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**EMPATHY TOWARDS NON-HUMAN ANIMALS:  
ITS ROLE IN EMOTION RECOGNITION, VETERINARY MEDICINE AND  
ANIMAL HOARDING DISORDER**

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“Sympathy beyond the confines of man, that is, humanity to the lower animals, seems to be one of the latest moral acquisitions (...). This virtue, one of the noblest which man is endowed, seems to arise incidentally from our sympathies becoming more tender and more widely diffused, until they are extended to all sentient beings. As soon as this virtue is honoured and practiced by some few men, it spreads through instruction and example to the young, and eventually becomes incorporated in public opinion.”

Charles Darwin  
in *“The descent of man, and selection in relation to sex”*, 1871.

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## *Abstract*

**Background:** empathy has been defined as a vicarious affective response that arises from attending another individual's emotional experience and is more appropriate to another's situation than one's own. It is a complex and multidimensional psychological process, which involves both emotional and cognitive components: the former refers to affective resonance with others' emotions and the generation of an appropriate emotional response, while the latter includes abilities such as recognizing and understanding another's emotions distinguishing between self and others, and perspective taking. Empathy has also visible effects on behaviour, leading either to prosocial behaviour, namely the effort to alleviate the distress of the others and to promote their welfare, or to defensive behaviours and strategies of affective control due to an excessive personal distress.

Although empathy towards humans has been extensively studied, only a few studies have focused on empathy towards non-human animals, which is considered as a psychological side effect of empathy towards people, triggered by animal signals or behaviour that resemble those that elicit empathy among humans.

There is evidence that empathy towards humans is related to important social skills, such as emotion recognition and prosocial behaviour, therefore empathy is regarded as an important aspect not only in daily social interactions but also in caring professions; in particular, the relevance of empathy as a professional skill has been extensively studied and underlined in human health professionals, with studies proving a decline in empathy towards people during medical education. Furthermore, given the relevance of empathy towards people, its impairment is considered a sign of psychopathology and characterizes a number of mental disorders such as antisocial, borderline and narcissistic personality disorders and autism spectrum disorders.

Although some studies have suggested that empathy towards animals may be related to the way in which people interpret animal behaviour and it may be influenced by particular job and educational contexts and mental disorders, these themes are still understudied. Yet, a deepen analysis of these issues could have important consequences both for animal and human welfare: in particular, recognition of animal emotions is crucial for their well-being and, as in human health professions, empathy towards animals may be central to the role of veterinarians, especially in companion animal practice. Furthermore, the new edition of the diagnostic and statistical manual of mental disorders includes the animal hoarding disorder, which is a poorly understood mental disease, likely related to empathy towards animals.

**Aim of the project:** the main aim of this work is to investigate three important and little studied aspects of empathy towards non-human animals, namely: 1. its relation to animal emotion

recognition, 2. its status in and the way in which it may be affected by veterinary education and practice and 3. its potential role in animal hoarding disorder. Moreover, since a condition to feel empathy towards animals is their ability to feel emotions, I have also briefly reviewed the scientific literature on animal emotions, which evidences the need to combine behavioural and physiological indexes to study them. Therefore, I carried out two studies aimed at investigating the possibility to use novel and non-invasive tools to study animal emotions, along with behavioural and traditional physiological measures. The dog (*Canis familiaris*) has been chosen as a model both for studying animal emotions and human ability to recognize them, since this species has a long history of domestication, lives in strict contact with humans and its ability to emotionally communicate with them has been widely proved.

**Results:** six studies and one book I have co-authored are presented in this dissertation, which are the results of the work carried out in the last three years at the *Canis sapiens – Comparative cognition & Human- Animal Interaction – Lab* of the University of Milan (Department of Physiopathology and Transplantation, section of Neuroscience). These studies cover three major themes, which are described in three different chapters, following an introductory section. Three studies and the book have already been published, while the others are in press or have been submitted to international scientific journals.

*Chapter 1: Introduction - An overview of human empathy towards humans and other animals.*

The chapter offers an overview of the concept of empathy and the results of the main studies carried out on empathy towards humans and towards animals. Given the importance of empathy towards people in recognizing human emotions and in predicting prosocial behaviour towards conspecifics, the importance of studying empathy towards animals in order to improve both animal and human welfare is discussed, with particular interest for its potential role in animal emotion recognition, veterinary medicine and animal hoarding disorder.

*Chapter 2: Recognizing emotions in non-human animals.*

This chapter reviews the scientific evidence about the ability of non-human animals, at least mammals, to feel a number of basic emotions, such as happiness, sadness, fear, anger, surprise and disgust. Furthermore findings about human ability to recognize animal emotions are discussed, underlining the lack of consistent evidence of human ability to recognize animal visual emotional signals, such as body postures and facial expressions. A brief section examines the suitability of the dog (*Canis familiaris*) as a model for studying both animal emotions recognition and animal emotions, discussing also the validity of behavioural clues alone to assess dog emotions, evidencing the need to find more reliable and objective tools. Finally I present my research activity in this area.

- Study 1: “*Expertise, empathy, gender and the recognition of dog (Canis familiaris) emotional facial expressions*”. This work investigated the relation between expertise, empathy and gender and

accuracy in the recognition of dog emotional facial expressions. A group of experts (veterinary behaviourists and dog trainers) and 3 groups of participants differing in their experience with dogs (veterinarians, dog owners and people who had never owned a dog) classified 21 photographs of a dog's facial expressions, realized under standardized and behaviourally defined conditions aimed at activating in the dog the six basic emotions already described in humans (i.e., happiness, surprise, sadness, fear, anger and disgust). We found that experts in dog behaviour were not particularly accurate in identifying the dog's emotional states and correctly recognized only a limited number of the dog's emotions. Interestingly we also found a clear effect of the level of expertise on the recognition of some of the dog's expressions, but we didn't find any effect of empathy or gender, suggesting an experience-dependent mechanism at the basis of inter-specific emotion recognition from facial expressions. The possibility that some antecedent stimuli used to elicit emotions in the dog could not be fully appropriate and that the photographs we used lacked ecological validity were also discussed.

- Study 2: *“Hot dogs”: Thermography in the assessment of stress in dogs (Canis familiaris) - A pilot study*. This study evaluated for the first time the usefulness of Infra-Red Thermography (IRT) to assess dogs' emotional responses to an unpleasant and stressful event. A sample of 14 healthy adult dogs was observed during a standardized veterinary examination, carried out by an unfamiliar veterinarian in the presence of their owners. The dogs' behaviours and eye temperatures were recorded before the start of the veterinary visit, during, and after the clinical examination. Interestingly, the dogs showed an increase in eye temperature during the examination phase compared with both pre- examination and post-examination phases, despite a concomitant significant decrease in their level of activity. Results suggested that IRT may represent a useful tool to investigate emotional psychogenic stress in dogs.

- Study 3: *“How good is this food? A study on dogs' emotional responses to a potentially pleasant event using Infra-Red Thermography”*. In this study, IRT was used in combination with behavioural measures, heart rate (HR) and heart rate variability (HRV) to investigate dogs' emotional responses to a potentially pleasant event: receiving highly palatable treats from the owner. Nineteen adult pet dogs, 8 females and 11 males, were tested and their eye temperature, heart rate, heart rate variability and behaviour were recorded during a 30 minutes test consisting of three 10 min consecutive phases: Phase 1 (Baseline), Phase 2 (Feeding), namely positive stimulation through the administration of palatable treats and Phase 3 (Post-feeding) following the positive stimulation. The dogs' eye temperature and mean HR significantly increased during the positive stimulation (Phase 2) compared with both Baseline and Post-feeding phases, despite a concomitant significant decrease in dogs' level of activity. During the stimulation with food, the dogs engaged in behaviours indicating a positive emotional state, such as being focused on the treats and showing an

increase in tail wagging. However, HRV increased only in Phase 3, after the positive stimulation occurred. Overall results pointed out that IRT may be a useful tool in assessing emotional states in dogs in terms of arousal but fails to discriminate emotional valence, whose interpretation cannot disregard behavioural indexes. The role of HRV in understanding emotional valence and the actual emotional meaning of food treats were also discussed.

*Chapter 3: Exploring the field of veterinary medicine: the importance of empathy towards animals.*

This chapter presents a brief introduction of the role of empathy towards animals in animal-related jobs, highlighting how both empathy towards animals and towards people are two central aspects of veterinary medicine, especially in companion animal practice, where they are respectively related to animal welfare and clients' satisfaction. Although studies carried out in other countries proved that veterinary education may have a negative impact on empathy towards animals, in particular in male students, little was known about the effect of veterinary practice on empathy. The aim of this chapter is presenting my research activity in this area.

- Study 4: "*Empathy towards animals and belief in animal-human-continuity in Italian veterinary students*". In the present cross-sectional study we used the Animal Empathy Scale and the Human-Animal Continuity Scale to investigate empathy towards animals and beliefs in animal-human continuity in a sample of first year (n = 131) and last year (n = 158) veterinary students of the University of Milan (Italy). Results revealed a difference in empathy towards animals, with first year students scoring significantly higher than those at the end of their academic training. This variation in empathy over time emerged in both male and female students, however females always had higher scores in empathy than males. Moreover, students at the end of their university education reported a more instrumental attitude toward animals, more pronounced in males than in females. Similarly, there was a difference in the perception of continuity between human and animals which was more evident in males, with first year students scoring higher than fifth year students in some items. Results are discussed in relation to previous studies carried out in other countries and, given the importance of empathy in the veterinary profession, potential reasons underlying its apparent decrease are considered. This is the first study on empathy in veterinary students carried out in Italy.

- Study 5: "*Empathy towards animals and people in a sample of Italian vets: the role of gender and length of career*". The aim of this study was to investigate empathy towards animals and humans in veterinarians, assessing whether and to what extent they are influenced by variables such as gender and length of career. We used the Animal Empathy Scale to assess empathy towards animals and the Empathy Quotient to assess empathy towards people in a sample of 107 vets, practicing in veterinary clinics in Milan area and working mainly with dogs and cats. Results revealed an effect of gender on empathy towards animals, with women scoring higher than men, and an effect of

length of career on empathy toward people, with more experienced vets scoring higher than their younger colleagues. This is the first study in the literature evaluating both empathy towards animals and people in vets working in small animal practice and suggests a positive profile of veterinarians, reporting themselves to be empathic both towards animals and people, meeting the expectations of society and likely linked to the feminization of veterinary medicine. Given the role of empathic concern in caring for animals and for clients' satisfaction, but also as a risk factor for burnout in caring professions, further studies are needed.

*Chapter 4: The Animal Hoarding Disorder: a mental disorder related to anomalies in empathy towards animals?*

A number of mental disorders, such as antisocial, borderline and narcissistic personality disorders and autism spectrum disorders, entails a deficit in empathy towards people, to such an extent that a new classification of these psychopathologies as “empathy-related disorders” has been proposed. So far, anomalies in empathy towards animals have never been specifically related to any mental disorders and its impairment is mentioned only among the diagnostic criteria for conduct disorder, as “cruelty to animals”. Yet, the last edition of the diagnostic and statistical manual of mental disorders (DSM-5) includes for the first time “animal hoarding”, considering it as a special manifestation of “hoarding disorder”.

The crucial feature of animal hoarding is the failure to provide proper care for animals and to recognize their suffering, therefore some authors considered it as a manifestation of “pathological altruism”, which is rooted in empathy anomalies. In Italy, animal hoarding is almost unknown, although media and press often report cases of people who hoard animals resulting in animal abuse, but interpret them as animal cruelty or, conversely, as “too much love for animals”.

In this chapter I present the first review on animal hoarding, written in Italian before the Italian edition of DSM-5 was published, with the aim to inform Italian mental health professionals about this phenomenon; furthermore, I report a brief summary of a book on animal hoarding that I have co-authored and that has recently been published.

- Study 6: “*Animal hoarding: lifestyle, animal abuse or psychopathology? A critical review of the literature*”. This study reviews the international scientific literature on animal hoarding, considering how for a long time it has been regarded as a “lifestyle”, then as a form of animal maltreatment, but only recently as a mental disorder. The aim of this review was to describe the main features of animal hoarding and to introduce the most frequent hypotheses about its aetiology, with particular reference to Hoarding Disorder and to the role of trauma; moreover, strengths and weaknesses of current interventions were analyzed, in order to promote an interdisciplinary approach to the problem. Special emphasis was given to the importance of understanding animal hoarding

behaviour in the light of the normal human-animal bond, suggesting new research directions which consider aspects such as attachment and empathy toward animals.

- Book: “*Una pericolosa arca di Noè: L’accumulo di animali tra cronaca e ricerca*” (*A dangerous Noah’s ark: animal hoarding between press reports and scientific research*), published by *Cosmopolis*. With the contribution of experts in psychology, psychiatry, ethology veterinary medicine and law, the book deals with themes such as the diagnostic criteria of animal hoarding, the underlying psychological and neuropsychological mechanisms, its relation with animal abuse and normal human-animal bond, legal consequences of animal cruelty and the possibility to cure and rehabilitate both people and animals. Furthermore, three main categories of animal hoarders are described and the phenomenon of “lager shelters” is discussed as a possible consequence of this mental disorder. This is the first essay on animal hoarding disorder published in Italy and analyses this issue in the light of the international scientific literature and through the narration of cases derived from the Italian press. Conclusions highlight the need for further research on animal hoarding, aimed at investigating its prevalence and aetiology and the efficacy of psychotherapy in its treatment.

**Conclusions:** the work presented in the current thesis is a starting point for the investigation of empathy towards animals and its role in animals’ emotions recognition, veterinary medicine and animal hoarding disorder, mirroring the available literature on empathy towards humans. In fact, there is evidence that empathy is related to the recognition of human emotional facial expressions, but represents a controversial aspect of human medicine, since it declines during medical training but it is considered an important skill in medical practice. Furthermore, a number of mental disorders are related to deficits in empathy towards people.

Since research on the recognition of animal emotions from visual signals is still very limited, we chose to focus on dog’s (*Canis familiaris*) emotions because of its long history of domestication and its high diffusion in human society. Results suggest that empathy towards animals may not be related to the ability to recognize animal emotions from facial expressions (at least with respect to the dog), which seems to be an experience-dependent cognitive mechanism. Furthermore, we noticed a lack of agreement even among experts in dog’s behaviour, at least for some emotions, and this result is in line with those of studies that criticized the reliability of behavioural clues to investigate emotions in animals, and thus also in dogs, suggesting to combine them with physiological measures. The results on the use of changes in dogs’ eye temperature, detected through Infra-Red Thermography, to investigate emotions in dogs showed that IRT could be a useful tool to assess emotional arousal but not to discriminate emotional valence (i.e., positive or negative), whose interpretation cannot disregard behavioural indexes.

With respect to the role of empathy towards animals in veterinary medicine, results seem to parallel those emerging for empathy towards people in human medicine: in fact, we found that last-year veterinary students were less empathic than their first year colleagues, suggesting a decline in empathy towards animals during veterinary education similar to that observed in medical students. Furthermore, examining for the first time the effect of length of career in veterinary companion-animal practice on both empathy towards animals and people, we found that empathy towards people was higher among older professionals, suggesting a role of clinical practice in improving empathy, as reported in a previous study on physicians. Interestingly, we found that, like empathy towards people, also empathy towards animals is affected by gender, as females are usually more empathic than males. Given the on-going process of feminization of the veterinary professions, taken together these findings offer a positive profile of veterinarians, who seem to be able to show empathy both towards animal-patients and human-clients, meeting the expectations of society. Finally, like empathy towards people, empathy towards animals seems to be vulnerable to anomalies related to mental disorders: in particular, the review of the available international literature shows that aberrations of empathy towards animals seems to be a crucial aspect of animal hoarding disorder.

## *Aims of the research and dissertation structure*

The aim of this work is to investigate three important themes related to empathy towards non-human animals, which are still little studied: 1) its role in non human-animal emotions recognition, with a particular focus on the dog (*Canis familiaris*), a species with a long history of domestication and whose ability to emotionally communicate with humans has been widely proved; 2) its status in veterinary medicine and the way in which it may be affected by veterinary education and veterinary clinical practice; 3) its anomalies in mental disorders, namely in animal hoarding disorder. Finally, since a condition to feel empathy towards animals is their ability to feel emotions, I have also briefly reviewed the scientific literature on animal emotions, which evidences the need to combine behavioural and physiological indexes to study them. Therefore, I carried out two studies aimed at investigating the possibility to use novel and non-invasive tools to study animal emotions, along with behavioural and traditional physiological measures. The dog (*Canis familiaris*) has been chosen as a model both for studying animal emotions and human ability to recognize them, since this species has a long history of domestication and its ability to emotionally communicate with humans has been widely proved.

Therefore, this dissertation brings together different studies, which examine different aspects of empathy towards animals.

This thesis consists of four chapters:

*Chapter 1* offers an overview of the concept of empathy and reviews a number of studies carried out both on empathy towards humans and towards non-human animals, highlighting similarities and differences between this two kinds of empathy. Moreover, this section shows how the importance of empathy towards people has been proved in relation to human emotions recognition, medical practice and some form of mental disorders, while little is known about the role of empathy towards non-human animals in symmetrical contexts such as non-human animal emotions recognition, veterinary medicine and mental disorders that involve anomalies in the human-animal bond, such as animal hoarding disorder.

*Chapter 2* deals with emotions in non-human animals, human ability to recognize them and with the suitability of the dog (*Canis familiaris*) as a model to study inter-specific emotional communication. There is now evidence that non-human animals, at least mammals, can feel emotions and that humans are able to recognize their vocal emotional signals, yet there is little evidence on inter-specific recognition of emotional visual signals, such as facial expressions.

Furthermore, the study of emotional states in animals is challenging, due to the complex nature of emotions and the absence of verbal language. Thus, non-invasive tools allowing to detect animal emotions in an objective way, along with behaviour analysis, are highly needed. In this section I present three studies: *Study 1* is focused on human ability to recognize a dog's emotional facial expressions, in relation to empathy level, expertise in dog behaviour and gender. *Study 2* and *3* investigate whether Infra-Red Thermography is a suitable a tool to detect positive and negative emotions in dogs.

*Chapter 3* briefly reviews the literature about empathy towards non-human animals in animal-related jobs, focusing in particular on studies that show a decline in empathy towards animals during veterinary education and on studies that underline the need of both empathy towards people and animals in companion-animal practice, since they are related, respectively, to animal welfare and clients' satisfaction. This section includes two studies: *Study 4* investigates empathy towards animals in first year and last year veterinary students, while *Study 5* is concerned with the effect of gender and length of career on empathy towards animals and towards people in veterinary practice, namely in vets working with companion-animals.

*Chapter 4* focuses on anomalies in empathy towards animals and presents a critical review of the literature on animal hoarding disorder (*Study 6*) and the summary of a book that I have co-authored.

References are reported at the end of each chapter. An additional final section offers some concluding remarks and suggests future directions in this research area.

The research took place at the Canis sapiens – Comparative cognition and Human-Animal Interaction - Lab of the University of Milan (Department of Pathophysiology and Transplantation, section of neuroscience) and is the result of a three-year project carried out with Emanuela Prato-Previde, professor of psychology at the university of Milan, and Paola Valsecchi and Annalisa Pelosi (Department of Neuroscience of the University of Parma).

# ***Chapter 1 – Introduction: an overview of human empathy towards humans and other animals***

## **1.1 What is empathy?**

Empathy may be defined as a vicarious affective response that arises from attending another individual's emotional experience and is more appropriate to another's situation than one's own (Zahn-Waxler & Radke-Yarrow, 1990; Hoffman, 2000; de Vignemont & Singer, 2006; McPhedran, 2009).

Empathy allows one to quickly relate to the emotional states of others and has visible effects on overt behavior. For example, the understanding of others' suffering is characterized by a negative experience, which can lead both to prosocial behavior, namely the behavioral effort to alleviate the distress of the others and to promote their welfare (de Waal, 2008; Knafo *et al.*, 2008), and to defensive behaviors or strategies of affective control due to an excessive personal distress (Wetsbury & Neumann, 2008).

Empathy-related emotional responses have also correspondent physiological outcomes, for instance changes in skin conductance responses, respiration, heart rate and corrugator muscle activity (Westbury & Neumann, 2008; Oliveira-Silva & Gonçalves, 2011).

Although part of psychological lexicon, there's still debate in literature about this concept and some authors distinguish between emotional or affective empathy and cognitive empathy (de Vignemont & Singer, 2006; Dziobek *et al.*, 2008): the former refers to affective resonance with others' emotion and the generation of an appropriate emotional response, while the latter includes abilities such as recognizing and understanding another's emotion through facial expression, speech or behaviour (Decety & Jackson, 2004; Taylor & Signal, 2005), distinguishing between self and others, and a developed theory of mind, which allows perspective taking (Baron-Cohen & Wheelwright, 2004; Decety & Jackson, 2004; Schulte-Rüther *et al.*, 2008). However, most studies considers empathy as a complex multidimensional psychological process, which involves both emotional and cognitive components and implies various levels of empathy, more and less complex from a cognitive point of view (i.e., Stephan & Finlay, 1999; Decety & Jackson, 2004). This broadest definition of empathy is useful to understand its ontogenetic and phylogenetic evolution, from passive emotional contagion to high-level cognitive phenomena such as sympathetic concern and empathic perspective taking (Preston & de Waal, 2002; de Waal, 2008; Schulte-Rüther *et al.*, 2008; Bekoff & Pierce, 2009).

Although the construct of empathy has been initially investigated in humans, with a particular interest in assessing empathy towards conspecifics, many studies have focused on the phylogeny of empathy, comparing different animal species and, to a lesser extent, on people ability to feel empathy towards other animals.

## **1.2 Phylogeny of empathy**

### **1.2.1 The evolutionary steps of empathic ability**

According with Preston and de Waal (2002), the simplest form of empathy is represented by emotional contagion, a phylogenetically ancient mechanism which appears to be widespread across species and consists of an automatic physiological response which causes an individual to be affected by another's emotional or arousal state and leads them to imitate other's expressions and actions.

Emotional contagion is typical of many species of group-living animals, including ground squirrels, birds and monkeys, and likely started in the context of parental care, since it increases mother's responsivity to her offspring and allows her to identify and respond immediately to their needs (Preston & de Waal, 2002; de Waal, 2008). Such an emotional connectedness is advantageous above all in regard to distress situations: signalling their state through distress vocalization, offspring obtain help by their mother, enhancing their chance of survival (de Waal, 2008).

Mother's emotional responsivity is a key component of nurturing behaviour, which entails the various care-giving behaviours directed toward offspring (Bradshaw & Paul, 2010; de Waal, 2008). Nurturance is a stereotyped response, evoked not only by emotional contagion-inducing signals, but also by a set of infant features (round face, large forehead, large and low-lying eyes, bulging cheeks, small nose and mouth, short and thick limbs and clumsy movements) and vocal signals, shared by the young of most birds and mammals (including human infants) which act as "social releasers" (Lorenz, 1943; Archer, 1997; Archer & Monton, 2010; Bradshaw & Paul, 2010). In particular, Lorenz (1943) outlined the so-called "baby schema response" or "cute response", which causes these stimuli to elicit the tendency to be attracted by, and to show protective and caring behaviour towards one's offspring (Bradshaw & Paul, 2010; de Waal, 2008; Borgi et al., 2014). This response seems very important to transmit parents' genes to the next generation, it is enhanced in females and has a positive correlation with affective empathy (Lehmann et al., 2013).

Outside the mother-offspring bond, high pitched sounds that resemble alarm calls, screams or crying induce fast action in situation of danger or for needs like food, comfort and warmth. Thanks

to this behavior, it is sufficient that one individual detects dangerous stimuli to quickly alert the entire group, allowing each member to spend less time on vigilance, favouring activities related to reproductive success, such as feeding (Preston & de Waal, 2002). The importance of signals that evoke emotional contagion in term of increasing chance of survival is also supported by the fact that mammals retain distress vocalization into adulthood (de Waal, 2008).

Sympathetic concern is the next evolutionary step and is defined as an affective response of sorrow and concern for a distressed or needy other. Differently from emotional contagion, this reaction implies self-other distinction, cognitive evaluations about the cause of the other's emotion and separation between internally and externally generated emotions (Hoffman, 2000; de Waal, 2008). The best documented example of sympathy is consolation, which is showed by apes, chimpanzees, large-brained birds and humans (de Waal, 2008).

Finally, the most sophisticated form of empathy is empathic perspective taking, which combines theory of mind ability, such as the adoption of the other's point of view, with emotional engagement. Unlike emotional contagion, empathic perspective taking is characterized by the awareness that the felt emotional state arises from that of another individual and, differently from sympathy, the affective response is not simply concern but involves the same feelings experimented by the other individual: as stated by Bekoff & Pierce (2009), if sympathy can be translated in "feeling for someone", empathy means "feeling with someone". Moreover, this kind of empathy doesn't need to attend physically to another's emotional situation, but it can depend only on imagination (de Wall, 2008; Bekoff & Pierce, 2009). De Vignemont and Singer (2006) identified four requirements peculiar to empathic perspective taking, namely: (i) an individual is in an affective state; (ii) this state is isomorphic to another individual's affective state; (iii) this state is elicited by the observation or imagination of another individual's affective state; (iv) one knows that the other individual is the source of one's own affective state.

In sum, affect sharing, or emotional resonance with others' emotions, represents the core element of empathy and it was the first to appear during phylogeny. Later in the evolution, this initial emotional contagion became associated with growing cognitive abilities, like self-other awareness, allowing for reactions that are more focused on other's emotions than one's own (Geangu *et al.*, 2011), and perspective taking.

### 1.2.2 The adaptive function of empathy: gender, similarity and familiarity biases

Broadly defined, empathy is a phylogenetically ancient capacity, widespread in the animal kingdom, from birds and rodents to humans (Bekoff & Pierce, 2009) and this suggests its adaptive function.

As we have seen above, empathy has an important role within the context of mother-offspring bond, providing better parental care, which increases offspring's chance of survival and bears an evolutionary advantage for the species (de Waal, 2008; Preston, 2013). The existence of gender and hormonal effects supports theory of empathy that emphasizes its origin within mother-offspring relationship.

In fact, many studies have found that women are usually more empathic than men (e.g. Davis, 1980; Eisenberg et al., 1995; Baron-Cohen & Wheelwright, 2004). However, these findings are consistent only with older children/adolescents and adults (Schulte-Rüther *et al.*, 2008; Bandstra *et al.*, 2011; Roth-Hanania *et al.*, 2011), and this could suggest the internalization of social expectation regarding gender role and gender identity, through social learning processes (Roth-Hanania *et al.*, 2011). Yet, it can't be excluded a genetic effect, that might involve female reproductive hormones. During late childhood and adolescence, pubertal hormonal changes take place, increasing estrogen and progesterone levels in females, and these hormones seem to have a role in predisposing women to be attracted by infant features (Sprenghelmeyer *et al.*, 2009), in emotion recognition accuracy and in affective responsiveness to negative social stimuli (Derntl et al., 2013).

Another hypothesis (de Waal, 2008) suggests that empathy is essential for the regulation of social interactions, since it motivates kin selection and altruistic behavior, providing coordinated activity and cooperation among members of a same group. Moreover, the ability to share other individuals' emotional experiences might facilitate social communication and create affiliation and fondness (de Vignemont & Singer, 2006). The fact that empathic response is amplified by similarity (for example in appearance, racial group and personality) and familiarity (social closeness and previous positive experiences with other), while is suppressed in relation to stranger and defectors (Krebs, 1975; Preston & de Waal, 2002; de Waal, 2008; Westbury & Neumann, 2008, Drwecki *et al.*, 2011) are evidences supporting this theory.

It has also been proposed that familiarity and similarity biases could be considered as a self-regulation mechanism of empathy (Hoffman, 2000), which, in addition to guide it appropriately toward those perceived to be more "like us", preserves us to experience intolerable levels of distress: in fact, to feel sorrow for everyone who suffers would most result in emotional exhaustion (Pallotta, 2008).

Finally, other authors suggest an epistemological role of empathy (de Vignemont & Singer, 2006): this theory is based on the discovery of mirror neuron system (Gallese et al., 1996; Gallese 2003) and views empathy as a form of “mind reading”, allowing us to predict other individual’s future actions and intentions.

### **1.2.3 Why do humans feel empathy toward other species? The key role of similarity bias in the evolution of inter-specific empathy.**

As Würbel (2009) noticed, the evolution of empathy toward animals can be seen as a psychological side effect of empathy with humans, which is triggered by animals’ signals, behaviours or physical features which closely resemble a set of human characteristics that arouse empathy among humans. Hence, similarity bias is likely to have a central role in this phenomenon and it can be analysed at different levels, such as infant features, phylogenetic closeness, physical appearance and behaviour. As seen above, empathy may have evolved in the context of parental care and its affective component covaries with the cute response elicited by the “baby schema” (de Waal, 2008; Bradshaw & Paul, 2010; Archer & Morton, 2011; Lehmann et al., 2013). Archer (1997) noticed that this response is not only evoked by infants of the same species and demonstrated that humans found 1-day-old chicks, kittens and puppies cute (Archer, 1997; Archer & Morton, 2011) and valued non-human faces with infant features, such as those of puppies and kittens, as attractive as baby faces (Archer & Morton, 2011). According to this view, the responsiveness to cute infant non human-animals would be an evolutionary aberration, due to an overgeneralization of features of the human baby schema to other animals (Lehmann et al., 2013; Preston, 2013). The existence of a biological mechanism deeply-rooted in parental bond that account for empathy towards animals it is also suggested by the large diffusion of pet-keeping and interspecific nurturant behavior, which are general human traits (Serpell, 1987; Archer, 1997; Bradshaw & Paul, 2010). In particular, most common pet species, such as dogs and cats, have been selected over centuries to preserve infantile characteristics also into adulthood, favouring our attraction and caring attitude toward them (Batson et al., 2005; Knight, 2008; Waller et al., 2013; Borgi et al., 2014). An additional evidence supporting this theory derives from studies which found a gender effect on empathy towards animals analogous to that on empathy toward people, by which women are more emphatic with animals and have more positive attitudes toward them than males (Hills, 1993; Paul & Podberscek, 2000; Signal & Taylor, 2007; Preylo & Arikawa, 2008; Ellingsen *et al.*, 2010).

Similarity effect reveals itself also in regard to phylogenetic closeness: comparing non-human animal visual stimuli, graded along a continuum for phylogenesis (i.e. birds, quadruped mammals

and primates), with human stimuli, it was found that the greater was the similarity of the species with humans, the larger was the empathic response, detected both through self-report and psychophysiological measures such as skin conductance response (Westbury & Neumann, 2008; Prguda & Neumann, 2014).

Another important factor in predicting humans attitude towards animals is behavioural similarity (Batt, 2009) which is related to humans' ability to recognize animals' emotional signals: for example, humans are able to differentiate negative from positive emotions conveyed through vocalizations of other mammals, such as pigs (Tallet *et al.*, 2010), dogs (Pongrácz *et al.*, 2005), cats (Nicastro & Owren, 2003) and chimpanzees (Belin *et al.*, 2008). Such an ability might be based on common structural rules in emotional vocalizations across species, which show an universal relationship between structure and emotional context: in particular, low pitch and atonal vocalizations denote aggressive intentions, while high pitch and tonal vocalizations reflect friendly or submissive intention (Morton, 1977; Owings & Morton, 1998; Tallet *et al.*, 2010; Preston, 2013, pp. 1319-1321; but see also Scheumann *et al.*, 2014). For instance, McComb and colleagues (2009) found a high frequency component within the purr produced by cats to solicit feeding by their owner which is also typical of human infants' cry. Moreover, it has been found a near-perfect relationship between perceptions of an animal's ability to communicate with humans and empathy for that animal (Harrison & Hall, 2010).

Most studies have not differentiated between affective and cognitive component in empathy towards animals, however the ability to recognize animal emotions and to appreciate their communicative aims could be ascribed to the latter one. In particular, it has been proposed that anthropomorphism or the tendency to project human thoughts, feelings and attributes on to non-human animals (Bradshaw & Paul, 2010), can be considered the greatest expressions of cognitive component of interspecific empathy; Harrison & Hall (2010) suggested that it is a component of a theory of mind ability, which may have evolved from the need to understand the intentions and emotions of conspecifics. In support of this hypothesis, it has been found that also anthropomorphism, as empathy, varies with a species genetic relatedness to humans (Harrison & Hall, 2010). Moreover, Apostol and colleagues (2013) found significant correlations between anthropomorphic beliefs and empathy toward animals, suggesting that anthropomorphic interpretations could facilitate perspective taking, and consequently the affective empathic reaction. Although anthropomorphism has usually a negative acceptation since it's considered as a tendency to overattribute human feelings, beliefs and intentions to animals (Archer, 1997), this tendency could be useful because of its predictive and explicative values about animals' behaviour, which also gives us the capacity to control it (Rollin, 1998). In fact, the development of a theory of mind for animals may have brought some evolutionary advantages, since it allows us to predict predators'

and preys' movements and intentions and so to develop more sophisticated hunting strategies (Würbel, 2009; Bradshaw & Paul, 2010). This explanation of the function of interspecific empathy parallels that of empathy among humans, which suggests an epistemological role of this ability (de Vignemont & Singer, 2006).

Moreover, according to Bradshaw & Paul (2010), cognitive empathy toward animals could have acted in combination with affective empathy to allow nurturance of young wild animals and so for domestication: an emotional attachment to some of these animals would have prevented their killing, favouring the selection and transmission of the genetic characteristics suitable for domestication.

However, there is still debate in the literature about the evolutionary significance of empathy towards other animals in terms of humans' fitness. The owner-pet bond is probably the best example of empathy towards other species, which are actually part of our social environment. Archer (1997) argued that, in evolutionary terms, prosocial behaviors toward other species, derived from empathy, represent a fitness cost to humans because of the impact of affection, time and money directed to animals instead of human kin. He considered pet-keeping as a form of social parasitism, that spread from the manipulation, by pets, of the human parenting responses to cute features typical of young animals, and allows them to enhance their fitness. Yet, considering not only pets, but also farm and research animals and the contribute that empathy with animals may have brought to the domestication process (Bradshaw & Paul, 2010), this behaviour seems to be advantageous also for human kind.

Moreover, the affective bond with animals has positive consequences on human physical and psychological health. Companion animals represent an emotional resource, providing their owners with support, comfort and companionship. There are also evidences that an emotional bond with an animal has significant health effects on people (Julius et al., 2014), such as lowered risk factors for cardiovascular disease (Anderson *et al.*, 1992) and higher chance to survive after myocardial infarction (Friedmann & Thomas, 1995). Moreover, people perceive pets as important, supportive parts of their lives and those perceptions are associated with a decrease of physiological and psychological responses to stress and anxiety: pets can buffer cardiovascular reactivity to acute stress as well as diminish perceptions of stress (Allen *et al.*, 2002). Pets appear to elicit positive-feeling states, such as happiness, laughter and relaxation (Allen *et al.*, 2002) that have beneficial effects on psychobiological stress systems, probably through the central activity of oxytocin (Nagasawa *et al.*, 2009; Cirulli *et al.*, 2011), which is linked with affiliative behaviours, attachment and stress reduction in highly social mammals, humans included (Ditzen *et al.*, 2009). There are also evidences that an emotional bond with an animal contributes positively to increase empathy

and socio-emotional and cognitive development in children (Ascione, 2001; Daly & Suggs, 2010; Endenburg & van Lith, 2011).

Finally, an alternative explanation is that empathy and the related likely consequent prosocial behaviour toward animals, as towards other humans, could have a selfish intention: for instance, if animal suffering signals are able to elicit empathy, they can make us feel bad; so, prosocial behaviour might allow to avoid unpleasant feelings (Würbel, 2009).

However, measuring fitness costs and benefits of empathy with animals is not easy, therefore it is unclear whether this behaviour is maladaptive, exploiting biases typical of empathy towards our conspecifics or whether it has been maintained during phylogeny because of its adaptive value (Bradshaw & Paul, 2010).

## **1.3 Empathy ontogeny**

### **1.3.1 Empathy development in humans toward other humans**

Hoffman (1987) outlined an analysis of the ontogeny of empathy, from birth to late infancy, which evolves from emotional contagion to empathic perspective taking, as in phylogeny (Preston & de Waal, 2002). Yet, as Hoffman (2000) noticed, there's a great individual difference about the age at which each stage is reached, since empathy development is influenced by numerous genetic, demographic and personality variables. Moreover, when assessing empathy development it is very important to distinguish among affective and cognitive components, since the latter, in particular, undergo a dramatic improvement over time (Davidov et al., 2013; Cheng et al., 2014; Schwenck et al., 2014.).

According to Hoffman (2000), emotional contagion or “global empathy” covers the first year of life and it can be noticed in newborns few hours after birth; it is considered an automatic, involuntary reaction to another's distress: contagious crying, the emotional reaction of distress to the cry sound of a peer, is a typical example of this phenomenon, and it has long been attributed to a confusion between self and others' distress, where children lack of self-other awareness and take other's emotions for their owns (Simner, 1971; Geangu, 2011). Thus, children empathic responses would first emerge as personal distress, with corresponding self-focused behaviors, like self-soothing (Bandstra *et al.*, 2011). Later in infancy, the affective resonance to others' emotions persists but becomes more sophisticated when complex cognitive abilities, in particular self-other awareness and perspective taking, develop. In particular, Hoffman (1987) maintained that only in the second year of life infants become capable of other-oriented empathy, because by this time they can differentiate self from others and feel concern for them.

It is worth noting that recent findings suggest that empathic self-distress may not reflect the lack of self-other differentiation but, rather, it may underline difficulties in emotion regulation abilities: according to this view, signals of empathic concern would already be present in the first year of life (see Davidov et al., 2013 for a review). In fact, by the age of two years, children also become better able to control their own emotional experience, so they can focus on the needs of others in distress (Bandstra *et al.*, 2011), showing sympathetic concern for the victim (Zahn-Waxler *et al.*, 1992). Prosocial attempts to comfort and help others are the first signs of this kind of empathy, but recent studies located them at an early age (Geangu, 2011; Roth Anania *et al.*, 2011), with modest levels of sympathy observed from 8 to 16 months (Roth Anania *et al.*, 2011), which increase from 14 to 20 months (Knafo *et al.*, 2008).

During the third year of life, children show various empathic behaviours, such as concern and interest in another's distress, expressed verbally or through facial mimicry, and helping behaviours (McDonald & Messinger, 2011).

Around the age of four years, with the acquisition of theory of mind, the cognitive ability to imagine and understand others' mental states, such as beliefs, intentions and desires (Wimmer & Perner, 1983), some capacity for role taking emerge, allowing the development of empathic perspective taking (Hoffman, 1987). This complex kind of empathic responding allow us to feel empathy also beyond the immediate situation, for example with regard to adverse living conditions (Hoffman, 2000). Longitudinal studies on empathy development are rare, however there are evidences accounting for adolescence as a crucial period for the increasing of perspective taking abilities (i.e., van der Graaf et al., 2013). Yet, it's worth noting that empathy likely keeps on developing all life long, being affected by a variety of genetic, developmental and environmental factors (Hoffman, 2000; Chen et al., 2014)

### **1.3.2 Familiarity bias and environmental factors affecting the ontogeny of empathy: parental care and style, culture and education.**

In their study with twins from 14 to 36 months, Knafo and colleagues (2008) showed that empathy is an enduring disposition, relatively stable across time and consistent across contexts and across its cognitive and affective aspects. According with these authors, individual differences in empathy are due to both genetic and environmental contributions. Besides, also temperamental and personality variables are related to empathy: for example, sociable temperament has been linked to greater empathic concern in the first years of life (Light & Zahn-Waxler, 2011); on the contrary, in adults, high levels for need of power are negative related to empathy, since they lead to an utilitarian view

of others as means for self-gratification rather than as living beings worthy of respect and concern (Bennett, 1988; Oleson & Henry, 2009).

In particular social learning processes have a significant role in canalizing empathy towards appropriate targets and in shaping empathic abilities.

From the beginning, empathy is affected by familiarity bias, in fact children are most responsive to distress in their mothers than toward unfamiliar persons (Zahn-Waxler *et al.*, 1992): the difference favouring mothers increases with age, reflecting the increasing mother-child closeness and emotional investment in the relationship (Knafo *et al.* 2008).

