistical regression analyses on two different models. The first model, PDDOC, considered all the significant differences found between dysfunctional and functional dyads. The model generated demonstrated high sensitivity in predicting potential dysfunctional dyads (figure 3) where the variables included in the model were husbandry choice namely diet place of purchase and housing condition, C-BARQ subscales of DAF and DR, and EPQ-R lie/social

desirability dimension. Within the context of shelter medicine, asking potential adopting owners questions regarding how they will care for their new dog, knowing the C-BARQ subscales scores and the human EPQ-R score, a predictive probability is obtained for whether the resulting dyad will be dysfunctional, and therefor improve the human-dog paring process (Jones & Gosling, 2005; King et al., 2012; McMillan, 2017; Payne et al., 2015; Rehn & Keeling, 2016; Stephen & Ledger, 2007; Taylor & Mills, 2006; Turcsán, Range, Virányi, Miklósi, & Kubinyi, 2012).

Within a clinical context however, this model is difficult to apply, since it requires that the owner complete the EPQ-R which they may be unwilling to do because of the personal nature of the questions. Due to this fact, we conducted a second logistical regression analyses on a model that contained only the significant variables that could be reasonability obtained within a clinical context. The second model generated, PDDC, also demonstrated high sensitivity in predicting potential dysfunctional dyads (figure 3), where the variables included in the model were the husbandry, choice of diet place of purchase and C-BARQ subscales of DAF, DR and EL. By requiring owners to complete a C-BARQ questionnaire, and taking a complete medical history (McGreevy & Masters, 2008), a veterinarian can obtain a probability of a dyad being dysfunctional. The application of this model could provide information about owner dog care commitment, since it has been suggested that human members of dysfunctional dyads are less careful with their dogs' health care (Bennett & Rohlf, 2007; Pulczer et al., 2013; Siracusa et al., 2017; Slater, 2001). This knowledge would allow clinicians to make appropriate therapeutic choices (ex. frequency and route of administration) and take preventative action before serious consequences, such as dog aggression, occur.

Although more studies are needed to evaluate the applicability of these results in a wider and more varied populations, this study shows that a more proactive approach to dealing with dysfunctional dyads is possible and lays out simple methods that can be easily applied.

Chapter VII: Discussion

7.1 General Discussion

Dysfunctional human-dog dyads are unavoidable due to man's proximity to dogs. While it is true that the evolution of this relationship has led to an ever-increasing list of benefits for man (Barker et al., 2003; González Ramírez & Landero Hernández, 2014) it is also responsible for increased negative consequences when the relationships go awry (Casey et al., 2014; Dalla Villa et al., 2010; Mustiana et al., 2015). Dog behavioural problems, which directly result from dyad dysfunction, can have serious consequences ranging from incidences of canine aggression (Kahn et al., 2003; Matthias et al., 2015; Oxley, Christley, & Westgarth, 2018) to broad public health concerns (Cito et al., 2016). Studies point to inappropriate caregiving behaviour as the root of dyadic dysfunction, with dogs resorting to problem behaviour in efforts to solicit appropriate owner caregiving responses (Rehn & Keeling, 2016). Although researchers have attempted to identify the predisposing conditions that lead to inappropriate owner caregiving choices (Col et al., 2016; Takeuchi et al., 2001) and to dog unwanted solicitation behaviour, few studies have employed an approach that incorporates both parties in the human-dog dyad (Rehn & Keeling, 2016). In fact, studies have focused on the resulting consequences of existing and past problematic dog behaviour (Beverland, Farrelly, & Lim, 2008; Casey et al., 2014; Coe et al., 2014; Fielding, 2010; Le Brech et al., 2016; Marston et al., 2004, 2010; Pérez-Guisado & Muñoz-Serrano, 2009; Rezac et al., 2015; Weng et al., 2006). Such approaches have limited the usability of data within the context of programs to prevent or correct dysfunction.

This study focuses on identifying characteristics that are common to dysfunctional dyads, with emphasis on pre-emptively identifying such problematic partnerships. The researcher intends for this work to assist with perfecting such an approach. This analysis will permit the development of targeted prevention programs, improved veterinary involvement, and better human-dog matching.

7.2 Identifying Common Characteristics of Dysfunction in Dog Health Care Histories

The most challenging aspect of any attempt to study dyadic dysfunction is the identification process, with the most common form of detection being based on the occurrence of problem behaviours displayed by the dog (Oxley et al., 2018). Although the presence of problem canine behaviours suggests that the dyad in question is a dysfunctional one, identification at

that stage makes preventative measures inconsequential. Ideally, identification should take place based on the potential for problem behaviour, rather than once problem behaviours are actively in place (Bennett & Rohlf, 2007). Since owners within dysfunctional dyads may be reluctant to self-identify (Bennett & Rohlf, 2007; Calvo et al., 2016), an alternative method of dyadic recognition is required for the facilitation of studies of pre-emptive identification.

The most obvious sources of data for markers of dysfunction would be a dog's health care history and information regarding the events that have taken place during the dog's lifetime. Owners could be asked about their dog's health, allowing for an evaluation of dysfunction without the owner's awareness that that such a label was being applied. Owners who were aware of the fact that they were being assessed for the dysfunction of their relationships with their dogs might condition their responses on factors such as social stigma (Coe et al., 2014; Ferrando, 2008) or the fear of legal consequences (Assembleia da República, 2017).

To mitigate such concerns, a simple, non-threating, one-page questionnaire to identify occurrences within a single owner's experience with dog health care was developed. The instrument was then distributed widely (clinics and hospitals) within the metropolitan areas of Lisbon, Portugal, and also was made available online. Since it has been shown that self-selecting groups are subject to bias (McGreevy & Masters, 2008; Shabelansky & Dowling-Guyer, 2016; Tiplady, Walsh, & Phillips, 2012), the owners who accessed the instrument online may be more motivated and therefore less likely to be members of dysfunctional dyads. As a result, a conscious attempt was made to include municipal rabies campaigns and clinics in unfavourable areas of the city in the distribution of the instruments, thereby minimizing the influence on results that might otherwise have been exerted by the self-selected nature of the internet sample.

Due to the exploratory nature of the data obtained, MCA analysis was chosen as the method of identifying groupings within these health histories, with the large sample size providing a robust evaluation (Di Franco, 2016). The analysis made it possible to identify specific occurrences within dog healthcare histories that suggested dyadic dysfunction. Partnerships with dogs that had been bitten, that had suffered traumas, or that had been involved in vehicular accidents were flagged as potentially dysfunctional human-dog dyads. These findings identified problematic dyads based on easy-to-obtain canine clinical history, thereby facilitating pre-emptive identification of potential dysfunction.

7.3 Gathering Information Dyadic Characteristics

After demonstrating that dysfunctional dyads could be pre-emptively identified without compromising owner responses, the next phase of the project was initiated – gathering information about individual dyadic members. Since gathering the greatest amount of data possible was one of the objectives, a citizen science approach was used (Hecht & Spicer Rice, 2015). This relied on participation by members of the general population who may not have had any previous experience with the subject matter under investigation (Fratkin et al., 2015; Wiener & Haskell, 2016). Many studies have relied on this form of information gathering (Bennett & Rohlf, 2007; Kubinyi et al., 2009; Lakestani et al., 2011; Lit, Schweitzer, & Oberbauer, 2010; Rayment et al., 2016; Shabelansky & Dowling-Guyer, 2016). Questionnaires have proven to be reliable sources of information so long as the researcher bears in mind the self-reporting nature of the data obtained.