Mother-child relationship is one of the most important for empathy development. As in phylogeny, also in regard to ontogeny, emotional connectedness starts in the context of parental care, where human infants emotional signals exploit the emotional contagion mechanism to elicit nurturance in adults. It is widely accepted that infants and their caregiver share emotions during daily interaction: for instance, from the second month of life infants are able to recognize their mothers' expressions of joy and anger and match this affect states (Haviland & Lelwica, 1987). At the same time, mothers imitate their children's emotions, especially the positive ones, and transform negative affects (Tronick, 1989). Continuous and coordinated emotional interactions between mothers and infants organize infant's emotion regulation abilities, which determine the emotional competence of the individual and are required for empathic competence throughout life (Tronick, 1989; Stern 1977; Hoffman, 2000). As seen above, emotion regulation is functional to empathy development since it allows an individual to reduce self distress due to early emotional arousal (Pitcairn & Wishart 1994; Weinberg & Tronick, 1994; Calkins & Johnson, 1998; Diener *et al.* 2002; Jahromi *et al.* 2008) and therefore to focus on the needs of others, even if they are the source of distress. Thus, without interactions based on mother-child emotional connection, infants can't learn to regulate their emotions, compromising development of more advanced forms of empathy (Preston & de Waal, 2002).

After the acquisition of more complex cognitive and motor abilities, empathy can reveal itself through prosocial behaviors, which are affected by parenting style. Children's prosocial behavior is associated with mothers' empathic caregiving and with mothers' affectively delivered explanations about the distress their children witness: mothers who explain rules explicitly and show the consequences of child's actions, emphasizing correlated feelings, have more possibilities to promote prosocial attitudes in their children. Also appreciating children's prosocial qualities, defining them as "kind" or "generous", is useful to help children to interiorize these attributes as part of their personality (Robinson *et al.* 1994; Zahn-Waxler *et al.*, 1979). As well, an affectionate relationship between child and caregiver and secure attachment in infancy are related to empathy development (Waters *et al.*, 1979). Finally, parents' model, namely the caregivers' ability to show

an altruistic behavior toward others, can condition the development of the same ability in their child, through imitation (Robinson *et al.* 1994; Zahn-Waxler *et al.*, 1979).

Another important factor is culture, by which children, adolescents and young adults differ systematically on empathic responding. For example, preschool children from East-Asian culture, compared to children from Western culture, displayed more self-focused distress and less prosocial behavior (Tromsdorff *et al.*, 2007). Similar results have been found with high school and university students, as those from East Asian culture reported greater personal distress and less empathic concern than those from Western countries; a bicultural sample (individuals born and raised in Canada, but of East Asian ethnicity) showed levels of empathic concern and personal distress intermediate between those of Western and East Asian groups, suggesting the critical role of culture in the development of empathy (Cassels *et al.*, 2010). These results demonstrate that values and socializations practices peculiar to a culture influence the way in which empathy develops and its behavioral outcomes.

Finally, research highlights that certain types of education may influence empathy. In particular, medical training seems to be related with a decrease in expressions of empathy, probably because formal teachings are very concerned with the biomedical and technological aspects of care, without engaging students in the psycho-social aspects; moreover, increased responsibility and role modelled behaviour could negatively influence medical students' empathy (Pedersen, 2010; Michalec, 2011; Ward *et al.*, 2012).

### 1.3.3 The ontogeny of empathy toward other animals

As for empathy among humans, it appears difficult to draft an exact and universal scheme about the ontogeny of empathy toward animals, since it is influenced by many personality and environmental variables.

The sensitivity to animals' feelings and needs presupposes, first of all, the awareness that animals are living beings (Ascione, 2005): growing up, individuals improve their knowledge about animals and develop more sophisticated cognitive and emotional abilities, so empathy and attitudes toward animals varies with age.

Even if infants under six months of age are able to distinguish animate from inanimate objects on the base of their perceptive features (Gelman, 1990), it seems that under six years of age there is little recognition or appreciation of the feelings of animals: in particular, Carey (1997) found that four and five years old children didn't know that all animals eat and breathe.

The age between six and nine years old seems to be particularly important for the development of empathy toward animals, since in this period important changes in children's sensitivity to animals take place. By this age, children become more aware that animals might suffer pain and distress and become able to gather direct equivalency in physical appearance or in important functions (such as breathing and seeing) of animals and humans (Kellert, 1996; Kahn, 1997): comparisons focused on similarity between animals and humans appear a key element for the development of empathy toward non-human animals (Pallotta, 2008).

Moreover, in Conduct Disorder, 6.5 years is the median age for onset of the symptom "hurting animals", suggesting that by this age children understand that animals have the capacity for experiencing pain and distress (Ascione, 2001).

From infancy to adolescence children increase also their reasoning about animals and nature in general and develop values about them, that vary from unelaborated concerns for their well-being to homocentric (utilitarian views of animals) and biocentric reasoning (animals have moral standing that is at least partly independent of its value as a human commodity), depending also on culture and personal experiences (Kahn, 1997). An increasing experience with animals, in particular, can help children to correctly understand animals' emotional signals, especially if there's a competent adult to guide them (Ascione, 2005).

Therefore, knowledge about animals and experience with them seem to be two central factors in the development of empathy toward animals, probably because they exploit the same familiarity bias that affects empathy among humans (Zahn-Waxler *et al.*, 1992; Preston & de Waal, 2002; de Waal, 2008; Westbury & Neumann, 2008; Drwecki *et al.*, 2011). Experience with animals may also

increase the ability to imaginatively take the role of the animal-other, promoting positive attitude toward them (Pallotta, 2008).

With regard to animals, the level and the kind of experience of an individual with a particular animal or species influence humans' ability to understand animals' emotional signals and empathy toward them. For example, some studies demonstrate that individuals who kept pets in childhood or own them at the moment of the research have more humane attitudes toward pets and high levels of animal-directed empathy compared to those who didn't (Daly & Morton, 2009; Ellingsen *et al.*, 2010). The kind of experiences affects also human attitudes toward animal, as much as the level of experience. Among dog owners, empathy levels are higher for individuals who keep dogs for companionship than for those who use them for hunting, reflecting the different influences of utilitarian and affiliative aims on the relationship with animals (Ellingsen *et al.* 2010).

### **1.3.3.1 Factors affecting the development of empathy towards other animals**

A number of factor affecting empathy towards other people can be found also in regard to empathy towards other animals, however research in this field is quite limited.

First of all two personality traits show a negative correlation with empathy toward animals, namely hostility and need for power, with the latter revealing its negative influence also on empathy toward humans (Bennett, 1988). Individuals with high levels for need of power are characterized by an utilitarian view of others, which decreases empathy. Instead, hostility causes a temporary reduction of empathy, enhancing aggressions and predicting less sensitivity to animal maltreatment (Oleson & Henry, 2009). On the contrary, Mathews & Herzog (1997) found that other personality traits, such as sensitivity, typical of tender-minded, artistic and intuitive individuals, and imaginativeness, or the tendency to be unconventional, are positively correlated to a fair attitude towards animals.

Like empathy toward humans, empathy toward animals may be influenced by culture, which has an important role in developing ideology about animals. Al-Fayez and colleagues (2003) found evidences consistent with a less positive attitude toward companion animals in Muslim countries than in the USA, since the Muslim world has usually an instrumental views of animals, ascribing an economic rather than an emotional value to them; for example, dogs are regarded as "dirty" in Islamic religion and they are used for hunting and for guarding of fields and herds but they aren't considered as companion animals. Also animals' social status depends on culture, as clearly demonstrated, for example, by attitudes towards insects in Japan, where insects seem to be the first animal with which a child plays and some of them, such as rhinoceros beetle or stag beetle, are considered not simply toys but as playmates. These insects are perceived by children as familiar

animals, not dangerous, with whom communication is possible; children play with them, breed them, observe them, listen to them and sing songs about them, in the context of mutual interactions in which play and emotional bonding are important elements (Laurent, 2000).

What is common to most cultures is a larger ambivalence toward non-human animals, which are relegated to different cultural categories based upon species, for example “food”, “companion”, “research tool” or “wildlife” (Pallotta, 2008). As expected, studies comparing individuals within animal protection and vegetarians, who share the purpose to avoid cruelty toward animals and to protect them, to general community samples, found that subjects from the first two samples had better attitudes towards the treatment of animals and enhanced empathic brain response toward them than others (Signal & Taylor, 2007; Preylo & Arikawa, 2008; Filippi et al., 2010).

Pallotta (2008) noticed that young children are oblivious to the moral distinctions among different species of animals, which are learned during the socialization process; through normal socialization children learn to place boundaries between themselves and all other animals, and between different species of animals, in terms of norms, emotions and moral treatment, and to channel empathy toward our own species and species with a high social status.

Childhood socialization and cultural conditioning are mediated by parents, so attitudes toward animals are developed at first in a family setting. In a study with American family members, pet attitude of adolescents was best predicted by attitude of the adolescent’s mother (Schenk *et al.*, 1994), while attitude toward pets of Kuwaiti adolescents correlates more highly with that of their fathers than that of their mothers; this different family pattern seems to be congruent with the father’s more dominant role in Arab families (Al-Fayez *et al.*, 2003). Even if the precise mechanisms of transmission have not been determined by these studies, imitation is probably involved, as suggested by the fact that children and adolescents often begin to abuse animals reproducing the behaviour of a parent who exerts a violent and coercive “discipline” on pets (Ascione, 2001). Parental modelling also constitutes a mechanism by which fear of animals may be acquired early in life (Davey *et al.*, 1993; Gerull & Rapee, 2002) and being afraid of animals is associated with a less favourable attitude toward them (Schenk *et al.*, 1994; Ascione, 2001).

Finally, as medical education influences empathy toward humans (Michalec, 2011), so, in the same way, veterinary education influences students’ attitudes and empathy towards animals. Paul and Podberscek (2000) found that veterinary students in their later years rated the sentience of animals as lower than students in their earlier years, and among male students empathy toward animals decreased over time. This change reflects what happens with medical students, with the development of a more detached attitude toward their patients as they progress through their degree (Hazel *et al.*, 2011).

## **1.4 Empathy with animals and with humans: two faces of the same coin?**

The existence of common factors acting both on empathy with humans and with animals, such as similarity and familiarity biases, gender, personality traits, culture and education, and evidences that these two kinds of empathy very often covary (Paul, 2000; Signal & Taylor, 2007; Preylo and Arikawa, 2008; Daly & Morton, 2009), could suggest an underlined unique empathic ability. However, as Paul (2000) noticed, when deeply analysed, some of these factors correlate differentially with the two types of empathy: for instance, pet ownership and veterinary education are related only to empathy towards animals, while child rearing and medical education are specifically related to empathy for humans. What seems to be clear is that humans are able to generalize empathic responses to other animals: recently, Prguda e Neumann (2014) maintained that the link between inter-human empathy and empathy towards other animals is a function of phylogenetic similarity, while others suggested that empathy is rooted in nurturant tendencies and therefore is elicited by those who appear more childlike, vulnerable or distressed (i.e., Batson et al., 2005; Preston, 2013); yet, developmental experiences with animals seem to be as much important in predicting empathy toward them (Paul, 2000).

The link between humans- and animals-directed empathy emerges both in researches carried out on adults and children.

With regard to adults, Paul (2000) found a modest but significant correlation between empathy with humans and empathy with other animals and Taylor and Signal (2005) reported a significant relationship between empathy toward humans and attitudes toward animals, so that individuals who demonstrated higher empathic concern exhibited more welfare-related attitudes toward animals; these results are consistent with those of other researches, involving general community samples (Paul, 2000; Signal & Taylor, 2007), university students (Taylor & Signal, 2005) and samples selected on the basis of their attitudes toward animals, such as vegetarians (Preylo & Arikawa, 2008), pet owners (Daly & Morton, 2009) and animal protection activists (Signal & Taylor, 2007). Similar results has been found with respect to children, where empathy with animals seems to generalize to empathy with people in humane educational programs (Ascione, 1992; Daly & Suggs, 2010; Faver 2010); moreover, during childhood, pet ownership is related to higher empathy levels (Ascione & Weber, 1996), which are preserved also later in life, during adulthood (Paul & Serpell, 1993; Daly & Morton, 2009).

Some researches postulated an association between violence towards humans and/or animals and a lack of animal directed empathy (Ascione, 2001; Sherley, 2007; Daly & Morton, 2008) with empathy being proposed as a mediating factor in aggression to both humans and animals, since if individuals can vicariously experience the consequences of their actions towards others trough

empathy, then they will avoid to hurt others (Mc Phedran, 2009). Daly and Morton (2008) found that individuals who had witnessed multiple experiences of animal abuse reported lower levels of personal distress and higher scores in perspective taking on measure of empathy toward humans. The authors explained these findings attributing lower personal distress to habituation to suffering and suggested the possibility that witnessing multiple acts of animal abuse may increase cognitive empathy while depressing the emotional component; therefore they suggested that chronic exposure to animal abuse or killing may lead to empathy disintegration.

Yet, studies about the link between empathy with human and with animals are correlational, so a causal relationship cannot be established (McPhedran, 2009; Endenburg & van Lith, 2011).

### **1.5 Why does empathy towards non-human animals matter?**

Beyond the potentiality of empathy towards animals to generalize to empathy towards humans, enhancing it through humane education programs (i.e., Ascione, 1992, Daly & Suggs, 2010; Faver 2010), the study of empathy towards animals is interesting especially for professionals who work in direct contact with animals, first of all for veterinarians, since it may influence both professionals' and animals' well-being.

In recent years there has been a marked increase in interest in animal welfare, both in scientific research and in society, with the aim to minimize their suffering and to promote animals' positive emotions and welfare (Wurzel, 2009; Hemsworth et al., 2009; Rollin, 1998; Regan, 2004; Foer, 2009). Pets, in particular, nowadays play an integral role in people's lives and most pet owners consider their pets as members of the family, forming with them long lasting and intense affectional bonds (Julius et al., 2014) which are considered the motivation for people to seek veterinary care for their animals (Martinsen, 2007; Mitchener & Ogilvie, 2002).

Vets need to be aware of the current social view because this may influence the attitudes of animal owners, consumers and general public on what treatments are acceptable or unacceptable (Hazel et al., 2011). In particular, pet owners and society expect veterinarians to treat their patients with care and compassion and consider them as those who can and should alleviate pain and suffering in animals (Mitchener and Ogilvie, 2002; Martinsen, 2007).

Moreover, given the deep affectional bond between people and their pets, vets working in companion animal practice need to pay attention not only to the medical needs of the pet but also to the relationship between caregivers and their pets, taking into account and supporting also their emotional needs (Mitchener & Ogilvie, 2002; McArthur & Fitzgerald, 2013). Therefore, an

important aspect of the veterinary practice is the ability to interact with people in situations that require empathy.

Despite the recent acknowledgment of veterinary medicine as a caring profession, with some studies starting to recognize the importance of empathy in veterinary practice (e.g., Mitchener & Ogilvie, 2002; Martinsen, 2007; Carney et al., 2012), there are some evidences that veterinary students often undergo a process of hardening and detachment during their education, characterized by a decline in empathy toward animals (Paul and Podberscek, 2000; Levine et al., 2005; Hazel et al., 2011; Colombo et al., 2015). This finding is in line with studies on medical students, reporting a decrease in empathy toward patients (Pedersen, 2010; Michalec, 2011; Ward et al., 2012).

Moreover, there are some evidences that veterinarians are at risk of burn-out (Bartram & Baldwin, 2010; Hatch et al., 2011; Platt et al., 2012), a pathological condition characterized by an impairment of empathic ability, often observed in caring professions, as a result of a massive exposure to suffering (Hoffman, 2000; Ghetti et al., 2009; Mitchener & Ogilvie, 2002 ).

However, as far as I'm aware, there are no studies investigating empathy toward animals in qualified vets and only one study, focused on vets' communication skills has assessed the expression of empathy towards pet owners during clinical consultation, finding that it was related with clients' satisfaction (McArthur & Fitzgerald, 2013): therefore further research is needed in order to assess this important issue, which may help to increase both professionals and animal welfare in the field of veterinary medicine, gaining also additional knowledge about the relation between empathy towards animals and towards people.

Furthermore, recently Baron-Cohen (2011) has suggested that some kinds of psychopathology, such as borderline, antisocial and narcissistic personality disorders and autism spectrum disorders, could be rethought as empathy-related disorders, characterized by the selective impairment of the emotional or the cognitive component of empathy.

So far, no mental disease has been recognized as specifically related to a lack of empathy towards animals, even if "hurting animals" is included among the diagnostic criteria of Conduct Disorder. However, the last version of DSM (2013) includes a new kind of mental disorder, namely the Hoarding Disorder, with a special manifestation called "Animal Hoarding". This particular condition is characterized by "*the accumulation of a large number of animals and a failure to provide minimal standards of nutrition, sanitation, and veterinary care and to act on the deteriorating condition of the animals (i.e., disease, starvation, death) and the environment (i.e., severe overcrowding, extremely unsanitary conditions).*" Since animals are legally considered as properties and diagnostic criteria for HD don't specify the type of hoarded possessions, Animal hoarding has not been distinguished from object hoarding, despite the fact that the former deals with animate subjects whereas the latter with inanimate objects; however this classification is still a

matter of debate (Frost et al., 2011; 2015). Although there has been a dramatic increase in research on Hoarding Disorder in the last 20 years, there is a dearth of knowledge about Animal Hoarding; therefore, further studies are needed in order to better understand this pathology, which appears to be not so uncommon. A new interpretation of Animal Hoarding disorder could be related to an impairment of empathy towards animals, since the predominant features of this behaviour are an intense emotional attachment to the hoarded animals combined with the inability to provide them with adequate care and the incapacity to recognize their suffering (Patronek, 1999).

## References

- Al-Fayez G., Awadalla A., Templer D.I. and Arikawa H. (2003). Companion animal attitude and its family pattern in Kuwait. *Society & Animals*, 11 (1), 17-28.
- Allen K., Blascovich J. and Mendes W.B. (2002). Cardiovascular reactivity and presence of pets, friends and spouses: the truth about cats and dogs. *Psychosomatic Medicine*, 64, 727-739.
- American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders (DSM-5®)*. American Psychiatric Pub.
- Anderson W.P., Reid C.M. and Jennings G.L. (1992). Pet ownership and risk factors for cardiovascular disease. *Medical Journal of Australia*, 157, 298-301.
- Apostol, L., Rebeaga, O. L., & Miclea, M. (2013). Psychological and socio-demographic predictors of attitudes toward animals. *Procedia-Social and Behavioral Sciences*, 78, 521-525.
- Archer J. (1997). Why do people love their pets?. *Evolution and Human Behavior*, 18, 273-259.
- Archer J. & Monton S. (2011). Preferences for infant facial features in pet dogs and cats. *Ethology*, 117, 217-226.
- Ascione F.R. (1992). Enhancing children's attitudes about the humane treatment of animals: generalization to human directed empathy. *Antrozoös*, 5, 176-191.
- Ascione F.R. (2001). Animal abuse and youth violence. *Juvenile Justice Bulletin*.
- Ascione F.R. (2005). *Children and animals, exploring the roots of kindness and cruelty*. Purdue University Press.
- Ascione F.R. & Weber C.V. (1996). Children's attitudes about the humane treatment of animals and empathy: one-year follow up of a school-based intervention. *Antrozoös*, 9, 188-195.
- Bandstra N.F., Chambers C.T., McGrath P.J and Moore C. (2011). The behavioural expression of empathy to others' pain versus others' sadness in young children. *Pain*, 152, 1074-1082.
- Baron-Cohen, S. (2011). *The science of evil: On empathy and the origins of cruelty*. Basic books.
- Baron-Cohen S. & Wheelwright S. (2004). The Empathy Quotient: an investigation of adults with Asperger Syndrome or High Functioning Autism, and normal sex difference. *Journal of Autism and Developmental Disorders*, 34 (2), 163-175.
- Bartram D.J. and Baldwin D.S. (2010). Veterinary surgeons and suicide: a structured review of possible influences on increased risk. *Veterinary Record*, 166, 388-397.
- Batson, C. D., Lishner, D. A., Cook, J., & Sawyer, S. (2005). Similarity and nurturance: Two possible sources of empathy for strangers. *Basic and applied social psychology*, 27(1), 15-25.
- Batt, S. (2009), Human attitudes towards animals in relation to species similarity to humans: a multivariate approach. *Bioscience Horizons*, 2 (2), 180-190

- Bekoff M. & Pierce J. (2009). *Wild justice. The moral lives of animals*. The University of Chicago.
- Belin P., Fecteau S., Charest I., Nicastro N., Hauser M. and Armony J. (2008). Human cerebral response to animal affective vocalizations. *Proceedings of the Royal Society B-Biological Sciences*, 275, 473-481.
- Bennett J. (1988). Power and influence as distinct personality traits: development and validation of a psychometric measure. *Journal of Research in Personality*, 22, 361-394.
- Bock B.B., Van Huik M.M., Prutzer M., Kling Eivellard F. and Dockes A. (2007). Farmers' relationship with different animals: the importance of getting close to the animals. Case studies of French, Swedish and Dutch cattle, pig and poultry farmers. *International Journal of Sociology of Food and Agriculture*, 15(3), 108-125.
- Borgi, M., Cogliati-Dezza, I., Brelsford, V., Meints, K., & Cirulli, F. (2014). Baby schema in human and animal faces induces cuteness perception and gaze allocation in children. *Frontiers in psychology*, 5.
- Bradshaw J.W.S. & Paul E.S. (2010). Could empathy for animals have been an adaptation in the evolution of Homo sapiens?. *Animal Welfare*, 19 (S), 107-112.
- Calkins S.D. & Johnson M.C. (1998). Toddler regulation of distress to frustrating events: temperamental and maternal correlates. *Infant behavior and development*, 21, 379 – 395.
- Carey S. (1987). *Conceptual change in childhood*. Cambridge, MA: MIT Press.
- Cassels T.G., Chan S., Chung W. and Birch S.A.J. (2010). The role of culture in affective empathy: cultural and bicultural differences. *Journal of Cognition and Culture*, 10, 309-326.
- Chen, Y. C., Chen, C. C., Decety, J., & Cheng, Y. (2014). Aging is associated with changes in the neural circuits underlying empathy. *Neurobiology of aging*, 35(4), 827-836.
- Cheng, Y., Chen, C., & Decety, J. (2014). An EEG/ERP investigation of the development of empathy in early and middle childhood. *Developmental cognitive neuroscience*, 10, 160-169.
- Cirulli F., Borgi M., Berry A., Francia N. and Alleva E. (2011). Animal-assisted interventions as innovative tools for mental health. *Annali dell'Istituto Superiore di Sanità*, 47 (4), 341-348.
- Daly B. & Morton L.L. (2008). Empathic correlates of witnessing the inhumane killing of an animal: an investigation of single and multiple exposure. *Society and Animals*, 16, 243-255.
- Daly B. & Morton L.L. (2009). Empathic differences in adults as a function of childhood and adult pet ownership and pet type. *Anthrozoös*, 22 (4), 371-382.
- Daly B. & Suggs S. (2010). Teachers' experiences with humane education and animals in the elementary classroom: implications for empathy development. *Journal of Moral Education*, 39 (1), 101-112.
- Darwin C. (1872). *The expression of the emotions in man and animals*. Oxford University Press.

- Davey G.C.L., Forster L. and Mayhew G. (1993). Familial resemblance in disgust sensitivity and animal phobias. *Behaviour Research and Therapy*, 31 (1), 41-50.
- Davidov, M., Zahn-Waxler, C., Roth-Hanania, R., & Knafo, A. (2013). Concern for others in the first year of life: theory, evidence, and avenues for research. *Child Development Perspectives*, 7(2), 126-131.
- Davis M.H. (1980). A multidimensional approach to individual differences in empathy. *JSAS Catalogue of Selected Documents in Psychology*, 10, 85-104.
- Decety, J., & Jackson, P. L. (2004). The functional architecture of human empathy. *Behavioral and cognitive neuroscience reviews*, 3(2), 71-100.
- de Vignemont F. & Singer T. (2006). The empathic brain: how, when and why?. *Trends in Cognitive Science*, 10 (10), 435-441.
- de Waal F.B.M. (2008), Putting the altruism back into altruism: the evolution of empathy. *Annual Review of Psychology*, 59, 279-300.
- Derntl, B., Hack, R. L., Kryspin-Exner, I., & Habel, U. (2013). Association of menstrual cycle phase with the core components of empathy. *Hormones and behavior*, 63(1), 97-104.
- Diener, M.L., Mangelsdorf, S.C., McHale, J.L., and Frosch, C.A., (2002). Infants' behavioral strategies for emotion regulation with fathers and mothers: associations with emotional expressions and attachment quality. *Infancy*, 3, 153 — 174.
- Ditzen B., Schaer M., Gabriel B., Bodenmann G., Ehler U. and Heinrichs M. (2009). Intranasal oxytocin increases positive communication and reduces cortisol levels during couple conflict. *Biological Psychiatry*, 65, 728-731.
- Drwecki B.B., Moore C.F., Ward S.E. and Prkachin K.M. (2011). Reducing racial disparities in pain treatment: the role of empathy and perspective taking. *Pain*, 152, 1001-1006.
- Dziobek I., Rogers K., Fleck S., Bahnemann M., Heekeren H.R., Wolf O.T. and Convit A. (2008). Dissociation of cognitive and emotional empathy in adults with Asperger Syndrome using the Multifaced Empathy Test (MET). *Journal of Autism and Developmental Disorders*, 38, 464-473.
- Eisenberg N., Carlo G., Murphy B. and Van Court P. (1995). Prosocial development in late adolescence: a longitudinal study. *Child Development*, 66, 1179-1197.
- Ellingsen K., Zanella A.J., Bjerkås E. and Indrebø A. (2010). The relationship between empathy, perception of pain and attitudes toward pets among Norwegian dog owners. *Anthrozoös*, 23 (3), 231-243.
- Endenburg N. & van Lith H.A. (2011). The influence of animals on the development of children. *The Veterinary Journal*, 190, 208-214.
- Faver, C. A. (2010). School-based humane education as a strategy to prevent violence: Review and recommendations. *Children and Youth Services Review*, 32(3), 365-370.
- Feshbach N.D. & Roe K. (1968). Empathy in six- and seven-years-olds. *Child Development*, 39 (1), 133-145.

- Filippi M., Riccitelli G., Falini A., Di Salle F., Vuilleumier P., Comi G. and Rocca M.A. (2010). The brain functional networks associated to human and animal suffering differ among omnivores, vegetarians and vegans. *PLoS One*, 5 (5): e10847.
- Foer J.S. (2009). *Eating animals*. USA, Little Brown.
- Friedmann E. & Thomas S.A. (1995). Pet ownership, social support, and one-year survival after acute myocardial infarction in the Cardiac Arrhythmia Suppression Trial (CAST). *American Journal of Cardiology*, 76, 1213-1217.
- Frost, R. O., Patronek, G., & Rosenfield, E. (2011). Comparison of object and animal hoarding. *Depression and anxiety*, 28(10), 885-891.
- Frost R.O., Patronek G., Arluke A. and Steketee G. (2015). The Hoarding of Animals: an update. *Psychiatric Times*.
- Gallese, V. (2003) The roots of empathy: the shared manifold hypothesis and the neural basis of intersubjectivity. *Psychopathology*, 36: 171-180.
- Gallese, V., Fadiga, L., Fogassi, L. and Rizzolatti, G. (1996) Action recognition in the premotor cortex. *Brain*, 119: 593-60
- Geangu E. (2011), Individual differences in infants' emotional resonance to a peer in distress: self-other awareness and emotion regulation. *Social Development*, 20 (3), 450-470.
- Geangu E., Benga O., Stahl D. and Striano T. (2011). Individual differences in infants' emotional resonance to a peer in distress: self-other awareness and emotion regulation. *Social Development*, 20 (3), 450-470.
- Gelman R. (1990). First principles organize attention to and learning about relevant data: number and the animate inanimate distinction as examples. *Cognitive Sciences*, 14, 79-106.
- Gerull F.C. & Rapee R.M. (2002). Mother knows best: effects of maternal modelling on the acquisition of fear and avoidance behavior in toddlers. *Behaviour Research and Therapy*, 40 (3), 279-287.
- Ghetti, C., Chang, J., & Gosman, G. (2009). Burnout, psychological skills, and empathy: balint training in obstetrics and gynecology residents. *Journal of graduate medical education*, 1(2), 231-235.
- Harrison M.A. & Hall A.E. (2010). Anthropomorphism, empathy and perceived communicative ability vary with phylogenetic relatedness to humans. *Journal of Social, Evolutionary and Cultural Psychology*, 4 (1), 34-48.
- Hatch, P. H., Winefield, H. R., Christie, B. A., & Lievaart, J. J. (2011). Workplace stress, mental health, and burnout of veterinarians in Australia. *Australian veterinary journal*, 89(11), 460-468.
- Haviland J.M. & Lelwica M. (1987). The induced affect response: 10-week-old infants' responses to three emotion expressions. *Developmental Psychology*, 23, 97-104.

- Hazel S.J., Signal T.D. and Taylor N. (2011). Can teaching veterinary and animal-science students about animal welfare affect their attitude toward animals and human-related empathy?. *Journal of Veterinary Medical Education*, 38, 74-83.
- Hellyer P., Frederick C., Lacy M. and Wagner A. (1999). Attitudes of veterinary medical students, house officers, clinical faculty, and staff toward pain management in animals. *Journal of the American Veterinary Medical Association*, 214, 238-244.
- Hemsworth P.H., Barnett J.L. and Coleman G.J. (2009). The integration of human-animal relations into animal welfare monitoring schemes. *Animal Welfare*, 18, 335-345.
- Hills A. (1993). The motivational bases of attitudes toward animals. *Society and animals*, 1 (2), 111-128.
- Hoffman M.L. (1987). The contribution of empathy to justice and moral judgment. In Eisenberg N. and Strayer J., *Empathy and its development*. Cambridge University Press, Cambridge.
- Hoffman M.L. (2000). *Empathy and moral development*. Implications for caring and justice. Cambridge University Press, Cambridge.
- Jahromi, L.B., Gulsrud, A. e Kasari, C. (2008). Emotional Competence in Children With Down Syndrome: Negativity and Regulation, *American Journal on Mental Retardation*, 113, 32 – 43.
- Julius, H., Beetz, A., Kotrschal, K., Turner, D. C., & Unväs-Moberg, K. (2014). *Bindung zu Tieren: psychologische und neurobiologische Grundlagen tiergestützter Interventionen*. Hogrefe Verlag
- Kahn P.H. (1997). Developmental psychology and the biophilia hypothesis: children's affiliation with nature. *Developmental review*, 17, 1-61.
- Kellert S.R. (1996). *The value of life*. Washington D.C.: Island Press.
- Knafo A., Zahn-Waxler C., Van Hulle C. and Robinson J.L. (2008), The developmental origins of a disposition toward empathy: genetic and environmental contributions. *Emotion*, 8 (6), 737-752.
- Knight, A. J. (2008). "Bats, snakes and spiders, Oh my!" How aesthetic and negativistic attitudes, and other concepts predict support for species protection. *Journal of Environmental Psychology*, 28(1), 94-103.
- Krebs, D. (1975). Empathy and altruism. *Journal of personality and social psychology*, 32(6), 1134.
- Laurent E.L. (2000). Children, "insects" and play in Japan. In Podberscek A.L., Paul E.S. and Serpell J.A., *Companion animals and us*, 61-89. Cambridge: Cambridge University Press.
- Lehmann, V., Huis, E. M., & Vingerhoets, A. J. (2013). The human and animal baby schema effect: Correlates of individual differences. *Behavioural processes*, 94, 99-108.
- Levine E.D., Mills D.S. and Houpt K.A. (2005). Attitudes of veterinary students at one US college toward factors relating to farm animal welfare. *Journal of Veterinary Medical Education*, 32 (4), 481-490.
- Lorenz K. (1943). Der angeborenen formen möglicher erfahrung. *Zeitschrift für Tierpsychologie*, 5, 235-409.

- Mathews S. & Herzog H. (1997). Personality and attitudes toward the treatment of animals. *Society & Animals*, 5, 169-175.
- McArthur, M. L., & Fitzgerald, J. R. (2013). Companion animal veterinarians' use of clinical communication skills. *Australian veterinary journal*, 91(9), 374-380.
- McComb, K., Taylor, A. M., Wilson, C., & Charlton, B. D. (2009). The cry embedded within the purr. *Current Biology*, 19(13), R507-R508.
- Mc Donald N.M. & Messinger D.S. (2011). The development of empathy: how, when and why. In Sanguinetti, J. J., Acerbi, A., & Lombo, J. A. (Eds.). *Moral Behavior and Free Will: A Neurobiological and Philosophical Approach*. Pontificium Consilium de Cultura, 341-368.
- McPhedran S. (2009). A review of the evidence for associations between empathy, violence and animal cruelty. *Aggression and Violent Behavior*, 14, 1-4.
- Michalec L. (2011). Learning to cure, but learning to care? *Advances in Health Sciences Education*, 16, 109-130.
- Mitchener K.L. and Ogilvie G.K. (2002). Understanding compassion fatigue: keys for the caring veterinary healthcare team. *Journal of the American Animal Hospital Association*, 38, 307 – 310.
- Morton E.S. (1977). On the occurrence and significance of motivation-structural rules in some bird and mammal sounds. *American Naturalist*, 111, 855-869.
- Nagasawa M., Kikusui T., Onaka T., Ohta M. Dog's gaze at its owner increases owner's urinary oxytocin during social interaction. *Hormones & Behavior*, 55, 434-441.
- Nicastro N. & Owren M.J. (2003). Classification of domestic cat (*Felis catus*) vocalizations by naive and experienced human listeners. *Journal of Comparative Psychology*, 117, 44-52.
- Oleson J.C. & Henry B.C. (2009). Relations among need for power, affect and attitudes toward animal cruelty. *Anthrozoös*, 22(3), 255-265.
- Oliveira-Silva P. & Gonçalves O.F. (2011). Responding emphatically: a question of heart, not a question of skin. *Applied Psychophysiology and Biofeedback*, 36, 201-207.
- Owings D. & Morton E.S. (1998). *Animal vocal communication: a new approach*. Cambridge, UK: Cambridge University Press.
- Pallotta N.R. (2008). Origin of adult animal rights lifestyle in childhood responsiveness to animal suffering. *Society and animals*, 16, 149-170.
- Patronek, G. J. (1999). Hoarding of animals: an under-recognized public health problem in a difficult-to-study population. *Public Health Reports*, 114(1), 81.
- Paul E.S. (2000). Empathy with animals and with humans: are they linked? *Anthrozoös*, 13 (4), 194-202.
- Paul E.S. & Podberscek A.L. (2000). Veterinary education and students' attitudes towards animal welfare. *The veterinary record*, 146, 269-272.

- Paul E.S. & Serpell J.A. (1993). Childhood pet keeping and humane attitudes in adulthood. *Animal Welfare*, 2, 321-337.
- Pedersen, R. (2010). Empathy development in medical education—a critical review. *Medical teacher*, 32(7), 593-600.
- Pitcairn T.K. e Wishart J.G. (1994). Reactions of young children with Down's syndrome to an impossible task. *British Journal of Developmental Psychology*, 12, 485 – 489.
- Platt, B., Hawton, K., Simkin, S., & Mellanby, R. J. (2012). Suicidal behaviour and psychosocial problems in veterinary surgeons: a systematic review. *Social psychiatry and psychiatric epidemiology*, 47(2), 223-240.
- Pongrácz P., Molnár C., Miklòsi A. and Csányi V. (2005). Human listeners are able to classify dog (*Canis familiaris*) barks recorded in different situations. *Journal of Comparative Psychology*, 119, 136-144.
- Preston, S. D. (2013). The origins of altruism in offspring care. *Psychological Bulletin*, 139(6), 1305.
- Preston S.D. & de Waal F.B.M (2002). Empathy: its ultimate and proximate bases. *Behavioral and Brain Sciences*, 25 (1), 1-71.
- Prguda, E., & Neumann, D. L. (2014). Inter-human and animal-directed empathy: A test for evolutionary biases in empathetic responding. *Behavioural processes*, 108, 80-86.
- Preylo B.D. & Arikawa H. (2008). Comparison of vegetarians and non-vegetarians on pet attitude and empathy. *Anthrozoös*, 21 (4), 387-395.
- Regan T. (2004). *Empty cages: facing the challenge of animal rights*. USA: Rowman and Littlefield Publishing.
- Robinson J.L., Zahn-Waxler C. and Emde R. (1994). Patterns of development in early empathic behavior: environmental and child constitutional influences. *Social Development*, 3, 125-145.
- Rollin B. (1998). *The unheeded cry – Animal consciousness, animal pain, and science*. Expanded ed. Iowa State University Press.
- Roth-Hanania R., Davidov M. and Zahn-Waxler C. (2011). Empathy development from 8 to 16 months: early signs of concern for others. *Infant Behaviour & Development*, 34, 447-458.
- Schwenck, C., Göhle, B., Hauf, J., Warnke, A., Freitag, C. M., & Schneider, W. (2014). Cognitive and emotional empathy in typically developing children: The influence of age, gender, and intelligence. *European Journal of Developmental Psychology*, 11(1), 63-76.
- Schenk S.A., Templer D.I., Peters N.B. and Schmidt M. (1994). The genesis and correlates of attitudes toward pets. *Anthrozoös*, 7 (1), 60-69.
- Scheumann, M., Hasting, A. S., Kotz, S. A., & Zimmermann, E. (2014). The voice of emotion across species: how do human listeners recognize animals' affective states?. *PloSone*, 9(3).

- Schulte-Rüther M., Markowitsch H.J., Shah N.J., Fink G.R. and Piefke M. (2008). Gender differences in brain networks supporting empathy. *NeuroImage*, 42, 393-403.
- Serpell J.A. (1987). Pet keeping in non-western societies. *Anthrozoos*, 1, 166-174.
- Sherley M. (2007). Why doctors should care about animal cruelty. *Australian Family Physician*, 36 (1/2), 61-63.
- Signal T.D. & Tailor N. (2007). Attitude to animals and empathy: comparing animal protection and general community samples. *Anthrozoös*, 20 (2), 125-130.
- Simner M.L. (1971). Newborn's response to the cry of another infant. *Developmental Psychology*, 5, 136-150.
- Sprengelmeyer R., Perrett D.I., Fagan E.C., Cornwell R.E., Lobmaier JS, Sprengelmeyer A., Aasheim H.B.M., Black I.M., Cameron L.M., Crow S., Milne N., Rhodes E.C. and Young A.W. (2009). The cutest little baby face: a hormonal link to sensitivity to cuteness in infant faces. *Psychological Science*, 20, 149-154.
- Stephan W.G. and Finlay K. (1999). The Role of Empathy in Improving Intergroup Relations. *Journal of Social Issues*, 55 (4): 729 – 743.
- Stern D. (1977). *The first relationship: infant and mother*. Harvard University Press.
- Tallet C., Spinka M., Maruscáková I. and Simecek P. (2010). Human perception of vocalization of domestic piglets and modulation by experience with domestic pigs (*Sus scrofa*). *Journal of Comparative Psychology*, 124 (1), 81-91.
- Taylor N. & Signal T.D. (2005). Empathy and attitudes to animals. *Anthrozoös*, 18 (1), 18-27.
- Trommsdorff G., Friedlmeier W. and Mayer B. (2007). Sympathy, distress and prosocial behaviour of preschool children in four cultures. *International Journal of Behavioral Development*, 31, 284-293.
- Tronick E.Z. (1989). Emotions and emotional communication in infants. *American Psychologist*, 44 (2), 112-119.
- Van der Graaff, J., Branje, S., De Wied, M., Hawk, S., Van Lier, P., & Meeus, W. (2014). Perspective taking and empathic concern in adolescence: gender differences in developmental changes. *Developmental psychology*, 50(3), 881.
- Waller, B. M., Peirce, K., Caeiro, C. C., Scheider, L., Burrows, A. M., McCune, S., & Kaminski, J. (2013). Paedomorphic facial expressions give dogs a selective advantage. *PLOSone*, 8 (12), e82686
- Ward, J., Cody, J., Schaal, M., & Hojat, M. (2012). The empathy enigma: an empirical study of decline in empathy among undergraduate nursing students. *Journal of Professional Nursing*, 28(1), 34-40.
- Waters E., Wippman J. and Sroufe L.A. (1979). Attachment, positive affect and competence in the peer group: two studies in construct validation. *Child Development*, 50 (3), 821-829.

- Weinberg, M.K. e Tronick, E.Z (1994). Beyond the face: an empirical study of infant affective configurations of facial, vocal, gestural, and regulatory behaviors. *Child Development*, 65, 1503 - 1515.
- Westbury H.R. & Neumann D.L. (2008). Empathy-related responses to moving film stimuli depicting human and non-human targets in negative circumstances. *Biological Psychology*, 78, 66-74
- Wimmer H. & Perner J. (1983). Beliefs about beliefs: representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, 13, 103-128.
- Würbel H. (2009). Ethology applied to animal ethics. *Applied Animal Behaviour Science*, 118, 118-127.
- Zahn Waxler C., Radke-Yarrow M., and King R.A. (1979). Child-rearing and children's prosocial initiations toward victims of distress. *Child Development*, 50, 319-330.
- Zahn-Waxler, C. & Radke-Yarrow, M. (1990). The origins of empathic concern. *Motivation and emotion*. 14(2), 107-130.
- Zahn-Waxler, C., Radke-Yarrow, M. and Wagner E. (1992). Development of concern for others. *Developmental Psychology*. 28 (1), 126-136.

## ***Chapter 2 – Recognizing emotions in non-human animals***

Two necessary conditions to feel empathy towards other individuals, either human or not, are that they are able to experience emotions and that the observer is capable to recognize their emotional states. Hence, in order to speak about empathy towards non-human animals, we need evidence that animals do feel emotions and that, at least to some extent, humans are able to correctly recognize them.

In this chapter, after a brief introduction about scientific evidences of emotions in non-human animals, inter-specific emotion recognition (with a particular focus on the dog, which is an interesting model to investigate inter-specific emotional communication) and the relation between empathy and the ability to identify emotions, I'll present three studies: the first one (section 2.5) is on human ability to recognize emotions in the dog (*Canis familiaris*), according to their expertise, gender and level of empathy; the other two studies (sections 2.6.1 and 2.6.2) are related to the investigation of emotions in other species: in particular they focus on the importance of finding objective, non-invasive and reliable methods to detect emotions in other species and examine the possibility to use infra-red thermography to measure emotional arousal in dogs, in situations aimed at evoking either negative or positive emotional states.

### **2.1 Can non-human animals feel emotions?**

Darwin (1872), in his book "*The expression of emotions in man and animals*" was probably the first scientist to provide evidences that not only humans but also many other animal species express emotions. According to his theory, emotions are products of the brain refined by natural selection because of their adaptive value, therefore their expression should be universal within humans, who are also supposed to share a number of affective states with other non human animals.

Emotions can be defined as coordinated changes in physiology, cognition and behaviour, are evoked by specific situations, and have motivational, cognitive and communicative functions (Nesse, 1990): they represent an interface between the individual and its environment and guide the selection of appropriate behaviours (Scherer et al., 1984; Lazarus, 1991); they influence actions, which can be planned on the bases of the expected emotional state (Nesse, 1990); they participate in cognitive evaluation of stimuli (Harding et al., 2004; Bateson et al., 2007; Mendl et al., 2010) and they convey information about an individual's inner state, facilitating social interactions (Hess & Thibault, 2009; Kemp & Kaplan, 2013).

Darwin underlined similarities between the expression of emotions in humans and other animal species and assumed an evolutionary continuum in emotional states, so that some of them would exist also in non-human animals. This approach to the study of emotions, which maintains the existence of a number of biologically determined emotions whose expression and recognition share similar features across human cultures and animal species, conveying the same emotional content, is known as “discrete emotional theory” (Ekman, Soreson & Friesen, 1969; Ekman & Friesen, 1971; Izard, 1971; 1992). An alternative perspective is represented by the “dimensional models” (i.e., Russell, 1980), which describe emotional states in terms of quantitative differences along at least two main dimensions: arousal (low to high activation) and valence (positive to negative).

The evidence supporting the discrete theory of emotions derives mainly from studies carried out with humans, especially by Ekman and colleagues; these authors demonstrated that facial expressions played a central role in communicating emotions, to such an extent that some of them share similar features across different cultures, conveying the same emotional content (Ekman Soreson & Friesen, 1969; Ekman & Friesen, 1971; Izard, 1971). In particular, they identified six discrete emotions that seem to rely on universal antecedent events and features for their expression and recognition, namely happiness, sadness, fear, surprise, anger, and disgust: therefore they called them “basic” emotions and considered them an evolutionary heritage (see Ekman & Cordaro, 2011 for a review).

Ekman’s classification of basic emotions has been used in a number of researches (i.e., Baron-Cohen et al., 1997; Bloom & Friedman, 2013; Konok et al., 2015), although there is not complete agreement on the number of emotions that can be considered as basic. For example, some authors don’t consider disgust a basic emotion (eg. Panksepp 2007; Kohler et al., 2003), while others believe that surprise is difficult to detect, since it has a very quick onset and can suddenly change into any of the other emotions, depending on the triggering event (Kohler, 2004). According to Panksepp (2005, 2011), neurobiological evidence supports the existence of underpinned brain mechanisms only for happiness, sadness, anger, fear and curiosity: these emotions are related to the five underling emotional systems of play, panic, rage, fear and seeking, whose existence has also been proved in many non-human mammals. Hence, affective neuroscience supports the existence of a continuum between human and animal emotions, which likely evolved as adaptive means to deal with common environmental challenges, such as finding food and mates and defending themselves against aggressions (Hess & Thibault, 2009), coping with the environment and building adaptive social relationships (Scherer, 1984; Lazarus, 1991; Boone and Buck, 2003; Frith and Frith, 2007; Gaspar, 2006; Schmidt and Cohn, 2001; Shariff and Tracy, 2011).

Along with the emotions classified as “basic”, a number of other “complex” or “secondary” emotions exists in humans, such as jealousy, shame or guilt, which are considered a combination of

some of the basic ones and often imply some degree of self-consciousness (Griffiths, 2003; Morris et al., 2008; Harris and Prouvost, 2014). Although humans tend to attribute these emotions to a wide range of animal species (Morris et al., 2008; Konok et al., 2015), they haven't been demonstrated in non-human animals yet.

## **2.2 Are humans able to recognize animal emotional expressions?**

Darwin (1872) argued that emotions served an important communicative function and underlined their adaptive value in facilitating social interactions either in intraspecific or interspecific contexts. Interestingly, he analysed different postures and facial expressions displayed by humans and other species to express emotions and used in particular drawings of cats and dogs to show that humans were able to understand emotions in other species.

Over the years Darwin's hypotheses have been sustained by considerable empirical evidences, proving that humans and other animals express emotions and recognize conspecifics' emotional states through a variety of signals including vocalizations, body postures and facial expressions (Fox, 1970; Ekman 1993, 2003; Seyfarth and Cheney 2003; Owings and Morton 1998; Kemp & Kaplan 2013; Palagi and Mancini, 2011; Batty and Taylor, 2006; Snowdon, 2003).

Moreover, in line with an evolutionary view, there is growing evidence that some emotional expressions can be successfully recognized across species (eg. Aubin et al., 1991; Fichtel, 2004, McComb et al., 2009; Merola et al., 2013) and that humans can identify the emotions of other species, at least to some extent, using visual and acoustic signals (Linnankoski et al., 1994; McComb et al., 2009; Tami and Gallagher, 2009; Wan et al., 2012; Bloom and Friedman, 2013; Molnar et al., 2006, 2010; Pongracz et al., 2005, 2006, 2011; Nicastro and Owren, 2003; Tallet et al., 2010).

Overall, three factors seem to influence humans' performance in recognizing emotions of other animals: the communicative channel considered (i.e, auditory vs. visual), the amount and kind of experience with a particular species and the specific emotion considered.

As regards the communicative channel used to express emotions, there are evidences that humans are able to differentiate negative from positive emotions conveyed through vocalizations of mammals, such as pigs (Tallet *et al.*, 2010), dogs (Pongracz *et al.*, 2005), cats (Nicastro & Owren, 2003) and chimpanzees (Belin *et al.*, 2008). As supposed by Darwin (1872), such an ability might be based on common structural rules in emotional communication across mammals, whose vocalizations show in fact an universal relationship between structure and emotional context: low pitch and atonal vocalizations denote aggressive intentions, while high pitch and tonal vocalizations

reflect friendly or submissive intention (Morton, 1977; Owings & Morton, 1998; Tallet et al., 2010).

With respect to the kind of emotion considered, there is evidence that distress vocalizations can be recognized in interspecific context in many species (Aubin, 1991; Fichtel, 2004) and humans seem to identify more easily negative emotions, while positive states are often confused each other (Pongràcz et al., 2005; Tallet et al., 2010); Aubin (1991) explained this last finding suggesting the adaptive value of discriminating with precision negative states, since they may be triggered by dangerous stimuli that can be avoid detecting other species' emotional signals.

Finally, the role of experience with a species emerges in a number of researches: Tallet and colleagues (2010) showed that, even if people without any experience of pigs were able to detect differences in the valence and the intensity of emotions transmitted in piglet vocalizations (pain, distress and positive emotions), ethologists and farmers were more skilled in discriminating different emotions than naive people. They also found that the kind of experience influenced the judgment of emotional intensity of vocalizations: in fact, ethologists assigned more negative levels of valence than farmers (probably because they were more concerned about animal welfare), who in turn found emotions less intense than individuals without any experience (probably because of an habituation process). Similarly, McComb et al., (2009), using playbacks of cat purrs emitted while cats were actively seeking food (i.e. solicitation purrs) and in other contexts found that even participants with no experience of owning cats judged the 'solicitation' purrs to be more urgent and less pleasant. However, individuals that had owned a cat performed significantly better than non-owners, suggesting that the ability to identify these purrs can improve through learning. An important role of the experience with a particular species was also found by Scheumann and colleagues (2014), who also outlined that, in order to recognize emotions from humans', chimps', dogs' and tree shrews' vocalizations, humans listeners had to be familiar not only with the species but also with the specific sound evoked by a given context.

Similarly, with regard to the visual channel, Wan et al. (2012) found that individual differences in experience with dogs predicted the ability to perceive their emotions from videos, and that the role of experience was most pronounced in the interpretations of fearful, rather than happy examples of dog behavior. However, compared to the amount of data derived from studies on emotional vocalizations, human ability to recognize animal emotions from visual signals has received little attention and the available evidence is often difficult to compare because of the use of different procedures and poorly standardized materials (Gross, 2004; Marshall-Pescini et al., 2009; Tami & Gallagher, 2009; Meinst et al., 2010; Bloom & Friedman, 2013).

Studies on people ability to recognize their conspecifics' emotions have demonstrated that visual cues, and in particular facial expressions, are crucial elements of emotional communication (i.e.,

Ekman Soreson & Friesen, 1969; Ekman & Friesen, 1971; Izard, 1971; Ekman, 1993; Schmidt & Cohn, 2001), to such an extent that an impairment of this ability is frequent in various kind of psychopathology (i.e., Baron-Cohen et al., 2001; Stevens et al., 2001; Kosson et al., 2002; Gross, 2004; Smith et al., 2010); yet, little is known about human ability to correctly recognize other species' emotional facial expression and the variables that may affect it.

Research on these themes could be interesting both for theoretical and practical reasons, allowing to gain further knowledge about the evolution of emotions and their expression but also enhancing both animal and human welfare (for instance, it could allow to avoid aggressions or poor animals management due to a misinterpretation of animal emotional communication).

### **2.3 Empathy and emotion recognition**

In the field of intraspecific recognition of emotions in humans, various studies highlighted a positive correlation between empathy and the ability to recognize others' emotions from visual cues, and in particular facial expressions: (Lawrence et al., 2004; Vellante et al., 2013; Sucksmith et al., 2013). This finding is to some extent expected, since empathy entails the ability to perceive others' emotions and emotion recognition is considered a basic component of cognitive empathy (i.e., Decety and Jackson, 2004).

Moreover, with respect to empathy, a gender effect has been found also in emotion recognition, so that women are usually more skilled in recognizing emotions than men (Lawrence, et al., 2004; Vellante et al., 2013; Proverbio, et al., 2007, Barrett et al., 2000; Hall, 1978; Hall and Matsumoto, 2004).

Despite a growing interest in humans' attitude and empathy towards animals, the relationship between empathy and the ability to identify emotions in other species has been poorly investigated. However, some authors have suggested that the way people interpret animal behaviour and emotional states may be related to the empathy level towards them: for example, empathy towards animals is a good predictor of how dog-owners and vets rate pain, respectively in dogs (Ellingsen et al., 2010) and in cattle (Norrington et al., 2014). Moreover, in their study on human ability to recognize piglets' emotional vocalizations, Tallet et al. (2010) found that ethologists assigned them a more negative valence than did farmers. The authors hypothesized a difference in empathy among respondents, with ethologists being more empathic since they are usually interested in animal welfare. Finally, Meyer et al., (2014), using videos of dogs to investigated the influence of empathy on the interpretation of dog behaviour and emotions, found that participants with low level

of empathy toward animals and no experience with dogs tended to judge dogs as more aggressive than those with high level of empathy towards animals.

Another aspect that has been poorly investigated is the effect of gender on recognition of emotions in animals; as far as I know, only Tallet and colleagues (2010) described a small gender difference in the evaluation of piglets' vocalizations (56% of correct answer for instance for women vs. 50% for men), but no study has examined this issue yet.

## **2.4 The dog (*Canis familiaris*): an interesting species to study human ability to recognize emotions in other animals**

The dog (*Canis familiaris*) is an interesting subject for studying interspecific emotional recognition and factors that may affect it, since dogs and humans have been living together, interacting and communicating, for long time (Miklósi et al., 2007; 2009); moreover, domestication might have favoured convergent evolution in emotional communication of dogs and humans (Miklosi et al, 2007). Dogs are actually part of our society and people's experience with them may vary widely, from no direct experience (e.g., people who have never owned a dog) to different kind and levels of expertise (e.g., dog owners, dog trainers, vets and veterinary behaviourists): thus, investigating the way in which they communicate emotions and whether and to what extent we recognize their emotional states could offer interesting insight about the role of expertise and familiarity with a species in the understanding of its emotional communication. Moreover, dogs are widespread companion animals and, at least in western cultures, there is growing interest about their welfare, which can be improved trough the understanding of what emotions they can feel and how they express them. Finally, dogs are often employed as working animals, such as in police, pet therapy and search and rescue activities, and a better understanding of their emotional signals and of the factors that may affect their comprehension would improve training methods, allowing also to avoid aggression due to a misunderstanding of their communication. In fact, there is increasing evidence that human-dog relational problems often depend on interspecific miscommunication and that a critical factor in episodes of canine aggression is the victim's inability to correctly interpret the dog's warning signals (Wright 1985; Overall & Love 2001; De Keuster et al. 2006; Rosado et al. 2009).

There are evidences that dogs use body postures, vocalizations and a range of facial expressions that reveal emotional states (Fox, 1970; Abrantes, 1987; Wiss, 2012). Moreover, a number of studies have investigated the ability of humans of various age and with different levels of dog experience to interpret dogs' emotional vocalizations, such as barks, showing that people have

usually a good performance, irrespective of their experience with dogs (Molnar et al., 2006, 2010; Pongracz et al., 2005, 2006 Pongracz et al., 2011). Conversely, studies focused on human ability to infer dog emotional states from visual cues (i.e., body language and facial expressions), using either photographs (e.g. Meinst et al., 2010 ; Marshall-Pescini et al., 2009; Bloom & Friedman, 2013) or videoclips (e.g Tami and Gallagher, 2009; Wan et al., 2012), provided contradictory results on the role of age, experience and knowledge about dog behaviour in recognizing dog emotional signals. Moreover, results are often difficult to compare, since they have been obtained using different procedures and methods and often are based on poorly standardized materials. Finally, as far as I'm aware, no study has investigated the relationship between the recognition of dog emotions, empathy and gender, two variables whose role in human emotion recognition has been widely analyzed. In the next section, I'll present my work on the relationship between expertise, empathy, gender and the recognition of a dogs' emotions from facial expressions.

## **2.5 Study 1: “Expertise, empathy, gender and the recognition of dog (*Canis familiaris*) emotional facial expressions”**

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Submitted to *PlosOne*

### **Abstract**

Only a few studies have investigated human capacity to recognize dog emotional states and little is known about human ability to identify them through facial expressions; moreover, the relationship between empathy, gender and the ability to recognize other species' affective states is almost unexplored.

The current study further investigates human ability to assess dog emotions and starts investigating the possible relationship between expertise, empathy and gender and accuracy in the recognition of a dog's emotional facial expressions.

A group of experts (veterinary behaviourists and dog trainers) and 3 groups of participants differing in their experience with dogs (veterinarians, dog owners and people who had never owned a dog) classified 21 photographs of a dog's facial expressions, realized by Bloom and Friedman (2013) under standardized and behaviourally defined conditions aimed at activating in dogs the six basic emotions described by Ekman in humans. Participants' level of empathy towards animals and humans was measured using two validated scales, namely the Animal Empathy Scale and the Empathy Quotient. Experts in dog behaviour were not particularly accurate in identifying the dog's

emotional states and correctly recognized only a limited number of dog emotions. Interestingly we also found a clear effect of the level of experience on the recognition of some dog expressions but not on others.

Our results also provide first evidence that empathy may not be linked to the ability to correctly recognize the emotional content of dog facial expressions and suggest that this ability is, at least for some emotions, experience dependent. However, the possibility that some antecedent stimuli used to elicit emotions in the dog could be not fully appropriate and that the photographs we used lacked ecological validity are also discussed.

*Key Words:* dog, empathy, emotion recognition, facial expressions, experience, gender differences.

## **Introduction**

The idea that facial expressions convey relevant information about emotional states, not only in human intraspecific interactions but also in human-dog interactions, goes back to 1872 when Darwin, in his book *“The expression of emotions in man and animals”*, underlined the communicative role of emotional expressions, using in particular drawings of dogs and cats to show that visual signals of emotions had some common features across different species. Darwin also hypothesised that emotions and their underlying brain processes were the outcome of an evolutionary process, therefore their expression should be universal within humans, who were also supposed to share a number of affective states with other non-human animals. Finally, he suggested the adaptive value of emotional expression in facilitating social interactions either in intraspecific or interspecific contexts.

Over the years, Darwin’s hypotheses have triggered considerable empirical research, proving that humans and other animals express their emotions and recognize those of their conspecifics using a variety of signals including vocalizations, body postures and facial expressions (Fox, 1970; Ekman 1993, 2003; Seyfarth and Cheney 2003; Owings and Morton 1998, Kemp & Kaplan 2013; Palagi and Mancini, 2011; Snowden, 2003; Reefmann et al., 2009). Studies by Ekman and colleagues demonstrated that facial expressions played a central role in emotional communication in humans, to such an extent that some of them share similar features across different cultures, conveying the same emotional content (Ekman Soreson & Friesen, 1969; Ekman & Friesen, 1971; Izard, 1971). In particular, Ekman identified six emotions that seem to rely on universal antecedent events and features for their expression and recognition, namely happiness, sadness, fear, surprise, anger, and disgust: therefore he called them “basic” and considered them an evolutionary heritage (see Ekman & Cordaro, 2011 for a review). According to Panksepp (2005, 2011), there is neurobiological

evidence for the existence of underpinned brain mechanisms for happiness, sadness, anger, fear and curiosity, related to five underlying emotional systems of play, panic, rage, fear and seeking, also in non-human mammals. Hence, affective neuroscience supports the continuum between human and animal emotions, which likely evolved as adaptive means to deal with common challenges to survival, such as finding food and mates, defending themselves against aggressions (Hess & Thibault, 2009), coping with the environment and building adaptive social relationships (Scherer, 1984; Lazarus, 1991; Boone and Buck, 2003; Frith and Frith, 2007; Gaspar, 2006; Schmidt and Cohn, 2001).

Moreover, there is now evidence of interspecific recognition of emotions (eg. Aubin et al., 1991; Fichtel, 2004, McComb et al., 2009; Merola et al., 2015), including human ability to recognize, at least to some extent, the emotions of other species.

Studies on human ability to recognize other species' emotional signals have focused mainly on the auditory channel, suggesting that even naïve people are able to recognize emotional vocalizations of various animals, such as macaques (Linnankoski et al., 1994), pigs (Tallet et al., 2010), dogs (Pongracz et al., 2005, 2006, 2011; Molnar et al., 2006, 2010) and cats (Nicastro e Owren, 2003; McComb et al., 2009). This findings have been explained on the basis of common structural rules in emotional communication across mammals, whose vocalizations show a universal relationship between structure and emotional context: low pitch and atonal vocalizations denote aggressive intentions, while high pitch and tonal vocalizations reflect friendly or submissive intention (Morton, 1977; Owings & Morton, 1998).

Yet, many studies outlined that performance may vary according to the amount and type of experience with the species (Nicastro & Owren, 2003; McComb et al., 2009; Tallet et al., 2010; Scheumann et al., 2014) and the specific emotion considered (Tallet et al., 2010; Pongracz et al., 2005; Scheumann et al., 2014), suggesting also an experience-dependent cognitive mechanism underlying cross-species emotion recognition (Scheumann et al., 2014).

The role played by visual signals, and in particular by facial expressions, in the recognition of affective information has been extensively investigated in humans, whereas human accuracy in recognizing different emotional states of other animals from their facial expressions has received only limited attention (Bloom & Friedmann, 2013; Gross, 2004).

The dog (*Canis familiaris*) is considered an interesting candidate for studying interspecific emotion recognition and the different variables that may affect it, since dogs and humans have been living together, interacting and communicating, for a long time (Hare et al., 2002; Hare and Tomasello, 2005). In addition, people can form strong long lasting affectional bonds with dogs, may have different attitudes towards them and also different experience with them and knowledge about their behaviour (ranging from no experience to highly specialised expertise).

People tend to attribute to dogs a wide range of emotional states, both basic and complex, such as jealousy or guilt (Konok et al., 2015; Morris et al., 2008) and there is evidence that dogs use body postures, vocalizations and a range of facial expressions to communicate their emotional states (Fox, 1970; Abrantes, 1987; Wiss, 2011). Interestingly, Bolwing (1962) noticed that, despite a very different facial muscular arrangement, dogs and some primates, including man, use the muscles they have in common in a similar manner to express emotions such as joy, fear and anger.

Studies assessing the ability of humans of various ages or with different levels of dog experience to correctly interpret dog vocal emotional signals such as barks, show that experience with dogs seems to have a limited role in recognizing their appropriate contextual and emotional content (Molnar et al., 2006, 2010; Pongracz et al., 2005, 2006 Pongracz et al., 2011).

Conversely the literature on human ability to infer dog emotional states from body postures and facial expressions using either photographs (e.g. Meinst et al., 2010; Marshall-Pescini et al., 2009; Gross, 2004; Bloom & Friedman, 2013) or videoclips (e.g. Tami and Gallagher, 2009; Wan et al., 2012) provides less clear results on how age, experience and knowledge about dog behaviour affect recognition of their emotional signals. Meinst et al., (2010.) found a strong effect of age on the recognition of dog facial expressions, with younger children misunderstanding aggressive expression with happy ones; an age effect was reported also by Marshall-Pescini et al., (2009), but in this study it emerged that teeth visibility was considered by children a clear index of unfriendliness in dogs. Moreover, Gross (2004) found that even children with autism, language disorders and mental retardation performed significantly above chance in recognizing happy, sad, surprised, angry and neutral facial expressions of a dog.

Tami and Gallagher (2009) used videoclips of dog-dog interactions to compare the interpretations of adult participants with different experience (i.e. veterinarians, trainers, owners, non-owners) and found a high variability in emotional interpretations but few differences due to experience. In their study the most easily recognized behaviours were indifference, fear, friendliness and play solicitation and they found that tail movement was the most common cue used by participants to interpret the dogs' behaviour, followed by muzzle-related cues and body postures. In a later study Wan et al. (2012), used video stimuli of happy or fearful behaviours, to test a sample of 2,163 adult participants with different levels of dog experience (occasional experience, dog ownership, professional experience). The authors asked participants to categorize dogs' emotional states and also to report which features of the dog (i.e. eyes, ears, mouth/tongue, legs/paws, tail) they used to infer the specific emotion; it emerged that people with experience with dogs were significantly more skilled in identifying fearful behaviour compared to inexperienced people, while both were able to recognize examples of happiness. It also emerged that experience was a good predictor of the number of features that participants selected for both happy and fearful emotional example, with

experienced respondents being more likely to look at facial cues, and in particular at the ears. Interestingly, Wan et al. (2012) initially asked eight experts of dog behaviour to characterize the emotional state of dogs displayed in video clips according to five emotional conditions (happiness, sadness, fear, anger and neutral) but found percentages of agreement greater than 75% only for fearful and happy behaviours, suggesting that this result could be due either to the lack of agreement among experts on the appearance of anger or sadness in dogs or to the low frequency of these emotions during everyday situations.

Finally, a recent study by Bloom and Friedman (2013) found little difference between experienced and inexperienced people in classifying emotions from a dog's face, with experts and non experts making similar errors and all performing above chance level. Thus, they concluded that the ability to read a dog's emotions via its facial expressions might not be strongly affected by learning and experience. This study is particularly interesting because, to our knowledge, it is the first testing adult human ability to recognize different emotions in dog exclusively from its facial expressions and is the only one adopting an approach borrowed from human studies on discrete emotions (i.e., Ekman et al., 1969; Ekman & Friesen, 1971; Ekman, 1993; 2003). In fact, the authors used photographs of the face of one dog, a trained Malinois, taken under standardized and behaviourally defined conditions, using stimuli aimed at evoking in him the six basic emotions described by Ekman in humans: happiness, sadness, surprise, disgust, anger, fear (see Bloom & Friedman, 2013 for a description of the emotional antecedents).

Two important variables linked to the recognition of affective information that have received considerable attention in research on intraspecific recognition of emotions in humans are empathy, which refers to the ability to perceive, understand and share another individual's emotional state (Zahn-Waxler & Radke-Yarrow, 1990), and gender. Various studies highlighted the relationship between empathy towards others and the ability to recognize others' emotions from visual cues, and in particular facial expressions: the more individuals are empathic, the more they are accurate in recognizing emotional states (Lawrence et al., 2004; Vellante et al., 2013; Sucksmith et al., 2013), and in general women are more empathic and more skilled in recognizing emotions than men (Lawrence, et al., 2004; Vellante et al., 2013; Proverbio, et al., 2007, Barrett et al., 2000; Hall, 1978; Hall and Matsumoto, 2004).

Despite a growing interest in humans' attitude and empathy towards animals, the relationship between empathy and the ability to interpret animal behaviour and emotions has been poorly investigated. Empathy towards animals seems to be a good predictor of how dog-owners and vets rate pain, respectively in dogs (Ellingsen et al., 2010) and in cattle (Norrington et al., 2014). Moreover, in their study on human ability to recognize piglets emotional vocalizations, Tallet et al. (2010) found that ethologists performed better than naïve people when asked to identify the context

in which pig vocalizations were emitted and also assigned them a more negative valence than did farmers. The authors hypothesized a difference in empathy among respondents, with ethologists being more empathic since they are usually interested in animal welfare. Recently, Meyer et al., (2014) used short videos of dogs to investigate the influence of empathy on the interpretation of dog behaviour and emotions. They found that participants with low level of empathy toward animals and no experience with dogs tended to judge them as more aggressive than those with high level of empathy towards animals.

Finally, another aspect that has been poorly investigated is the effect of gender on recognition of emotions in animals: a small gender difference in the evaluation of pig vocalizations was reported by Tallet et al. (2010), with 56% of correct answer for women vs. 50% for men.

The aim of this study was to evaluate whether, besides experience with dogs, empathy and gender influenced the recognition of a dog's emotional facial expressions. To reach this goal we used the dog photographs realized by Bloom and Friedman, (2013), as they were standardized and validated in their study. We tested four group of participants with different levels and kind of experience with dogs (inexperienced people, dog owners, vets, veterinary behaviourists and dog trainers) and evaluated the possible relationship between their level of empathy towards animals and humans (assessed using the Animal Empathy Scale by Paul, 2000, and the Empathy Quotient by Baron-Cohen and Wheelwright, 2004) and their accuracy in recognizing the dog's emotions.

Given the findings obtained by Bloom and Friedman, we predicted that experts in dog behaviour would be successful in recognizing the different emotions, and that even participants without a specialized knowledge would obtain a good performance; we also assumed that some dog facial expressions (i.e. disgusted/surprised/neutral) would be more difficult to recognize than others. As regards to empathy and gender, based on the available evidence, we hypothesized a relationship between empathy and the recognition of the dog's emotions or at least of some of them (i.e. anger, as found in Meyer et al.'s study) and also expected that women would be more empathic and more skilled than men in recognizing the dog's emotions or at least some of them.

## **Materials and methods**

### **Participants**

Participants were recruited throughout fliers, phone calls and word of mouth, informing them that we were carrying on a study on people's ability to recognize dog's emotions. Participation was voluntary.

We tested four groups of respondents which differed in their experience with dogs: veterinary behaviorists and dog trainers were used as experts for a preliminary classification and recognition of the photographs, as they had considerable experience in dog behavior. The participants of the

remaining three groups varied in their type of experience with dogs, ranging from no experience (people who had never had a dog), to a daily interaction as dog owners and vets. In particular vets were considered an interesting sample because they have daily experience with dogs and with their emotions but, in Italy, they don't receive a specific training on dog behaviour.

- *Experts* (N=35, 25 women; 36.7±9.3): they included 12 *veterinary behaviourists* (11 women; age: 40.5±7.8), having a specialization in companion animal behavioral medicine and daily working with dogs with behavioral problems (all of them, moreover, were dog owners); and 23 *dog trainers* (14 women; age: 34.6±9.6): they were all members of the same dog training school, having attended at least one course for dog trainers based on gentle method, and they shared a common education/approach, which was very concerned with dogs' behaviour and emotions. At the time of the study, all had a dog.
- *Veterinarians* (N=22, 11 women; age: 42.8±11.1); all of them worked in companion animal practice, so they had almost daily contact with dogs and 45.5% were also dog owners.
- *Dog owners* (N=25, 14 women; age: 45.6±13.1); they had at least one family dog in the household; none of them had neither a degree in veterinary medicine nor skills in dog training.
- *People who had never owned a dog* (N=21, 11 women; age: 40.6±9.5); they had never owned companion animals and they qualified themselves as having no direct experience with dogs.

## Questionnaire

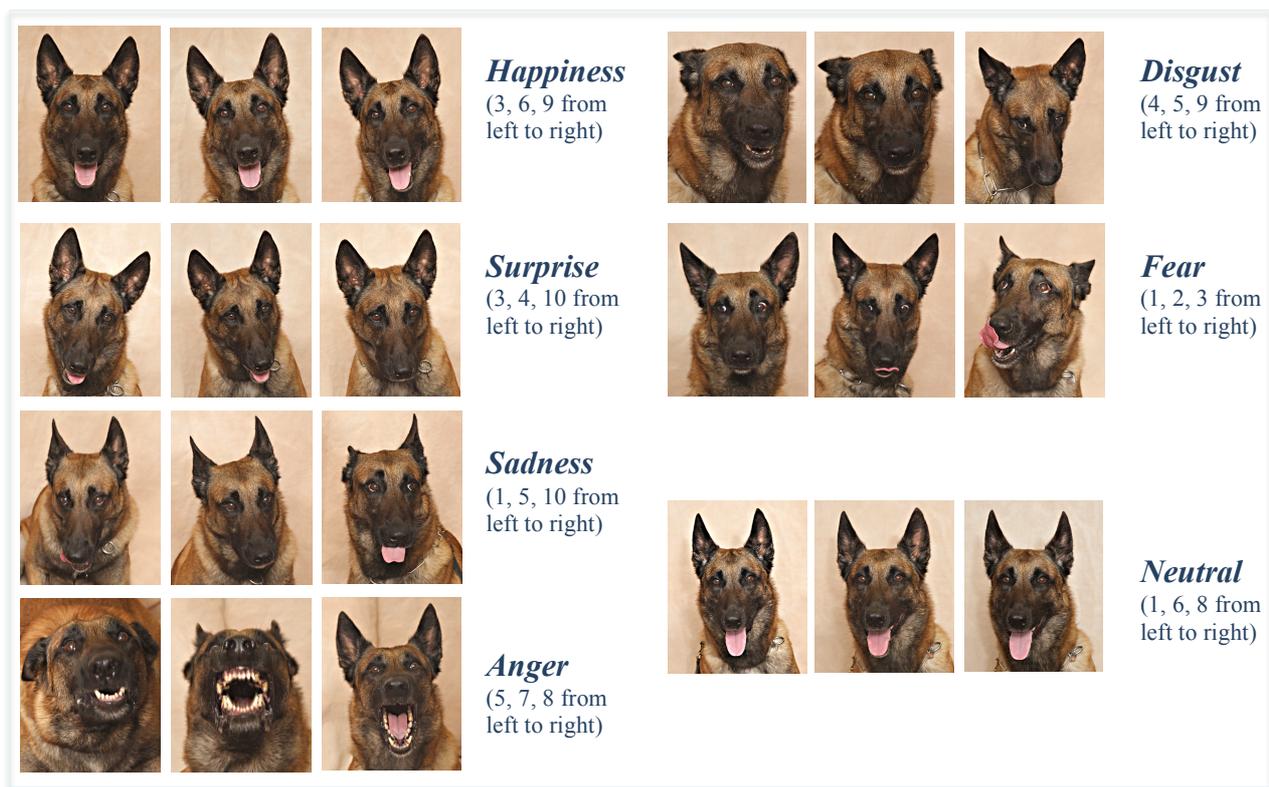
The whole questionnaire consisted of three parts. The first part contained general information on participants' age, gender and experiences which could affect their responses (past or actual pet ownership, religion, eating habits – vegetarian/vegan or not). Then, in a counterbalanced order, followed two scales:

- **AES – Animal Empathy Scale:** developed by E. Paul (2000) to measure empathy towards animals, this scale consists of 22 items, 11 representing unempathic sentiments and 11 empathic sentiments. Responses to each item are based on a 9 point Likert – type scale ranging from ' very strongly agree ' to ' very strongly disagree ', with agreements with empathic statements scoring high (maximum 9) and agreements with unempathic statements scoring low (minimum 1). The total score, ranging from a minimum of 22 to a maximum of 198, is calculated as the sum of scores at each item. Higher scores indicate a higher level of self-reported empathy. As reported by the author, the AES has a good internal consistency (Chronbach's alpha = .78). The scale was back translated into Italian.

- EQ – Empathy Quotient: constructed and validated by Baron Cohen and Wheelwright (2004), it comprises 40 questions, assessing empathy towards other people; 20 items are worded to produce a “disagree” response, and 20 an “agree” response. The scale has a forced-choice format, with four possible responses to each item: strongly agree, strongly disagree, slightly agree and slightly disagree. A respondent scores two points if he/she gives a strongly empathic response, and one point if he/she gives a slightly empathic response; unempathic responses are scored zero point, so the EQ has a maximum score of 80 and a minimum of zero. The scale is available in Italian language and has been published in the Italian edition of the book “The science of evil: on empathy and the origins of cruelty”, by Baron Cohen (2011). The scale has a good internal reliability, with Chronbach’s alpha = .85 (Muncher & Ling, 2006).

### **Dog facial expressions photographs**

The dog’s photographs used in this study were facial expressions of a male Belgian Malinois, named Mal, provided to us by Tina Bloom and Harris Friedman, who first created and published them (2013). These photographs had been taken on a neutral background and under behaviorally defined conditions aimed at activating in the dog the six basic emotions described by Ekman in humans. As in Bloom and Friedman’s Study 2 we used only the 21 images that had been ranked by the 3 experts as representative of Ekman’s six basic emotions and of a neutral facial expression. Thus, participants were shown 21 photographs, three images for each facial expression: happy, surprised, sad, disgusted, angry, fearful and neutral (see figure 2.1).



**Figure 2.1:** The dog's photographs used in the study: the number of each image is the same as in the original study by Bloom & Friedman (2013)

## Procedure

Before taking part in the study, participants were asked to read and sign an informed consent, which informed them about aims and methods of the study and assured the respect of privacy norms, according to the national Privacy Law 675/96.

Half of the participants fill in the questionnaire before rating the dog's photographs, while the other half first rated the photographs and then filled the questionnaire.

For the photographs ratings, we created Power Point presentations in which images were put together in a randomized order (so each participant watched a different sequence of photographs) and spaced out with a coloured screen.

Participants could look at each image as long as they needed before indicating on a response sheet the emotion that in their opinion the dog's face expressed. The response sheet reported a list of the six basic emotion (happy, surprised, sad, disgusted, angry, fearful) and the option "neutral": participants were told that they could choose just one answer per image, selecting the emotion that best described what Mal was feeling; if they thought that Mal wasn't feeling any particular emotion they could select "neutral". We also told them that, even if all images were different, several photographs representing the same emotion could appear in the sequence, even consecutively.

Finally, participants were informed that once given their answer, they couldn't see previous images again and change their mind.

The study was arranged in two phases:

Phase 1- Since in Bloom and Friedman's Study 1 the selection of the stimuli was based on the judgment of just three experts, i.e. dog trainers expert in Schutzhund, and in Study 2 their sample of 25 experienced people (i.e., dog trainers) had some difficulties in identifying the neutral, surprise and disgust expressions, in the first phase we tested a larger group of experts, namely 12 veterinary behaviorists and 23 dog trainers, to verify the real discriminability of the 21 stimuli selected in their study.

Phase 2- In this phase, only the images correctly classified by the 35 experts, that is in a non-random way and with a good agreement between the two groups, were used to test the remaining three groups of participants, i.e. dog owners, non owners and vets.

### **Data analysis**

Total scores on the AES and EQ were calculated and the internal consistency of both scales was assessed using Cronbach's alpha. Binomial and one-way chi-square tests were used to esteem the experts' accuracy in recognizing the 21 dog facial expressions; a cell frequency greater than random expectancy were determined by a standardized cell residual  $\geq 1.96$ . Factorial analysis of covariance (covariate: years of experience; factors: group and gender) was used to evaluate possible differences in empathy scores. Finally, parametric factorial analysis of covariance (ANCOVA) was run to assess the effect of expertise and empathy upon the facial emotions identification.

All the statistical analyses were carried out with SPSS Statistics 21 (IBM, NY, USA), with alpha set at 0.05.

### **Results**

Eight subjects (1 dog trainer, 2 veterinary, 2 owners and 3 non-dog owners), whose score exceeded  $|2|$  standard deviations from AES and/or EQ averages, were considered as outliers and excluded from subsequent analysis.

#### *Emotional stimuli*

The interquartile range of experts' correct responses distribution varied from 36.9 to 52.4, that is the 75% of dog trainers and veterinary behaviorists correctly recognized, at most, the 52% of the stimuli: on average, experts correctly identified the  $43.7\% \pm 11.3$  of the photographs. Experts' performance on each single emotion is outlined in table 2.1.