7.3.1 Owner Characteristics

7.3.1.1 Demographics

Overall, few difficulties where encountered when gathering information regarding owner characteristics. Economic status information was obtained by asking for employment status rather than actual income, as participants may have been tempted to provide misleading information (Coe et al., 2014). Therefore, economic status within the context of this project was inferred rather than established. It is important to note that no attempt was made to verify the information provided by the owners. Although it has been suggested that human subjects are sometimes less than truthful when responding to questionnaires, studies have rejected such suggestions (Cull, O'Connor, Sharp, & Tang, 2005; Johnson et al., 2014; Leeuw, 2005; Siemiatycki, 1979). Subjects actually tend to be truthful, especially when anonymity is guaranteed, as it was in this case (Perneger et al., 2014; Segurson, Serpell, & Hart, 2005). There was no information provided that would allow for the identification of particular individuals.

7.3.1.2 Owner Personality

A wide variety of human personality questionnaires are available, either based on the FFM or on the Eysenck model. A full discussion of the various questionnaires and how each relates to the others is outside the scope of this work, as is a full exploration of the two models and how they are used. It is important to note, however, that when human personality is evaluated

within the context of human-dog dyads, the same methodology is not used. For the purposes of this study, the EPQ-R was chosen for assessing owner personalities since it has been successfully validated in Portuguese (Almiro et al., 2014). Since linguistics are incredibly important in correctly classifying personality (McCrae & John, 1992), it would have been inappropriate to choose an unvalidated questionnaire in a foreign language, such as the NEO-PI. Since the three dimensions and the one scale used in the Eysenck model correspond with those of the FFM, the use of the EPQ-R allowed for comparisons between owner personalities within the pre-emptively identified dysfunctional dyads and within those proven to be dysfunctional in the literature (McCrae & John, 1992; O'Connor, 2008).

Most owners filled out this part of the questionnaire without any problem. There were, however, a few who recognized the nature of the instrument and refused to complete it. This clearly showed that it would be difficult to classify owner personality within a clinical context, since it is possible that some individuals would refuse to provide the necessary information.

7.3.2 Dog Characteristics

7.3.2.2 Demographics

No difficulty was encountered in soliciting canine demographic information. As with owner demographic information, the researcher did not take steps to confirm canine demographic information. The clarification of this point is important since owners are not reliable sources of breed information (Cornelissen & Hopster, 2010; Ozanne-Smith et al., 2001). Although some studies have made use of breed photographs to improve such classification (Cornelissen & Hopster, 2010), it was decided not to apply such a strategy here. Since a wide population was asked to participate, it would have greatly increased the complexity of the questionnaire given the large number of recognized dog breeds. British Kennel Club breed categories were used to group breed information to facilitate comparisons to existing studies.

7.3.2.3 Canine Personality

None of the existing dog personality questionnaires described within the literature have been validated for European Portuguese. As with human personality, the evaluation of dog behaviour depends on the owners' understanding of the terms used (González-Ramírez et al., 2017). For the purposes of this study, the C-BARQ was chosen because it has been validated across the greatest variety of languages and cultures (González-Ramírez et al., 2017; Hsu & Sun, 2010; Marshall-Pescini et al., 2008; Nagasawa et al., 2011; Rosa et al., 2017; Svartberg, 2005; Tamimi et al., 2015; van den Berg et al., 2006).

The resulting psychometric properties of the European Portuguese C-BARQ (table 7 and 8) reinforce the stability of the C-BARQ. The slight differences found – namely when it came to the differentiation of DDF and DDA subscales – can be attributed to the recent acceptance of the dog as an integral member of the family in Portugal. The differences found in the TR and TS subscales, however, may not have a solely cultural basis. Both of the items that incorrectly loaded in the European Portuguese C-BARQ (Duffy & Serpell, 2012) described behaviours that were very different from the rest of the items on the subscale. As such, it is possible that they reflect problems with the conception of the phrasing of the questionnaire.

Regardless of the small differences detected in the European Portuguese C-BARQ, the structure of the resulting questionnaire remained enough like the others in use to permit successful comparisons between personality traits of dogs in the current study with dogs described in the literature (González-Ramírez et al., 2017; Hsu & Sun, 2010; Tamimi et al., 2015).

7.4 Characteristics of Pre-emptively Identified Dysfunctional Dyads

As postulated, it was possible to identify specific characteristics common to pre-emptively identified dysfunctional dyads. Many of these characteristics have in fact been shown to exist in dyads proven to be problematic. However, when it came to the demographic characteristics of both owners and dogs, while other studies have shown definite tendencies within dysfunctional dyads (Eken Asp et al., 2015; Kubinyi et al., 2009; Pérez-Guisado & Muñoz-Serrano, 2009; Pirrone et al., 2015), no such tendencies were identified in this study population.

In terms of dog personality, those traits associated with aggression and excess energy were found to be characteristics of dysfunction (Col et al., 2016; Khoshnegah et al., 2011). Dogs in problematic dyadic relationships had higher ODA, DDF and DR scores, all traits associated with the display of inappropriate aggressive behaviour (Duffy, Hsu, & Serpell, 2008; González-Ramírez et al., 2017; Rayment et al., 2016). The fact that these canines also had lower EL scores was more unexpected, but this can be attributed to housing conditions since dogs within dysfunctional dyads are more likely to be housed on verandas or plots of land. This arrangement can create distance between owners and dogs, making it difficult for owners to correctly classify their dogs' energy levels.

Physical separation between dyadic members may explain why such dogs develop inappropriate behaviours when faced with unresponsive owners (Marston & Bennett, 2003). Such dogs may try increasingly exuberant behaviours to elicit responses. Like children, (Gulley, Oppenheimer, & Hankin, 2014), dogs may determine that negative attention is better than no attention at all (Waters, Forrest, Peters, Bradley, & Mogg, 2015).

Owners in dysfunctional dyads tended to have higher scores on neuroticism and low scores on lie/social dimensions. This makes sense, since those individuals are considered to have greater affective lability, being more reactive and responding less appropriately to stressors (Furnham, Eysenck, & Saklofske, 2008; Poropat, 2011). In situations where dogs' caregiving solicitations may seem impossible to provide for, these individuals may respond ineffectively or not at all, resulting in escalations of the canine behaviour. In the same way, a low score on the lie/social desirability scale makes sense within the context of dysfunction. This scale measures respondents' tendencies to respond in socially expected ways rather than in ways that align with their true personalities (Callegaro, 2008; Ferrando, 2008). It would be reasonable to expect that owners who are part of dysfunctional dyads might display certain attitudes towards their dogs that would be socially unacceptable, such as physical correction (Hiby, Rooney, & Bradshaw, 2004; O'Connor et al., 2016). Their willingness to admit to this behaviour increases the likelihood of pre-emptively identifying them.

7.5 Predictive Capacity of the Identified Dyadic Characteristics

The pre-emptive identification of dysfunctional dyads is only useful if it can be used on a naïve partnership. To evaluate whether the identified dyadic characteristics have predictive value, logistical regression analyses was performed on two different models.

7.5.1 Predictive Dysfunction with Dog and Owner Characteristic (PDDOC)

The first model was identified for use in situations where owners could be asked to complete the EPQ-R, such as when adopting a new dog or being paired with a service animal (King et al., 2012; Ley et al., 2008; Taylor & Mills, 2006). One of the most serious repercussions of dysfunctional human-dog dyads is the resulting relinquishment and abandonment of problem animals (Fatjó et al., 2015; New et al., 2000). If a way can be found to better match future owners with shelter dogs and service animals, relinquishments could be reduced or even eliminated (Marston & Bennett, 2003).

The PDDOC model proved effective in correctly classifying dysfunctional dyads 79.7% of the time. Use of this model requires information regarding husbandry decisions – namely, where the owner intends to purchase the dog's food and where he or she will house the dog. PDDOC use also requires that dogs eligible for rehoming have a complete C-BARQ classification done since the DAF and EL subscales are included in the model. This could be accomplished by asking relinquishing owners to complete a C-BARQ on the dogs they are giving up (Segurson et al., 2005) or by having shelter staff complete them (Duffy, Kruger, & Serpell, 2014). In much the same way, owner personalities would need to be evaluated using the EPQ-R.

With these values available, potential dysfunctionality could be anticipated. This would allow for the vetting of adoptions, for recommending other animals that would be more appropriate for particular owners, or reconsidering service dog placements. The resulting dyads would be more likely to be functional and would yield benefits to society rather than posing problems.

7.5.2 Predictive Dysfunction with dog characteristics (PDDC)

The identification of dysfunctional dyads is just as important in clinical settings as in the context of shelter medicine. Clinicians face ever-increasing expectations that they should be able to pre-emptively identify dysfunction and be active participants in preventing problem dog behaviour (Roshier & McBride, 2013; Voith, 2009). It is unrealistic, however, to expect veterinarians to instantly recognize problem behaviours, given the inadequacy of veterinary curricula in regards to teaching and learning animal behaviour and ethology (Christiansen & Forkman, 2007; Wickens, 2007). Moreover, since problematic canine behaviour is context dependent (Hsu & Sun, 2010; Figure 1), clinicians may never see the signals that are associated with dysfunction.

Besides these two issues, clinicians bear the responsibility of providing the best possible care to their canine patients, sometimes in spite of their owners (Roshier & McBride, 2013). Understanding owner motivations, therefore, is a critical part of making therapeutic decisions or suggesting complementary diagnostics (Robinson, Brennan, Cobb, & Dean, 2016; Robinson, Dean, et al., 2016). Since it has been suggested that the human members of dysfunctional dyads are generally less motivated owners (Bennett & Rohlf, 2007), identifying such pairings could have profound clinical implications.

Since some study participants refused to complete the EPQ-R, a second model for dealing with such eventualities was tested. The researcher posited that if some owners refuse to complete EPQ-Rs in research settings where anonymity is guaranteed, such individuals would be even less likely to do so within veterinary contexts. The resulting model was even more

successful in identifying dysfunction (80.2%). It contemplated only characteristics easily obtained within clinical contexts – location of diet purchases and C-BARQ scores. Data on diet purchases are simple to obtain when taking full patient histories. Similarly, C-BARQ scores can be obtained when dogs are first seen at clinics or hospitals, with owners asked to complete the questionnaire in the waiting room.

7.6 Conclusions

This research set out to determine whether dysfunctional human-dog dyads could be pre-emptively identified from easily accessed clinical data about the canine members of partnerships. The researcher pursued the study to fill the gap in existing knowledge regarding measures that could prevent dysfunction and to alter the existing focus on addressing dysfunction already posing problems to the human-dog dyads involved and to society at large. With this study, the researcher aims to identify preventative methods including improved owner education and improved human-dog pairing.

After successfully demonstrating that such identification was possible through the use of a simple one-page questionnaire regarding dog healthcare histories, the researcher noted the need to establish identifying characteristics of dysfunctional dyads. Although some studies have identified certain characteristics associated with dysfunction, few researchers have approached the problem from a dyadic perspective. This researcher, therefore, aimed to use well-established and widely used tools to identify dyadic characteristics and to facilitate comparisons between pre-emptive identification and after-the-fact identification that typifies existing literature. This was accomplished, in part, through the development and validation of a European Portuguese C-BARQ.

The researcher first identified specific characteristics common to dysfunctional dyads – diets purchased at agricultural cooperatives, dogs housed on verandas or plots of land, dogs with high ODA, DAF, DR but low EL C-BARQ scores, and owners with high neuroticism but low lie/social desirability scores, for example. The researcher then developed models for establishing probabilities of the dysfunctionality of particular dyadic partnerships between humans and dogs. It is important to note that these models apply to specific pairings; therefore, individuals could show different results when partnered with different companions.

By proving the feasibility of pre-emptive identification of dysfunctional human-dog dyads, the researcher demonstrated the possibility of taking preventative action. By correctly making

pre-emptive identifications of potential dysfunction, it would be possible to prevent the formation of dysfunctional dyads in the first place or to address dysfunction before it causes problems within partnerships and in society at large. Proving the feasibility of pre-emptive dysfunction identification engenders hope that educational programs could be developed for specific populations, that human-dog matches could be made more successfully, and that veterinarians could be provided with tools to aid them in preventing and correcting dysfunction.

Chapter VIII: Future Perspectives

The results of this work pave the way for future research into dyadic dysfunction and leaves the following suggestions:

- A conscious effort should be made for future studies to use a dyadic approach, considering both human and dog.
- Studies should use well established, correctly validated instruments in the necessary language
- Future studies could focus on validating the models here presented by using data from novel populations, using the same methodology.
- Attempts should be made to confirm information given by owners regarding husbandry choices and canine characteristics
- Predictive model viability within a shelter context should be evaluated with actual relinquishing data

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Annex I

European Portuguese C-BARQ

Canine Behavioural Assessment & Research Questionnaire (C–*BARQ*)

As seguintes perguntas foram desenvolvidas para permitir descrever o comportamento do seu cão nos últimos 3 meses.

Por favor, tente responder todas as perguntas, deixando uma questão em branco se nunca observou o seu animal na situação descrita.