**Table 2.1** Percentage of correct and incorrect emotion identifications by experts

Stimulus		Emotion identification		c <sup>2</sup> test
		Correct	Incorrect	
Happiness	3	44.1	<b>55.9</b> (neutral=35.3; surprise=14.7; sad, fear=2.9)	c <sub>4</sub> <sup>2</sup> =24.2, p<.01
	6	<b>64.7</b>	35.3 (neutral=20.6; surprise=8.8; sad=5.9)	c <sub>3</sub> <sup>2</sup> =30.2, p<.01
	9	<b>55.9</b>	44.1 (neutral=35.3; surprise=8.8)	c <sub>2</sub> <sup>2</sup> =11.3, p<.05
Surprise	3	<b>64.7</b>	35.3 (neutral=17.6; happy=8.8; disgust=5.9; fear=2.9)	c <sub>4</sub> <sup>2</sup> =40.5, p<.01
	4	<b>67.6</b>	32.4 (neutral=20.6; happy, fear=5.9)	c <sub>3</sub> <sup>2</sup> =34.9, p<.01
	10	38.2	<b>61.8</b> (sad=32.4; neutral=17.6; fear=5.9; happy, disgust=2.9)	c <sub>5</sub> <sup>2</sup> =24.6, p<.01
Neutral	1	<b>55.9</b>	44.1 (happy=38.2; surprise=5.9)	c <sub>2</sub> <sup>2</sup> =13.1, p<.05
	6	44.1	<b>55.9</b> (happy=38.2; surprise=8.8; sad=5.9; fear=2.9)	c <sub>4</sub> <sup>2</sup> =26.0, p<.01
	8	44.1	<b>55.9</b> (happy=44.1; surprise=8.8; fear=2.9)	c <sub>3</sub> <sup>2</sup> =20.1, p<.01
Sadness	1	11.8	<b>88.2</b> (fear=61.8; disgust=17.6; surprise=5.9; neutral=2.9)	c <sub>4</sub> <sup>2</sup> =39.2, p<.01
	5	26.5	<b>73.5</b> (fear=44.1; sad=26.5; neutral=8.8; disgust=5.9)	c <sub>4</sub> <sup>2</sup> =19.8, p<.01
	10	14.7	<b>85.3</b> (fear=52.9; surprise=20.6; disgust=8.8; neutral=2.9)	c <sub>3</sub> <sup>2</sup> =260, p<.01
Disgust	4	14.7	<b>85.3</b> (fear=41.2; angry=35.3; surprise=8.8)	c <sub>3</sub> <sup>2</sup> =10.0, p<.05
	5	2.9	<b>97.1</b> (fear=50.0; sad=35.3; neutral, happy, angry=2.9)	c <sub>5</sub> <sup>2</sup> =43.7, p<.01
	9	35.3	<b>64.7</b> (fear=35.3; sad=11.8; angry:8.8; surprise=5.9; neutral=2.9)	c <sub>5</sub> <sup>2</sup> =22.2, p<.01
Fear	1	<b>55.9</b>	44.1 (surprise=32.4; disgust=11.8)	c <sub>2</sub> <sup>2</sup> =9.9, p<.01
	2	<b>55.9</b>	44.1 (surprise=23.5; disgust=17.6; angry=2.9)	c <sub>3</sub> <sup>2</sup> =20.3, p<.01
	3	<b>91.3</b>	8.7 (surprise, sad, disgust=2.9)	c <sub>3</sub> <sup>2</sup> =79.4, p<.01
Anger	5	26.5	<b>73.5</b> (fear=20.6; happy, surprise, neutral, sad, disgust=2.9)	c <sub>6</sub> <sup>2</sup> =66.1, p<.01
	7	<b>70.6</b>	29.4 (fear)	c <sub>1</sub> <sup>2</sup> =5.8, p<.01
	8	29.4	<b>70.6</b> (fear=29.4; surprise=29.4; neutral=11.8)	<i>not significant</i>

Photographs number corresponds to that reported in figure 2.1

As table 2.1 shows, experts' percentages of incorrect identifications significantly exceeded the percentages of correct ones (one-way  $\chi^2$  test) for all the Sadness and Disgust stimuli as well as for two out of three Neutral and Anger photographs; moreover, experts' responses were randomly distributed, even if foremost inaccurate, for the stimulus Anger 8.

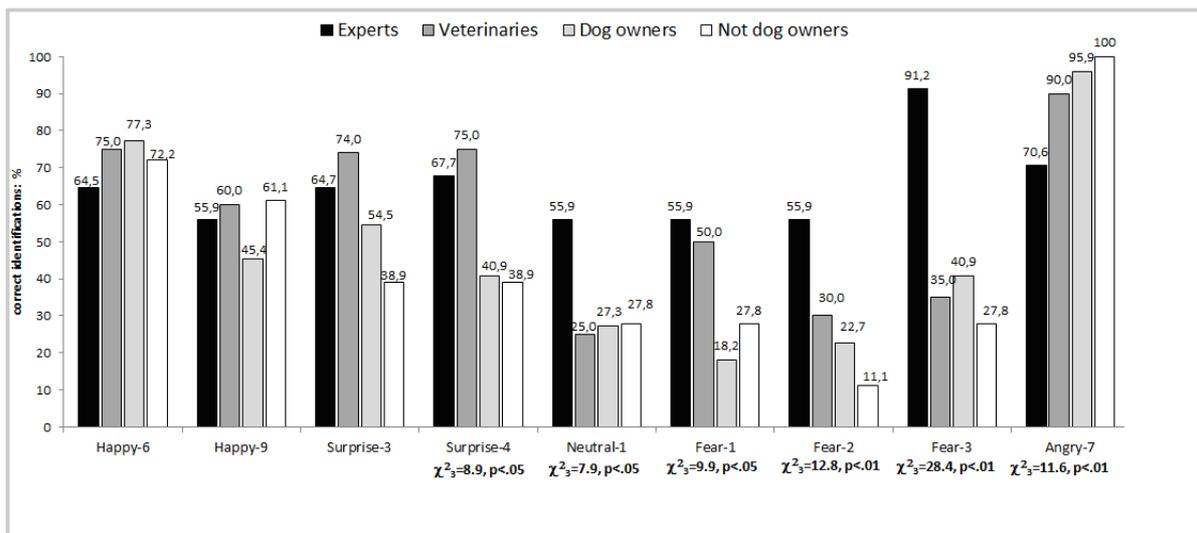
Their performance was more accurate for Happiness 6-9, Surprise 3-4 and Anger 7, as well as for all Fear stimuli: however, it is worth noting that experts tended to categorize all negative emotions as "fear", which was the emotion more often attributed also to either Sadness, or Disgust and Anger (Sad 1, Disgust 5 and Angry 7, see table 1).

The response pattern was similar in the two experts groups, even though veterinary behaviourists performed significantly better in recognizing happiness (Happiness 3: 75.0% versus 27.3%,  $\chi^2=7.2$ , p<.01) and disgust (Disgust 4: 41.7% versus 0.0%,  $\chi^2=10.7$ , p<.01), whereas, on the contrary, dog trainers' responses were more accurate for Fear stimuli (Fear 1: 68.2% versus 33.3%,  $\chi^2=3.9$ , p<.05; Fear 2: 72.7% versus 25.0%,  $\chi^2=7.2$ , p<.01). However, considering the overall

performance, their mean scores were not significantly different (ANOVA,  $p > .05$ ), either for these nine stimuli (veterinary behaviourists:  $5.8 \pm 1.8$ ; dog trainers:  $5.9 \pm 1.2$ ) or for all the stimuli ( $9.5 \pm 2.8$  versus  $9.0 \pm 2.1$ , respectively).

Based on the experts' performance, which clearly suggested that our panel of experts had problems in reading the dog's emotions, we decided to test the other three groups of subjects using only the 9 best recognized stimuli (Happiness 6 and 9; Surprise 3 and 4; Neutral 1; Fear 1, 2, 3. See Figure 2.1) and excluding the remaining 12 ones (see Table 2.1).

As figure 2.2 shows, focusing on the 9 best recognized stimuli, experts performed significantly better than the other groups on Neutral and Fear stimuli, but significantly worse on the Anger stimulus; participants who had never owned a dog showed an overall less accurate performance, except for Anger and Happiness stimuli. The performance on the Happiness stimuli was comparable among the four groups.



**Figure 2.2:** Percentages of correct identifications and standardized cell residuals among groups on the 9 best recognized stimuli

### Empathy

Both AES (asymmetry ranging from  $|.33|$  to  $|.64|$  and kurtosis from  $|.17|$  to  $|.77|$ ) and EQ (asymmetry ranging from  $|.02|$  to  $|.48|$  and kurtosis from  $-.14|$  to  $|1.21|$ ) group distributions were analogous to a normal distribution (Shapiro–Wilks normality tests were not significant). Their reliability in the whole sample was good (Cronbach's alpha: AES= .799 and EQ= .841). The comparison between groups' total scores and the theoretical maximum score that a respondent could obtain, showed that in all groups AES average scores were rather or very high, suggesting

that strong feelings of empathy toward animals were quite common, whereas the average empathy toward people scores was less pronounced. Mean and standard deviations by group and gender are shown in Table 2.2.

**Table 2.2** Empathy towards animals (AES) and people (EQ) by group belonging and gender: mean (standard deviation)

	Animal Empathy Scale total score			Empathy Quotient total score		
	Female	Male	Total	Female	Male	Total
Expert	171.7(14.2)	170.5(10.6)	171.3(13.1)	43.4(7.9)	43.6(5.5)	43.5(7.2)
Veterinary	155.8(19.3)	155.7(15.8)	155.8(17.3)	49.1(8.3)	46.4(8.8)	47.9(8.4)
Dog owner	162.1(16.6)	158.0(12.7)	160.3(14.9)	50.1(5.9)	42.7(9.3)	46.9(8.3)
Not dog owner	151.4(15.2)	148.7(17.6)	150.1(16.0)	50.8(6.3)	46.7(9.1)	48.7(7.9)
<i>Total</i>	<i>163.2(17.5)</i>	<i>158.5(15.9)</i>	<i>161.3(16.9)</i>	<i>47.2(7.9)</i>	<i>44.8(8.1)</i>	<i>46.2(8.0)</i>

The Levene test for the homogeneity of residual variance was not significant both for AES ( $F[7,87]=.73, p>.05$ ) and EQ ( $F[7,87]=1.57, p>.05$ ) total scores: therefore, since both normality and homoscedasticity error distributions were demonstrated, we run parametric factorial analysis of covariance (ANCOVA: gender by groups, covariate: age). There were no significant effects of age and gender on empathy toward animals: only the participants' group determined a quite strong significant difference ( $F[3,86]=8.49, p<.01, \eta^2=.230$ ): experts' AES score was significantly the greater of all (post hoc Tukey's HSD  $t$ -test,  $p<.05$ ) and no differences emerged between the other three groups. On the contrary, the effect of group on the EQ scores was not significant, and there was only a weak effect of gender ( $F[1,86]=4.7, p<.05, \eta^2=.052$ ) but not of age.

We found no significant correlation between empathy toward animals and toward people either in the entire sample (Pearson's  $r=.091, p>.05$ ), or in each group ( $r$  coefficients ranged from .161 to .283,  $p>.05$ ).

#### *Empathy and recognition of the dog's emotions*

To assess the possible relationship between empathy and the accuracy in recognizing the dog's emotions from facial expressions an Ancova (age x AES x EQ x Gender x Group) was carried out considering performance on all the 21 stimuli, on the 9 best recognized stimuli and single emotions. It emerged that neither empathy towards animals nor empathy towards people had a significant impact on participants' ability to correctly identify the dog's emotions.

## Discussion

The goal of the current study was to further explore human ability to assess dogs' emotions from their facial expression and to start investigating whether empathy towards animals and humans could influence the recognition of a dog's emotional facial expressions.

A weakness of the few studies on human identification of canine visual emotional signals is the use of video-clips or photographs selected by experts on the basis of their knowledge of the features that should characterize the expression of a given emotion rather than based on emotion evoking situations. Thus, we decided to use the dog photographs realized and employed by Bloom and Friedman (2013), as they were taken under standardized and behaviourally defined conditions aimed at eliciting in the dog the six basic emotions described by Ekman in humans.

Taken together, results provide evidence that high levels of expertise with dog behaviour, namely being a veterinary behaviourist or a dog trainer, do not necessarily imply accuracy in the identification of dog's emotional states. In addition they indicate that the recognition of the dog's facial expressions is affected by the kind of experience with dogs but not by gender and empathy.

The finding that our panel of experts had problems in the identification of the dog's facial expressions related to some of the basic emotions (e.g., disgust, sadness and anger) is interesting and to a certain extent unexpected. Considering that the 21 dog stimuli used in this study had been rated by three judges in Bloom and Friedman's study as the best and more representative photographs of the different emotions and that, in the same study, experts' performance was below chance level only for the disgust and neutral expressions, we expected our experts to correctly recognize most of the dog facial expressions.

But our results clearly show that this was not the case since 75% of the experts correctly recognized, at most, 52% of the dog's photographs, with an average equal to 43.7%: in particular, percentages of incorrect identifications significantly exceeded the percentages of correct ones for all the Sadness and Disgust photographs (which were mainly interpreted as fear) and for two out of three Neutral and Anger expressions (which were mainly interpreted as happiness and fear respectively). Our experts recognized two out of three Happiness and Surprise facial expressions (Happiness 6, 9, Surprise 3, 4) and succeeded in recognizing all Fear expressions. However, it is worth noting that they tended to categorize all negative emotions as "fear", which in fact was the emotion more often attributed to either Sadness, or Disgust and Anger. Interestingly, also in the study by Wan et al. (2012) experts had problems in finding clear examples of dogs' behaviour related to sadness, anger and neutral conditions.

These results are in line with some comments made by the judges in Bloom and Friedman's study, namely that the Neutral condition appeared to display happiness, the disgust condition was difficult to differentiate from the other negative emotions, the sad condition could be confused with

submissiveness, and likely with fear, and that two anger expressions revealed a mixture of aggression and fear (except anger photograph n° 8). However, our experts' performance deviated in part from that of the experts' group in Bloom and Friedman's work: in particular, our experts were more accurate in identifying fear and surprise and they didn't recognize happiness in all the neutral stimuli, but correctly identified one of them. Conversely, they had a lower performance on happiness photographs (92% of correct answers vs. 64.7% on the best recognized happiness photograph). Moreover, when focusing on errors, our experts often confused anger with fear but not with happiness (as occurred in Bloom and Friedman's experts group) and happiness with the neutral condition.

Thus overall the response pattern exhibited by our panel of experts seems to contradict Bloom and Friedman's conclusion that "humans were able to classify, responding well above chance, the emotion conveyed by a dog's facial expressions".

It's worth noting that a number of factors could be responsible for our experts' performance: although Bloom and Friedman removed from the photographs the elements that could be used as cues by participants to infer the dog's emotional state, all our experts noticed that Mal was wearing a "choke" collar and most of them commented that the dog could have been trained using methods based on punishment. This interpretative bias could partly explain why in the current study experts tended to read all negative emotions as fear.

Another possibility is that not all the emotion-producing conditions used in Bloom and Friedman's study succeeded in evoking the emotion they were aimed to, due to variables such as dog's previous training experiences and the adequacy of the emotion-evoking condition.

If, for example, Mal had been trained using coercive methods, the fact of giving him a command and then verbally expressing disappointment for his performance (Sad condition) might have induced fear rather than sadness. In fact, also Bloom and Friedman's experts often identified fear instead of sadness in the Sadness photographs, as predicted by the judges who had ranked them. Since sadness is considered an emotional response to the loss of an important relationship or to separation (Freed and Mann, 2007; Panksepp, 2011), probably a better condition to evoke this emotion in dogs would be separation from their owner, as in Pongràcz et al.'s study on dog emotional vocalizations (2005). Similarly, the "bad guy" condition, in which a person wearing a standard Schutzhund protective clothing teased Mal, might have evoked a mixture of anger and fear rather than anger alone.

Finally, it's worth noting that we used a statistical procedure different from that used by Bloom and Friedman: in their study they compared the percentage of correct answers to the random responding, posited at 14%, which is a rather low percentage. In our opinion, the procedure used by Poncracz et al. (2011) to calculate the chance level, i.e. considering both the number of stimuli

(photographs) for each condition (emotions) and the number of possible answers, would have been more conservative and more suitable for the methodological design of the experiment. Adopting this procedure, chance level would be equal to 42.9% (3 photographs for each condition / 7 potential answers). However, as in Gross' study (2004), we considered more appropriate to use chi-square analyses to compare the frequency with which each facial expression was identified as the expected emotion or as another one.

Another interesting result is the discrepancy between our results and those obtained by Bloom and Friedman (2013) on the effect of experience on the ability to identify the dogs' facial displays. These authors reported that there was little difference between people experienced and inexperienced with dogs: both groups consistently identified happiness, sadness, anger and fear in the the dog's photographs, while surprise resulted more difficult to recognize in the inexperienced group, whose performance was at chance level. Similarly, Tami and Gallagher (2009) found few differences due to experience in the interpretation of dogs' behaviour. Yet, our results indicate a significant difference among groups, according with the kind of experience with dogs.

As experts had problems in reading the dog's emotions, we assessed group differences on the 9 best recognized facial expressions (3 Fear, 2 Happiness, 2 Surprise, 1 Neutral and 1 Anger photographs), excluding the remaining 12 ones; experts in dog behaviour performed significantly better than veterinarians, dog owners and non-dog owners on Neutral and Fear photographs, but significantly worse on the Anger one; moreover, participants who had never owned a dog showed an overall less accurate performance, except for Anger and Happiness facial expressions, with all groups being comparable in the recognition of the Happiness stimuli.

The finding that experts were less accurate in detecting anger cues is in line with what reported by Bloom and Friedman, who also found that, paradoxically, experienced people sometimes identified angry facial expressions as displaying happiness, an error noticed also by Meinst at al. (2010) who found that children interpreted dogs bearing their teeth as being smiling. Instead, our experts often confused anger with fear, probably on the basis of cognitive evaluation about the reasons of aggressiveness, since fear is often a drive to aggressive behaviour (Borchelt, 1983; Galac & Knol, 1997). The evidence that participants who had never owned a dog were very successful in recognizing this expression (100% of correct answers) is in line with other studies (e.g. Marshall-Pescini et al., .2009) and could be due to the high survival value derived from the ability to detect anger in others, which can allow to predict their aggressive intentions, thus avoiding or facing them (Wright 1985; Overall & Love 2001; De Keuster et al. 2006; Hess & Thibault, 2009; Rosado et al. 2009). Bowling (1962) noticed that dog and human facial expression of joy and anger were quite similar, despite a different muscular arrangement: the overall good performance in identifying these emotions, even in people without any experience with dogs, might suggest that participants were

able to detect anger and happiness in the dog relying on the same cues typical of these expressions in humans.

Our experts' advantage in recognizing fear but not happiness is in line with Wan and colleagues' (2012) results, showing that expertise with dogs predicted the accuracy in the identification of fear but not happiness in video stimuli of dog behaviour. These authors also noted that facial features were reported as more informative in the recognition of fearful rather than happy behaviour and that experts were more likely to look at facial cues than inexperienced people.

Interestingly, in our study percentages of correct recognitions of fear facial expressions in the other three groups (vets, dog owners and non-owners) were overall quite low, suggesting that a specific training is needed to learn what visual signals are indexes of fear in dogs: most of them are in the dog face, such as holding ears back, eyes wide open, tense areas around dog's eyes and muzzle and lip licking (Wan et al., 2012). All these features were present in Fear photograph n° 3, which was the best recognized by our experts but not by the other three groups. Failure in fear recognition could be a matter of concern especially for vets, who often interact with fearful dogs (Döring et al., 2009; Travain et al., 2015), but also for dog owners, who share their lives with dogs, and non-owners, since fear can result into aggression (Borchelt, 1983; Galac & Knol, 1997). Moreover, if owners and vets fail to recognize fear in dogs, this could impair also dogs' welfare.

Finally, our results are in line with other studies indicating that evoking and recognizing neutral facial expressions is difficult (Bloom & Friedman, 2013; Wan et al., 2012; Parr et al., 2007; Ekman & Friesen, 2003; Lee et al., 2008) and with Bloom and Friedman's finding on difficulties in identifying disgust.

The lack of a correlation between empathy toward animals and toward people either in the entire sample or within each group, suggests that these two forms of empathy might be distinct and not necessarily linked. Even if there are evidences that these two kinds of empathy are often mildly but significantly correlated (Paul, 2000; Signal & Taylor, 2007; Preylo & Arikawa, 2008; Daly & Morton, 2009), Paul (2000) noticed that some factors could influence differentially the one or the other and therefore she supposed that empathy toward animals and towards humans may have different evolutionary and developmental trajectories. Further studies are needed to address this issue in more detail.

Another interesting finding is the lack of gender differences in empathy towards animals and the significant effect of the group. Experts (veterinary behaviourists and dog trainers) scored higher than veterinarians, dog owners and non owners, which in turn were comparable in their level of reported empathy; this result supports those of studies focused on the effect of humane education, which showed that a specific education in animal behaviour and emotions often resulted in enhanced levels of empathy toward animals (Ascione, 1992; Ascione & Weber, 1996; Niccoll et al.,

2008; Daly & Suggs, 2010; Hazel et al., 2011). Yet, the fact that males and females participants were comparable in their level of reported empathy toward animals contrasts with previous literature showing that in general females are more empathic than males. However, it's worth noting that in this study AES average scores were high or very high in all groups, suggesting strong feelings of empathy toward animals: this ceiling effect could have masked gender differences.

There was no effect of group on EQ scores, suggesting that the differences we found in dog emotions recognition, related to expertise, were not due to a difference among participants in general social skills.

Finally we found no relationship between empathy (especially towards animals) and gender and the accuracy in recognizing dog's basic emotions. In the human literature empathy towards people is related to the ability to recognize their emotion from facial expressions (Lawrence et al., 2004; Vellante et al., 2013; Sucksmith et al., 2013) and women are more skilled than men (Lawrence, et al., 2004; Vellante et al., 2013; Proverbio, et al., 2007, Barrett et al., 2000; Hall, 1978; Hall and Matsumoto, 2004), but this relationship has never been tested in regards to animal emotions. Thus, we cannot exclude that our findings could be due to the inadequacy of the photographs we used, either because they may have failed to clearly represent the target emotion (i.e., sadness condition) or because they lacked ecological validity, since important cues such as postures, body movement and vocalization were omitted. Further research is needed to gain insight on this quite unexplored topic.

## **2.6. The study of emotional states in non-human animals: combining behaviour with reliable and non-invasive physiological tools to detect dog emotions**

As mentioned above, emotional states have a very complex nature, which entails physiological, cognitive, motivational, expressive and subjective components (Nesse, 1990; Scherer et al., 1984; Lazarus, 1991). Given this complexity, the investigation of emotions in non-human animals is not easy and there are evidences that, in line with the results of Study 1, even for ethologists and expert in dog behaviour, behavioural cues alone can be difficult to interpret and there is not always agreement on their meaning.

Behavioral parameters are considered an interesting tool to investigate emotions in dogs in a non-invasive way, and a variety of behavioral responses have been reported to occur during acute stress (Beerda et al., 1997) or in positive circumstances (Khune et al., 2014; Rehn et al., 2014). So far, behavioural measures have been used to assess dog welfare in a wide range of situations such as shelter housing (Tod et al., 2005), separation from the owner (Konok et al., 2011), agility

competition (Pastore et al., 2011), and exposure to novel and startling stimuli (King et al., 2003), however their reliability can be criticized, at least to some extent (Mendl et al., 2010a). For instance, lip licking in dogs has previously been indicated as a signal of distress (Beerda et al., 1997; 2000), but has recently been related to positive emotions evoked by the reunion with the owner after a long period of separation (Rehn & Keeling, 2011): similarly, self-grooming in dogs can be considered as an index of relaxation and appropriate self-maintenance but can also be associated with an attempt to relieve stress or anxiety (Rooney et al., 2009).

Overall, these results suggest that behavioral indices may have a considerable variability, due to the individual (e.g. gender, breed, previous experience) or to the type of stimulus involved in the situation, which can play a main role in modulating behavioral response (Beerda et al., 1998; Denham et al., 2014; Part et al., 2014). However, also physiological parameters can be ambivalent and difficult to interpret when considered separately: for example, heart rate can increase in situation inducing either positive or negative emotional states, since it may reflect a general condition of arousal (Boissy et al., 2007; Palestini et al., 2005; Imfeld-Mueller et al., 2011). Therefore, there is a general agreement that a combination of behavioral (e.g. tail wagging, proximity and contact seeking, gazing, stress signals, vocalizations), physiological (heart rate and heart rate variability), endocrine (cortisol and oxytocin levels) and cognitive markers of emotional states is needed for an objective evaluation (i.e., Beerda et al., 2000; Ogata et al., 2006; Mendl et al., 2010a) and it has been suggested that observation of spontaneous behavior could be useful to facilitate the interpretation of physiological data (Beerda et al., 2000).

According to the dimensional theory of emotions, emotional states are characterized by at least two main dimensions: arousal (low to high activation) and valence (positive to negative) (Russels, 1980; Barrett et al., 1999; Mendl et al., 2010a). Recently, this two-dimensional model has been applied to the understanding of the role that emotions play in animal welfare (Désiré et al., 2002; Boissy et al., 2007a), with most studies focusing on emotions induced by distress and negative experiences (Veissier & Boissy, 2007; Van Borrell et al., 2007)]; however, a growing number of researchers outlined that animal welfare cannot be conceptualized as the absence of negative emotions but it also entails the presence of positive emotional states (Boissy et al., 2007a; Yeates & Main, 2008). Therefore, the measurement of both positive and negative valence of affective states is important to understand and assess animal emotions.

Dogs highly depend on humans for both health and care, and several studies have investigated negative emotions, namely stress responses, in dogs in different situations, using both behavioral and physiological indices, mainly cortisol sampling and heart rate (Beerda et al., 1997, 1998; Palestini et al., 2005; Ogata et al., 2006; Fallani et al., 2007; Hennessy, 2013; Part et al., 2014).

A novel technique that has been used to assess acute and chronic stress in laboratory (e.g., Ludwig et

al., 2007), farm (e.g., Stewart et al., 2007; 2008) and sporting animals (Yarnell et al., 2013; Hall et al., 2014) is represented by Infrared thermography (IRT), a passive, remote, and non-invasive method that measures surface temperature, detecting infrared radiation emitted by a subject and providing a pictorial representation of body temperature in animals (Speakman and Ward, 1998; Stewart et al., 2005). In animal welfare studies, IRT relies on the close relationship between stress and the metabolic system: stress-inducing stimuli activates the hypothalamic- pituitary-adrenal (HPA) axis and, as a result of increases in catecholamines and cortisol levels as well as blood flow responses, they will produce changes in the animal's heat production and loss (Schaefer et al., 2002; Bouwknecht et al., 2007).

The use of changes in temperature in order to evaluate negative emotions in dogs, namely fear, was suggested also by Ogata and colleagues (2006), who tested a sample of dogs using a Pavlovian fear-conditioning protocol and found that, although behavioral responses had a high individual variability, all subjects had a similar increase in core body temperature (measured with a rectal thermometer).

Although the literature on positive emotions and affective states in farm animals is rapidly growing, the same topic has received little attention in companion animals and in dogs in particular; moreover, IRT has been rarely used to explore emotions in animals and there are no studies based on this method in dogs.

In the following sections I describe two studies I carried out with my colleagues on emotions in animals using for the first time IRT with dogs. In particular, IRT was used to detect changes in dogs' surface temperature during the exposure to a presumably negative (i.e., veterinary examination; see figure 2.3) and positive (i.e., the owner gave the dog highly palatable food treats; see figure 2.4) situation, and it was combined with other frequently used physiological indicators (heart rate and heart rate variability) which are considered as a suitable tool to investigate the role of autonomic nervous system in the modulation of affect and emotion (Von Borrell et al., 2007; Reefman et al., 2009; Zebunke et al., 2011; 2013).



Phase 1 – Pre-examination: the dog remained sit near the owner in the veterinary clinic waiting room



Phase 2 – Clinical examination: the vet lifted the dog on the table and performed the clinical examination



Phase 3 - Post-examination: the dog remained near to the owner, who was talking with the vet

**Figure 2.3:** The procedure used in Study 2 to induce a negative emotional state in dogs: a veterinary examination.



Phase 1 - Baseline: the dog remained quietly close to the owner



Phase 2 - Feeding: the owner gave the dog highly palatable treats



Phase 3 - Post-feeding: as in Phase 1, the dog remained quietly close to the owner

**Figure 2.4:** The procedure used in Study 3 to induce a positive emotional state in dogs: the owner gave the dog highly palatable treats.

## 2.6.1 Study 2 – “Hot dogs: Thermography in the assessment of stress in dogs (*Canis familiaris*) - A pilot study”

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### Research

## Hot dogs: Thermography in the assessment of stress in dogs (*Canis familiaris*)—A pilot study



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### ABSTRACT

Infrared thermography (IRT) represents a non-invasive method to investigate stress responses in animals. Despite the large existing literature about stress responses in dogs, the potential use of IRT in assessing dogs' stress reactions has not been investigated so far. This study evaluates the usefulness of IRT to assess dogs' emotional responses to an unpleasant and stressful event. After a preliminary test, aimed to evaluate the correlation between eye temperature and rectal temperature in dogs in a stressful situation, a sample of 14 adult healthy dogs was observed during a standardized veterinary examination, carried out by an unfamiliar veterinarian in the presence of their owners. Dogs' behaviors and eye temperatures were recorded before the start of the veterinary visit, during, and after the clinical examination. Dogs' levels of activity and stress-related behaviors varied across the different phases of the visit. Interestingly, the dogs showed an increase in eye temperature during the examination phase compared with both pre-examination and post-examination phases, despite a concomitant significant decrease in their level of activity. However, it also emerged that the thermographic camera, although remote and non-invasive, was disturbing for the dogs, to some extent, as they showed avoidance behaviors, including averting their gaze and/or turning their head, exclusively when the thermographic camera was oriented to them. Overall results suggest that IRT may represent a useful tool to investigate emotional psychogenic stress in dogs. Nevertheless, further research is needed to establish the specificity and sensitivity of IRT in this context and to assess how different dogs' characteristics, breed, previous experience, and the nature and severity of the stressor could influence the magnitude and type of the stress response.

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### Introduction

Infrared thermography (IRT) is a passive, remote, and non-invasive method that measures surface temperature, detecting infrared radiation emitted by a subject and providing a pictorial representation of body temperature in animals (Speakman and Ward, 1998; Stewart et al., 2005). Several studies have shown that IRT provides information on an animal's health detecting

inflammatory conditions and infections (Schwartzkopf-Genswein and Stookey, 1997; Berry et al., 2003; Fonseca et al., 2006). IRT also represents a useful method to assess acute and chronic stress in laboratory (e.g., Ludwig et al., 2007), farm (e.g., Stewart et al., 2007, 2008) and sporting animals (Yarnell et al., 2013; Hall et al., 2014) as there is a close relationship between stress and the metabolic system. When an animal becomes stressed, the hypothalamic-pituitary-adrenal (HPA) axis is activated, and as a result of increases in catecholamines and cortisol levels as well as blood flow responses, it will produce changes in the animal's heat production and loss (Schaefer et al., 2002; Bouwknecht et al., 2007).

The exposure to both physiological and psychological stressors of different intensities activates a defensive response, including an increase in heart rate and body temperature. This relative short-lasting rise in core body temperature induced by stress has been

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reported across numerous species, such as mice, rats, rabbits, ground squirrels, pigs, silver foxes, baboons, and humans and is known as stress-induced hyperthermia (Bouwknicht et al., 2007). Many psychological stressors, such as handling, exposure to a novel environment (Oka et al., 2001), and conditioned fear (Vianna and Carrive, 2005; Ogata et al., 2006), induce an elevation in body temperature of just a few Celsius degrees, which might be beneficial to the “fight or flight” reaction to potential threatening stimuli through warming up muscles and the central nervous system (Kataoka et al., 2014).

Even if it is not yet clear whether stress-induced hyperthermia is a form of fever (comparable to that produced by exogenous pyrogens like bacteria, through the activation of immune system), these 2 processes have overlapping properties and both result in a higher body temperature induced by the activation of some common pathways that likely include neurons in the dorsomedial hypothalamus (Vinkers et al., 2009; Kataoka et al., 2014).

Recently, Johnson et al. (2011) evaluated whether IRT could be used to detect fever in ponies after vaccination and found a good correlation between thermographic eye temperature and rectal temperature, suggesting that eye temperature can be a valid index to measure core body temperature and its variation. Despite that the aim of this study was to detect fever, a number of other studies based on IRT have shown that the temperature of the eye is also a good indicator of heat changes in body temperature due to physiological and psychological stress (e.g. Cook et al., 2001, 2006; Pavlidis et al., 2002).

The temperatures of small areas around the posterior border of the eyelid and of the lacrimal caruncle, which have rich capillary beds innervated by the sympathetic system, respond especially to changes in blood flow (Pavlidis et al., 2002; Stewart, 2008). The lacrimal caruncle is an anatomic area which is very sensitive to both pain and stressful events affecting an individual, and changes in its temperature have been attributed both to the sympathetic response of the autonomic nervous system and to HPA activation (Cook et al., 2001; Stewart, 2008; Valera et al., 2012). The sympathetic branch of the autonomic nervous system responds rapidly, preparing the individual for the “fight or flight” reaction (Cannon, 1929; Koolhaas et al., 2010), whereas the parasympathetic system is predominant during passive reactions, such as freezing (Alm, 2004; Romero, 2010), when HPA axis activation is more delayed and is particularly sensitive to psychogenic stressors not producing physical damage (Johnson et al., 1996; Toates, 2001; Gabry et al., 2003). Stewart et al. (2007, 2008) found that in cattle, during the first few seconds of a stressor presentation (acute phase), eye temperature dropped rapidly, likely because of a sympathetic response (peripheral vasoconstriction); however, if the stressor persists for a longer time, the HPA axis induces a cortisol release that can be maintained from minutes to hours (chronic phase), causing several thermogenic reactions in tissue metabolism (Valera et al., 2012). Therefore, HPA axis response to stressors, along with peripheral vasodilatation due to the parasympathetic activation that follows the initial sympathetic response, can produce an increase in eye temperature (Cook et al., 2001; Valera et al., 2012).

Dogs are widespread companion animals that highly depend on humans for both health and care, and several studies have investigated stress responses in dogs in different situations, using both behavioral and physiological indices, mainly cortisol sampling and heart rate (Beerda et al., 1997, 1998; Palestini et al., 2005; Ogata et al., 2006; Fallani et al., 2007; Hennessy, 2013; Part et al., 2014).

Behavioral parameters are considered an interesting tool to establish stress in dogs easily and non-invasively, and a variety of behavioral responses have been reported to occur during acute stress (Beerda et al., 1997). These behaviors have been used to assess dogs' welfare in a wide range of situations such as shelter

housing (Tod et al., 2005), separation from the owner (Konok et al., 2011), agility competition (Pastore et al., 2011), and exposure to novel and startling stimuli (King et al., 2003). However, these results suggest that behavioral and physiological indicators of stress are not always related because of a considerable variability in stress-related behaviors: factors such as individual variability (e.g., gender, breed, previous experience) or the type of stimulus involved in the stress situation play a main role in modulating behavioral response (Beerda et al., 1998; Denham et al., 2014; Part et al., 2014). Therefore, it has been suggested that observation of spontaneous behavior could be useful to facilitate the interpretation of physiological data but not as a welfare indicator per se (Beerda et al., 2000). In particular, Ogata et al. (2006) tested a heterogeneous sample of dogs using a Pavlovian fear-conditioning protocol and found that although behavioral responses had a high individual variability, all subjects had a similar increase in core body temperature (measured with a rectal thermometer), suggesting that this autonomic parameter could be a more reliable and consistent measure of fear in dogs than behavior. As far as we know, IRT has been considered as a diagnostic technique in dogs only recently (Biondi et al., 2013), but so far, it has never been used to investigate variation in dogs' eye temperature due to stress reactions. Only 1 study has used dogs' surface temperature (detecting nose temperature by infrared thermometer) as a potential index of stress, finding that it seems to be a good indicator of psychological arousal in dogs (Part et al., 2014).

The aim of the present study was to evaluate the potentialities of IRT in the investigation of dogs' psychological stress due to veterinary examination. Veterinary examination has been reported to be stressful for most dogs (Döring et al., 2009), with dogs exhibiting fear reactions especially during the clinical examination but also showing anticipatory fear reactions before entering the veterinary clinic for being examined (Stanford, 1981). A pre-test was carried out on a sample of dogs to evaluate whether the correlation between eye and core body temperature in dogs exists as already shown in other animals (Cook et al., 2001, 2006; Johnson et al., 2011). Second, a different sample of dogs was tested during a standardized veterinary examination carried out by an unfamiliar veterinarian in the presence of their owner, and their behavior and eye temperature variations were recorded before, during, and after the clinical examination. The aim of the examination was to induce a negative psychological state in dogs, and thus, it consisted of routine and not painful assessments of dogs' health.

## Materials and methods

### Pre-test

### Subjects

The subjects were 20 healthy dogs (8 females, 12 males) of different breeds and body size, whose ages ranged from 7 months to 15 years (mean = 9.0 years; standard deviation [SD] = 4.67 years). The sample included 16 pure-breed dogs (1 pinscher toy size; 1 pug; 2 dachshunds, miniature size; 1 West Highland white terrier; 2 Jack Russell terriers; 3 poodles, medium size; 1 golden retriever; 1 Czechoslovakian wolfdog; 1 Italian pointer; 1 Cane Corso; 1 Spanish galgo; 1 English setter) and 4 medium size mixed-breed dogs. All the dogs were kept for companionship and lived within the human household. They were accustomed to being taken to the veterinarian; none of them was reported to be aggressive during veterinary examinations. All the owners were informed about the aims of the study and the procedure, and their informed consent was obtained. None of these dogs took part in the subsequent test.

### Procedure

The study was conducted in a veterinary clinic in Milan, Italy (Danilo Bellucci's Veterinary Clinic). The dogs visited during opening hours, before a routine booster vaccination. The pre-test consisted of a unique phase in which dogs' rectal and eye temperatures were measured.

The owner and the dog went into the examination room; the veterinarian lifted the dog on the examination table and measured rectal temperature. Dogs were not physically restrained, so the owners assisted the veterinarian by holding their dog if necessary, preventing them from jumping down from the table and calming them as needed. The entire examination lasted 2 minutes. The sequence of events was standardized, and the examination circumstances (handling, room features, equipment used) were always the same.

### Data collection

The thermographic infrared images were captured by a certified technician (E.H.) using a portable IRT camera (AVIO TVS 500 camera; NEC, Japan) with standard optic system, and analyzed with IRT Analyzer software (GRAYESS, FL, USA). To calibrate the camera reflectivity temperature, samples were taken and emissivity was set at 0.97. Several images per dog were collected during the pre-test to select the images that provided the most optimal operating conditions for analysis (90° angle and 1 m of distance). A total of 62 (per dog mean  $\pm$  standard error [SE] =  $3.10 \pm 0.18$ ; minimum = 2; maximum = 4) images were analyzed evaluating the emission of eye's lachrymal sites. The maximum temperature for each lachrymal site was determined using an instantaneous field of view of 1.68 mm at 1 m distance, within an oval area traced around the eye, including the eyeball and approximately 1 cm surrounding the outside of the eyelids. Only images perfectly on focus were used (Figure 1). To optimize the accuracy of the thermographic image and to reduce sources of noise, before testing each dog, the same image of a Lambert surface was taken to define the radiance emission and to nullify the effect of sunlight or other surface reflections on tested animals, thus controlling for external artifacts (Smith, 2007). Furthermore, the testing environment was air-conditioned, and thus, temperature and humidity remained constant during the procedure.

Rectal temperature of all dogs was taken by D.B. with an electronic veterinary rectal thermometer (Solution TD0004, Vega Technology, Taiwan) emitting an acoustic signal when the attained temperature remains stable for >15 seconds.

### Statistical analysis

To assess the correlation between mean rectal temperature and mean eye temperature, the Pearson correlation was calculated.

### Test

#### Subjects

The subjects were 14 adult and clinically healthy dogs (9 females, 5 males) of different body size, whose ages ranged from 1.5 to 11 years (mean = 5.8 years; SD = 2.54 years). The sample included 9 pure-breed dogs (1 poodle, toy size; 2 fox terriers; 2 Jack Russell terriers; 1 dachshund, miniature size; 1 golden retriever; 1 Bergamasco shepherd; and 1 great Anglo-French hound) and 5 mixed-breed (2 small-medium, 1 medium, 1 Alaskan malamute mix, and 1 Siberian husky mix). All the dogs were kept for companionship and lived within the human household. All dogs had previous experience of being taken to the veterinarian, and as reported by their owners, they clearly disliked this kind of situation; however, none of them was reported to be aggressive during veterinary examinations. Furthermore, all dogs had never been to this veterinary clinic before, and thus, they were completely unfamiliar with the veterinarian and the environment. All the owners were informed about the aims of the study and the procedure, and their informed consent was obtained.