Seção 1 – Treino e Obediência

Indique o comportamento do seu cão nas seguintes situações:

	Nunca	Raramente	Às Vezes	Quase Sempre	Sempre
1 – Quando está solto, vem imediatamente quando é chamado(a)	❑	❑	❑	❑	❑
2 – Obedece ao comando SENTA imediatamente:	❑	❑	❑	❑	❑
3- Obedece ao comando FICA imediatamente	❑	❑	❑	❑	❑
4- Parece ouvir/estar atento(a) ao que o dono diz ou faz	❑	❑	❑	❑	❑
5- Demora a responder as correções ou castigos	❑	❑	❑	❑	❑
6- Demora aprender novos truques ou tarefas	❑	❑	❑	❑	❑
7-Distrai-se facilmente com o que vê, ouve ou cheira	❑	❑	❑	❑	❑
8 – Vai buscar ou tenta ir brinquedos, bolas ou objetos.	❑	❑	❑	❑	❑

Seção 2: Agressão

Indique a tendência do seu cão para exibir comportamentos agressivos (ladrar, rosnar, exibir dentes) em cada um dos contextos indicados, escolhendo o número apropriado na escala (0= Não há agressão e 4= agressão séria):

9. Quando corrigidos/punidos verbalmente (gritos, etc) por um membro do agregado familiar:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) — **0**.....**1**.....**2**.....**3**.....**4** — Agressão séria (Mordeduras ou tentativas de morder)

10. Quando abordado diretamente por um **adulto desconhecido** durante um passeio com trela na via publica:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) — **0**.....**1**.....**2**.....**3**.....**4** — Agressão séria (Mordeduras ou tentativas de morder)

11. Quando abordado diretamente por uma **criança desconhecida** durante o passeio com trela na via publica:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

12. Quando uma pessoa desconhecida aproxima-se do cão quando está dentro dum carro (por exemplo, no posto de combustível):

Agressão Moderada
(Ladra, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

13. Quando lhe são retirados brinquedos, ossos ou outros objetos por pessoas do agregado familiar:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

14. Quando um membro do agregado familiar lhe escova ou dá banho:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

15. Quando uma pessoa desconhecida aproxima-se de um membro do agregado familiar dentro de casa:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

16. Quando uma pessoa desconhecida aproxima-se de um membro do agregado familiar na via publica:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

17. Quando um membro do agregado família aproxima-se enquanto come:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

18. Quando carteiros ou entregadores aproximam-se da sua casa:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

19. Quando um membro do agregado familiar lhe tira comida:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

20. Quando pessoas desconhecidas passam pela sua casa enquanto o cão está no exterior:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

21. Quando uma pessoa desconhecida tenta dar-lhe uma festa:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

22. Quando corredores, ciclistas, skatistas ou patinadores passam pela sua casa passam pela sua casa enquanto o cão está no exterior:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

23. Quando abordado diretamente por um **cão desconhecido** durante um passeio com trela na via publica:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

24. Quando abordado diretamente por uma cadela desconhecida durante um passeio com trela na via publica:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

25. Quando encarado (olhos nos olhos) diretamente por um membro do agregado familiar:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

26. Quando cães desconhecidos visitam em sua casa:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

27. Quando gatos, ratos ou outros animais entram no quintal (ou área externa):

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

28. Quando uma pessoa desconhecida visita a sua casa.

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

29. Quando um cão desconhecido late, rosna ou mostra-lhe os dentes:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

30. Quando está deitado e um membro do agregado familiar lhe passa por cima:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

31. Quando um membro do agregado familiar recupera um objecto roubado pelo cão:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

32. Como se comporta com outro cão residente na mesma habitação (o co-habitante):

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

33. Quando o co-habitante (cão) aproxima-se do seu lugar preferido de descanso:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

34. Quando o co-habitante (cão) aproxima-se dela/dela a comer:

Agressão Moderada
(Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão) **0**.....**1**.....**2**.....**3**.....**4** Agressão séria (Mordeduras ou tentativas de morder)

35. Quando o co-habitante (cão) aproxima-se dela/dela enquanto brinca/roi um brinquedo, osso, etc.:

Agressão Moderada
Ladrar, rosnar, exibição de dentes)

Sem agressão (Não há sinais visíveis de agressão)	**0**.....**1**.....**2**.....**3**.....**4**	Agressão séria (Mordeduras ou tentativas de morder)

Seção 3: Medo e Ansiedade

Indique a tendência do seu cão para exibir comportamentos de medo em cada um dos contextos indicados, escolhendo o número apropriado na escala (0= Não há sinais de medo e 4= medo extremo).

36. Quando abordado diretamente por um **adulto** desconhecido fora da sua casa:

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade	**0**.....**1**.....**2**.....**3**.....**4**	Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

37. Quando abordado diretamente por uma **criança** desconhecida fora da sua casa:

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade	**0**.....**1**.....**2**.....**3**.....**4**	Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

38. Em resposta a barulhos altos ou súbitos (ex. aspirador de pó, objetos a cair no chão, rater etc.)

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade	**0**.....**1**.....**2**.....**3**.....**4**	Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

39. Quando uma pessoa desconhecida visita a sua casa.

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade	**0**.....**1**.....**2**.....**3**.....**4**	Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

40. Quando uma pessoa desconhecida tenta dar-lhe uma festa:

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade	**0**.....**1**.....**2**.....**3**.....**4**	Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

41. Quando se encontra dentro de um carro parado em transito intenso:

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade — **0**.....**1**.....**2**.....**3**.....**4** — Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

42. Quando vê objetos desconhecidos na via publica (sacos de plastico, folhas, lixo, bandeiras, etc):

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade — **0**.....**1**.....**2**.....**3**.....**4** — Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

43. Quando examinado por um médico veterinário:

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade — **0**.....**1**.....**2**.....**3**.....**4** — Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

44. Durante tempestades, fogo de artifício ou outros eventos similares:

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade — **0**.....**1**.....**2**.....**3**.....**4** — Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

45. Quando abordado diretamente por um cão desconhecido do mesmo tamanho ou maior.

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade — **0**.....**1**.....**2**.....**3**.....**4** — Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

46. Quando abordado por um cão desconhecido mais pequeno:

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade — **0**.....**1**.....**2**.....**3**.....**4** — Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

47. Quando tem um experiência nova pela primeira vez (primeira viagem de carro, primeira vez no elevador, primeira visita ao veterinário, etc):

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade — **0**.....**1**.....**2**.....**3**.....**4** — Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

48. Qual e a sua reação ao vento ou a objetos que "produzem" vento (ventiladores, ar condicionados, secadores, etc)

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade — **0**.....**1**.....**2**.....**3**.....**4** — Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

49. Quando alguém do agregado familiar lhe corta as unhas:

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade — **0**.....**1**.....**2**.....**3**.....**4** — Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

50. Quando um membro do agregado familiar lhe escova ou dá banho:

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade — **0**.....**1**.....**2**.....**3**.....**4** — Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

51. Quando tem suas patas enxutas por um membro do agregado familiar:

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade — **0**.....**1**.....**2**.....**3**.....**4** — Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

52. Quando cães desconhecidos visitam a sua casa:

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade — **0**.....**1**.....**2**.....**3**.....**4** — Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

53. Quando um cão desconhecido ladra, rosna ou mostra lhe os dentes:

Medo/ Ansiedade discreta
(evitar contato visual, evitar o objeto/pessoa/situação temido, encolher-se com a cauda baixa/escondida entre as pernas, chorar, ficar paralisado, tremer)

Sem medo/ansiedade — **0**.....**1**.....**2**.....**3**.....**4** — Medo Extremo (encolher-se exageradamente, tentativa vigorosa para fugir ou esconder do objeto/pessoa/situação temido)

Seção 4 – Comportamentos relacionados à separação

Indique a frequência com que o seu cão exibiu os comportamentos abaixo indicados quando sabe que vai ser deixado sozinho ou quando está sozinho.

	Nunca	Raramente	Às Vezes	Quase Sempre	Sempre
54 - Tremores intensos	❑	❑	❑	❑	❑
55 - Salivação excessiva	❑	❑	❑	❑	❑
56 - Agitado/anda de um lado para o outro	❑	❑	❑	❑	❑
57 - Chora	❑	❑	❑	❑	❑
58 - Ladra	❑	❑	❑	❑	❑
59 - Uiva	❑	❑	❑	❑	❑
60 - Arranha/mordisca portas, chão, janelas, cortinas, etc.	❑	❑	❑	❑	❑
61 - Perde o apetite	❑	❑	❑	❑	❑

Seção 5: Excitabilidade

Indique a tendência do seu cão para ficar excitado em cada um dos contextos indicados, escolhendo o número apropriado na escala (0= Calmo e 4= extremamente excitado):

62. Quando um membro do agregado familiar volta a casa após uma breve ausência:

Excitabilidade discreta a moderada
(aumento do estado de alerta, movimentos direcionados à origem da novidade, episódios breves de ladrar)

Calmo (Nenhuma reação em especial)	**0**.....**1**.....**2**.....**3**.....**4**	Extremamente excitado (reações exageradas: ladram/choram histericamente, difíceis de acalmar)

63. Quando brinca com um membro do agregado familiar:

Excitabilidade discreta a moderada
(aumento do estado de alerta, movimentos direcionados à origem da novidade, episódios breves de ladrar)

Calmo (Nenhuma reação em especial)	**0**.....**1**.....**2**.....**3**.....**4**	Extremamente excitado (reações exageradas: ladram/choram histericamente, difíceis de acalmar)

64. Quando alguém toca a campainha/bate à porta:

Excitabilidade discreta a moderada
(aumento do estado de alerta, movimentos direcionados à origem da novidade, episódios breves de ladrar)

Calmo (Nenhuma reação em especial)	**0**.....**1**.....**2**.....**3**.....**4**	Extremamente excitado (reações exageradas: ladram/choram histericamente, difíceis de acalmar)

65. Imediatamente antes de ser levado a passear:

Excitabilidade discreta a moderada
(aumento do estado de alerta, movimentos direcionados à origem da novidade, episódios breves de ladrar)

Calmo (Nenhuma reação em especial)	**0**.....**1**.....**2**.....**3**.....**4**	Extremamente excitado (reações exageradas: ladram/choram histericamente, difíceis de acalmar)

66. Imediatamente antes de ser levado andar de carro:

Excitabilidade discreta a moderada
(aumento do estado de alerta, movimentos direcionados à origem da novidade, episódios breves de ladrar)

Calmo (Nenhuma reação em especial)	**0**.....**1**.....**2**.....**3**.....**4**	Extremamente excitado (reações exageradas: ladram/choram histericamente, difíceis de acalmar)

67. Quando há visitas a sua casa:

Excitabilidade discreta a moderada
(aumento do estado de alerta, movimentos direcionados à origem da novidade, episódios breves de ladrar)

Calmo (Nenhuma reação em especial)	**0**.....**1**.....**2**.....**3**.....**4**	Extremamente excitado (reações exageradas: ladram/choram histericamente, difíceis de acalmar)

Seção 6: Vinculação e comportamentos para chamar atenção.

Indique a frequência com que o seu cão exibiu os seguintes sinais de apego e solicitação de atenção.

	Nunca	Raramente	Às Vezes	Quase Sempre	Sempre
68- Mostra um vinculo muito forte com um membro do agregado familiar em particular	❑	❑	❑	❑	❑
69- Segue membros do agregado familiar de divisão em divisão.	❑	❑	❑	❑	❑
70- Quando um membro do agregado familiar está sentado, o cão tenta sentar perto ou em contato com o mesmo.	❑	❑	❑	❑	❑
71- Pede atenção fisicamente aos membros do agregado familiar (fusa, dá a pata, etc) quando estão sentados.	❑	❑	❑	❑	❑
72- Fica agitado (choros, pulos, tentativas de atrapalhar) quando você mostra afeto por outra pessoa	❑	❑	❑	❑	❑
73- Fica agitado (choros, pulos, tentativas de atrapalhar) quando se mostra afecto por outro cão ou outro animal	❑	❑	❑	❑	❑

Seção 7: Diversos

Indique a frequência com que o seu cão exibiu os seguintes comportamentos.

	Nunca	Raramente	Às Vezes	Quase Sempre	Sempre
74- Persegue ou tenta perseguir gatos, quando tem essa oportunidade	❑	❑	❑	❑	❑
75- Persegue ou tenta perseguir pássaros, quando tem essa oportunidade	❑	❑	❑	❑	❑
76- Persegue ou tenta perseguir ratos, esquilos, ou outros animais pequenos quando tem essa oportunidade	❑	❑	❑	❑	❑
77(91)- É brincalhão, tem comportamentos de cachorro	❑	❑	❑	❑	❑
78(92)- Ativo, energético, sempre pronto para brincar ou praticar alguma atividade	❑	❑	❑	❑	❑

Annex II

Indirect Publications

Owner Experience and the Choice to Euthanize

Rute Canejo-Teixeira, Isabel Neto, Luís V. Baptista, Maria M. R. E. Niza

Published in International Journal of Sciences: Basic and Applied Research. 2018; 42(3):118

International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Owner Experience and the Choice to Euthanize

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Abstract

The human-dog relationship has change significantly over the decades, with the dog now frequently being considered a member of the family, but it still falls to the human to grantee the dog's well-being, both legally and morally. One of the decisions required of a dog owner is when, and if, to euthanize an animal. It has been suggested that chronic illness, financial considerations and behaviour issues may predispose a dog to euthanasia. Through the use of questionnaires administered to dog owners, this study evaluated possible connections between reported canine health issues and owner choice to euthanize. Owners were asked if they had cared for at least one dog with chronic illness, that suffered a trauma (vehicular or otherwise), had been hospitalized, if their dog had bitten a person or an animal and if they had ever euthanized a dog. Contrasting with some previous reports, no association was found between any of the issues investigated and euthanasia. It is possible that the voluntary nature of this study may have introduced a bias, attracting owners with higher educational and economical status, which may make them more reluctant to euthanize their dog. In any case, more studies are required to clarify this issue.

Keywords: euthanasia; dog; owner; dyad; relationship.

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1. Objectives of the Study

The relationship between humans and dogs has changed in the last decades, with the dog now being considered a member of the family [1].

Within this relationship the human is morally, and in many countries legally [2], responsible for the dogs' well-being.

This responsibility goes beyond the provision of food, water, and shelter, into the area of quality of life. For this reason, the question of euthanasia is of particular relevance.

In the literature dogs with chronic illness, requiring expensive treatment, and those with behavioural problems have an increased chance of being euthanized, even against veterinary recommendations [3,4].

This study aimed to evaluate possible connections between owners reported health issues with their dog and euthanasia in a sample population.

In such a way we hope to contribute to a better understanding of dog euthanasia.

2. Materials and Methods

A questionnaire was distributed to dog owners in the Lisbon area to animal 3 hospitals, 10 clinics and 7 municipal anti-rabies vaccination programs.