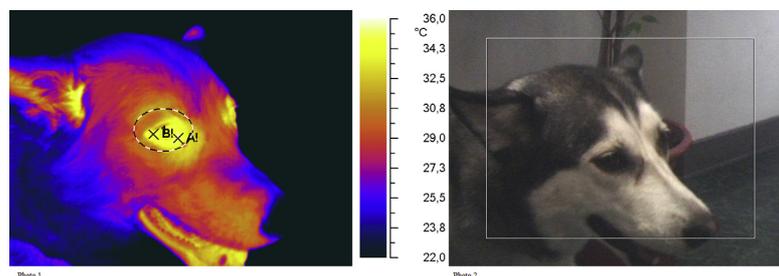
#### Procedure

The study was conducted in the same location and under the same conditions as the pre-test. The procedure consisted of 3 consecutive phases in which dogs' behaviors were recorded and eye temperatures were measured.

**Phase 1: pre-examination.** After the dog and the owner entered the veterinary clinic waiting room, the owner was asked to sit quietly keeping the dog on leash next to him for 10 minutes, pretending to wait his turn.

**Phase 2: examination.** This phase was a standardized general examination. The owner and the dog went into the examination room and the veterinarian lifted the dog on the examination table and performed the following checks: conjunctiva, ears and oral mucosa, palpation of the dog's abdomen, examination of lymph nodes, and heart auscultation with a stethoscope. Dogs were not physically restrained, but the owner assisted the veterinarian by holding the dog if necessary, thus preventing his or her dog from jumping down the table, and calming it. The entire examination lasted 4–5 minutes (average duration = 262.22 seconds; SE = 17.86 seconds). During this phase, the sequence of events was standardized and the examination circumstances (handling, room features, equipment used) were always the same.

**Phase 3: post-examination.** The veterinarian put the dog down to the ground and sat at his desk with the owner, talking about the dog



**Figure 1.** Thermographic image (photo 1) and corresponding picture (photo 2) of Tika, Siberian husky mix, in the waiting room (phase 1). A! is the lacrimal caruncle and the hottest spot on the eye. B! is the second hottest spot on the eye and it is highlighted for control purposes.

**Table 1**  
Description and measure of mutually exclusive stress- or fear-related behaviors

Behavior	Description	Frequency/duration
Panting <sup>a</sup>	Rapid breaths in short gasps	D (% on total time)
Freezing <sup>a</sup>	Complete motionless, without noticeable panting	D (% on total time)
Avoidance <sup>a</sup>	Lateral movement of the head and gaze averting	F (event/minute)
Nose/lip licking	Rapid extension and flicking of the tongue on the nose or between the lips	F (event/minute)
Paw lift	Raise a paw at a time when it is standing or sitting still	F (event/minute)
Posture change	Change posture, from lying on the ground to sitting or standing and vice versa	F (event/minute)
Mouth opening/closing	Rapid movements of opening/closing mouth	F (event/minute)
Shake off	Rapid movements of body shaking	F (event/minute)
Yawning	Involuntary intake of breath through a wide open mouth, not for thermal regulation	F (event/minute)

<sup>a</sup> Behaviors singly analyzed, all other behaviors were pooled for purpose of analysis.

for 5 minutes. Then the dog and the owner left the examination room and the clinic.

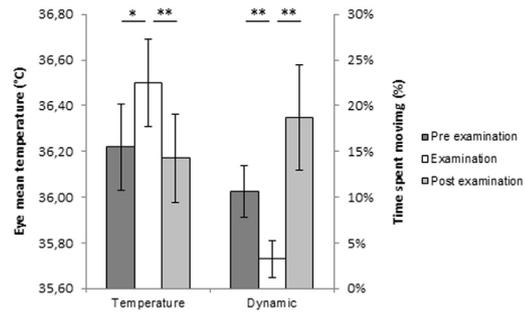
#### Data collection

The thermographic infrared images were captured following the same procedures used in the pre-test during the whole time of every phase (Figure 1). A total of 546 (per dog mean  $\pm$  SE = 39.00  $\pm$  4.20; minimum = 17; maximum = 66) images were analyzed evaluating the emission of eye's lachrymal sites.

The behavior of the dogs during the 3 different phases was recorded using a camcorder (Leica Dicomar; Panasonic, Japan) placed on a tripod, and behavioral data were scored from videos using Solomon Coder beta 12.09.04 (ELTE TTK, Hungary). The ethogram consisted of 2 main categories of mutually exclusive behaviors, and in particular, we focused on (1) dogs' level of activity, namely whether the subject was engaged in observable physical activity, such as walking, jumping or being agitated while standing on the table (dynamic), or was sitting, standing, or lying down, and therefore, movement was almost absent or very limited, that is, head or ear movements (static) and (2) stress- or fear-related signals which included shake off, yawning, nose or lip licking, paw lift, mouth opening and closing, panting, posture change, freezing, and avoidance (see Table 1 for a description; Beerda et al., 1997, 1998). In addition, to evaluate whether the mere fact of directing the thermographic camera toward the dogs' muzzles could affect their stress displays during coding, each behavioral element was accompanied by a marker indicating the presence of the thermographic camera. The dog's behavior was coded from videos by one of the authors (E.S.C), whereas a second independent coder (T.T.) analyzed 20% of the data to assess interobserver reliability.

#### Statistical analysis

Interobserver reliability was assessed using Spearman correlations on the main behaviors (dynamic; freezing; panting; avoidance; stress or fear signals). Differences in dogs' degree of activity, stress- or fear-related behaviors, and eye temperature in the 3 phases were evaluated using nonparametric and 2-tailed statistical tests, setting alpha at 0.05. Stress or fear signals reported in Table 1 were pooled because of their low occurrence, with the exception of avoidance, which occurred only when the thermographic camera was oriented to the dogs' muzzles, and of panting and freezing, which were measured as duration. Friedman analysis of variance



**Figure 2.** Mean eye temperature ( $^{\circ}$ C) and mean percentage of dynamic behavior expressed by the 14 dogs during the 3 phases of the experiment (pre-examination, examination, post-examination). Crossing lines represent standard errors. Post hoc results are reported for both temperature and dynamic. \* $P < 0.05$  and \*\* $P < 0.01$ .

for ranks with the minimum-difference post hoc tests (Siegel and Castellan, 1988) were run to detect differences among phases in dogs' eye temperatures and to evaluate differences among phases in behavior and stress- or fear-related signals. The Wilcoxon rank sum test was used to evaluate whether the presence of the thermographic camera affected dogs' behavior. All the statistical analyses were carried out with SPSS Statistics 21 (IBM, NY, USA).

## Results

### Pre-test

The mean rectal temperature of the sample of dogs was 38.57 $^{\circ}$ C (SD = 0.43 $^{\circ}$ C), whereas the mean eye temperature was 36.18 $^{\circ}$ C (SD = 0.68 $^{\circ}$ C). Pearson correlation between eye and rectal temperature was  $r = 0.661$ ;  $P = 0.002$ .

### Test

#### Thermographic data

Dogs' eye temperatures increased during the examination phase and decreased to pre-examination values in the post-examination phase (Figure 2). The Friedman analysis of variance showed that the variation in eye temperature was significant ( $\chi^2 = 8.714$ ;  $df = 2$ ;  $P = 0.013$ ), and the post hoc test revealed a significant difference between the pre-examination and examination phases (minimum  $D = 0.726$ ; observed  $D = 0.929$ ;  $P < 0.05$ ) and between examination and post-examination phase (minimum  $D = 0.968$ ; observed  $D = 1.000$ ;  $P < 0.01$ ).

#### Behavioral data

There was a good interobserver reliability for the behavioral categories analyzed (dynamic:  $r = 1$ ;  $P < 0.001$ ; freezing:  $r = 1$ ;  $P < 0.001$ ; panting:  $r = 1$ ;  $P < 0.001$ ; avoidance:  $r = 0.95$ ;  $P = 0.004$ ; stress or fear signals:  $r = 0.986$ ;  $P < 0.001$ ).

Considering the level of activity, there was a significant difference among the 3 different phases in the duration of dynamic behavior (Friedman:  $\chi^2 = 16.000$ ;  $df = 2$ ;  $P < 0.001$ ). In particular, dogs' activities significantly decreased in the examination phase (pre-examination vs. examination: minimum  $D = 0.968$ ; observed  $D = 1.143$ ;  $P < 0.01$ ; examination vs. post-examination: minimum  $D = 0.968$ ; observed  $D = 1.429$ ;  $P < 0.01$ ; Figure 2). Dogs showed stress or fear signals during the whole test (on average, 2.40 stress or fear signals per minute), with some signals occurring more than the others (Table 2).

**Table 2**

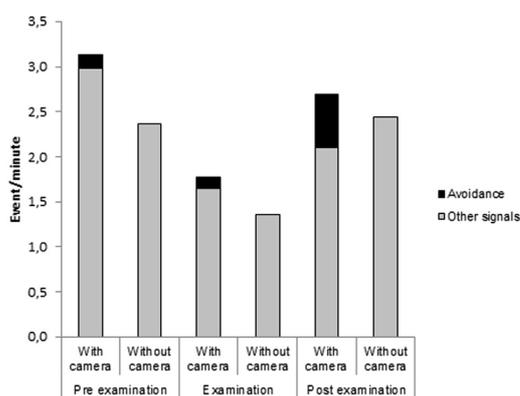
Mean and standard error (SE) of stress- or fear-related behaviors in the 3 phases of the experiment (before examination, examination, and after examination) and *P* value of Friedman *T* test

Behavior	Pre-examination, mean ± SE	Examination, mean ± SE	post-examination, mean ± SE	<i>P</i> value
Panting <sup>a</sup>	23.8 ± 7.1	14.1 ± 6.9	26.1 ± 7.7	0.07
Freezing <sup>a</sup>	0.0 ± 0.0	11.3 ± 4.4	0.0 ± 0.0	Not analyzed <sup>b</sup>
Avoidance <sup>a</sup>	0.16 ± 0.04	0.13 ± 0.06	0.60 ± 0.17	0.029
Nose/lips licking	0.68 ± 0.15	0.38 ± 0.15	0.63 ± 0.15	0.135
Paw raising	0.09 ± 0.04	0.37 ± 0.18	0.11 ± 0.09	
Posture change	0.47 ± 0.08	0.12 ± 0.07	0.56 ± 0.16	
Mouth open/close	0.88 ± 0.29	0.70 ± 0.22	0.58 ± 0.22	
Body Shaking	0.09 ± 0.03	0.00 ± 0.00	0.19 ± 0.04	
Yawning	0.14 ± 0.04	0.00 ± 0.00	0.11 ± 0.05	

<sup>a</sup> Behaviors singly analyzed; all other behaviors were pooled for the purpose of analysis.

<sup>b</sup> Freezing behavior was not statistically analyzed as it occurred only in examination phase.

The highest frequency of stress signals, apart from freezing, was observed in phase 3 post-examination: 2.78 signals/minute), whereas the lowest one during phase 2 (examination phase: 1.68 signals/minute). Overall, mouth opening and closing was the most frequent signal of stress (0.78 times/minute during the whole test), whereas yawning and shaking off were the 2 less frequent signals (both 0.10 times/minute). Differences in stress or fear signal frequency across phases were not statistically significant (Friedman:  $\chi^2 = 4.000$ ; *df* = 2; *P* = 0.135), except for avoidance behavior which varied significantly among phases: It dropped during the examination phase, increasing again in the post-examination phase (Friedman:  $\chi^2 = 7.091$ ; *df* = 2; *P* = 0.029). Nine dogs (64.3%) showed panting during the procedure and this behavior occurred for 22.2% of the overall time, being present in phases 1, 2, and 3 on average for 23.8%, 14.1%, and 26.1% of the time, respectively. Although panting decreased during the examination phase, differences in this behavior among phases were not significant (Friedman:  $\chi^2 = 5.314$ ; *df* = 2; *P* = 0.07). Freezing behavior was found exclusively during the examination phase, and 7 of the 14 dogs (50% of the subjects) exhibited this behavior. This may explain why during the examination phase there was the lowest frequency of stress or fear signals and the lowest duration of panting and dynamic behavior.



**Figure 3.** Mean frequency of avoidance and other stress or fear signals when the thermographic camera was oriented (with camera) or not to the dog's muzzle (without camera) in the 3 phases of the experiment (pre-examination, examination, post-examination).

It emerged that throughout the test dogs showed avoidance behavior, that is, turning the head and/or looking away, exclusively when the technician oriented the thermal camera toward the dogs' muzzles to capture images (Figure 3). Thus, a further analysis was carried out to assess differences in the frequency of dogs' other stress or fear signals and the duration of freezing and panting behaviors when the thermographic camera was directed vs. not directed toward the dogs' muzzles. Results revealed a significant difference in the duration of freezing (Wilcoxon:  $Z = -2.197$ ; *P* = 0.028) and no significant difference in frequency of the remaining stress or fear signals (Wilcoxon:  $Z = -1.726$ ; *P* = 0.084) and the duration of panting (Wilcoxon:  $Z = -1.244$ ; *P* = 0.214).

## Discussion

In the present study, we aimed to evaluate the potentialities of IRT in the investigation of dogs' psychological stress due to an unpleasant situation, that is, a veterinary visit. In the literature it is well documented that stress can induce an increase in core body temperature (Oka et al., 2001; Vianna and Carrive, 2005; Ogata et al., 2006; Bouwknecht et al., 2007), which in turn influences the temperature of a particular area of the eye, the lacrimal caruncle, whose variations can be detected by IRT (Cook et al., 2001; Stewart et al., 2007; Stewart, 2008; Valera et al., 2012). There is also some evidence that eye temperature is particularly sensitive to psychological stress (Pavlidis et al., 2002).

So far, various studies have focused on stress responses in dogs in a variety of conditions, combining behavioral and physiological measures (e.g., Beerda et al., 1997, 1998; Palestini et al., 2005; Ogata et al., 2006; Fallani et al., 2007; Hennessy, 2013; Part et al., 2014); however, to our knowledge this is the first study in which IRT is used with dogs to investigate stress responses.

Initially, in a pre-test conducted on a sample of dogs, we evaluated whether there was a correlation between eye temperature and rectal temperature in dogs, as already reported for other animal species (Schaefer et al., 2007; Johnson et al., 2011). Results of this pre-test confirm previous findings, revealing that eye temperature can be a good indicator of core body temperature also in dogs.

Given the evidence of a correlation between eye and rectal temperature, a second sample of dogs was tested during a standardized veterinary examination, aimed at inducing a negative psychological state in dogs and carried out by an unfamiliar veterinarian. In this part of the study, dogs' behaviors and eye temperatures were recorded before, during, and after the clinical examination.

Thermographic data obtained when the dogs were exposed to the psychologically stressful situation, that is, the veterinary visit (Döring et al., 2009), highlighted a peak in dogs' eye temperatures during the clinical examination phase. Because at the behavioral level this phase was characterized by a clear drop in dynamic behavior and by the occurrence of freezing behavior in half of the subjects, it is unlikely that the observed increase in eye temperature simply depended on dogs' activities. Rather, it appears that the temperature increase was associated to a condition of emotional stress because of the visit itself. In this respect, our results confirm those by Döring et al. (2009), who found that veterinary examination is perceived as stressful by dogs. Our procedure did not involve any physical injury to animals, and thus, it likely represented a psychogenic stressor due to exposure to a novel (dogs had never been in this veterinary clinic before) and threatening environment and a lack of control over external events (Toates, 2001; Hennessy, 2013). Probably, when faced with the veterinarian, the dogs realized that no active strategy was possible and showed a passive behavior, displaying a more static posture than in the other conditions or even showing freezing. The HPA axis is especially sensitive to this

kind of psychogenic stressor and its effects on metabolism, and along with peripheral vasodilatation due to parasympathetic activation during freezing response (Alm, 2004; Romero, 2010), it may explain the increase in eye temperature detected by thermography when dogs were on the examination table (Cook et al., 2001; Valera et al., 2012). Moreover, all our dogs had previous experiences with veterinary examinations, so the anticipation of an unpleasant experience could have played a role in the stress response, supporting studies that have linked a cognitive component of stress with the increase in eye temperature (Pavlidis, 2002; Stewart et al., 2007; Valera et al., 2012). In particular, our findings are in line with those obtained by Ogata et al. (2006), who found that dogs' body temperatures increased consistently in response to a fear-conditioned stimulus, regardless of their breed, gender, or age. The authors suggested that body temperature response to fear may not be strongly influenced by these variables and could provide an objective index of stress in dogs, particularly when multiple breeds are tested together. A similar result was reported also by Part et al. (2014), who found no effect of kennel type or experience, sex, neuter status, and age on the drop in surface temperature observed after kenneling; thus, they suggested that this variable could be an "easy to measure" indicator of psychological arousal in dogs, although its emotional valence could not be assessed.

However, this is the first study using IRT to assess dogs' responses to an unpleasant situation, and because of the small and heterogeneous sample tested, further studies should be undertaken to highlight the potential role of individual variables (e.g., age, breed, and gender) on eye temperature and other stress responses in dogs as, for instance, these variables were found to be relevant in horses (Bartolomé et al., 2013). It would be also interesting to compare dogs with and without previous experience with veterinary examinations to investigate to what extent anticipation of an unpleasant experience could have modulated the dogs' stress responses and eye temperatures.

It is worth noting that the dogs also exhibited an avoidance reaction only when the thermographic camera was directly oriented toward their muzzle. In particular, this reaction decreased during the examination phase and increased again in the post-examination phase, exceeding the pre-examination phase level. Furthermore, freezing and other stress or fear signals increased when the thermographic camera was directed toward the dogs, and this suggests that, although remote and non-invasive, it was to some extent disturbing for the dogs and that possibly it determined a short-term sensitization effect. It is also possible that the dogs' avoidance responses depended also, at least in part, on having an unfamiliar human facing them while holding a strange object. There is evidence that for most nonhuman species a direct and prolonged duration of gaze is considered as a threatening behavior (Emery, 2000), and this has been reported also for wolves and dogs (Schenkel, 1967; Bradshaw and Nott, 1995). It has also been shown that, in the absence of other accompanying signals, a direct and prolonged gaze puts dogs in an uncomfortable situation (Vas et al., 2005, 2008; Hernádi et al., 2012; Gácsi et al., 2013). Thus, it is possible that dogs perceived a prolonged photo framing by a static and silent human as a threat and thus reacted with avoidance, averting gaze, and turning the head.

## Conclusions

This study represents a first step in the validation of IRT as a method for measuring stress in dogs, and our results indicate that the IRT is a useful tool to detect temperature variation due to psychological stress in dogs. Further researches are needed to establish whether sensitivity of IRT is context dependent, that is, emotional distress, or is applicable in positive context as well. Both

in the field of comparative cognition and animal welfare, there is an increasing interest in understanding and assessing animals' positive and negative emotional states, and IRT could be an additional useful instrument to investigate them in dogs. However, the fact that dogs showed avoidance behaviors, looking away or even turning their head, when the thermographic camera was focused on them suggests that it could be a mild stressor per se, and this aspect deserves further investigation. Additional studies are required to assess whether and to what extent different dogs' characteristics, that is, breed, age, previous experience, and the nature and severity of the stressor, could influence the magnitude and type of the stress response and consequently the applicability of the IRT. It would be also interesting to compare IRT with other physiological measures of emotional stress, such as heart rate variability, to better understand the physiological mechanisms that cause changes in the dogs' eye temperatures.

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## Ethical considerations

No special permission for use of animals (dogs) in non-invasive observational studies is required in Italy. The relevant ethical committee is the Ethical Committee of the Università degli Studi di Milano. All dog owners were informed about the nature and scope of the study and their written consent was obtained before the study was initiated.

## Conflict of interest

Tiziano Travain and Elisa Silvia Colombo were supported by a doctoral grant from the Università di Parma and Università di Milano, respectively. Paola Valsecchi obtained partial funding from Università di Parma (FIL 2012).

## References

- Alm, P.A., 2004. Stuttering, emotions, and heart rate during anticipatory anxiety: a critical review. *J. Fluency Disord* 29, 123–133.
- Bartolomé, E., Sánchez, M.J., Molina, A., Schaefer, A.L., Cervantes, I., Valera, M., 2013. Using eye temperature and heart rate for stress assessment in young horses competing in jumping competitions and its possible influence on sport performance. *Animal* 7, 2044–2053.
- Beerda, B., Schilder, M.B.H., van Hooff, J., de Vries, H.W., 1997. Manifestations of chronic and acute stress in dogs. *Appl. Anim. Behav. Sci.* 52, 307–319.
- Beerda, B., Schilder, M.B.H., van Hooff, J., de Vries, H.W., Mol, J.A., 1998. Behavioral, saliva cortisol and heart rate responses to different types of stimuli in dogs. *Appl. Anim. Behav. Sci.* 58, 365–381.
- Beerda, B., Schilder, M.B.H., van Hooff, J., de Vries, H.W., Mol, J.A., 2000. Behavioural and hormonal indicators of enduring environmental stress in dogs. *Anim. Welf.* 9, 49–62.
- Berry, R.J., Kennedy, A.D., Scott, S.L., Kyle, B.L., Schaefer, A.L., 2003. Daily variation in the udder surface temperature of dairy cows measured by infrared thermography: potential for mastitis detection. *Can. J. Anim. Sci.* 83, 687–693.
- Biondi, F., Dornbusch, P.T., Sampaio, M., Montiani-Ferreira, F., 2013. Infrared ocular thermography in dogs with and without keratoconjunctivitis sicca. *Vet.*

- Ophthalmol. <http://onlinelibrary.wiley.com/doi/10.1111/vop.12086/full>, accessed 5 August 2014.
- Bouwknicht, J.A., Olivier, B., Paylor, R.E., 2007. The stress-induced hyperthermia paradigm as a physiological animal model for anxiety: a review of pharmacological and genetic studies in the mouse. *Neurosci. Biobehav. Rev.* 31, 41–59.
- Bradshaw, J.W.S., Nott, H.M.R., 1995. Social and communication behavior of companion dogs. In: Serpell, J. (Ed.), *The Domestic Dog: its Evolution, Behavior and Interactions With People*. Cambridge University Press, Cambridge, pp. 115–130.
- Cannon, W.B., 1929. Bodily changes in pain, hunger, fear, and rage: an account of recent researchers into the function of emotional excitement. Appleton, New York.
- Cook, N.J., Schaefer, A.L., Warren, L., Burwash, L., Anderson, M., Baron, V., 2001. Adrenocortical and metabolic responses to ACTH injection in horses: an assessment by salivary cortisol and infrared thermography of the eye. *Can. J. Anim. Sci.* 81, 621 (abstract).
- Cook, N.J., Schaefer, A.L., Church, J.S., 2006. Nutritional therapy modulates stress responses of elk (*Cervus elaphus canadensis*) to removal of velvet antler. *OJVR* 10, 20–25.
- Denham, H.D.C., Bradshaw, J.W.S., Rooney, N.J., 2014. Repetitive behaviour in kennelled domestic dog: stereotypical or not? *Physiol. Behav.* 128, 288–294.
- Döring, D., Roscher, A., Küchenhoff, H., Erhard, M., 2009. Fear-related behavior of dogs in veterinary practice. *Vet. J.* 182, 38–43.
- Emery, N.J., 2000. The eyes have it: the neuroethology, function and evolution of social gaze. *Neurosci. Biobehav. Rev.* 24, 581–604.
- Fallani, G., Prato Previde, E., Valsecchi, P., 2007. Behavioral and physiological responses of guide dogs to a situation of emotional distress. *Physiol. Behav.* 90, 648–655.
- Fonseca, B.P.A., Alves, A.L.G., Nicoletti, J.L.M., Thomassian, A., Hussni, C.A., Mikail, S., 2006. Thermography and ultrasonography in back pain diagnosis of equine athletes. *J. Equine Vet. Sci.* 26, 507–516.
- Gabry, E.K., Chrousos, G., Gold, P.W., 2003. The hypothalamic-pituitary-adrenal (HPA) axis: a major mediator of the adaptive responses to stress. *Neuro-immune Biol.* 3, 379–414.
- Gácsi, M., Vas, J., Topál, J., Miklósi, A., 2013. Wolves do not join the dance: sophisticated aggression control by adjusting to human social signals in dogs. *Appl. Anim. Behav. Sci.* 145, 109–122.
- Hall, C., Kay, R., Yarnell, K., 2014. Assessing ridden horse behaviour: professional judgment and physiological measures. *J. Vet. Behav. Clin. Appl. Res.* 9, 22–29.
- Hennesy, M.B., 2013. Using hypothalamic-pituitary-adrenal measures for assessing and reducing the stress of dogs in shelters: a review. *Appl. Anim. Behav. Sci.* 149, 1–12.
- Hernádi, A., Kis, A., Turcsán, B., Topál, J., 2012. Man's underground best friend: domestic ferrets, unlike the wild forms, show evidence of dog-like social-cognitive skills. *PLoS One* 7, e43267.
- Johnson, E.O., Kamilaris, T.C., Carter, C.S., Calogero, A.E., Gold, P.W., Chrousos, G.P., 1996. The biobehavioral consequences of psychogenic stress in a small, social primate (*Callithrix jacchus jacchus*). *Biol. Psychiatry* 40, 317–337.
- Johnson, S.R., Rao, S., Hussey, S.B., Morley, P.S., Traub-Dargatz, J.L., 2011. Thermographic eye temperature as an index to body temperature in ponies. *J. Equine Vet. Sci.* 31, 63–66.
- Ludwig, N., Gargano, M., Luzzi, F., Carenzi, C., Verga, M., 2007. Technical note: applicability of infrared thermography as a non-invasive measurement of stress in rabbit. *World Rabbit Sci.* 15, 199–206.
- Kataoka, N., Hioki, H., Kaneko, T., Nakamura, K., 2014. Psychological stress activates a dorsomedial hypothalamus-medullary raphe circuit driving brown adipose tissue thermogenesis and hyperthermia. *Cell Metab.* 20, 1–13.
- King, T., Hemsforth, P.H., Coleman, G.J., 2003. Fear of novel and startling stimuli in domestic dogs. *Appl. Anim. Behav. Sci.* 82, 45–64.
- Konok, V., Döka, A., Miklósi, A., 2011. The behavior of the domestic dog (*Canis familiaris*) during separation from and reunion with the owner: a questionnaire and an experimental study. *Appl. Anim. Behav. Sci.* 135, 300–308.
- Koolhaas, J.M., de Boer, S.F., Coppens, C.M., Buwalda, B., 2010. Neuroendocrinology of coping styles: towards understanding the biology of individual variation. *Front. Neuroendocrinol.* 31, 307–321.
- Ogata, N., Kikusui, T., Takeuchi, Y., Mori, Y., 2006. Objective measurement of fear-associated learning in dogs. *J. Vet. Behav. Clin. Appl. Res.* 1, 55–61.
- Oka, T., Oka, K., Hori, T., 2001. Mechanisms and mediators of psychological stress-induced rise in core temperature. *Psychosom. Med.* 63, 476–486.
- Palestrini, C., Prato Previde, E., Spiezio, C., Verga, M., 2005. Heart rate and behavioral responses of dogs in the Ainsworth's Strange Situation: a pilot study. *Appl. Anim. Behav. Sci.* 94, 75–88.
- Pastore, F., Pirrone, F., Balzarotti, F., Faustini, M., Pierantoni, L., Albertini, M., 2011. Evaluation of physiological and behavioral stress-dependent parameters in agility dogs. *J. Vet. Behav. Clin. Appl. Res.* 6, 188–194.
- Pavlidis, I., Eberhardt, N.L., Levine, J.A., 2002. Seeing through the face of deception. *Nature* 415, 35.
- Part, C.E., Kiddie, J.L., Hayes, W.A., Mills, D.S., Neville, R.F., Morton, D.B., Collins, L.M., 2014. Physiological, physical and behavioural changes in dogs (*Canis familiaris*) when kennelled: testing the validity of stress parameters. *Physiol. Behav.* 133, 260–271.
- Romero, L.M., 2010. Fight or Flight responses. In: Breed, M.D., Moore, J. (Eds.), *Encyclopedia of Animal Behavior*. Oxford Academy Press, Oxford, pp. 710–714.
- Schaefer, A.L., Matthews, L.R., Cook, N.J., Webster, J.R., Scott, S.L., 2002. Novel non-invasive measures of animal welfare. In: Proceedings of Animal Welfare and Behavior: From Science to Solution; Joint NAWAC/ISAE Conference, Hamilton, New Zealand.
- Schaefer, A.L., Cook, N.J., Church, J.S., Basarab, J., Perry, B., Miller, C., Tong, A.K.W., 2007. The use of infrared thermography as an early indicator of bovine respiratory disease complex in calves. *Res. Vet. Sci.* 83, 376–384.
- Schenkel, R., 1967. Submission: its features and function in the wolf and dog. *Am. Zool.* 7, 319–329.
- Schwartzkopf-Genswein, K.S., Stookey, J.M., 1997. The use of infrared thermography to assess inflammation associated with hot-iron and freeze branding in cattle. *Can. J. Anim. Sci.* 77, 577–583.
- Smith, W., 2007. *Modern Optical Engineering*. McGraw-Hill, New York.
- Siegel, S., Castellan Jr., N.J., 1988. *Nonparametric Statistics for the Behavioral Sciences*. McGraw-Hill, New York.
- Speakman, J.R., Ward, S., 1998. Infrared thermography: principles and applications. *Zool. Anal. Complex. Sy.* 101, 224–232.
- Stanford, T.L., 1981. Behavior of dogs entering a veterinary clinic. *Appl. Anim. Ethol.* 7, 271–279.
- Stewart, M., 2008. *Non-invasive Measurement of Stress and Pain in Cattle Using Infrared Thermography*. Thesis, PhD in Animal Science, Massey University.
- Stewart, M., Webster, J.R., Schaefer, A.L., Cook, N.J., Scott, S.L., 2005. Infrared thermography as a non-invasive tool to study animal welfare. *Anim. Welfare* 14, 319–325.
- Stewart, M., Webster, J.R., Verkerk, G.A., Schaefer, A.L., Colyn, J.J., Stafford, K.J., 2007. Non-invasive measurement of stress in dairy cows using infrared thermography. *Physiol. Behav.* 92, 520–525.
- Stewart, M., Stafford, K.J., Dowling, S.K., Schaefer, A.L., Webster, J.R., 2008. Eye temperature and heart rate variability of calves disbudged with or without local anaesthetic. *Physiol. Behav.* 93, 789–797.
- Toates, F., 2001. *Biological Psychology: an Integrative Approach*. Pearson Education, Harlow.
- Tod, E., Brander, D., Waran, N., 2005. Efficacy of dog appeasing pheromone in reducing stress and fear related behaviour in shelter dogs. *Appl. Anim. Behav. Sci.* 93, 3–4, 295–308.
- Valera, M., Bartolomé, E., Sánchez, M.J., Molina, A., Cook, N., Schaefer, A., 2012. Changes in eye temperature and stress assessment in horses during show jumping competitions. *J. Equine Vet. Sci.* 32, 827–830.
- Vas, J., Topál, J., Gácsi, M., Miklósi, A., Csányi, V., 2005. A friend or an enemy? Dogs' reaction to an unfamiliar person showing cues of threat and friendliness at different times. *Appl. Anim. Behav. Sci.* 94, 99–115.
- Vas, J., Topál, J., Györi, B., Miklósi, A., 2008. Consistency of dogs' reactions to threatening cues of an unfamiliar person. *Appl. Anim. Behav. Sci.* 112, 331–344.
- Vianna, D.M.L., Carrive, P., 2005. Changes in cutaneous and body temperature during and after conditioned fear to context in the rat. *Eur. J. Neurosci.* 21, 2505–2512.
- Vinkers, C.H., Groenink, L., van Bogaert, M.J.V., Westphal, K.G.C., Kalkman, C.J., van Oorschoot, R., Oosting, R.S., Olivier, B., Korte, S.M., 2009. Stress-induced hyperthermia and infection-induced fever: two of a kind? *Physiol. Behav.* 98, 37–43.
- Yarnell, K., Hall, C., Billett, E., 2013. An assessment of the aversive nature of an animal management procedure (clipping) using behavioral and physiological measures. *Physiol. Behav.* 118, 32–39.

### **2.6.2 Study 3 – “How good is this food? A study on dog emotional responses to a potentially pleasant event using Infra-Red Thermography”**

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#### **Abstract**

Understanding how animals express positive emotions is becoming an interesting and promising area of research in the study of animal emotions and affective experiences.

In the present study, we used infrared thermography in combination with behavioral measures, HR, and HRV to investigate dog emotional responses to a potentially pleasant event: receiving palatable food from the owner.

Nineteen adult pet dogs, 8 females and 11 males, were tested and their eye temperature, heart rate, heart rate variability and behavior were recorded during a 30 minutes test consisting of three 10 min consecutive phases: baseline (Phase 1), positive stimulation through the administration of palatable food treats (Phase 2) and post-feeding condition following the positive stimulation (Phase 3).

Dogs' eye temperature and mean HR significantly increased during the positive stimulation phase compared with both baseline and post-feeding phases, despite a concomitant significant decrease in their level of activity. During the positive stimulation with food, dog engaged in behaviors indicating a state of positive arousal, being focused on food treats and increasing tail wagging. However, there was no evidence of an increase in HRV during Phase 2 compared to the baseline, with both RMSSD and SDNN significantly increasing only in Phase 3, after the positive stimulation occurred.

Overall results point out that IRT may be a useful tool in assessing emotional states in dogs in terms of arousal but fails to discriminate emotional valence, whose interpretation cannot disregard behavioral indexes. The role of HRV in understanding emotional valence and the actual emotional meaning of food treats are also discussed.

*Keywords:* Dog; Positive emotion; Behavior; Infrared thermography; Heart Rate; Heart Rate Variability

#### **Introduction**

Since Darwin's (1872) classic book on “The Expression of emotions in man and animals” considerable research showed that besides humans many animal species express emotions through a

variety of observable signals (Fox, 1970; Kemp & Kaplan, 2013). Emotions can be defined as psychological states occurring when an individual is exposed to specific environmental and/or social stimuli and events, represent an adaptive interface between the individual and its environment, and guide the selection of appropriate behavioral decisions (Scherer, 1984; Dawkins, 2008). Psychological research on humans indicates that emotions have a complex multi-component character and incorporate subjective feelings, physiological activation, motor expressions, cognitive appraisals, and behavioral tendencies (Scherer, 1984, 2005; Niedenthal et al., 2006). This complexity of emotional states makes their investigation in non-human animals a hard challenge. According to one of the current approaches to the study of human emotions (i.e. the dimensional perspective), which is gaining attention even among researchers studying animals (Mendl et al., 2019), emotional states are characterized by at least two main dimensions: arousal (low to high activation) and valence (positive to negative) (Barrett et al., 1999; Russell, 1980). Recently, this two-dimensional model has been promisingly applied to the understanding of the role that emotions play in animal welfare (Désiré et al., 2002; Boissy et al., 2007). Even though most studies, for obvious reasons, focused on emotions induced by distress and negative experiences [Johnson et al., 1992; Veisser & Boissy, 2007; Von Borrell et al., 2007) a growing number of researchers pointed out that animal welfare cannot be conceptualized as the absence of negative emotions but it also entails the presence of positive emotional states (Boissy et al., 2007; Yeates & Main, 2008; Coulon et al., 2015). Therefore, the measurement of positive and negative valence of affective states is important to understand and assess animal emotions, and there is a general agreement that a combination of different behavioral, physiological, and cognitive markers of emotional states is needed for an objective evaluation. In fact, some parameters can be ambivalent and difficult to interpret when considered separately. For example, HR can increase in situation inducing either positive or negative emotional states, since they may reflect a general condition of arousal rather than a difference in valence, that may depend on the context (Palestrini et al., 2005; Boissy et al., 2007; Mendl et al., 2009). Imfeld-Mueller and colleagues (2011) reported that in pigs HR and HRV were not differentially influenced by the valence of the test situation consisting in access to popcorn (positive situation) and in crossing of a black ramp (negative situation). Even behavioral measures are not always easy to interpret (Mendl et al., 2010): lip licking in dogs has previously been explained as a signal of stress (Beerda et al. 1997; 2000) but has recently been related to an increased positive arousal determined by the reunion with the owner after a long period of separation (Rehn & Keeling, 2011). Similarly, self-grooming in dogs can be considered as an index of relaxation and appropriate self-maintenance but can also be associated with an attempt to relieve stress or anxiety (Rooney et al., 2009).

While the literature on positive emotions and affective states in farm animals is rapidly growing (Reefman et al., 2009; Imfeld-Mueller et al., 2011; Sandem et al., 2002; Reefman et al., 2009, 2009<sup>o</sup>; Moe et al., 2012; Boissy & Lee, 2014; Veerbek et al., 2014; Westerath et al., 2014; Briefer et al., 2015; Proctor et al., 2015), the same topic has received little attention in companion animals and in dogs in particular (Burman et al., 2011; McGowan et al., 2014; Khune et al., 2014; Rehn et al., 2014). Dogs' positive affective states have been investigated in female laboratory beagles tested in three different experimental protocols: Burman and colleagues (2011) used the 'cognitive bias test', Rehn and colleagues (2014) used a separation/reunion to a familiar person paradigm and McGowan and colleagues (2014) used a problem solving operant task. In a further recent study, Kuhne and colleagues (2014) evaluated pet dogs' emotional state and behavioral responses to physical human–dog contact by a familiar or unfamiliar person. Taken together these studies provided interesting initial evidence that certain circumstances and events elicit positive emotional states in dogs that can be measured through behavioral (e.g. tail wagging, proximity and contact seeking, gazing, stress signals, vocalizations), physiological (HR and HRV) and endocrine (oxytocin and cortisol) indicators.

The aim of this study was to expand the knowledge of when and how dogs may experience a positive emotional state testing a sample of pet dogs receiving food treats from their owners. We chose to combine behavioral and physiological measurements, including infrared thermography (IRT), a remote and non-invasive technique used to detect changes in peripheral blood flow that has been recently utilized to assess stress and emotions in animals (Moe et al., 2012; Nakayama et al., 2005; Stewart et al., 2007, 2008; Edgar et al., 2011; Kuraoka et al., 2011; Valera et al., 2012; Dai et al., 2015; Travain et al., 2015). Since IRT has been yet scarcely used to explore emotions in animals, and to our knowledge changes in superficial temperature during exposure to a presumably positive situation have never been studied in dogs, we combined IRT with frequently used physiological indicators, heart rate and heart rate variability, which are regarded as a suitable tool to investigate the role of ANS in the modulation of affect and emotion (Boissy et al., 2007; Von Norrell et al., 2007; Reefman et al., 2009a; Zebinke et al., 2011, 2013).

Dogs' eye temperature, heart rate, heart rate variability and behavior were recorded prior (baseline), during (feeding) and after (post-feeding) food treats delivery. Food is considered a positive, rewarding stimulus for animals (Mendl et al., 2010; Boissy et al., 2007; Moe et al., 2012; Veerbek et al., 2014; Briefer et al., 2015; Moe et al., 2009). Dog owners and trainers to reward their dogs often use food and there is evidence that feeding enrichment positively affects behavior in kennel laboratory dogs (Schipper et al., 2008). Therefore, we hypothesized that receiving very palatable food treats by the owner would be a source of positive excitement, determining an increase in HR mainly due to arousal (Valsecchi et al., 2010; Gácsi et al., 2013) and would attract dogs' attention

toward the owner, significantly increasing gazing behavior (Prato-Previde et al., 2014). In addition, if the delivery of food would cause in dogs an emotional state of positive valence we should observe an increase in tail wagging (McGowan et al., 2014) and in HRV (Boissy et al., 2007).

Making predictions on eye temperature changes is difficult, given that the available evidence on changes in temperature under emotional conditions is relative to a variety of body surface areas, tools and species tested with opposite results (comb in hens: Moe et al., 2012; nose in cows: Proctor et al., 2015; eye in dogs: Travain et al., 2015; eye in horses: Dai et al., 2015; nose in macaques: [Nakayama et al., 2005; Kuraoka et al., 2015]). However, in dogs eye temperature correlates with core body temperature (Travain et al., 2015) and thus it is possible that eliciting an attentional state through the delivery of food would determine an increase in eye temperature as result of a general state of arousal.

## **Materials and methods**

### **Subjects**

The subjects were 19 healthy dogs (8 females, 11 males) of different breeds and body size, whose ages ranged from 2 to 11 years (mean = 6.36 years, SD = 2.72 years). The sample included 13 pure-breed dogs (1 Jack Russell Terrier, 2 Australian Kelpies, 1 Border Collie, 1 Irish Setter, 1 Irish Red and White Setter, 4 Labrador Retrievers, 2 Golden Retrievers, 1 Newfoundland) and 6 mixed-breed dogs (1 miniature size, 2 small size, 3 medium size). All the dogs were kept for companionship, lived within the human household and were accustomed to share daily activities with their owner (e.g. travel by car, going to unfamiliar places, encountering unfamiliar humans) and most important for the purpose of the study, which required wearing a chest strap for heart rate recording, they were used to wear the harness. As far as their owners were aware, none of the dogs had ever shown aggression towards a human.

### **Procedure**

The study was conducted at the *Canis sapiens* Lab of the University of Milan (Italy). The test took place in an unfamiliar bare room (3.00 x 5.30 m) equipped with one chair, a carpet and a video camera (Leica Dicomar, Panasonic, Japan) mounted on a tripod. During the test the video camera operator (E.S.C.), the infrared thermography technician (E.H.) and the owner were present. To minimize extraneous noise and disturbance, testing was conducted on weekends over a period of four months. Owners were asked not to feed their dogs for at least four hours prior testing.

On arrival, the human-dog pairs were escorted to a waiting room where the procedure was briefly described to the owners who were asked to provide their written consent to record behavior and to use the collected data according to the national Privacy Law 675/96. To apply the heart rate

monitor (Polar), the dogs were sheared under the right and left armpits for a surface of approximately 10 cm<sup>2</sup>. Then the Polar was fixed to the dog chest by means of a belt (see data collection paragraph for further details). After this manipulation, dogs were allowed to explore freely the waiting room for a period of 5 minutes and they could familiarize with the people present in the room during the test. The test procedure consisted of three consecutive phases in which dogs' behavior, eye temperature, and heart rate were recorded.

Phase 1, Baseline: After the dog and the owner entered the experimental room, the Polar was switched on and the owner was asked to sit on the chair while the dog, on leash, remained quietly close to her/him for 10 minutes; the aim of this phase was to obtain physiological baseline values for each dog.

Phase 2, Feeding: The owner stayed sit and was asked to attract dog's attention showing treats in her/his hands and to give a treat to the dog at an interval of 20 sec. approximately. Treat consisted of 1-gram chicken croquettes (Nature Snack - Mini sandwiches for dog, Ferribiella, Italy). The entire phase lasted 10 minutes and allowed to track possible changes in physiological and behavioral parameters related to the delivery of food treats (i.e. positive stimulation).

Phase 3, Post-feeding: As in Phase 1, the owner remained sit while the dog was quietly close to her/him for 10 minutes to assess the trend of the physiological and behavioral parameters in a neutral situation following the positive stimulation.

### **Behavioral measurements**

Behavioral data were scored from videos using Solomon Coder beta® 15.01.13 (ELTE TTK, Hungary). The ethogram (Table 2.3) consisted of the following behavioral categories: 1. Movement (dynamic or static behavior); 2. Stress/fear related signals (shake off, yawning, nose/lip liking, panting, avoidance); 3. Owner/experimenter directed behavior (gazing owner/experimenter, gazing owner's hand/food, hand sniffing/licking, jump on owner, touching with paw); 4. Environment directed behavior (attention). Furthermore, duration of relaxed tail wagging was recorded assuming it could be an index of a dog positive internal state.

**Table 2.3:** Description and measure of coded behaviors recorded during the test.

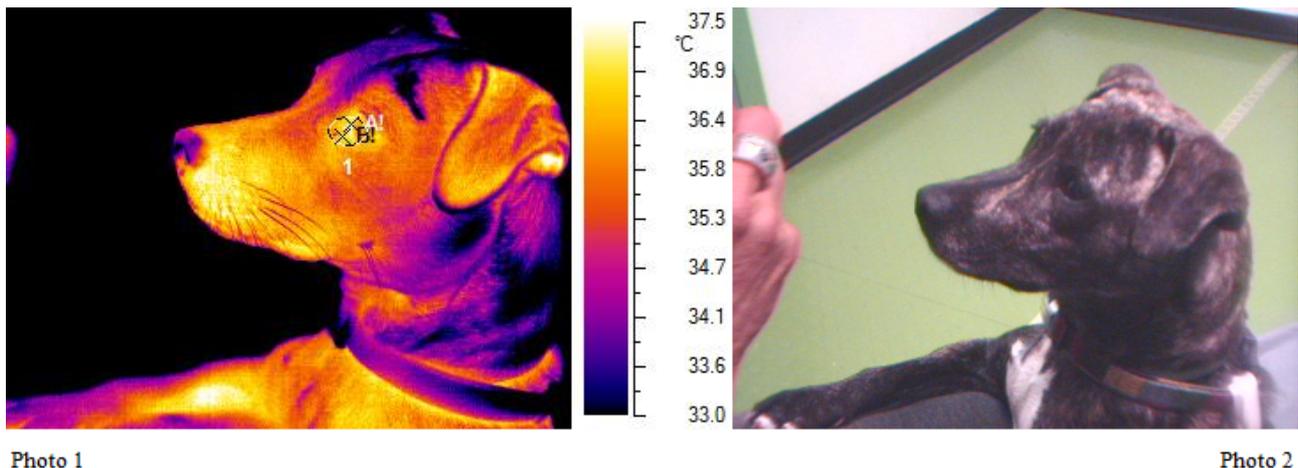
Category	Behavior	Description	Frequency/Duration
Movement	Dynamic	Walking, jumping, or being agitated	D (% on total time)
	Static	Standing still, sitting, or lying down	D (% on total time)
Stress/fear related signals	Shake off	Rapid movements of body shaking	F (events/min)
	Yawning	Intake of breath through a wide open mouth	F (events/min)
	Nose/lip licking	Rapid extension and flicking of the tongue on the nose or between the lips	F (events/min)
	Panting	Rapid breaths in short gasps	D (% on total time)
	Avoidance	Lateral movement of the head and gaze averting	F (events/min)
Owner/experiment directed behaviors	Gazing owner/experimenter	Staring at the owner or at the experimenter	D (% on total time)
	Gazing owner's hand/food	Staring at the owner's hand or at the food held by the owner	D (% on total time)
	Hand sniffing/licking	Sniffing or licking owner's hand, regardless of the presence or absence of the food	D (% on total time)
	Jump on owner	Jumping on the owner	F (events/min)
	Touching with paw	Touching the owner with the paw	D (% on total time)
Environment directed behaviors	Attention	Visual/olfactory exploration of the environment	D (% on total time)
Tail wagging	Tail wagging	Relaxed tail wagging	D (% on total time)

To evaluate whether the thermographic camera directed towards the dogs' muzzle could affect their stress displays (see Travain et al., 2015), during coding, a marker indicating the presence of the thermographic camera accompanied each behavioral element. The dogs' behavior was coded from videos by one of the authors (T.T.) whereas a second independent coder analyzed 32% of the data to assess inter-observer reliability.

### Physiological measurements

The thermographic infrared images were captured by a certified technician (E.H.) using a portable IRT camera (AVIO TVS500® camera, NEC, Japan) with standard optic system, and analyzed with IRT Analyzer Software® (Grayess, FL, USA). To calibrate the camera reflectivity temperature, samples were taken and emissivity was set at 0.97. Several images per dog were collected, to select the images that provided the most optimal operating conditions for analysis (90° angle and 1 m of distance). 982 (per dog: mean = 51.68, SD = 10.83; minimum = 31; maximum = 77) images were analyzed evaluating the emission of eyes lachrymal sites. The maximum temperature for each lachrymal site was determined using an Instantaneous Field of View of 1.68 mm at 1 m of distance,

within an oval area traced around the eye, including the eyeball and approximately 1 cm surrounding the outside of the eyelids. Only images perfectly on focus were used (Figure 2.4). To optimize the accuracy of the thermographic image and to reduce sources of noise, before testing each dog the same image of a Lambert surface was taken to define the radiance emission and to nullify the effect of sunlight or other surface reflections on tested animals, thus controlling for external artefacts (Smith, 2007). Furthermore, the testing environment was air-conditioned and thus temperature and humidity remained constant during the procedure (Travain et al., 2015).



**Figure 2.4.** Thermographic image (photo 1) and corresponding picture (photo 2) of Easy, Staffordshire bullterrier mix, during Phase 2 (feeding). A! is the lacrimal caruncle and the hottest spot on the eye. B! is the second hottest spot on the eye and it is highlighted for control purposes. 1 is the marker for the oval area traced around the eye.

Heart rate data were collected using a Polar® RS800CX human HR monitor (Polar® Electro, Finland). The Polar wearlink strap was positioned around the dog thorax and the size was adjusted to provide a tight but comfortable fit. Farmacare ultrasound transmission gel (Farmacare, Italy) was applied to the 2 electrodes of the Polar® wearlink strap. The electrodes were positioned over the right and left axillary regions. The Polar® watch computer was fixed dorsally to the wearlink strap. The Polar® was set on the R-R interval recording mode and data collection lasted for the whole duration of the experiment. R-R interval data were analyzed using Kubios HRV software (Version 2.1 Biosignal Analysis and Medical Imaging Group, Department of Applied Physics, University of Eastern Finland, Kupio, Finland). Prior to analyses artefacts were removed using Kubios' inbuilt artifact correction features. Heart rate (HR, beats per minute) and HRV parameters were calculated for the central 8 min within each experimental phase. The following time-domain variables were chosen for analysis: mean HR, root mean square of the standard deviation (RMSSD) and standard deviation of R-R intervals (SDNN).

## **Statistical analysis**

The normality and equality of variance of the data (for both physiological and behavioral parameters in each phase) were assessed with the Kolmogorov Smirnov and Levene tests, respectively. Since data were not normally distributed, we performed non-parametric statistical analysis setting alpha at 0.05.

Interobserver reliability for the behavioral categories analyzed was assessed using Spearman correlations and it was significant for all the behaviors, with  $r$  ranging from 0.725 to 0.998. For sake of simplicity only the behaviors used for statistical analysis are reported (dynamic:  $r = 0.880$ ;  $P < 0.001$ ; hand sniffing/licking:  $r = 0.835$ ;  $P < 0.001$ ; tail wagging:  $r = 0.600$ ;  $P = 0.008$ ; attention to the environment:  $r = 0.920$ ; gaze owner:  $r = 0.977$ ;  $P < 0.001$ ).

A preliminary analysis was carried out to detect sex differences in physiological and behavioral parameters using Mann Whitney U test. Since no difference emerged, male and female dogs were pooled for subsequent analysis. Friedman ANOVA for ranks were run to detect differences among phases in dogs' eye temperature, HR and HRV parameters and behaviors with the minimum difference post hoc tests to compare Phase 1 vs. Phase 2 and Phase 2 vs. Phase 3 (Siegel & Castellan, 1988).

All statistical analyses were carried out using SPSS Statistics 22 (IBM, NY, USA)

## **Results**

### **Behavior**

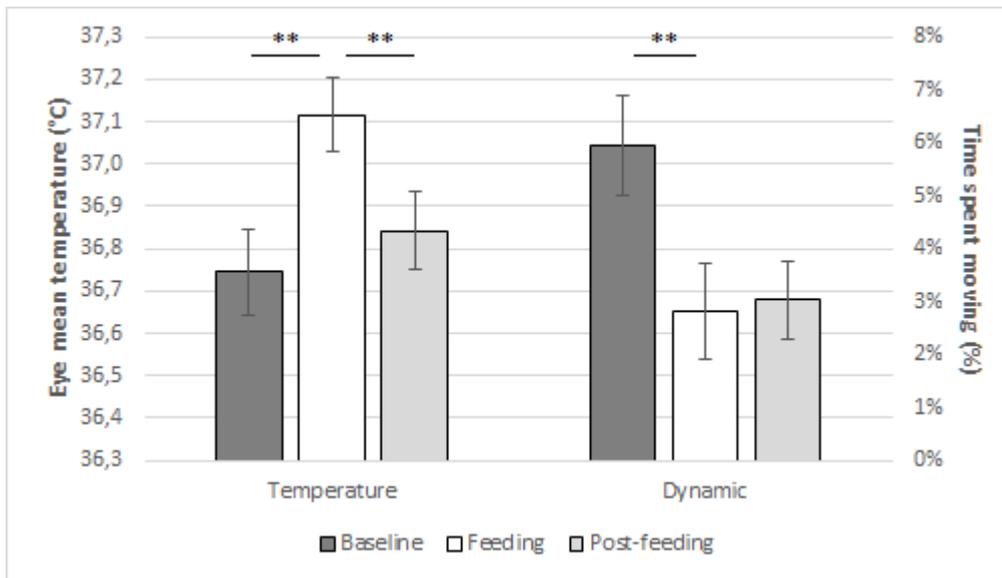
As dogs were kept on leash during the test, their activity was to some extent limited (Table 2.4 for details). In Phase 1, dogs were static most of the time (96%), engaged mainly in visual and/or olfactory exploration of the room (54%) and in gazing toward the camera operators and the owner (15% and 11% respectively). In Phase 2, dogs spent most of the time static (either sitting 38% or standing 35%), gazing at the owner's hand (59%) and sniffing/licking their hands (20%). In Phase 3, dogs behaved very similarly to Phase 1 but showed less attention to the environment (35%) and laid down close to the owner (64%). None of the dogs showed fearful behaviors and postures throughout the test. Statistical analysis was carried out only for behaviors relevant to the purpose of the study.

**Table 2.4:** Mean and SE of frequency and durations of analyzed behaviors in the three phases of the experiment (baseline, feeding and post-feeding) and P value of Friedman T test.

<b>Behavior</b>	<b>Baseline mean ± SE</b>	<b>Feeding mean ± SE</b>	<b>Post-feeding mean ± SE</b>	<b>P Value</b>
Dynamic <sup>b</sup>	6.0 ± 0.9	2.8 ± 0.9	3.0 ± 0.7	<i>P</i> < 0.001
Shake off <sup>a,c</sup>				
Yawning <sup>a,c</sup>	1.49 ± 0.23	0.95 ± 0.22	1.06 ± 0.13	<i>P</i> = 0.016
Nose/lip licking <sup>a,c</sup>				
Panting <sup>a,c</sup>				
Avoidance <sup>c</sup>	0.02 ± 0.01	0.00 ± 0.00	0.00 ± 0.00	Not analyzed
Gazing owner <sup>b</sup>	10.86 ± 2.67	5.29 ± 1.29	16.82 ± 0.16	n.s.
Gazing owner's hand/food <sup>b</sup>	0.00 ± 0.00	59.13 ± 4.81	0.00 ± 0.00	Not analyzed
Hand sniffing/licking <sup>b</sup>	1.05 ± 0.27	20.72 ± 3.84	1.30 ± 0.52	<i>P</i> < 0.001
Jump on owner <sup>c</sup>	0.07 ± 0.06	0.21 ± 0.17	0.01 ± 0.01	n.s.
Touching with paw <sup>b</sup>	0.00 ± 0.00	1.37 ± 0.51	0.00 ± 0.00	Not analyzed
Attention <sup>b</sup>	53.52 ± 4.73	11.74 ± 2.18	34.35 ± 3.85	<i>P</i> < 0.001
Tail wagging <sup>b</sup>	2.61 ± 0.90	9.09 ± 4.33	1.82 ± 0.72	<i>P</i> < 0.001

<sup>a</sup> Behaviors pooled together for purpose of analysis. <sup>b</sup> Behaviors measured as duration (% of total time). <sup>c</sup> Behaviors measured as frequency (events/min).

A significant difference among the three phases emerged in the duration of dynamic behavior (Friedman:  $\chi^2 = 13.053$ ;  $df = 2$ ;  $P < 0.001$ ): dogs' movements significantly decreased in Phase 2 (P1 vs. P2: minimum  $D = 0.831$ ; observed  $D = 1.158$ ;  $P < 0.01$ ; P2 vs P3: minimum  $D = 0.623$ ; observed  $D = 0.421$ ;  $P = n.s.$ ; Figure 2.5).



**Figure 2.5:** Mean eye temperature (°C) and mean percentage of dynamic behavior exhibited by the 19 dogs during the three phases of the experiment (baseline, feeding, post-feeding). Crossing bars represent standard errors. Post hoc results are reported for both temperature and dynamic ( $P < 0.05$  \* and  $P < 0.01$  \*\*).

Dogs significantly focused their attention on the environment in Phase 1 and 3 (Friedman:  $\chi^2 = 22.211$ ;  $df = 2$ ;  $P < 0.001$ ; P1 vs. P2: minimum  $D = 0.831$ ; observed  $D = 1.526$ ;  $P < 0.01$ ; P2 vs. P3: minimum  $D = 0.623$ ; observed  $D = 0.684$ ;  $P < 0.05$ ) and, of course, in Phase 2 their interest was directed to the owners' hand and food. Hand sniffing/licking were significantly higher in Phase 2 than in the other two phases (Friedman:  $\chi^2 = 27.1$ ;  $df = 2$ ;  $P < 0.001$ ; P1 vs. P2: minimum  $D = 0.831$ ; observed  $D = 1.33$ ;  $P < 0.01$ ; P2 vs. P3: minimum  $D = 0.831$ ; observed  $D = 1.38$ ;  $P < 0.01$ ). Gazing owners' hand/food was present only in Phase 2 thus no statistical analysis was carried out. Gazing at the owner face was constant across phases (Friedman:  $\chi^2 = 4.53$ ;  $df = 2$ , n.s.).

The duration of tail wagging changed significantly during the test (Friedman:  $\chi^2 = 7.53$ ;  $df = 2$ ;  $P < 0.001$ ) and it was higher in Phase 2 compared to Phase 3 (P1 vs. P2: minimum  $D = 0.623$ ; observed  $D = 0.58$ ; n.s; P2 vs. P3: minimum  $D = 0.623$ ; observed  $D = 0.68$ ;  $P < 0.05$ ).

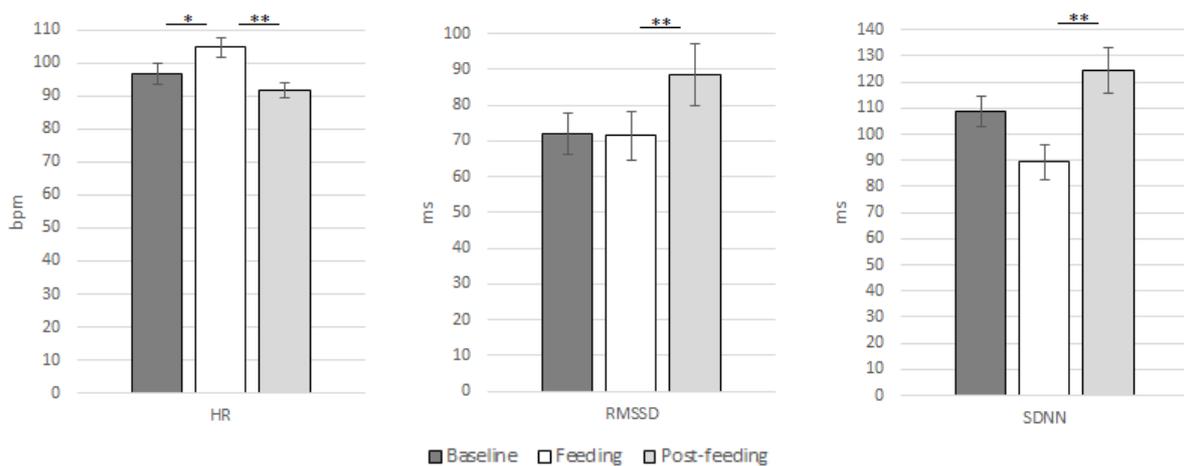
The occurrence of stress signals, although very limited, varied significantly across phases (Friedman:  $\chi^2 = 8.316$ ;  $df = 2$ ;  $P = 0.016$ ): they decreased from Phase 1 to Phase 2 remaining stable in Phase 3 (P1 vs. P2: minimum  $D = 0.831$ ; observed  $D = 0.895$ ;  $P < 0.01$  P2 vs. P3: minimum  $D = 0.623$ ; observed  $D = 0.211$ ; n.s.). In Phase 1, 2 dogs out of 19 showed avoidance behavior (one and two times respectively) when the technician oriented the thermal camera toward them.

### Physiological data

Both eye temperature and heart rate varied significantly across the three phases (Eye temperature, Friedman ANOVA:  $\chi^2 = 24.827$ ;  $df = 2$ ;  $P < 0.001$ ; HR, Friedman ANOVA:  $\chi^2 = 19.26$ ;  $df = 2$ ;  $P < 0.001$ ). Both parameters were higher in Phase 2, when dogs received food treats, than in Phase 1

and 3 (Eye temperature: P 1 vs. P2: minimum D = 0.831; observed D = 1.553; P < 0.01; P2 vs. P3: minimum D = 0.831; observed D = 1.132; P < 0.01; Figure 2; HR: P1 vs P2: minimum D = 0.623; observed D = 0.789; P < 0.05; P2 vs P3: minimum D = 0.831; observed D =1.42; P < 0.01, Figure 3).

HRV parameters, i.e. RMSSD and SDNN, significantly increased in Phase 3 after the food treats delivery period (Friedman ANOVA, RMSSD:  $\chi^2 = 8.00$ ; df = 2; P = 0.018; P1 vs P2: minimum D = 0.831; observed D = 0.105; n.s.; P2 vs P3: minimum D = 0.831; observed D = 0.842, P < 0.01; Friedman ANOVA, SDNN:  $\chi^2 = 6.74$ ; df = 2; P = 0.03; P1 vs P2: minimum D = 0.831; observed D = 0.421; n.s.; P2 vs P3: minimum D = 0.831; observed D = 0.842; P < 0.01; Figure 2.6).



**Figure 2.6.** Mean values of heart rate (bpm), RMSSD and SDNN (ms). Crossing bars represent standard errors. Post hoc results are reported for all parameters (P < 0.05 \* and P < 0.01 \*\*).

Since not all owners respected the established time interval for food delivery (1 croquette every 20 seconds) a correlation analysis among the number of croquettes eaten and eye temperature, HR and HRV parameters was carried out. Dogs received an average of 30.9 croquettes (SD = 13.5) and no significant correlations emerged between the food eaten and any of the physiological parameters considered (see Table 2.6).

**Table 2.6:** Correlations between number of croquettes eaten by dogs and physiological parameters considered.

Test	Phase	Spearman Rho	P Value
Number of croquettes vs Eye temperature	2	0.162	n.s.
Number of croquettes vs Eye temperature	3	-0.110	n.s.
Number of croquettes vs Heart rate	2	-0.062	n.s.
Number of croquettes vs Heart rate	3	0.137	n.s.
Number of croquettes vs RMSSD	2	0.035	n.s.
Number of croquettes vs RMSSD	3	0.128	n.s.
Number of croquettes vs SDNN	2	-0.260	n.s.
Number of croquettes vs SDNN	3	-0.076	n.s.

## Discussion

The aim of the present study was to investigate eye temperature, detected through IRT, as a potential physiological indicator of emotional states in pet dogs. In addition to eye temperature, cardiac activity (i.e. HR and HRV), was monitored to understand the interplay between the sympathetic and the parasympathetic branch of the ANS during a situation we assumed to be of high arousal and of positive valence for dogs: receiving a palatable food reward from the owner. The analysis of dogs' behavior was used to provide an integrative measure of the response to the positive stimulation.

Briefly, despite the dogs' limited physical activity, mean eye temperature and HR increased significantly during feeding (Phase 2), compared with the mean values of both the baseline (Phase 1) and the post-feeding (Phase 3). Furthermore, during feeding dogs showed signs of arousal, remaining focused on the owner and his/her hands, and of positive emotional state wagging their tail. Finally, it emerged that HRV increased in the post-feeding (Phase 3).

The available literature concerning the use of IRT in the study of animal emotions points out that surface body temperature can increase/decrease depending on the investigated species, the anatomical areas and the type of stimulus used, making cross-species comparisons difficult. We found that in dogs' eye temperature increased regardless the presumed valence of the stimulus: in fact in the current study temperature change occurred in relation to food delivery, while in the previous research it occurred in relation to a veterinary visit (Travain et al., 2015). Similarly, nasal temperature decreases in macaques during negative emotional states induced by threatening stimuli (Nakayama et al., 2005; Kuraoka et al., 2011), and in cows when exposed to a positive stimulus, i.e. being stroked by a humans in a preferred body region (Proctor et al., 2015). In hens comb

surface temperature significantly drops in response to anticipation and consumption of a palatable food reward (Moe et al., 2012) but also during exposure to unpleasant events, namely being handled (Cabanac et al., 2000). This contrasting effect on body temperature can be explained in terms of activation of the sympathetic branch of the ANS which induces an increase in core temperature, reflected in the eye, and a decrease in more peripheral body area, such as nose, face and ears, due to vasoconstriction (Stewart et al., 2007; 2008; Vianna & Carrive, 2005; Engert et al., 2014). Overall, these evidences suggest that body surface temperature is an optimal index of a general state of arousal but it does not allow discriminating the positive or negative emotional valence of the stimulus itself. As far as we know our previous study (Travain et al., 2015) and the current one are the first attempts to evaluate the usefulness of IRT to assess dogs' emotional states, thus other experimental evidences are desirable.

The analysis of behavior provides insight that dogs perceived the present situation as positive; in fact they showed neither fear nor avoidance of the IRT camera during the test as happened when dogs were exposed to the stress of a veterinary visit (Travain et al., 2015). On the contrary, during feeding dogs remained sit most of the time, oriented towards their owner and his/her hands, looking at the food and showing an increased tail wagging. Although differences in the duration of tail wagging were significant only between Phase 2 and 3, but not between Phase 1 and 2, it is worth noting that 6 out of 19 dogs never showed tail wagging even though only two of them had very short tail. Removing these dogs from the analysis would result in a significant increase of this behavior also between Phase 1 and 2. McGowan and colleagues (2014) showed that dogs facing a problem-solving task under their control had a more intense emotional response, expressed as frequency of tail wags, when the reward was food rather than contact with a conspecific and suggested that tail wagging can be used as an indicator of a positive affective state in dogs. In our opinion, tail wagging is an interesting behavioral index to assess emotional states in dogs (see also Siniscalchi et al., 2013), but breed (in our sample the most wagging dogs were 3 Labrador retriever and 1 Golden retriever), temperament and motivation are all factors that may affect its expression and thus further studies would be beneficial.

A huge body of evidence in many animal species and in humans demonstrated that HR is linked to emotional arousal during situations of both positive and negative valence for the individual (Palestrini et al., 2005; Selye et al., 1976; Randall et al., 1985; Aureli et al., 1999; Fallani et al., 2007; Wascher et al 2008). As expected, in Phase 2 (feeding) there was a significant rise in dogs' mean HR due to the activation of the sympathetic branch of the ANS (Appelhans & Luecken, 2006). As Zebunke and colleagues (2011) pointed out, changes in the sympathetic system represent the arousal dimension of the affect but they are not useful to investigate the hedonic value of the stimulus (valence). Recent evidences suggested that the analysis of the heart rate variability, and in

particular of the cardiac vagal tone, is a potential tool to measure the valence dimension of emotions (Boissy et al., 2007; Reefmann et al., 2009; Zebunke et al., 2013; Bergamasco et al., 2010).

The SDNN estimates the overall HRV and therefore includes the contribution of both branches of the autonomic nervous system to HR variations: it measures the state of balance between sympathetic and parasympathetic activities of the heart and is a good index of the long term variability (Von Borrell et al., 2007). RMSSD focuses on high frequency, short-term variations of HR, which are mainly due to the activity of the parasympathetic nervous system. Among the HRV parameters, we analyzed RMSSD (short-term variability) and SDNN (long-term variability). In the present study, we hypothesized that the rewarding nature of the food would have had a hedonic value for dogs and consequently receiving good food treats would have resulted in an increase in the HRV parameters, namely RMSSD and SDNN. Data analysis showed that both RMSSD and SDNN remained unvaried between the first two phases, indicating that the balance between the two branches of autonomous system did not change when dogs received food at the rate of 1 piece every 20 s. Nevertheless, we observed a change in the total HR variability during the post-feeding phase, when both RMSSD and SDNN increased. In the final phase the dogs did not receive any more food, relaxed themselves lying down on the carpet at the owner foot, this indicates that vagal tone had a predominant effect in the regulation of the cardiac activity (Von Borrell et al., 2007). However, it is unclear whether the observed increase in vagal tone indicates a positive affective state determined by the ‘contentment’ of having received very palatable food ‘for free’ (hedonic value of the experience), or is simply due to the end of the stimulation and thus to a decrease in arousal, or is the result of the combination of the two factors.

The evidence available in the canine literature is of limited help in discussing present results due to the heterogeneity of experimental protocols, HRV parameters measured and results obtained. Bowman and colleagues (2015) exposed dogs living in a rescue center to an environmental enrichment (i.e. classical music) for one week in order to reduce the stress of living in a shelter. The authors observed a decrease in HR and an increase in HRV (e.g. RMSSD and SDNN) in the first day of the introduction of this enrichment. The observed cardiac changes were accompanied by behavioral modification indicating a reduced stress: dogs laid down more and vocalized less.

In a protocol aimed at investigating the effects of human-dog physical contact on dogs’ behavior and cardiac activity it was demonstrated that being petted by a familiar and an unfamiliar person in different areas of the body induced different changes in HR and HRV (Kuhne et al., 2014). In particular, HR increased and RMSSD decreased compared to the baseline values, but cardiac response differed significantly between the dog groups: HR increment was stronger in the familiar group, while RMSSD decrement was stronger in the unfamiliar group. Compared to baseline

values, SDNN either increased or decreased during the sequence of petting but the authors neither analysed nor discussed this result.

Gásci and colleagues (Gásci et al., 2013) investigated the relationship between the behavioural and cardiac response in dogs while being approached by a threatening stranger in separation vs. in presence of the owner measuring HR and SDNN. They found that in reactive dogs (i.e. animals that showed stress vocalization to the separation from the owner and growled/barked to the stranger) the absence of the owner did not affect the mean HR but increased the HRV, while the approach of the threatening stranger determined a rise in HR and a decrease in SDNN to the baseline values but only when the owner was present. Finally, Maros and colleagues (2008) found that in dogs separated from their owner, but in the presence of the experimenter, mean HR did not change and HRV (i.e. SDNN) increased if the experimenter ceased to pet the dog. In the same study, the authors also showed that being oriented to the favorite toy for 40 s (i.e. a ball) did not affect the mean HR but determined an increase in the SDNN. In these two last studies, changes in HR and HRV were generically interpreted in terms of stress response and attention, without detailing the interplay between the two branches of the ANS. In contrast to the results of Maros and colleagues (2008), in our study dogs' orientation toward the owner and the food determined an increase HR and had no effect on the SDNN that increased only when the dogs' state of attention ended.

In sum, our data clearly showed that variations in HR and in eye temperature detected through IRT are not sufficient to separate the arousal and the valence dimensions of emotions. The analysis of HRV could offer interesting insight for the evaluation of the valence of emotional states but presently it still requires further investigation due to the ambiguous results available in the literature. Furthermore, recognition and validation of specific behavioral pattern linked to positive and negative experiences are crucial to understand dogs' emotional states.

## **Conclusions**

Our study is the first looking at eye temperature in dogs as a measure of positive emotional states and results showed that IRT is suitable to detect in a non-invasive way a state of arousal but not to assess the hedonic values of a stimulus, unless combined with behavioral indicators. Although HR and HRV were recorded to validate the use of the IRT and to disentangle the two dimensions of the affective response (i.e. arousal and valence), our results confirm that HR is sensitive to the arousal dimension, but suggest that further investigation is needed to evaluate the role of HRV in assessing valence and to understand why we found an HRV increase only when the positive stimulation ended. The administration of palatable food per se may not be the best protocol to elicit an emotion with a positive valence, a paradigm of anticipation and consumption of food reward, successfully used with other species, could be a future development of this research.

## 2.7 Chapter conclusions

Since Darwin's hypothesis on the phylogenetic continuity of emotional life across animal species, research has provided considerable evidences that non-human animals, at least mammals, can feel and express emotions through a variety of signals, using both vocal and visual channels. Moreover, it has been underlined the existence of a common structure among animals vocalization, which accounts for an evolutionary continuum between human and animal emotions. On the contrary, visual signals have a greater variation across species, due to morphological differences in faces and bodies, and our knowledge about their relevance in inter-specific emotions recognition is still limited.

Facial expressions play a crucial role in human emotional communication, and their recognition is influenced by factors such as empathy and gender; however research on inter-specific recognition of facial expression of emotions is scarce and evidences about the role of expertise are inconsistent.

The dog (*Canis familiaris*) represents a particularly interesting species to investigate the role of these variables in recognizing non-human animal emotions: in fact, dogs have a long history of domestication, which might have favoured convergent evolution of emotional communication in dogs and humans; moreover people have different levels of experience with dogs (ranging from no direct experience to high expertise in dog behaviour) and different attitudes towards these animals.

Using photographs of a dog's facial expressions validated in a previous study, in Study 1 my colleagues and I investigated people's ability to recognize in dogs the six basic emotions identified by Ekman in humans (happiness, fear, sadness, disgust, surprise and anger) and a neutral expression. Results pointed out that even people with a high expertise with dogs behaviour had some difficulties in recognizing the dog's emotions, showing a quite a low performance in the recognition of sadness, disgust and most neutral and anger facial expressions. Moreover, we found a significant effect of experience on the recognition of fear and surprise, which were better identified by people with high expertise in dog behaviour; on the contrary, anger was better identified by individuals without any experience with dogs than by experts, who, in turn, confused it with fear, likely in the attempt to find an explanation for aggressiveness. Despite the results from studies on humans' emotions recognition, we found that empathy and gender had no significant effect on the recognition of dog's emotions.

Our results are in line with prior studies suggesting an experience-dependent mechanism for inter-specific emotion recognition, at least with regard to some emotional states, and are also consistent with studies that highlighted the limits of using only behavioural cues in the assessment of dog emotions and welfare; in fact, their reliability may be poor and sometimes behaviours are not easy to interpret.

For this reason, and given the growing interest in the study of dog emotional communication and welfare, in Study 2 and 3 we examined the possibility to use a novel, non-invasive technique, namely the Infra-Red Thermography, to detect both negative and positive emotions in dogs, combining it with behavioural and traditional physiological measures (heart rate and heart rate variability). Results showed that IRT allows to detect in a non-invasive way a state of arousal but not to assess the emotional valence unless combined with behavioral indicators. Although HR and HRV were recorded in Study 2 to validate the use of the IRT and to disentangle the two dimensions of the affective response (i.e., arousal and valence), our results confirm that HR is sensitive to the arousal dimension, but suggest that further investigation is needed to evaluate the role of HRV in assessing emotional valence in animals and in particular in dogs.

## References

- Abrantes, R., 1987. The expression of emotions in man and canid. *Journal of Small Animals Practice* 28, 1030–1036.
- Andrew, R.J., 1963. Evolution of facial expression. *Science* 142, 1034.
- Appelhans, B. M., & Luecken, L. J. (2006). Heart rate variability as an index of regulated emotional responding. *Review of general psychology*, 10(3), 229.
- Ascione, F. R. (1992). Enhancing children's attitudes about the humane treatment of animals: Generalization to human-directed empathy. *Anthrozoös*, 5(3), 176-191.
- Ascione, F. R., & Weber, C. V. (1996). Children's attitudes about the humane treatment of animals and empathy: One-year follow up of a school-based intervention. *Anthrozoös*, 9(4), 188-195.
- Aubin T (1991) Why do distress calls evoke interspecific responses? An experimental study applied to some species of birds. *Behavioural Process* 23: 103–111.
- Aureli, F., Preston, S. D., & de Waal, F. (1999). Heart rate responses to social interactions in free-moving rhesus macaques (*Macaca mulatta*): a pilot study. *Journal of Comparative Psychology*, 113(1), 59.
- Baron-Cohen, S. (2011). *The science of evil: On empathy and the origins of cruelty*. Basic books.
- Baron-Cohen S and Wheelwright S 2004 The Empathy Quotient: an investigation of adults with Asperger Syndrome or High Functioning Autism, and normal sex difference. *Journal of Autism and Developmental Disorders* 34 (2): 163-175
- Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y., & Plumb, I. (2001). The “Reading the Mind in the Eyes” test revised version: A study with normal adults, and adults with Asperger syndrome or high-functioning autism. *Journal of child psychology and psychiatry*, 42(2), 241-251.
- Baron-Cohen, S., Wheelwright, S., & Jolliffe, A. T. (1997). Is there a " language of the eyes"? Evidence from normal adults, and adults with autism or Asperger syndrome. *Visual Cognition*, 4(3), 311-331.
- Barrett, L. F., Lane, R. D., Sechrest, L., & Schwartz, G. E. (2000). Sex differences in emotional awareness. *Personality and Social Psychology Bulletin*, 26(9), 1027-1035.
- Barrett, L. F., & Russell, J. A. (1999). The structure of current affect controversies and emerging consensus. *Current Directions in Psychological Science*, 8(1), 10-14.
- Bateson, M., and Matheson, S.M. (2007). Performance on a categorisation task suggests that removal of environmental enrichment induces ‘pessimism’ in captive European starlings (*Sturnus vulgaris*). *Animal Welfare* 16, 33–36.
- Batty, M., & Taylor, M. J. (2006). The development of emotional face processing during childhood. *Developmental science*, 9(2), 207-220.

- Beerda, B., Schilder, M. B., van Hooff, J. A., de Vries, H. W., & Mol, J. A. (1998). Behavioural, saliva cortisol and heart rate responses to different types of stimuli in dogs. *Applied Animal Behaviour Science*, 58(3), 365-381.
- Belin, P., Fecteau, S., Charest, I., Nicastro, N., Hauser, M. D., & Armony, J. L. (2008). Human cerebral response to animal affective vocalizations. *Proceedings of the Royal Society of London B: Biological Sciences*, 275(1634), 473-481.
- Beerda B, Schilder MBH, Van Hooff JARAM, De Vries HW. Manifestations of chronic and acute stress in dogs. *Applied Animal Behaviour Sciences* 1997; 52: 307–319.
- Beerda B, Schilder MBH, Van Hooff JARAM, De Vries HW, Mol J a. Behavioural and hormonal indicators of enduring environmental stress in dogs. *Animal Welfare*, 2000; 9: 49–62.
- Bergamasco, L., Osella, M. C., Savarino, P., Larosa, G., Ozella, L., Manassero, M., ... & Re, G. (2010). Heart rate variability and saliva cortisol assessment in shelter dog: Human–animal interaction effects. *Applied animal behaviour science*, 125(1), 56-68.
- Bloom, T., & Friedman, H. (2013). Classifying dogs'(Canis familiaris) facial expressions from photographs. *Behavioural processes*, 96, 1-10.
- Boissy, A., Arnould, C., Chaillou, E., Désiré, L., Duvaux-Ponter, C., Greiveldinger, L., ... & Veissier, I. (2007a). Emotions and cognition: a new approach to animal welfare. *Animal Welfare*, 16 (Supplement 1), 37-43.
- Boissy, A., & Lee, C. (2014). How assessing relationships between emotions and cognition can improve farm animal welfare. *Rev. sci. tech. Off. int. Epiz*, 33(1), 103-110.
- Boissy, A., Manteuffel, G., Jensen, M. B., Moe, R. O., Spruijt, B., Keeling, L. J., ... & Aubert, A. (2007). Assessment of positive emotions in animals to improve their welfare. *Physiology & Behavior*, 92(3), 375-397.
- Bolwing N. (1962) Facial expression in primates with remarks on a parallel development in certain carnivores (a preliminary report on work in progress). *Behaviour*, XXII: 167-192.
- Boone, R. T., & Buck, R. (2003). Emotional expressivity and trustworthiness: The role of nonverbal behavior in the evolution of cooperation. *Journal of Nonverbal Behavior*, 27(3), 163-182.
- Borchelt, P. 1983. Aggressive behavior of dogs kept as companion animals: Classification and influence of sex, reproductive status and breed *Applied Animal Ethology*, 10, (1–2), Pages 45–61.
- Bouwknicht, J. A., Olivier, B., & Paylor, R. E. (2007). The stress-induced hyperthermia paradigm as a physiological animal model for anxiety: a review of pharmacological and genetic studies in the mouse. *Neuroscience & Biobehavioral Reviews*, 31(1), 41-59.
- Bowman, A., Scottish, S., Dowell, F. J., & Evans, N. P. (2015). 'Four Seasons' in an animal rescue centre; classical music reduces environmental stress in kennelled dogs. *Physiology & behavior*, 143, 70-82.
- Boissy, A., Arnould, C., Chaillou, E., Désiré, L., Duvaux-Ponter, C., Greiveldinger, L., ... & Veissier, I. (2007). Emotions and cognition: a new approach to animal welfare. *Animal Welfare*, 16 (Supplement 1), 37-43.