The questionnaire was also available online for 8 months. Participation was voluntary in nature and owners where asked how many dogs they had cared to date, and if they had cared for a dog(s) with chronic illness, that suffered a trauma (vehicular or otherwise), been hospitalized, bitten a person or animal and if they had euthanized a dog.

Multiple correspondence analysis (MCA) was applied to detect and represent underlying structures in data, and Pearson's chi-square test was used to test independence between variables.

3. Results

A total of 1385 valid questionnaires where completed. Table 1 details the response rate for each dog health care occurrence.

MCA analysis (table 2) showed the variable "euthanasia" was placed at the origin of both dimensions and not associated with any of the other variables considered, a fact confirmed through the lack of significant findings though the use of Pearson's chi-square.

Table 1: Breakdown of responses to the second section of the questionnaire regarding medical occurrences experienced while caring for one or more dogs.

Acute Illness	Yes	Reported	894
		%	64.55%
	No	Reported	491
		%	35.45%
Chronic Illness	Yes	Reported	673
		%	48.59%
	No	Reported	712
		%	51.41%
Unspecified Trauma	Yes	Reported	382
		%	27.58%
	No	Reported	1003
		%	72.42%
Vehicular Trauma	Yes	Reported	364
		%	26.28%
	No	Reported	1021
		%	73.72%
Hospitalized	Yes	Reported	723
		%	52.20%
	No	Reported	662
		%	47.80%
Bitten	Yes	Reported	440
		%	31.77%
	No	Reported	945
		%	68.23%
Bit Other Animal	Yes	Reported	224
		%	16.17%
	No	Reported	1161
		%	83.83%
Bit a Person	Yes	Reported	182
		%	13.14%
	No	Reported	1203
		%	86.86%
Euthanized	Yes	Reported	335
		%	24.19%
	No	Reported	1050
		%	75.81%

Table 2: MCA dimensions discrimination measures

	Dimension		
	1	2	Mean
Total Dogs Owned	.327	.287	.307
Acute Illness	.165	.180	.172
Chronic Illness	.272	.140	.206
Unspecified Trauma	.292	.008	.150
Vehicular Trauma	.233	.003	.118
Bitten	.314	.041	.178
Hospitalized	.281	.153	.217
Bit Other Animal	.332	.243	.288
Bit a Person	.256	.179	.217
Euthanized	.000	.000	.000
Active Total	2.473	1.234	1.853

4. Discussion and conclusion

Although it has been suggested that there may exist factors that predispose owners to choose euthanasia for their dog, such as chronic illness and costly medical care [3], the results of this study seem to disagree with these findings. In our study euthanasia did not correlate with any of the other variables under evaluation (number of dogs, chronic illness, trauma, hospitalization, biting). It has been suggested that dogs with serious traumatic injury may be more likely to be submitted for euthanasia [5] but although experience with various types of trauma in their dog health care histories was reported by owners in this population, no association was found between trauma and euthanasia. Since the mortality rate of serious trauma is known to be high [6], it is possible that in the study population the canines were not submitted to euthanasia because they passed away before medical attention was sought.

Studies have shown that behavioural issues are frequently cited as a reason for the euthanasia of a canine companion [7–9], in this population however, such a link was not observed. Although 29.3% of owners in this study reported that they had cared for dogs that had bitten another animal or a person, they did not report more experience with euthanasia. Owners were not asked about breed or size of dog, since it has been suggested that larger dogs are euthanized for aggression more frequently then smaller breeds [10,11], it would have been interesting to see if this was the case.

It has been postulated that dogs adopted from shelters or as strays are submitted to euthanasia and abandonment more frequently than those that have been purchased [12–14]. Providence of the dogs under study was not addressed, so it is possible that all the dogs in the population were purchased, and as such more valued by their owners and less likely to be euthanized. Although other studies have shown that dogs with chronic illness are more frequently submitted to euthanasia [15], our results show no such link. The fact that participation in this study was voluntary may have introduced a selection bias [16] and participating owners may represent individuals with a strong attachment to their dogs. This may make them more reluctant to euthanize their pet, regardless of the seriousness of their illness [17].

In general terms, the choice to euthanize can be influenced by owners' culture, socioeconomic status, experience, beliefs, religion etc. [18], aspects of owners' lifestyles that were not addressed in this study. The influence these factors may have on the choice to euthanize needs to be accessed in future studies. The choice to euthanize is never an easy one and it is important to understand how and why owners chose to euthanize a dog, not only to deter convenience euthanasia, but also to prevent unnecessarily suffering for sick canines.

5. Acknowledgements

This work was supported by the project CIISA: UID/CVT/00276/2013.

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A mixed population of *Helicobacter pylori, Helicobacter bizzozeronii,* and *"Helicobacter heilmannii"* evidenced in the gastric mucosa of a domestic cat.

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Published in the Irish Veterinary Journal 2014; 67(1): 25.[2]

[2] The original doctoral project, with which the author obtained the FCT PhD fellowship, was entitled *The role of Helicobacter spp. in feline alimentary lymphoma* of which this publication would have been a part. However, it was not possible to design the required new doctoral project along the same lines of investigation.

Canejo-Teixeira *et al. Irish Veterinary Journal* 2014, **67**:25
http://www.irishvetjournal.org/content/67/1/25

IRISH VETERINARY JOURNAL
Iris Tréidliachta Éireann

SHORT REPORT Open Access

A mixed population of *Helicobacter pylori*, *Helicobacter bizzozeronii* and "*Helicobacter heilmannii*" in the gastric mucosa of a domestic cat

Rute Canejo-Teixeira*, Manuela Oliveira, Hugo Pissarra, Maria Manuela R E Niza and Christina L Vilela

Abstract

Background: The presence of *Helicobacter* within the gastric mucosa is responsible for producing pathology in many animal species, including man. Since humans have been shown to harbour many of the same bacterial species as domestic carnivores, concern over their zoonotic potential has been growing. *Helicobacter pylori*, a class 1 carcinogen responsible for cases of gastritis and gastric cancer in humans, produces similar pathology in pet carnivores and is considered an example of anthroponosis. The case here presented refers to a 13 year-old mixed breed spayed female cat seen at necropsy.

Findings: Stomach samples were analysed for the presence of *Helicobacter* spp. by cytology, histopathology and PCR. Mild mucosal atrophy was observed in the fundus and antrum, while lymphoplasmocytic infiltrates where noted in the lamina propria of the antrum. *Helicobacter*-like organisms were observed in the corpus and antrum, occupying gastric glands and surface mucosa. It was possible to detect *Helicobacter* spp., *H. pylori*, *H. heilmannii* and *H. bizzozeronii* in the fundus, corpus and antrum by PCR, while in the antrum PCR samples were positive for *H. pylori*.

Conclusions: The spayed female under study could represent either a yet un-described population of domestic cats infected with *H. pylori* or a case of anthroponosis.

Keywords: Feline, *Helicobacter*, Zoonosis, Gastritis, PCR, Histopathology

Findings

Background

Helicobacter pylori is a gram negative, urease positive, spiral bacteria classified by the World Health Organization as a class 1 carcinogen as its relationship to human gastritis and gastric cancer has been firmly established [1]. The majority of the 32 species described to date are enteric microorganisms of mammals, while 12 species are gastric inhabitants. Four species are now considered to be common in the gastric mucosa of domestic carnivores, *Helicobacter felis*, *Helicobacter bizzozeronii*, *Helicobacter salomonis*, *"Helicobacter heilmannii"* types 1, 2 and 4 [2,3], while the role of *H. bilis*' as a primary gastric organism remains questionable. Although the pathogenic role of these species in gastritis and/or gastric cancer has yet to be firmly established in pets [4,5], felines seem to be much more susceptible then canines [6]. Gastric fibroses and atrophy have been linked to *H. felis* infection in cats [7] while the presence of lymphoid follicles and inflammation have been related to *Helicobacter* spp. and *"H. heilmannii" senso lato* colonization [8,9].

It has been suggested that, similarly to *H. pylori* infected humans, the presence of *H. heilmannii* could play a role in feline alimentary lymphoma [10]. There are several reasons for the growing concern regarding the zoonotic potential of these bacteria [11]. Firstly, humans have been shown to harbour species other than *H. pylori* with pathological consequences; secondly, no environmental source for these bacteria has been found; and lastly, epidemiological studies have shown a link between animal contact and infection [12]. Although *H. pylori*

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produces similar pathology in pet carnivores and in humans, this species has yet to be found in normal domestic carnivore populations [13,14], making these cases good examples of anthroponosis [4,6,13]. However, Buczolits et al. [15] have identified two sequences from *Helicobacter*-like organisms 100% identical to *H. pylori* in the gastric mucosa of canines, re-kindling the debate on the role of pet carnivores in the transmission of this bacterium to humans. The present work describes the presence of *H. pylori* in a mixed population of *Helicobacter* species in the gastric mucosa of a domestic short-hair cat.

Case presentation

A 13 year-old mixed breed spayed female cat with a history of mammary tumors and pleural effusion, euthanized at the owners' request, was presented for necropsy to the Pathology Department of the Faculty of Veterinary Medicine, University of Lisbon. The stomach was opened along the greater curvature, brush cytology was performed and four full thickness biopsies where obtained from the fundus, corpus and antrum for histopathology and PCR analyses. Brush cytologies where obtained using sterile, single use inoculation loops and stained with May-Grünwald-Giemsa. One biopsy from each gastric region was stored in 10% formalin for histology processing. A combined sample, comprising one sample from each region, and the remaining biopsies from the three regions were kept frozen at −80°C, until DNA extraction with Qiagen DNeasy® Blood & Tissue Kit, according to the manufacturer's instructions. PCR reactions for *Helicobacter* spp., *H. pylori*, *H. felis*, *H. heilmannii*, *H. bizzozeronii*, *H. salomonis* and *H. bilis* were performed as previously described [3,7,16-19], using FidelTaq™ MasterMix (USB® Products – Affymetrix, Inc.). Reference strains *H. pylori* CCUG 17874 T, *H. felis* ATCC 49179, *H. bizzozeronii* CCUG 35045, *H. salomonis* CCUG 37845, *H. bilis* ATCC 51630 and *H. heilmannii* DNA (kindly provided by Professor K.W. Simpson) were used as positive controls. Biopsies for histopathology were imbedded in paraffin blocks, processed and stained with Hematoxylin and Eosin and with Giemsa.

Based on the World Small Animal Veterinary Association histopathological standards [20], mild mucosal atrophy was observed in the fundus and antrum, while moderate lymphoplasmocytic infiltrates were noted in the lamina propria of the antrum. *Helicobacter*-like organisms were observed in the corpus and antrum, occupying gastric glands and surface mucosa (Figure 1A), where colonization was classified as mild. Brush cytology was positive in the fundus and corpus (Figure 1B), but negative in the antrum. PCR performed using DNA extracted from the combined sample was positive for *Helicobacter* spp., *H. pylori*, *H. heilmannii* and *H. bizzozeronii*, originating 1200-bp, 298-bp, 580-bp and 420-bp amplicons, respectively (Figure 2). When tested individually, the three regions were positive for *Helicobacter* spp., *H. heilmannii* and *H. bizzozeronii*, while only the antrum was positive for *H. pylori*.

Conclusions

The presence of a *Helicobacter* mixed population has been previously described in feline gastric biopsies [21].

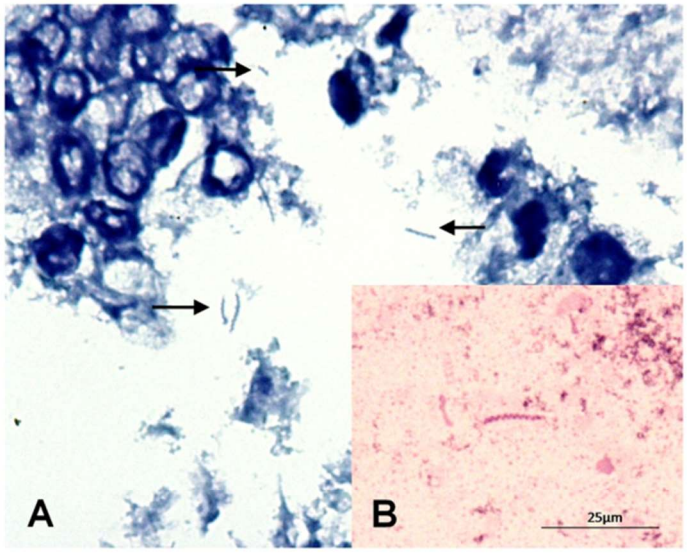

Figure 1 Spiral bacteria, consistent with Helicobacter spp. found in the stomach (A) in the surface mucosa. 1000x. Giemsa. **(B)** and brush cytology of the fundus region. 1000x. May-Grünwald-Giemsa. (Original photographs).

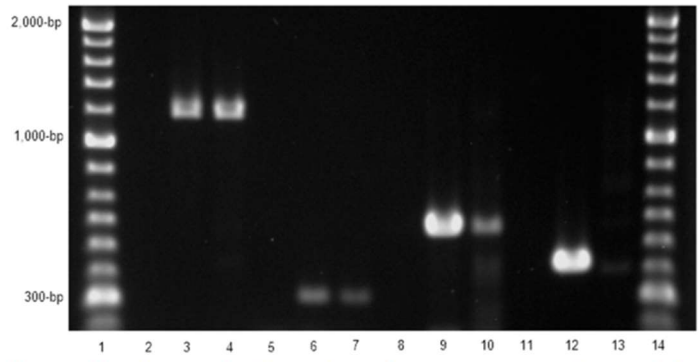

Figure 2 PCR reactions. Molecular ladder in lane 1 and 14 (Hyperladder II ™ Bioline); negative controls in lane 2, 5, 8 and 11; positive controls *Helicobacter* spp. (lane 3 using *H. felis* ATCC 49179), *H. pylori* (lane 6), *H. heilmannii* type 2 (lane 9), *H. bizzozeronii* (420-bp, lane 12); sample results *H.* spp (1,200-bp, lane 4), *H. pylori* (298-bp, lane 7), *H. heilmannii* (580-bp, lane 10) and *H. bizzozeronii* (420-bp, lane 13).