- Boissy, A., Manteuffel, G., Jensen, M. B., Moe, R. O., Spruijt, B., Keeling, L. J., ... & Aubert, A. (2007). Assessment of positive emotions in animals to improve their welfare. *Physiology & Behavior*, 92(3), 375-397.
- Briefer, E. F., Tettamanti, F., & McElligott, A. G. (2015). Emotions in goats: mapping physiological, behavioural and vocal profiles. *Animal Behaviour*, 99, 131-143.
- Burman, O., McGowan, R., Mendl, M., Norling, Y., Paul, E., Rehn, T., & Keeling, L. (2011). Using judgement bias to measure positive affective state in dogs. *Applied Animal Behaviour Science*, 132(3), 160-168.
- Cabanac, M., & Aizawa, S. (2000). Fever and tachycardia in a bird (*Gallus domesticus*) after simple handling. *Physiology & behavior*, 69(4), 541-545.
- Coulon M, Nowak R, Peyrat J, Chandèze H, Boissy A, Boivin X. Do Lambs Perceive Regular Human Stroking as Pleasant? Behavior and Heart Rate Variability Analyses. *PLoS One* 2015; 10: e0118617.
- Dai, F., Cogi, N. H., Heinzl, E. U. L., Dalla Costa, E., Canali, E., & Minero, M. (2015). Validation of a fear test in sport horses using infrared thermography. *Journal of Veterinary Behavior: Clinical Applications and Research*, 10(2), 128-136.
- Daly, B., & Suggs, S. (2010). Teachers' experiences with humane education and animals in the elementary classroom: implications for empathy development. *Journal of Moral Education*, 39(1), 101-112.
- Darwin, C., (1872). *The expression of the emotions in man and animals*. London, Murray.
- Dawkins MS (2008). The science of animal suffering. *Ethology*, 114: 937–945.
- Decety, J., & Jackson, P. L. (2004). The functional architecture of human empathy. *Behavioral and cognitive neuroscience reviews*, 3(2), 71-100.
- De Keuster, T., Lamoureux, J., Kahn, A. 2006. Epidemiology of dog bites: a Belgian experience of canine behavior and public health concerns. *Veterinary Journal*, 172, 482-7.
- Denham, H. D., Bradshaw, J. W., & Rooney, N. J. (2014). Repetitive behaviour in kennelled domestic dog: Stereotypical or not?. *Physiology & behavior*, 128, 288-294.
- Désiré, L., Boissy, A., & Veissier, I. (2002). Emotions in farm animals: a new approach to animal welfare in applied ethology. *Behavioural processes*, 60(2), 165-180.
- Döring, D., Roscher, A., Scheipl, F., Küchenhoff, H., Erhard, M., 2009. Fear-related behavior of dogs in veterinary practice. *Veterinary Journal*, 182, 38e43.
- Edgar, J. L., Lowe, J. C., Paul, E. S., & Nicol, C. J. (2011). Avian maternal response to chick distress. *Proceedings of the Royal Society of London B: Biological Sciences*, rspb20102701.
- Ekman, P., 1993. Facial expression and emotion. *American Psychologist* 48, 384–392.

- Ekman, P., 2003. *Emotions revealed: recognizing faces and feelings to improve communication and emotional life*. New York: Henry Holt and Company.
- Ekman, P., & Cordaro, D. (2011). What is meant by calling emotions basic. *Emotion Review*, 3(4), 364-370.
- Ekman, P., & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of personality and social psychology*, 17(2), 124.
- Ekman, P., Sorenson, E. R., & Friesen, W. V. (1969). Pan-cultural elements in facial displays of emotion. *Science*, 164(3875), 86-88.
- Ellingsen, K., Zanella, A. J., Bjerkås, E., & Indrebø, A. (2010). The relationship between empathy, perception of pain and attitudes toward pets among Norwegian dog owners. *Anthrozoös*, 23(3), 231-243.
- Engert, V., Merla, A., Grant, J. A., Cardone, D., Tusche, A., & Singer, T. (2014). Exploring the use of thermal infrared imaging in human stress research. *PloS one*, 9(3), e90782.
- Fallani, G., Previde, E. P., & Valsecchi, P. (2007). Behavioral and physiological responses of guide dogs to a situation of emotional distress. *Physiology & behavior*, 90(4), 648-655.
- Fichtel, C. (2004). Reciprocal recognition of sifaka (*Propithecus verreauxi verreauxi*) and redfronted lemur (*Eulemur fulvus rufus*) alarm calls. *Animal cognition*, 7(1), 45-52.
- Fox, M. W., 1970. A comparative study of the development of facial expressions in canids: wolf, coyote, and foxes. *Behaviour* 36, 4–73.
- Freed, P. J., & Mann, J. J. (2007). Sadness and loss: Toward a neurobiopsychosocial model. *American Journal of Psychiatry*, 164(1), 28-34.
- Frith, C. D., & Frith, U. (2007). Social cognition in humans. *Current Biology*, 17(16), R724-R732.
- Gácsi, M., Maros, K., Sernkvist, S., Faragó, T., & Miklósi, Á. (2013). Human analogue safe haven effect of the owner: behavioural and heart rate response to stressful social stimuli in dogs. *PloS one*, 8(3), e58475.
- Galac, S; Knol, B W 1997. Fear-Motivated Aggression in Dogs: Patient Characteristics, Diagnosis and Therapy. *Animal Welfare*, Volume 6, Number 1, February 1997, pp. 9-15(7)
- Gaspar, A. (2006). Universals and individuality in facial behavior—past and future of an evolutionary perspective. *Acta ethologica*, 9(1), 1-14.
- Griffiths, P. E. (2003). III. Basic Emotions, Complex Emotions, Machiavellian Emotions. *Royal Institute of Philosophy Supplement*, 52, 39-67.
- Gross, T. F. (2004). The perception of four basic emotions in human and nonhuman faces by children with autism and other developmental disabilities. *Journal of Abnormal Child Psychology*, 32(5), 469-480.

- Hall, C., Kay, R., & Yarnell, K. (2014). Assessing ridden horse behavior: professional judgment and physiological measures. *Journal of Veterinary Behavior: Clinical Applications and Research*, 9(1), 22-29.
- Hall, J. A. (1978). Gender effects in decoding nonverbal cues. *Psychological bulletin*, 85(4), 845.
- Hall, J.A., Matsumoto, D., 2004. Gender differences in judgments of multiple emotions from facial expressions. *Emotion* 4, 201–206.
- Harding, E.J., Paul, E.S., and Mendl, M. (2004). Cognitive bias and affective state. *Nature* 427, 312.
- Hare, B., Brown, M., Williamson, C., & Tomasello, M. (2002). The domestication of social cognition in dogs. *Science*, 298(5598), 1634-1636.
- Hare, B., & Tomasello, M. (2005). Human-like social skills in dogs?. *Trends in cognitive sciences*, 9(9), 439-444.
- Harris, C. R., & Prouvost, C. (2014). Jealousy in dogs. *PlosOne*, 9 (7), e94597
- Hennessy, M. B. (2013). Using hypothalamic–pituitary–adrenal measures for assessing and reducing the stress of dogs in shelters: A review. *Applied Animal Behaviour Science*, 149(1), 1-12.
- Hess, U., & Thibault, P. (2009). Darwin and emotion expression. *American Psychologist*, 64(2), 120.
- Imfeld-Mueller, S., Van Wezemaal, L., Stauffacher, M., Gygax, L., & Hillmann, E. (2011). Do pigs distinguish between situations of different emotional valences during anticipation?. *Applied Animal Behaviour Science*, 131(3), 86-93.
- Izard, C.E., 1971. *The Face of Emotion*. Appleton-Century-Crofts, New York.
- Izard, C.E. (1992). Basic emotions, relations among emotions, and emotion-cognition relations. *Psychological Review*, 99, 561-565.
- Johnson, E. O., Kamilaris, T. C., Chrousos, G. P., & Gold, P. W. (1992). Mechanisms of stress: a dynamic overview of hormonal and behavioral homeostasis. *Neuroscience & Biobehavioral Reviews*, 16(2), 115-130.
- Kemp C, Kaplan G. Facial expressions in common marmosets (*Callithrix jacchus*) and their use by conspecifics. *Animal Cognition* 2013; 16: 773–788.
- Kohler, C.G., Turner, T.T., Bilker, W.B., Brensinger, C., Siegel, S.J., Kanas, S.J., Gur, R.E., Gur, R.C., 2003. Facial emotion recognition in schizophrenia: intensity effects and error pattern. *American Journal of Psychiatry* 160, 1168–1174.
- Kohler, C. G., Turner, T., Stolar, N. M., Bilker, W. B., Brensinger, C. M., Gur, R. E., & Gur, R. C. (2004). Differences in facial expressions of four universal emotions. *Psychiatry research*, 128(3), 235-244.

- Konok, V., Nagy, K., & Miklósi, Á. (2015). How do humans represent the emotions of dogs? The resemblance between the human representation of the canine and the human affective space. *Applied Animal Behaviour Science*, 162, 37-46.
- Kosson, D. S., Suchy, Y., Mayer, A. R., & Libby, J. (2002). Facial affect recognition in criminal psychopaths. *Emotion*, 2(4), 398.
- Kuhne, F., Höbner, J. C., & Struwe, R. (2014). Behavioral and cardiac responses by dogs to physical human–dog contact. *Journal of Veterinary Behavior: Clinical Applications and Research*, 9(3), 93-97.
- Kuhne, F., Höbner, J. C., & Struwe, R. (2014a). Emotions in dogs being petted by a familiar or unfamiliar person: Validating behavioural indicators of emotional states using heart rate variability. *Applied Animal Behaviour Science*, 161, 113-120.
- Kuraoka, K., & Nakamura, K. (2011). The use of nasal skin temperature measurements in studying emotion in macaque monkeys. *Physiology & behavior*, 102(3), 347-355.
- Lazarus RS. *Emotion and adaptation*. New York: Oxford University Press; 1991.
- Lawrence, E. J., Shaw, P., Baker, D., Baron-Cohen, S., & David, A. S. (2004). Measuring empathy: reliability and validity of the Empathy Quotient. *Psychological medicine*, 34(05), 911-920.
- Lee, E., Kang, J.I., Park, I.H., Kim, J.J., An, S.K., 2008. Is a neutral face really evaluated as being emotionally neutral? *Psychiatric Research*, 157, 77–85.
- Linnankoski, I., Laasko, M.L., Leinonen, L., 1994. Recognition of emotions in macaque vocalizations by children and adults. *Language and Communication* 14,183-192.
- Ludwig, N., Gargano, M., Luzi, F., Carenzi, C., & Verga, M. (2010). Technical note: Applicability of infrared thermography as a non invasive measurements of stress in rabbit. *World Rabbit Science*, 15(4), 199-206.
- Maros, K., Dóka, A., & Miklósi, Á. (2008). Behavioural correlation of heart rate changes in family dogs. *Applied Animal Behaviour Science*, 109(2), 329-341.
- Marshall-Pescini S., Valsecchi P., Prato Previde E., 2009. Good or bad? Children’s and adults’ evaluation of dogs’ facial expression. *Journal of Veterinary Behavior: Clinical Applications and Research*, 4: 105.
- McComb, K., Taylor, A. M., Wilson, C., & Charlton, B. D. (2009). The cry embedded within the purr. *Current Biology*, 19(13), R507-R508.
- McGowan, R. T., Rehn, T., Norling, Y., & Keeling, L. J. (2014). Positive affect and learning: exploring the “Eureka Effect” in dogs. *Animal cognition*, 17(3), 577-587.
- Meints, K., Racca, A., & Hickey, N. (2010). Child-dog misunderstandings: children misinterpret dogs’ facial expressions. In Proceedings of the 2nd Canine Science Forum (Vol. 99).
- Mendl, M., Brooks, J., Basse, C., Burman, O., Paul, E., Blackwell, E., and Casey, R. (2010). Dogs showing separation-related behaviour exhibit a ‘pessimistic’ cognitive bias. *Current Biology* 20, R839–R840.

- Mendl, M., Burman, O. H., & Paul, E. S. (2010a). An integrative and functional framework for the study of animal emotion and mood. *Proceedings of the Royal Society of London B: Biological Sciences*, 277(1696), 2895-2904.
- Mendl, M., Burman, O. H., Parker, R. M., & Paul, E. S. (2009). Cognitive bias as an indicator of animal emotion and welfare: emerging evidence and underlying mechanisms. *Applied Animal Behaviour Science*, 118(3), 161-181.
- Meyer, I., Forkman, B., & Paul, E. S. (2014). Factors affecting the human interpretation of dog behavior. *Anthrozoös*, 27(1), 127-140.
- Merola, I., Prato Previde E., Lazzaroni, M., Marshall-Pescini S. 2013. Dogs' comprehension of referential emotional expressions: familiar people and familiar emotions are easier, *Animal Cognition*, 17 (2), 373-385.
- Merten, J., 2005. Culture, gender and the recognition of the basic emotions, *Psychologia* 48(4), 306–316.
- Meyer, I., Forkman, B., & Paul, E. S. (2014). Factors affecting the human interpretation of dog behavior. *Anthrozoös*, 27(1), 127-140.
- Miklósi, Á., Topál, J., Csányi, V. 2007. Big thoughts in small brains? Dogs as a model for understanding human social cognition. *NeuroReport*, 18: 467-471.
- Miklósi, Á. 2009. Evolutionary approach to communication between humans and dogs. *Veterinary Research Communications*, 33: S53–S59.
- Moe, R. O., Nordgreen, J., Janczak, A. M., Spruijt, B. M., Zanella, A. J., & Bakken, M. (2009). Trace classical conditioning as an approach to the study of reward-related behaviour in laying hens: a methodological study. *Applied Animal Behaviour Science*, 121(3), 171-178.
- Moe, R. O., Stubbsjøen, S. M., Bohlin, J., Flø, A., & Bakken, M. (2012). Peripheral temperature drop in response to anticipation and consumption of a signaled palatable reward in laying hens (*Gallus domesticus*). *Physiology & behavior*, 106(4), 527-533.
- Molnár, C., Pongrácz, P., Dóka, A., & Miklósi, A. (2006). Can humans discriminate between dogs on the base of the acoustic parameters of barks?. *Behavioural processes*, 73(1), 76-83.
- Molnár, C., Pongrácz, P., & Miklósi, A. (2010). Seeing with ears: Sightless humans' perception of dog bark provides a test for structural rules in vocal communication. *The Quarterly Journal of Experimental Psychology*, 63(5), 1004-1013.
- Morris, P. H., Doe, C., & Godsell, E. (2008). Secondary emotions in non-primate species? Behavioural reports and subjective claims by animal owners. *Cognition and emotion*, 22(1), 3-20.
- Morton E.S. (1977). On the occurrence and significance of motivation-structural rules in some bird and mammal sounds. *American Naturalist*, 111, 855-869.
- Nakayama, K., Goto, S., Kuraoka, K., & Nakamura, K. (2005). Decrease in nasal temperature of rhesus monkeys (*Macaca mulatta*) in negative emotional state. *Physiology & behavior*, 84(5), 783-790.

- Nelson, N. L., & Russell, J. A. (2011). Preschoolers' use of dynamic facial, bodily, and vocal cues to emotion. *Journal of experimental child psychology*, 110(1), 52-61.
- Nesse, R. M. (1990). Evolutionary explanations of emotions. *Human nature*, 1(3), 261-289.
- Nicastro, N., & Owren, M. J. (2003). Classification of domestic cat (*Felis catus*) vocalizations by naive and experienced human listeners. *Journal of Comparative Psychology*, 117(1), 44.
- Nicoll, K., Trifone, C., & Samuels, W. E. (2008). An in-class, humane education program can improve young students' attitudes toward animals. *Society & Animals*, 16(1), 45-60.
- Niedenthal, P. M., Krauth-Gruber, S., & Ric, F. (2006). Psychology of emotion: Interpersonal, experiential, and cognitive approaches. *Psychology Press*.
- Norring, M., Wikman, I., Hokkanen, A. H., Kujala, M. V., & Hänninen, L. (2014). Empathic veterinarians score cattle pain higher. *The Veterinary Journal*, 200(1), 186-190.
- Ogata, N., Kikusui, T., Takeuchi, Y., & Mori, Y. (2006). Objective measurement of fear-associated learning in dogs. *Journal of Veterinary Behavior: Clinical Applications and Research*, 1(2), 55-61.
- Overall, K.L. & Love, M. 2001. Dog bites to humans--demography, epidemiology, injury, and risk. *Journal of the American Veterinary Medical Association*, 218, 12, 1923-1934.
- Owings D. & Morton E.S. (1998). *Animal vocal communication: a new approach*. Cambridge, UK: Cambridge University Press.
- Palagi, E., & Mancini, G. (2011). Playing with the face: Playful facial “chattering” and signal modulation in a monkey species (*Theropithecus gelada*). *Journal of Comparative Psychology*, 125(1), 11.
- Palestrini, C., Previde, E. P., Spiezio, C., & Verga, M. (2005). Heart rate and behavioural responses of dogs in the Ainsworth's Strange Situation: A pilot study. *Applied Animal Behaviour Science*, 94(1), 75-88.
- Panksepp, J. (2005). Affective consciousness: Core emotional feelings in animals and humans. *Consciousness and cognition*, 14(1), 30-80.
- Panksepp, J. (2007). Criteria for basic emotions: Is DISGUST a primary “emotion”? *Cognition and Emotion*, 21(8), 1819-1828.
- Panksepp, J. (2011). The basic emotional circuits of mammalian brains: do animals have affective lives?. *Neuroscience & Biobehavioral Reviews*, 35(9), 1791-1804.
- Part, C. E., Kiddie, J. L., Hayes, W. A., Mills, D. S., Neville, R. F., Morton, D. B., & Collins, L. M. (2014). Physiological, physical and behavioural changes in dogs (*Canis familiaris*) when kennelled: Testing the validity of stress parameters. *Physiology & behavior*, 133, 260-271.
- Paul ES 2000 Empathy with animals and with humans: are they linked? *Anthrozoös* 13 (4): 194-202

- Pongrácz, P., Molnár, C., Dóka, A., & Miklósi, Á. (2011). Do children understand man's best friend? Classification of dog barks by pre-adolescents and adults. *Applied animal behaviour science*, 135(1), 95-102.
- Pongrácz, P., Molnár, C., & Miklósi, Á. (2006). Acoustic parameters of dog barks carry emotional information for humans. *Applied Animal Behaviour Science*, 100(3), 228-240.
- Pongrácz, P., Molnár, C., Miklósi, A., & Csányi, V. (2005). Human listeners are able to classify dog (*Canis familiaris*) barks recorded in different situations. *Journal of Comparative Psychology*, 119(2), 136.
- Prato-Previde, E., & Marshall-Pescini, S. (2014). Social looking in the domestic dog. In *Domestic Dog Cognition and Behavior* (pp. 101-131). Springer Berlin Heidelberg.
- Proctor, H. S., & Carder, G. (2015). Nasal temperatures in dairy cows are influenced by positive emotional state. *Physiology & behavior*, 138, 340-344.
- Proverbio, A., Matarazzo, S., Brignone, V., Zotto, M. D., & Zani, A. (2007). Processing valence and intensity of infant expressions: The roles of expertise and gender. *Scandinavian Journal of Psychology*, 48(6), 477-485.
- Randall, D. C., Skinner, T. L., & Billman, G. E. (1985). A comparison of the autonomic nervous control of the heart during classical aversive vs appetitive conditioning in dog. *Journal of the autonomic nervous system*, 13(2), 125-136.
- Reefmann, N., Wechsler, B., & Gygas, L. (2009). Behavioural and physiological assessment of positive and negative emotion in sheep. *Animal Behaviour*, 78(3), 651-659.
- Reefmann N, Bütikofer Kaszàs F, Wechsler B, Gygas L. (2009a) Ear and tail postures as indicators of emotional valence in sheep. *Applied Animal Behavioural Science*, 118: 199–207.
- Rehn, T., Handlin, L., Uvnäs-Moberg, K., & Keeling, L. J. (2014). Dogs' endocrine and behavioural responses at reunion are affected by how the human initiates contact. *Physiology & behavior*, 124, 45-53.
- Rehn, T., & Keeling, L. J. (2011). The effect of time left alone at home on dog welfare. *Applied Animal Behaviour Science*, 129(2), 129-135.
- Rooney, N., Gaines, S., & Hiby, E. (2009). A practitioner's guide to working dog welfare. *Journal of Veterinary Behavior: Clinical Applications and Research*, 4(3), 127-134.
- Rosado, B., Garcia-Belenguer, S., Leon, M. & Palacio, J. 2009. A comprehensive study of dog bites in Spain, 1995–2004. *The Veterinary Journal* 179, 383–391.
- Russell, J. A. (1980). A circumplex model of affect. *Journal of personality and social psychology*, 39(6), 1161-1178.
- Sandem, A. I., Braastad, B. O., & Bøe, K. E. (2002). Eye white may indicate emotional state on a frustration–contentedness axis in dairy cows. *Applied Animal Behaviour Science*, 79(1), 1-10.

- Schaefer, A. L., Cook, N. J., Church, J. S., Basarab, J., Perry, B., Miller, C., & Tong, A. K. W. (2007). The use of infrared thermography as an early indicator of bovine respiratory disease complex in calves. *Research in veterinary science*, 83(3), 376-384.
- Scherer KR. (1984) On the Nature and Function of Emotion: A Component Process Approach, in: Scherer K., Ekman P. (Eds.), *Approaches to Emotions*, New York: Psychology Press: pp. 293 – 317.
- Scherer, K. R. (2005). What are emotions? And how can they be measured?. *Social science information*, 44(4), 695-729.
- Scheumann, M., Hasting, A. S., Kotz, S. A., & Zimmermann, E. (2014). The voice of emotion across species: how do human listeners recognize animals' affective states?. *PloS one*, 9(3).
- Schipper, L. L., Vinke, C. M., Schilder, M. B., & Spruijt, B. M. (2008). The effect of feeding enrichment toys on the behaviour of kennelled dogs (*Canis familiaris*). *Applied Animal Behaviour Science*, 114(1), 182-195.
- Schmidt, K. L., & Cohn, J. F. (2001). Human facial expressions as adaptations: Evolutionary questions in facial expression research. *American journal of physical anthropology*, 116(S33), 3-24.
- Selye H. (1976). *The Stress of Life*. 1st ed. New York: McGraw-Hill.
- Seyfarth, R. M., & Cheney, D. L. (2003). Meaning and emotion in animal vocalizations. *Annals of the New York Academy of Sciences*, 1000(1), 32-55.
- Shariff, A. F., & Tracy, J. L. (2011). What are emotion expressions for? *Current Directions in Psychological Science*, 20(6), 395-399.
- Siegel S, Castellan NJJ (1988). *Nonparametric Statistics for The Behavioral Sciences*. 2nd ed. New York: McGraw-Hill Humanities/Social Sciences/Languages.
- Siniscalchi M, Stipo C, Quaranta A. (2013). “Like owner, like dog”: correlation between the owner’s attachment profile and the owner-dog bond. *PLoS One*, 8: e78455.
- Smith, M. J. L., Montagne, B., Perrett, D. I., Gill, M., & Gallagher, L. (2010). Detecting subtle facial emotion recognition deficits in high-functioning autism using dynamic stimuli of varying intensities. *Neuropsychologia*, 48(9), 2777-2781.
- Smith, W. J. (2007). *Modern optical engineering*, 4th ed. Tata McGraw-Hill Education.
- Snowdon, C. T. (2003). Expression of emotion in nonhuman animals. *Handbook of affective sciences*, 457-480.
- Speakman, J. R., & Ward, S. (1998). Infrared thermography: principles and applications. *Zoology*, 101, 224-232.
- Stevens, D., Charman, T., & Blair, R. J. R. (2001). Recognition of emotion in facial expressions and vocal tones in children with psychopathic tendencies. *The Journal of genetic psychology*, 162(2), 201-211.
- Stewart, M., 2008. Non-invasive Measurement of Stress and Pain in Cattle Using

Infrared Thermography. Thesis, PhD in Animal Science, Massey University.

Stewart, M., Webster, J.R., Schaefer, A.L., Cook, N.J., Scott, S.L., 2005. Infrared thermography as a non-invasive tool to study animal welfare. *Animal Welfare* 14, 319-325.

Stewart, M., Webster, J.R., Verkerk, G.A., Schaefer, A.L., Colyn, J.J., Stafford, K.J., 2007. Non-invasive measurement of stress in dairy cows using infrared thermography. *Physiology & Behavior*, 92, 520-525.

Sucksmith, E., Allison, C., Baron-Cohen, S., Chakrabarti, B., & Hoekstra, R. A. (2013). Empathy and emotion recognition in people with autism, first-degree relatives, and controls. *Neuropsychologia*, 51(1), 98-105.

Tallet, C., Špinková, M., Maruščáková, I., & Šimeček, P. (2010). Human perception of vocalizations of domestic piglets and modulation by experience with domestic pigs (*Sus scrofa*). *Journal of comparative psychology*, 124(1), 81.

Tami, G., & Gallagher, A. (2009). Description of the behaviour of domestic dog (*Canis familiaris*) by experienced and inexperienced people. *Applied Animal Behaviour Science*, 120(3), 159-169.

Travain, T., Colombo, E. S., Heinzl, E., Bellucci, D., Previde, E. P., & Valsecchi, P. (2015). Hot dogs: Thermography in the assessment of stress in dogs (*Canis familiaris*)—A pilot study. *Journal of Veterinary Behavior: Clinical Applications and Research*, 10(1), 17-23.

Valera, M., Bartolomé, E., Sánchez, M. J., Molina, A., Cook, N., & Schaefer, A. L. (2012). Changes in eye temperature and stress assessment in horses during show jumping competitions. *Journal of Equine Veterinary Science*, 32(12), 827-830.

Valsecchi, P., Previde, E. P., Accorsi, P. A., & Fallani, G. (2010). Development of the attachment bond in guide dogs. *Applied animal behaviour science*, 123(1), 43-50.

Verbeek, E., Ferguson, D., de Monjour, P. Q., & Lee, C. (2014). Generating positive affective states in sheep: The influence of food rewards and opioid administration. *Applied Animal Behaviour Science*, 154, 39-47.

Vellante, M., Baron-Cohen, S., Melis, M., Marrone, M., Petretto, D. R., Masala, C., & Preti, A. (2013). The “Reading the Mind in the Eyes” test: systematic review of psychometric properties and a validation study in Italy. *Cognitive neuropsychiatry*, 18(4), 326-354.

Veissier, I., & Boissy, A. (2007). Stress and welfare: Two complementary concepts that are intrinsically related to the animal's point of view. *Physiology & Behavior*, 92(3), 429-433.

Vianna, D. M., & Carrive, P. (2005). Changes in cutaneous and body temperature during and after conditioned fear to context in the rat. *European Journal of Neuroscience*, 21(9), 2505-2512.

von Borell, E., Langbein, J., Després, G., Hansen, S., Leterrier, C., Marchant-Forde, J., ... & Veissier, I. (2007). Heart rate variability as a measure of autonomic regulation of cardiac activity for assessing stress and welfare in farm animals—a review. *Physiology & Behavior*, 92(3), 293-316.

Wan, M., Bolger, N., Champagne F. A., 2012. Human Perception of Fear in Dogs Varies According to Experience with Dogs. *Plos One*, 7, e51775

Wascher, C. A., Scheiber, I. B., & Kotrschal, K. (2008). Heart rate modulation in bystanding geese watching social and non-social events. *Proceedings of the Royal Society of London B: Biological Sciences*, 275(1643), 1653-1659.

ISO 690

Westerath, H. S., Gygax, L., & Hillmann, E. (2014). Are special feed and being brushed judged as positive by calves?. *Applied Animal Behaviour Science*, 156, 12-21.

Wiss, V. (2012). Identifying facial expressions associated with positive emotional states in dogs.

Wright, J.C. 1985. Severe attacks by dogs: characteristics of the dogs, the victims, and the attack settings. *Public Health Report*, 100 (1), 55–61.

Yarnell, K., Hall, C., Billett, E., 2013. An assessment of the aversive nature of an animal management procedure (clipping) using behavioral and physiological measures. *Physiology & Behavior*, 118, 32-39.

Yeates, J. W., & Main, D. C. J. (2008). Assessment of positive welfare: a review. *The Veterinary Journal*, 175(3), 293-300.

Zahn-Waxler, C. & Radke-Yarrow, M. (1990). The origins of empathic concern. *Motivation and emotion*, 14(2), 107-130.

Zebunke, M., Langbein, J., Manteuffel, G., & Puppe, B. (2011). Autonomic reactions indicating positive affect during acoustic reward learning in domestic pigs. *Animal Behaviour*, 81(2), 481-489.

Zebunke, M., Puppe, B., & Langbein, J. (2013). Effects of cognitive enrichment on behavioural and physiological reactions of pigs. *Physiology & behavior*, 118, 70-79.

## ***Chapter 3 – Exploring the field of veterinary medicine: the importance of empathy towards animals***

Veterinary medicine is likely the field in which empathy towards animals is most important, since vets have the responsibility to assure animal welfare and empathy towards animals is related to the ability to perceive pain in animals, concern for their well-being, positive attitude and compassionate behaviour toward them. The few studies on animal-related jobs point out that, in situations where people are exposed to animals' suffering, such as intensive farming or biomedical research, working with them may be a source of distress for humans, causing a detached attitude towards animals and, often, impaired relationships with people. Yet, little is known about veterinary practice, which occupies a difficult moral position, trying to ensure animal welfare while dealing with humans' demands. Studies on veterinary students carried out in UK (Paul & Podberscek, 2000) and USA (Levine et al., 2005) outlined a decline in empathy towards animals during veterinary education, however it is unknown whether this trend goes on also after graduation. In this regards, companion animal practice represents a particularly interesting context to study empathy in vets, since professionals have to manage both the animal-patients' and the human-clients' emotions and are required to show empathy toward both. Moreover, veterinary medicine is ongoing a process of feminization and women are usually more empathic than men, so this gender-shift may promote a cultural change in veterinary medicine, which was traditionally a male preserve, characterized by though-minded and detached role models.

However, to my knowledge, no study has investigated empathy towards animals in practicing vets. Furthermore, no study has been carried out on empathy in veterinary students in Italy, therefore it is not clear to what extent previous findings can be generalized.

In this chapter, after giving some backgrounds about empathy towards animals in animal-related jobs and its importance in veterinary medicine, I'll present two studies: the former (section 3.3) is about empathy towards animals in a sample of Italian veterinary students, while the latter (section 3.4) is on empathy towards animals and people in vets working in companion animal practice.

### **3.1 Empathy towards animals in animal-related jobs**

In recent years, in many societies, there has been a dramatic increase in interest in animal welfare, with the aim to minimize animals' suffering and promote their well-being, not only in regards to pets but also to farm and laboratory animals (Hemsworth *et al.*, 2009; Würbel, 2009).

This issue is gradually spreading among general public and has important cultural, political and social consequences (Verbeke & Viaene, 2000; Taylor & Signal, 2005; Hemsworth *et al.*, 2009), reflected in the growing number of animal protection organizations (Herzog, 1993) and of books and articles about animal sentience and rights (e.g. Rollin, 1998; Regan, 2004; Foer, 2009; Broom, 2014). Moreover, also in the scientific world there is great attention to the development of animal welfare monitoring tools and schemes, according to national and international laws (Taylor and Signal, 2005; Barnett & Hemsworth, 2009; Hemsworth *et al.*, 2009; Wemelsfelder & Lawrence, 2001). Such changes are of great interest for people who work with animals, such as veterinarians, farmers and scientists who perform experiments on laboratory animals: in fact societal view may influence the extent to which particular treatments on animals are acceptable for pet-owners, consumers and people in general (Hazel *et al.*, 2011).

Empathy has a central role in the treatment of animals: for example, it is positively related to the ability to perceive pain in animals (Ellingsen *et al.*, 2010; Norring *et al.*, 2014), to concern for their well-being, positive attitude and compassionate behaviour toward them (Hills, 1993; Coleman *et al.*, 1998; Apostol *et al.*, 2013). However, studies on empathy towards animals in animal-related jobs are still limited.

In animal farming, empathy and attitudes toward animals have been influenced by the introduction of zootechnology and the use of industrial and intensified systems, which led to maximize the economical aspect of work with animals, often considering them as machines (Porcher, 2006; 2011), an instrumental attitude that is in contrast with empathy (Bennett, 1988; Oleson & Henry, 2009). Bock and colleagues (2007) showed that farmers' relationship with their animals varied from "detach detachment" (farmers view animals as tools of production) to "attach attachment" (farm animals are regarded as pets), depending on three main factors: number of animals, type of use of the animal (fattening or reproduction) and species. Yet, the most frequent attitude was "concerned detachment", namely farmers see animals as a function of commercial production, relate to them in a detached manner but handle them with care. Detachment was more likely to appear with regard to large number of animals and fattening animals, who stay on the farm for a less time period and requires less individual attentions than reproduction ones. Both these factors decreased the knowledge of the animal as individual and may prevent familiarity effect to take place, reducing empathy.

Similarly, Arluke (1993) and Birke and colleagues (2007) explored attitudes toward animals in the culture of biomedical research, providing a detailed account on how animals often become interchangeable and anonymous objects, in a context where people adopted detachment as a strategy for self-protection.

These findings have important implications both for animals' and peoples' welfare, since empathy toward animals may be related to the ability to empathize with humans (Paul, 2000) and may influence attitudes and behaviours directed toward animals (Hazel, 2011; Hills, 1993; Coleman et al., 1998; Apostol et al., 2013). Both studies on intensive animal farming and on context of animal experimentation point out the uneasiness of some worker to perform their job, often adopting a detached attitude towards animals that also results in impaired relationship with people and even in depression or anxiety (Arluke; 1993, Birke et al., 2007; Porcher, 2011). These findings could be interesting also for practicing vets, who are daily exposed to animal suffering and have a complex moral position, trying to ensure animal welfare while serving also human interests related to intensive animal farming, laboratory animals and pet-owners' demands (Paul & Podberscek, 2000).

### **3.2 Veterinary medicine as a suitable context for studying empathy towards animals**

Veterinary medicine represents a particular suitable field for investigating empathy towards animals, but also empathy towards humans since, during their education, vets deal with issues such as animal production, zootechnology and animals in the biomedical research, but most of them, after graduation, work in the companion animal practice, where both empathy toward animals and people are highly required (Mitchener & Ogilvie, 2002; Carney et al., 2012; McArthur & Fitzgerald, 2013).

At least in small animal practice, veterinary medicine can be considered a "caring profession", like human medicine, clinical psychology and nursing, where professionals are expected to show empathy towards their patients and are often exposed to others' suffering and distress (Hoffman, 2000; Mitchener & Ogilvie, 2002); yet, compared to these professions, vets, especially in companion animal practice, have to deal both with animal patients' and human clients' emotions, which represents two potential source of empathic feelings. For this reason and because of the several emotionally difficult aspects of veterinary work (i.e., complex ethical decisions, euthanasia, distress due to the impossibility to save an animal), empathy may be a complex aspect of veterinary practice: on one hand, it is important for animals' welfare and clients' satisfaction, but it might have negative effects on veterinarians' well-being (Paul & Podberscek, 2000). In fact vets, like doctors, psychologists and nurses, may experience high levels of personal distress, due to an empathic over- arousal, which can lead to pathological conditions such as "compassion fatigue" and "burn-out" (Hoffman, 2000; Mitchener & Ogilvie, 2002; Hatch et al., 2011).

This condition results from a depletion of an individual's internal emotional resources, which may occur when professionals provide empathy to someone and are often exposed to suffering (see Mitchener & Ogilvie, 2002, for a review). Depersonalization, or treating others as objects, is a common symptom and is related to a dramatic decline in empathy (Maslach, 1993; Conrad & Kellar-Guenther, 2006). Emotional exhaustion, the core element of compassion fatigue, is also recognized as one of the most frequent work-related stressors which could enhance the risk of suicide in veterinary surgeons (Bartram & Baldwin, 2010).

In order to avoid empathic over-arousal and the consequent compassion fatigue, individuals undergo a passive process of habituation to suffering or develop strategies to keep a psychological distance between the victim and themselves, reducing personal distress (Hoffman, 2000).

Studies carried out in USA, Australia and UK show that these processes seem to take place early in veterinary career, already during academic education: in fact, there are evidences that veterinary students undergo a progressive hardening, adopting a more detached attitude towards animals and decreasing empathy towards them (Paul and Podberscek, 2000; Levine et al., 2005; Hazel *et al.*, 2011), a process that resemble what happens to medical students' empathy towards patients during medical education (Michalec, 2011). Interestingly, there are evidences that in particular the cognitive component of empathy towards animals, namely belief in animal mind and sentience, may be affected by veterinary education (Paul & Podberscek, 2000; Levine et al., 2005) and this may act on emotional empathy reducing the perception of similarity between humans and other animals (Apostol et al., 2013).

These findings are quite troubling, however, to my knowledge, no study has investigated empathy towards animals in practicing vets, after graduation, and it is unknown whether the trend of decline in empathy observed in veterinary students goes on during professional career; also gender effect on empathy in veterinary practice is quite unexplored. Furthermore, no study has been carried out on empathy in veterinary students in Italy, therefore it is not clear to what extent previous findings can be generalized, since veterinary curriculum may vary across countries (for instance, Italian laws forbid to perform experiment on animals for didactic aims).

Finally, although in recent years there has been an increasing interest in veterinary-client relationship, especially as regards vets' communication skills (i.e., Hamood et al., 2014; McDermott et al., 2015), only one study focused on empathy, assessing the expression of empathic statements towards the client during veterinary examination (McArthur & Fitzgerald, 2013) and no study has investigated both empathy toward animals and humans in vets.

In the next two section I'll present my work on empathy in veterinary medicine, focused both on veterinary students (Study 4) and practicing vets working in companion animal practice (Study 5).

### **3.3 Study 4 - Empathy towards animals and belief in animal-human-continuity in Italian veterinary students.**

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*Animal Welfare*, in press.

#### **Abstract**

Empathy towards animals and beliefs in animal-human continuity appear to play an important role in shaping the human-animal relationship and in determining the way animals are treated and cared for. Veterinary medicine plays a central role in animal welfare and has been recognized as a highly caring profession, especially in companion animal practice: however, a number of studies indicate veterinary students show a decline in empathy towards animals and an increasing tendency to see them in Cartesian terms as they progress in veterinary education. In the present study we used the Animal Empathy Scale and the Human-Animal Continuity Scale to investigate empathy towards animals and beliefs in animal-human continuity in a sample of first-year (n = 131) and last year (n = 158) veterinary students of the University of Milan (Italy). Results revealed a difference in empathy towards animals, with first year students scoring significantly higher than those at the end of their academic training. This variation in empathy over time emerged in both male and female students, however females always had higher scores in empathy than males. Moreover, students at the end of their university education reported a more instrumental attitude toward animals, more pronounced in males than in females. Similarly, there was a difference in the perception of continuity between human and animals which was more evident in males, with first year students scoring higher than fifth year students in some items. Results are discussed in relation to previous studies carried out in other countries and, given the importance of empathy in the veterinary profession, potential reasons underlying its apparent decrease are considered.

*Keywords:* animal welfare, empathy, gender differences, human-animal continuity, veterinary medicine, veterinary students.

#### **Introduction**

In last years concern for the welfare of animals, not only pets but also farm, research and wild animals, has increased and the factors influencing human–animal interactions have received increasing attention (eg Taylor *et al* 2004; Signal and Taylor 2006; Serpell 2005; Sherman and Serpell 2008; Meyer *et al* 2014).