Our finding of mild mucosal atrophy is consistent with other studies [6,22]; however Simpson et al. [7] linked changes in the architecture of the gastric mucosa with the presence of *H. felis*, a species not found in this cat. *H. heilmannii* has been shown to alter gastric architecture but through epithelial proliferation and lymphoid follicular hyperplasia [9], not atrophy. It is possible however that the presence of *H. pylori* and *H. bizzozeronii* altered the pathogenic capacity of *H. heilmannii* as described for mixed infections of *H. bizzozeroniiI/H. felis* [11]. The fact that the fundus and antrum were the most affected regions is consistent with others findings [8] and, although not characteristic, the presence of inflammation in the antrum is similar to that found in felines experimentally infected with *H. pylori* [21].

The occurrence of *H. pylori* in the gastric mucosa of felines has been only reported in a particular commercial breeder [23] but not in stray and domestic populations [13,14,24]. The spayed female under study could represent either a yet un-described population of domestic cats infected with *H. pylori* or a case of anthroponosis, as hypothesized by some authors [4,5,13]. Considering *H. pylori*'s ability to survive in water [25] and the tendency for keeping indoor/outdoor cats in Portugal, colonization of this animal through a contaminated water source must also be considered. It was not possible to determine whether human co-inhabitants were *H. pylori* positive or if the animal had outdoor access.

The presence of *H. heilmannii* in cats has been linked to various alterations in gastric mucosa [9] and alimentary lymphoma [10]. Jergens et al. [22] have shown that treatment leads to the improvement of gastritis clinical signs and bacterial clearance, although histological signs of gastritis remain, suggesting a causal relationship similar to that seen in *H. pylori* infected humans [16]. However, as other studies could not evidence such relationship, other factors such as the effect of mixed infections and the possibility of strain dependent virulence, should be considered. The presence of a mixed infection of *H. heilmannii* and *H. pylori*, as found in this cat, could explain the development of pathology in some animals and not in others infected only with *H. heilmannii*. Given *H. pylori's* focal distribution pattern [6], the small sample size normally obtained through endoscopy and even biopsy [21] may explain the high rate of negative results for *H. pylori*.

The role played by *Helicobacter* in feline gastritis, associated or not with lymphoma, remains controversial. Several factors, such as the species of *Helicobacter* present, the virulence of the strain, and the genetic predisposition of the animal, should be further investigated in order to better understand their relation to clinical disease.

Abbreviations

PCR: Polymerase chain reaction; DNA: Deoxyribonucleic acid; Bp: Base-pairs.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

RCT identified the patient, collected the gastric samples and performed brush cytology. RCT and MO carried out the laboratory processes that permitted the processing of samples for PCR analyses. HP performed the histopathology. RCT and CLV were involved in data acquisition, analysis and interpretation and the drafting of the manuscript. MMREN was involved in revising the manuscript, contributing to its intellectual content. All authors read and approved the final manuscript.

Acknowledgements

The authors would like to thank CIISA/FMV for their financial support (Project PEst-OE/AGR/U10276/2014, funded by FCT), Professor Kenneth W. Simpson for the kind donation of *H. heilmannii* DNA used as a positive control for PCR, Professor Maria Conceição Peleteiro for her expert advice, as well as and Tec. Sandra Carvalho for her assistance with histopathology and Tec. Carla Carneiro for her assistance in the bacteriology laboratory.

Received: 14 April 2014 Accepted: 1 October 2014
Published: 19 November 2014

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doi:10.1186/2046-0481-67-25
Cite this article as: Canejo-Teixeira *et al.*: A mixed population of *Helicobacter pylori, Helicobacter bizzozeronii* and *"Helicobacter heilmannii"* in the gastric mucosa of a domestic cat. *Irish Veterinary Journal* 2014 **67**:25.

An exploratory study of dog ownership history: can owners be typified?

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Published in the Journal of Veterinary Science and Technology. 2017. 8 (4 Suppl):49

Rute Canejo-Teixeira et al., J Vet Sci Technol 2017, 8:4(Suppl)
DOI: 10.4172/2157-7579-C1-024

An exploratory study of dog ownership history: Can owners be typified?

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Statement of the Problem: The human-dog interaction has a 16000-year history. Within a functional human-dog dyad both the human and the dog benefit from the relationship. Nevertheless, some dyads are dysfunctional, normally due to irresponsible behavior displayed by owners, such as allowing their dogs to roam in public spaces and/or denying them veterinary care, which can be a danger to the dog and society. The study of these dysfunctional dyads has received attention in recent years, specially within the context of dog aggression. However, these dysfunctional dyads are difficult to study since unmotivated owners are unlikely to volunteer personal information, so alternative methods are needed to better understand why human-dog dyads fail. This study analyses owners´ history of dog health care to find patterns that could help clarify what is at the core of these troubled relationships.

Methodology & Theoretical Orientation: A questionnaire was distributed throughout the Lisbon Area to animal hospitals, clinics, anti-rabies vaccination programs, and made available online for 8 months. Owners where asked forced questions regarding the existence of specific occurrences in their history with dog health care (figure 1). MCA and chi-square analysis where completed.

Findings: 1385 valid questionnaires where completed. MCA analysis revealed 3 clusters with associations between chronic illness and hospitalization ($x^2=122.131$, $df=1$, $p<0.001$), vehicular trauma and unspecified trauma ($x^2=127.310$, $df=1$, $p<0.001$) and caring for more dogs and having a dog bite another ($x^2=85.236$, $df=3$, $p<0.001$).

Conclusion & Significance: In this population, owners of dogs with chronic illness could represent function dyads since this was associated with hospitalization, while those who report trauma (vehicular or not) may indicate dysfunctional dyads, where the dog is not adequately controlled. In this study, through the use of a questionnaire focused on owners' history with dog health care, patterns where recognized which could signal dysfunctional dyads.

Biography

Rute Canejo-Teixeira is a PhD candidate with CIISA at the faculty of Veterinary Medicine at the University of Lisbon in Portugal. After first completing a BscH in Biology and a BEd at Queen´s University, Kingston, ON, Canada, she returned to her native Portugal to pursue her DVM. Ruth completed her MIVM with the study of Helicobacter spp. In the dog and cat, having identified H. pylori in a cat (Irish Veterinary Journal 2014 67(1) 4). Before securing a scholarship through the FCT. Rute was a member of the clinical staff at the Veterinary Teaching.

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Notes:

Annex III

Contributing Information

Participation in Conferences

Canejo-Teixeira, R., Neto, I., Baptista, L. V., Niza, M.M.R.E (2017). An exploratory study of dog ownership history: can owners be typified? Conference Series. 7º International Veterinary Congress – Paris.

Canejo-Teixeira, R., Niza, M.M.R.E (2017). Owner Experience and the Choice to Euthanize. Poster. Spanish Association for Small Animal Veterinarian and North American Veterinary Community. 11º Southern European Veterinary Conference – Barcelona.

Invited Member Roundtable Panel. (2017). Encontrei um animal. O que fazer? GAAF – Faculdade de Medicina Veterinária – Universidade de Lisboa.

Canejo-Teixeira, R., P. A., Serpell, J. A., Baptista, L. V., Niza, M. M. R. E. (2018). Canine Behavioural Assessment and Research Questionnaire (C-BARQ): study of its factorial structure in European Portuguese. CIISA Congress – Lisbon.