It has been shown that empathy towards animals, anthropomorphism (ie the tendency to attribute mental states and emotions similar to our own to other species) and beliefs in animal mind and sentience play an important role in shaping both the concern for animal welfare and the human–animal relationship (Hills 1993; Serpell 2003; Butterfield *et al* 2012). There is also agreement that these three factors seem to be related with one another (Hills 1995; Knight *et al* 2004; Apostol *et al* 2013).

The term empathy, colloquially used to indicate the capacity that people have to understand and share the feelings of others (either conspecific or not), refers to a complex multidimensional psychological process, comprising both emotional and cognitive components (Davis 1980; Preston & de Waal 2002; de Waal 2008; Dziobek *et al* 2008); the former involves affective resonance with others' emotion and the generation of an appropriate emotional response, while the latter includes abilities such as recognizing and understanding another's emotions and feelings (Taylor & Signal 2005) and perspective taking (Baron-Cohen & Wheelwright 2004; Schulte-Rüther *et al* 2008).

As a whole empathy allows an individual to quickly relate to the emotional states of other individuals and has visible effects on overt behaviour: the understanding of others' suffering is characterized by a negative experience, which can lead both to prosocial behaviour, namely a behavioural effort to alleviate the distress of the others and to promote their welfare (de Waal 2008; Knafo *et al* 2008), and to personal distress, i.e. an excessive arousal that elicits defensive behaviours or strategies of affective control (Decety & Lamm 2011).

There is evidence that the empathic response is amplified by similarity (for example in appearance, racial group and personality) and familiarity (social closeness and previous positive experiences with other), and is suppressed in relation to strangers and defectors (de Waal 2008; Westbury & Neumann 2008; Drwecki *et al* 2011). In particular, similarity bias seems to have a central role in the evolution of empathy toward animals, which is triggered by animals' signals, behaviours or physical features that closely resemble human characteristics that arouse empathy among humans (Würbel 2009).

Anthropomorphism and belief in animal mind may enhance empathy towards animals acting through the similarity bias: in fact they increase the perception of human-animal continuity in terms of having awareness, thoughts and feelings (Hills 1995; Butterfield *et al* 2012; Apostol *et al* 2013).

Research has demonstrated that anthropomorphism varies with a species genetic relatedness to humans (Hills 1995; Harrison & Hall 2010), or with phylogenetic similarity: since this effect emerges also in relation to empathy (Westbury & Neumann 2008; Prguda & Neumann 2014), Harrison and Hall (2010) suggested that anthropomorphism could be considered the highest expressions of the cognitive component of interspecific empathy.

Recently, Apostol and colleagues (2013) found a correlation between belief in animal mind and the cognitive component of empathy toward animals and hypothesized that “*anthropomorphic interpretations could facilitate the perspective taking process, which, in turn, may lead to the affective empathic reaction*”.

So far a number of studies, mainly based on questionnaires and validated scales, have investigated how empathy towards animals, anthropomorphism and belief in animal mind are influenced by variables such as gender (Paul & Podberscek 2000; Taylor & Signal 2005; Ellingsen *et al* 2010) culture or religion (al Favez *et al* 2003; Phillips *et al* 2012), eating habits (Filippi *et al* 2010; Rothgerber 2014), education and specific knowledge and training (eg Paul & Podberscek 2000; Levine *et al* 2005; Fischer & Tamioso 2013; Phillips 2014).

In general females tend to be more empathic and to show more concern for other individuals, both human and non human beings (Davis 1980; Paul & Podberscek 2000; Baron-Cohen & Wheelwright 2004; Signal & Taylor 2007; Ellingsen *et al* 2010), and show a greater concerns for their welfare and suffering than males (Heath & Lanyon 1996; Capner *et al* 1999; Serpell 2005; Hazel *et al* 2011).

There is also evidence that education and specific training may influence empathy towards people and other animal species. In particular, there are studies showing that health professionals and medical students undergo a process of hardening and appear to become more cynical as they progress in clinical experiences and medical education, showing a decline in empathy (eg Austin *et al* 2007; Hojat *et al* 2009; Neumann *et al* 2011; Nunes *et al* 2011).

Similar findings have been reported for veterinary students with respect to empathy and attitudes towards animals, which appear to be impaired by veterinary education (O'Farrell 1990; Hellyer *et al* 1999; Paul & Podberscek 2000; Levine *et al* 2005).

Besides empathy, in veterinary medicine, also anthropomorphism and belief in animal mind and sentience are issues of particular interest, due to their link with empathy toward animals and to their role in promoting and maintaining our respect, care and compassion for other species (Harrison & Hall 2010).

Paul and Podberscek (2000) investigated veterinary students' empathy towards animals and their beliefs concerning the sentience of animals at two British universities. Comparing students of the first preclinical year, the first clinical year and the final year, they reported a decline in empathy toward animals (dogs, cats, cows and pigs) in students of the later years, with a particular involvement of the cognitive component: as the veterinary course proceeded students “counter-anthropomorphised” animals and tended to see them in more Cartesian terms, as machine-like and having less capacity for consciousness. In particular, it emerged that students in their later years rated the sentience of animals as lower than students in their earlier years, so that animals were

considered able to feel hunger and pain but not to experience complex feelings such as boredom. Moreover, the authors reported that among male students, empathy toward animals decreased over time, so they were less compassionate about animal hunger and pain, as well as fear and boredom, at the end of their training. These results, were consistent with those obtained in a previous study by Hellyer *et al* (1999), which showed that US fourth-year veterinary students were less likely to treat animal pain than second- or third-year students.

More recently Levine *et al* (2005) assessed veterinary students' perceptions of the cognitive abilities of different domesticated species in one North American Veterinary College, reporting that 90% of them believed that dogs and cats had cognitive abilities and were able to experience emotions, while the percentage of students believing in cognitive abilities and sentience of farm animals were lower, with less than a half of them believing poultry had cognitive processes. As the author noticed, students' beliefs about farm animals' cognition and emotions were inconsistent with current scientific evidence and this ignorance about the mentality of domestic species represented a cause of concern for how these future veterinarians would have promoted animal welfare: in fact, in this study it also emerged that students considered painful procedures such as hot branding and castration without anaesthesia or analgesia suitable for cows, small ruminants and pigs, but not for dogs and cats.

Taken together, these studies on veterinary students depict a potentially worrying situation, since a limited awareness of the current state of knowledge about animal cognition and sentience in different species and a detached, unempathic approach towards animals may have negative implications for vets' capacity to ensure animal welfare and concern about patients' wellbeing (Paul & Podberscek 2000). Indeed, a study by Ellingsen *et al* (2010) showed that empathy was the best predictor of how people rated pain in dogs and another study by Norring and colleagues (2014) revealed that empathic vets score cattle pain higher, with important consequences for the welfare of these animals.

Although some studies have focused on empathy towards animals in veterinary students, to our knowledge all of them have been carried out at British, Australian and North American universities, whereas research on veterinary students in Italian universities is completely lacking.

The main aim of the current study was to start exploring the Italian scenario of veterinary medicine, testing a sample of veterinary students to assess whether and to what extent veterinary education influenced empathy towards animals, anthropomorphism and beliefs in animal mind and sentience (namely perception of continuity between humans and other animals), as observed in other countries. The second aim was to evaluate whether gender differences emerged in undergraduate Italian veterinary students as clearly as in other countries and samples. To reach these goals we employed two validated scales, already used in the literature: the Animal Empathy Scale (AES)

developed by Paul (2000) and the Human-Animal Continuity Scale (HACS) constructed and validated by Templer *et al* (2006). To evaluate the effect of the scientific training, we compared students of the first and fifth-year of the veterinary course. Finally, we set out to investigate the relationship between empathy and continuity beliefs to see whether these concepts may be related. Based on previous literature suggesting a decrease in empathy and a weaker belief in animal mind and sentience over time (Paul & Podberscek 2000; Hellyer *et al* 1999; Shurtleff *et al* 1983) and showing gender is a relevant variable in the level of empathy towards animals (eg Paul & Podberscek, 2000; Ellingsen *et al* 2010), we predicted that first-year students would show a higher level of reported empathy towards animals and a greater perception of continuity between humans and non-human animals than those of the fifth year; we also hypothesized that females would obtain higher scores compared to males.

## **Materials and methods**

### *Participants*

The initial sample comprised 131 first-year (34 males, 97 females) and 158 fifth-year (44 males, 114 females) students of veterinary medicine at the University of Milan, Italy. All students were informed of the study during class time and their participation was voluntary and anonymous.

Fifteen participants (6 first year – 3 females and 3 males - and 9 fifth year, 5 females and 4 males) didn't complete the HACS and two participants (one first year male and one fifth year male) didn't complete the AES and thus were excluded from the correspondent analyses. Hence, the final sample consisted of 125 first-year students (31 males and 94 females ranging from 18 to 38 years of age: mean= 20.2, SD = 2.1) and 149 fifth-year students (40 males and 109 females ranging from 22 to 47 years of age; mean= 25.1, SD =3.4) for the HACS, and of 130 first year students (33 males, 97 females) and 157 fifth year students (43 males, 114 females) for the AES.

### *Procedure*

Participants were asked to complete the questionnaire 20 minutes before a lecture started and to return it to a researcher, who was present in the room to answer to any potential students' question about the questionnaire items.

Students were told that the purpose of the survey was to gain knowledge about the human-animal relationship and that their responses would remain anonymous and would be used for scientific research only. We didn't explicitly mention that the questionnaire aimed at assessing empathy and perception of human-animal continuity, in order to avoid a social desirability effect on students' responses; for the same reason, students were told that there were no right or wrong answers as we were interested in knowing their authentic point of view. After concluding to fill in the

questionnaire, they were fully debriefed about the real purpose of the study and they read and signed an informed consent form and an authorisation to allow us to use the data.

### *Questionnaire*

The whole questionnaire consisted of 3 parts. Part 1 aimed at obtaining information on students' age, gender and background experience (eg previous and present interaction/experiences with animals, past or actual pet ownership, religion, eating habits - vegetarian or not -) which could be relevant in affecting their responses. Part 2 comprised the Animal Empathy Scale (AES), designed to measure empathy toward animals (Paul, 2000). This scale includes a total of 22 items, 11 representing unempathic sentiments and 11 empathic sentiments. The majority of items emphasize negative events and emotions. Responses to each item are requested using a nine-point Likert-type scale, ranging from 'Agree very strongly' to 'Disagree very strongly', with agreements with empathic statements scoring high (maximum 9) and agreements with unempathic statements scoring low (minimum 1). The total Animal Empathy Scale score is calculated as the sum of the 22 responses: thus total score can range from a minimum of 22 to a maximum of 198, with higher scores indicating stronger levels of self-reported empathy (Paul 2000).

Part 3 comprised the Human-Animal Continuity Scale, constructed and validated by Templer *et al* (2006) to measure to which extent humans and animals are viewed on the same continuum or in a dichotomous way. The scale includes a total of 12 items about the perception of continuity between humans and animals and responses to each item are requested using a 7-point Likert-type scale, ranging from 'strongly disagree' (1) to 'strongly agree' (7). Some items represent anthropomorphic considerations about animals (eg item 8: "*animals can fall in love*"), others are related to the perception of similarity between humans and animals (eg item 4 "*people are animals*") and some measure to what extent people believe in animal sentience and cognition (eg item 2, "*Humans can think but animals cannot*"). The authors reported that factor analysis yielded three factors that were labelled "rational capacity", "superiority vs equality" and "evolutionary continuum". Hence, the scale content seemed to cover three important components of our relationship with animals, namely anthropomorphism, belief in animal mind and sentience and perception of similarity.

Total scores on the Human-Animal Continuity Scale (HACS) potentially range from 12 to 84, with higher scores indicating higher levels of self-reported perception of human-animal continuity.

Both scales had been previously validated and were specially translated into Italian (with back-translation) for this study. The AES and HACS scales were administered in a counter-balanced order.

### *Statistical analyses*

Total scores on the AES and HACS scales were calculated. The internal consistency of both scales was assessed using Cronbach's alpha and, if unsatisfying, an explorative factorial analysis was run in order to evaluate the scale dimensionality. Two-way analysis of covariance (ANCOVAs) were performed to evaluate the effect of gender, year of course and age on total score (AES) and on single items scores (HACS); subsequent simple effects analysis (one-way ANOVAs) verified the effects of one variable at individual levels of the other independent variable. Pearson correlation coefficient was used to assess the relationship between AES global score and HACS specific items. All the statistical analyses were carried out with SPSS Statistics 21 (IBM, NY, USA), except for the latent structure coefficients, evaluated with the R package "sem" (Fox, Nie and Byrnes, 2014).

### **Results**

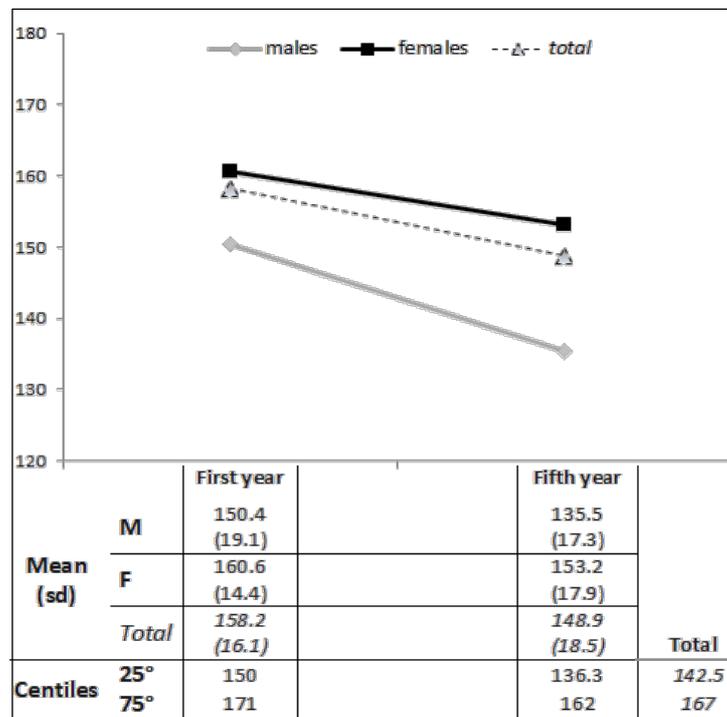
Twelve participants among those who completed the questionnaire were excluded from the dataset because their AES score exceeded  $\pm 2$  DS from the mean (first year: two males; fifth year: four females and six males); the remaining 261 students (76.2% females) were evaluated in subsequent analysis. Almost all subjects were neither vegetarian nor vegan (89.3%) and owned a pet at the moment the study (88.1%) or had owned a pet in the past (90%). Most participants declared to be either atheist/agnostic (39,8%) or Catholic (48,4%) with other religions being extremely rare (0,09%). As participants who declared to be Catholic didn't specify if they were practicing or not, we decided to exclude religion from the analyses.

### ***AES***

The Cronbach alpha's coefficient showed a good reliability for AES (alpha = 0.834), higher than that reported by Paul (2000, alpha = 0.78). AES total score distribution was analogous to the normal curve (asymmetry = -0.38, SE = 15; kurtosis = -0.29, SE = 0.30; Kolmogorov – Smirnov test:  $P > 0.05$ ) and thus we used parametric statistical tests. Descriptive statistics of the sample (mean scores, standard deviations and percentiles) are reported in Figure 3.1.

A two-way ANCOVA (gender x year of course; covariate: age) revealed a weak effect of age on empathy ( $F_{[1,257]} = 5.96, P < 0.05$ , partial eta squared = 0.02) and stronger, significant main effects of gender ( $F_{[1,257]} = 32.1, P < 0.01$ , partial eta squared = 0.11) and year of course ( $F_{[1,257]} = 20.5, P < 0.01$ , partial eta squared = 0.07), but not an interaction between these two factors. The subsequent simple effects analysis explored the effect of gender at the individual levels of year of course, and vice-versa. Males were slightly less empathic than females (one-way ANOVA,  $F_{[1,119]} = 9.07, P < 0.01$ , partial eta squared = 0.07) since the first year of course; this difference was maintained and only slightly increased up to the fifth years ( $F_{[1,138]} = 25.37, P < 0.01$ , partial eta squared = 0.15): in

fifth year, both males and females showed a lower AES score (females:  $F_{[1,197]} = 9.9, P < 0.01$ , partial eta squared = 0.05; males:  $F_{[1,60]} = 10.4, P < 0.01$ , partial eta squared = 0.13, Fig 1). Age was positively but weakly related only to the fifth year students' empathy ( $b = .96, 95\% \text{ CI: } 0.04 - 1.89$ )



**Figure 3.1:** Mean Animal Empathy Scale scores, standard deviations and percentiles of students in their first and final years of study

A number of items of particular interest for veterinary practice were selected and further analyzed: five of them concerned the sensitivity to the owner-pet bond (items 8,12 14, 16,19) and four were related to sensitivity to pets' (dogs and cats) distress signals (items 2, 4, 11).

A two-way ANOVA (gender x year of course) showed a main effect of gender: male students were less empathic in all the items concerning the sensitivity toward the owner-pet bond and in item 4 [*I get annoyed by dogs that howl and bark when they are left alone*] related to pets' distress. Moreover, there was an effect of the year of course, with fifth year students being less empathic than first year students in items 8, 12 e 19 (*“People who cuddle and kiss their pets in public annoy me”, “Many people are over-affectionate towards their pets”, People often make too much of the feelings and sensitivities of animals”*) and in items 2, 4, 11 (*“Often cats will meow and pester for food even when they are not really hungry”, “I get annoyed by dogs that howl and bark when they are left alone”, “Dogs sometimes whine and whimper for no real reason”*) (see Table 3.1).

**Table 3.1.** Gender and year differences in scores in single items of the Animal Empathy Scale related to the owner-pet bond and to pet distress

		Gender			Year of course		
		Males	Females	$F_{(1,259)}$ , sig.; $h^2_{par}$	First	Fifth	$F_{(1,259)}$ , sig.; $h^2_{par}$
AES –	AES 8	7.0 (2.3)	7.8 (2.1)	6.1, $p < .05$ ; .02	8.1 (1.8)	7.4 (2.4)	13.03, $p < .01$ ; .05
<b>Sensitivity</b>	AES 12	4.8 (2.7)	5.9 (2.9)	6.65, $p < .01$ ; .03	6.1 (2.9)	5.2 (2.9)	5.93, $p < .05$ ; .02
<b>toward</b>	AES14	7.5 (2.0)	8.5 (1.2)	20.9, $p < .01$ ; .08			
<b>owner-pet</b>	AES16	6.5 (2.5)	7.4 (2.4)	6.81, $p < .01$ ; .03			
<b>bond</b>	AES 19	6.7 (2.2)	7.5 (2.1)	6.17, $p < .05$ ; .02	7.8 (1.9)	6.9 (2.3)	8.7, $p < .01$ ; .03
AES –	AES 2				5.5 (2.5)	4.4 (2.8)	11.25, $p < .01$ ; .04
<b>Sensitivity to</b>	AES 4	6.2 (2.6)	7.3 (2.2)	10.61, $p < .01$ ; .04	7.6 (2.1)	6.6 (2.5)	13.27, $p < .01$ ; .05
<b>pets’</b>							
<b>distress</b>	AES 11				6.5 (2.5)	5.8 (2.5)	5.12, $p < .05$ ; .02
<b>signals</b>							

### HACS

With regard to the Human Animal Continuity Scale, we found an unsatisfactory internal consistency (Cronbach’s alpha = 0.51), also confirmed by its factors loading matrix (Principal Components Analysis, orthogonal Varimax rotation, Kaiser’s eigenvalues-greater-than-one rule, see Table 3.2), whose five factors, overall accounting only for 61% of variance, were formed only by one or two items, not semantically bounded (except for Factor 1, whose loadings were with items 7, 6, 11). Coherently, all factors presented insufficient internal consistency coefficients, ranging from alpha= 0.57 (factor 2) to alpha = 0.29 (Factor 1), and the overall factorial matrix showed a poor goodness of fit: Goodness of Fit Index GFI= 0.787 (GFIs are acceptable when > 0.9, see eg Jöreskog and Sörbom, 1984), Root Mean Squared Error of Approximation RMSEA= 0.256 (RMSEA are optimal when < 0.05, acceptable when < 0.08 or < 0.1, see eg Steiger and Lind, 1980). This result contrasts with that reported by Templer *et al* (2006), who constructed and validated this scale finding a quite acceptable internal consistency (Cronbach’s alpha = 0.69) and identifying three distinct factors.

Given the low internal consistency, we decided to focus on single items rather than on a global score. We focused on items that appeared suitable to assess two important aspects which may be affected by veterinary education: cognitive and phylogenetic continuity between humans and animals (i.e., item 2: “Human can think but animals cannot”; item 4: “People are animals” and item 6: “ People evolved from lower animals”), and instrumental attitude toward animals (ie item 10: “The needs of people should always come before the needs of animals”; item 11: “ It’s okay to use animals to carry out tasks for humans”; item 12: “It’s crazy to think of an animal as a member of

*your family*). All these items respected the normal distribution characteristics (asymmetry and kurtosis less or equal to |1| and not significant Shapiro normality test), except for item 2 and item 12, whose lower tails was quite underrepresented ( $kurtosis_{item2} = 8.5$ ;  $kurtosis_{item12} = 9.9$ ; Shapiro test P-values  $< 0.01$ ). However, as in our opinion these two items content was relevant to the topics of the study and in particular to the veterinary profession, we decided to consider them.

**Table 3.2.** The Human-Animal Continuity Scale rotated components pattern

Items	Component				
	1	2	3	4	5
7. people are superior to animals	.702	.315			
6. people evolved from lower animals	-.671				
11. it's ok to use animals to carry out tasks for human	.653				
10. the needs of people should always come before the needs of animals	.629				
2. human can think but animals cannot		.857			
1. humans have a soul but animals do not		.734	.368		
3. people have a life after death but animals do not		.325	.741		
9. people have a spiritual nature but animals do not			.726		
4. people are animals				.746	
5. animals are afraid of death				.706	
12. it's crazy to think of an animals as member of your family					.832
8. animals can fall in love				.486	.586

*Only loadings  $\geq .300$  are shown*

A two-way ANCOVA (gender x year of course; covariate: age) confirmed a not significant effect of age, for all the items considered. Scores on items related to the perception of phylogenetic and cognitive continuity revealed a weak and almost significant difference, depending from the main effect of the year of course, only for item 4 (*“People are animals”*:  $F_{[1,257]} = 3.4$ ,  $P = 0.07$ , partial eta squared = 0.01): fifth year students scored lower than first year ones. There was a significant main effect of gender ( $F_{[1,257]} = 6.7$ ,  $P < 0.05$ , partial eta squared = 0.02) and a gender per year effect ( $F_{[1,257]} = 5.91$ ,  $P < 0.05$ , partial eta squared = 0.02) on item 2 (*“Humans can think but animals cannot”*): the discrepancy between first and fifth year students’ scores was greater among males. On the contrary, scores on items related to an instrumental attitude toward animals (see Table 3.3) were higher in fifth year students (items 10, 11 and 12) and in males (items 10 and 12).

**Table 3.3** Gender and year differences in the Human-Animal Continuity Scale items on instrumental attitude toward animals

		Gender			Year of course		
		Males	Females	$F_{[1,246]}$ , sig.; $h^2_{par}$	First	Fifth	$F_{[1,246]}$ , sig.; $h^2_{par}$
HACS - instrumental	HACS 10	3.6 (.2)	2.63 (.1)	22.48, $p < .01$ ; .07	2.1 (.2)	3.55 (.2)	13.19, $p < .01$ ; .05
	HACS 11				3.93 (.2)	4.84 (.2)	13.98, $p < .01$ ; .05
	HACS 12	1.8 (.1)	1.2 (.1)	13.74, $p < .01$ ; .05	1.37 (.2)	1.69 (.1)	4.71, $p < .05$ ; .02

### ***Relationship between empathy and perception of human-animal continuity***

There were significant, moderate negative correlations (Pearson's  $r$  coefficients) between AES total score and scores on HACS items related to instrumental attitude toward animals ( $r_{T-10} = -0.419$ ,  $P < 0.01$ ;  $r_{T-11} = -0.396$ ,  $P < 0.01$ ;  $r_{T-12} = -0.333$ ,  $P < 0.01$ ).

### **Discussion**

The aim of the current study was to investigate the relationship between empathy toward animals, perception of human-animal continuity and veterinary education in a sample of Italian veterinary students.

Overall, our results are in agreement with those of previous studies carried out in other countries, which show that veterinary students' attitudes towards animals in terms of empathy, beliefs in animal sentience and beliefs in animal cognitive abilities seem to worsen during the veterinary education process, giving rise to a more instrumental attitude toward them and a more Cartesian perspective on their psychology. In addition, current findings confirm previous evidence that gender influences the level of empathy towards animals and attitudes towards them (Paul & Podberscek 2000; Taylor & Signal 2005; Signal & Taylor 2007; Ellingsen *et al* 2010).

In their UK cross-sectional study on veterinary students' attitudes towards the welfare of animals, Paul and Podberscek (2000) found that the year of study was significantly related to the perceived sentience of domestic animals (dogs, cats and cows), with students in their later years of study attributing lower levels of sentience; moreover, female students rated themselves as having significantly higher levels of emotional empathy with animals than did male students, and maintained relatively high levels of empathy over time, whereas male students showed decreasing levels of empathy through years.

The current study based on the AES scale revealed a significant difference in self-reported empathy towards animals between the first and the last year of the veterinary curriculum in both male and female students, which might suggest an effect of education. Male students always resulted less

empathic than females, independently of the year of study, and such an effect was stronger than that due to the year of course.

The presence of gender differences in empathy scores is consistent with the psychological literature, which demonstrate that in general females tend to be more empathic than males towards both human and non-human beings (Davis 1980; Paul & Podberscek 2000; Baron-Cohen & Wheelwright 2004; Signal & Taylor 2007; Ellingsen *et al* 2010), and show greater concern for their welfare and suffering than males (Heath & Lanyon 1996; Capner *et al* 1999; Serpell 2005; Hazel *et al* 2011). Interestingly, similar findings have been reported in human medicine with regards to empathy towards patients in both students and professionals (Hojat *et al* 2002; Austin *et al* 2007; Berg *et al* 2011).

In particular, it has been shown that females score higher than males especially on the measures of emotional reactivity (empathic concern and personal distress), while cognitive abilities, such as perspective taking and recognition of affect in others, reveal no consistent sex differences (Davis 1980). These findings, however, are consistent only with older children/adolescents and adults (Schulte-Rüther *et al* 2008; Bandstra *et al* 2011; Roth-Hanania *et al* 2011), and this may suggest the internalization of social expectation regarding gender role and gender identity, through social learning processes (Roth-Hanania *et al* 2011).

Yet, a genetic effect can't be excluded since it has been proposed that, during phylogeny, empathy might have evolved in the context of parental care, in order to facilitate the mother-offspring bond (Preston & de Waal 2002). Recently, Derntl and colleagues (2013) showed an effect of female reproductive hormones on empathy, suggesting the role of progesterone in predisposing women to empathic behaviour.

Like Paul & Podberscek's work (2000), our study was not a longitudinal one, so we cannot conclude that the difference in empathy towards animals we found necessarily represents a real decline due to an effect of education. However, our findings are in line with the hypothesis that students' empathy and attitudes towards animals could be impaired by veterinary education, as already reported for empathy towards people in human medicine (Austin *et al* 2007; Hojat *et al* 2009; Neumann *et al* 2011; Nunes *et al* 2011). The effect of education on empathy could be confused with the effect of age, however, our results indicate that the effect of age on empathy was very limited and, when partialized, the effect of education remained significant. As the selection test to enter the veterinary school, the curriculum and the teaching staff were the same for the two cohorts of students and questionnaire was administered during compulsory attendance lectures (and almost all students participated to the study), it is reasonable to assume that the two cohorts of students were comparable.

The potential effect of education on students' empathy is an interesting finding and, given the importance of empathy for animal welfare, more studies, and in particular longitudinal studies, would be necessary to confirm it and to gain a better understanding of the aspects of the Italian veterinary education that are responsible for this apparent decrease in empathy.

Paul and Podberscek (2000), reviewed possible reasons of veterinary students' decline in empathy and belief in animal mind and sentience, suggesting that this could be either a way of coping with the moral conflict and emotional distress which older students are expected to encounter in veterinary work, or the result of a role modelling process, similarly to what happens to medical students (Piace *et al* 2002; Burks & Kobus 2012). As the authors noticed, traditionally, the model whose behavior and attitudes towards animals could be emulated by younger veterinary students was essentially a masculine one, which appreciates tough-mindedness while devalues emotional concern.

More recently Levine *et al* (2005) suggested that differences in students' perception of companion-animal and farm-animal emotional and cognitive abilities emerged in their study could also depend on a lack of awareness of the current state of scientific knowledge about cognitive and emotional abilities of domestic species; they also suggested that it would be useful to educate veterinary students formally and specifically on animal cognition, in order to guarantee the application and maintenance of high standards of good animal welfare in practice. The current study, being the first carried out in Italy, does not allow to disentangle the possible reasons for the observed apparent decrease in empathy, but it would be interesting in further studies to address this aspect in more detail.

Although the difference in empathy towards animals emerged between first and last year veterinary students could in principle be a source of worry, it is worth considering that in this study the mean empathy score of both males and females in the first and last year of course was quite high, thus indicating an overall satisfactory level of empathy. Moreover, as 76.2% of the participants were females, and this preponderance of female students reflects a clear trend with a growing number of women undertaking veterinary medicine (Hart *et al* 1989), a more feminine and empathic attitude towards animals is likely to develop in Italy in the future.

Unfortunately, we could not directly compare our students' scores either with those reported by Paul and Podberscek (2000), since they used a 28-item version of the AES, or with those emerging in the study by Ellingsen *et al* (2010), since they adopted a 7-point Likert scale.

The only data available for comparisons are those by Paul (2000) and by Meyer *et al* (2014), which are relative to a general sample of Scottish adults and to a sample of second-year Swedish veterinary students (mainly females) respectively. Interestingly our first year students' scores appear to be slightly higher than those of Scottish pet owners, whereas fifth year male, but not

female, students' scores resemble more those of non pet owners. Moreover, our sample empathy scores seem to be higher than those reported by Meyer *et al* (2014), for second-year Swedish veterinary students.

In general, studies using the AES have considered only the total score (eg Paul 2000; Paul & Podberscek, 2000; Taylor *et al* 2004; Ellingsen *et al* 2010), whereas we decided to focus also on single items that could be particularly relevant for veterinary practice, namely those related to the sensitivity towards the owner-pet bond and sensitivity towards pets' distress signals. In fact in Italy, even if the veterinary core curriculum is common to all students and more related to farm animals and production, many students end up treating pets.

For both these aspects (sensitivity to owner-pet bond and to pets' distress signals), the general trend of empathy was confirmed: there was an effect of year of course, with last year students reporting lower levels of empathy, and a clear effect of gender, especially for items related to sensitivity to owner-pet bond, with females more sensitive than males. These results are of some concern as the human-animal bond is considered an important motivation for people to seek veterinary care for their pets and the veterinarians' sensitivity toward the owner-pet bond is recognized as a determinant of a successful private practice (Mitchner & Ogilvie 2002).

For these reasons, some changes in veterinary medical education have been suggested, such as training veterinary students to deal with the human-animal bond (Adams *et al* 2004) and in animal behaviour in order to improve vet-owner-pet relationship, animal handling, and managing of animals' pain and distress (Sherman & Serpell 2008; Rodan *et al* 2011; Carney *et al* 2012).

A lower sensitivity toward animals' distress in veterinary students in their final year was found also in previous studies (Hellyer *et al* 1999; Paul & Podberscek, 2000) and may be due to an habituation process, as suggested by Pillai Riddell and Craig (2007), who found that pediatricians attributed significant lower levels of pain to infants' facial expressions than did parents. As these authors noticed, health professionals may become slightly habituated to patients' pain signs because of their extended exposure to them. It would be interesting to evaluate this effect in veterinary students using visual or auditory material, such as photographs or videos of animals in pain or distress.

A further interesting finding is that the AES scale devised by Paul (2000) and used in other studies confirms to have good psychometrical characteristics, as also in this study its internal consistency was high, suggesting no cultural bias. This allows us to give a normative standard for Italian veterinary students and opens the way to a more systematic study of empathy towards animals in other samples (eg veterinary students from different Italian universities, veterinary professionals, stockpersons, scientists, etc), who in different ways work in areas related to animal welfare and care.

As regards the Human Animal Continuity Scale, in the current study it revealed low internal consistency and an unsatisfactory factorial structure. This scale was originally constructed by Templer *et al* (2006) with the interesting goal of measuring to what extent people view human and animals on the same continuum; the authors suggested the suitability of the scale in human-animal relationship research, so we used it to evaluate if and how perception of continuity between humans and other animals varied during veterinary education (ie with increasing practice and knowledge about animals), and whether a higher perception of continuity would be associated with a higher level of empathy towards animals.

The low internal consistency of the HACS scale emerged in this study suggests that this scale may not be readily employed with populations and aims different from those of the original study. However, to our knowledge this is the only study that used this scale since its original construction and validation; thus more work seems necessary before a final conclusion on its content validity and construct validity can be drawn. As underlined by Templer *et al* (2006), the issue of people beliefs in human-animal continuity is extremely interesting and really deserves further investigation.

In particular, it is reasonable to hypothesize a relationship between beliefs in human-animal continuity and the tendency to empathize with them (Westbury & Neumann 2008; Apostol *et al* 2013; Priguda & Neumann 2014). A reliable measure of whether and to what extent people consider humans and other animals on a continuum could provide insight on the different variables shaping people beliefs in animal-human continuity; it could also provide interesting information about the extent to which the growing scientific knowledge on animals' cognitive abilities coming from disciplines such as ethology, comparative psychology and neuroscience is spread among non-experts, and how it might help in promoting different aspects of animal welfare. As Levine *et al* (2005) suggested, given the key role of veterinarians in promoting animal welfare, it would be important to educate veterinary students on animal cognition and comparative cognition, to make them aware of the psychological processes that take place in the species they will take care of. Moreover, Hazel and colleagues (2011) demonstrated that veterinary students' attitude toward animals became more positive after an animal-welfare course.

Although total scores could not be used, some interesting results emerged from the analysis of the HACS items concerning instrumental attitude toward animals and perception of phylogenetic and cognitive continuity.

Regarding instrumental attitude, similarly to what emerged for empathy scores, for all items we found a significant effect of the year of course, with first year students having a lower instrumental attitude than their last year colleagues; there was also an effect of gender, with females being more prone to view an animal as a member of the family and less prone to take an instrumental attitude. It's worth noting that only for item 11 "*It's ok to use animals to carry out tasks for humans*" first

year students reported a slight disagreement and fifth years students a slight agreement, while for the other two items scores reflected a disagreement with the statements in both groups, suggesting that veterinary students in our sample had an overall positive attitude towards animals.

Results on perception of continuity between animals and humans (ie “*Human can think but animals cannot*”; “*People are animals*” and “*People evolved from lower animals*”) were more variable and the effect of year of course and gender less evident: an effect of gender and a gender-per-year effect was found only for the item “*humans can think but animals cannot*”, with females being more prone to attribute the capacity of thinking to animals and a more marked difference between first and fifth year male students, supporting the results obtained by Paul and Podberscek (2000). However, students’ scores remained within the positive range, revealing a good perception of phylogenetic and cognitive continuity between humans and animals.

Finally, we found a significant negative correlation between the empathy global score and the scores related to instrumental attitude toward animals, which supports the existence of a relationship between these two aspects. This result confirms the need to pay attention in planning academic veterinary curricula, for instance combining courses concerning animal production with those related to animal cognition and welfare, in order to avoid the development of an instrumental attitude toward animals (Levine *et al* 2005; Main, 2010; Hazel *et al* 2011). In fact, empathy and attitudes toward animals have been influenced by the introduction of zootechnology and the industrialization of animal farming, which is based on industrial and intensified systems. These two phenomena, which have led to maximize the economical aspect of work with animals and to the view of animals as machines (Porcher 2006; 2011), promoting negative attitudes, are in contrast with empathy and may have a negative impact also on veterinary students’ developing caring abilities (Martinsen 2007).

### **Future research**

In summary, the current study is a first step in the exploration of the Italian reality concerning empathy in veterinary medicine. The emerging scenario appears to be in tune with the evidence accumulated so far in different countries, although further studies are needed before a more general conclusion on the relationships between empathy toward animals, perception of human-animal continuity, and veterinary education can be put forward. This study, as most of those carried out so far (eg Paul & Podberscek 2000; Hellyer *et al* 1999, Shurtleff *et al* 1983) was based on a cross-sectional design, therefore it would be necessary to carry out longitudinal studies to assess whether the differences in empathy and attitudes towards animals we found are actually due to veterinary education. This kind of studies are still very limited in the veterinary field (eg Heath *et al* 1996;

Heath & Lanyon 1996) and, to our knowledge, none has focused on topics such as empathy towards animals or belief in animal mind.

It would be important also to integrate self-reports with other more objective measures of empathy, such as behavioural or physiological indexes, to overcome the limits due to self-rating. Moreover, it would be intriguing to assess whether and to what extent the apparent decrease in empathy exhibited by students represents a coping strategy, depends on role modelling or is attributable to an inadequate efficacy, or even the unwillingness, of universities to teach animal welfare, animal behaviour and psychology and animal ethics in veterinary courses (Arluke 2004; Martinsen 2007). It would also be relevant to evaluate whether the apparent changes in empathy occurring during veterinary education represent the first symptom of a trend which continues during veterinary profession.

Finally, cross-cultural studies employing the same methodology are needed to compare empathy levels and attitudes towards animals in veterinary students from different countries, in order to better understand the effect of gender and curricula; for example, in Italy animal experiments in veterinary education are not allowed, unlike in other countries (eg, Arluke 2004; Martinsen 2007), and this kind of didactic method may have a strong impact on students' empathy and attitudes (Arluke & Hafferty 1996; Birke & Arluke 2007; Daly and Morton 2008).

### **Animal welfare implications and conclusion**

In line with previous studies, our results revealed an apparent decline in empathy towards animals during the veterinary academic training, with first year students scoring significantly higher than those in their last year. Moreover, perception of continuity between humans and animals was different between the first and the last year of course, and students at the end of their university education reported a more instrumental attitude toward animals. This effect may be due to a process of role modeling, to a strategy of affective control to cope with personal distress in response to animals' suffering and to the structure of academic curriculum, which is very concerned with animal production. In order to avoid the development of a marked instrumental attitude toward animals in veterinary students, it could be useful to endorse courses about animal welfare, animal cognition, ethology and human-animal bond in veterinary education.

Finally, we found a gender effect on empathy toward animals and on perception of continuity between humans and animals, with females always obtaining higher scores than males. Since nowadays the majority of veterinary students are females, a more empathic attitude towards animals may develop in Italian veterinary medicine in the future.

### **3.4 Study 5 - Empathy towards animals and people in a sample of Italian vets: the role of gender and length of career**

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#### **Abstract**

Empathy towards animals plays an important role in shaping the relationship between human and non-human species and it affects the way animals are treated and cared for.

Veterinarians play a key role in regard to animal welfare and, especially in companion animal practice, they have to take care for "non-human patients" as well as for "human clients", showing sensitivity and empathy towards both. However, empathy in veterinary professionals has received very little attention so far.

The aim of this study was to investigate empathy towards animals and humans in veterinarians, assessing whether and to what extent they are influenced by variables such as gender and length of career. In fact, both these variables have been reported to affect empathy in a variety of human caring professions.

We used the Animal Empathy Scale to assess empathy towards animals and the Empathy Quotient to assess empathy towards people in a sample of 107 vets, practicing in veterinary clinics in Milan area and working mainly with dogs and cats.

Results revealed an effect of gender on empathy towards animals, with women scoring higher than men, and an effects of length of career on empathy toward people, with more experienced vets scoring higher than their younger colleagues.

This is the first study in the literature evaluating both empathy towards animals and people in vets working in small animal practice and suggests a positive profile of veterinarians, reporting themselves to be empathic both towards animals and people, meeting the expectations of society and likely linked to the feminization of veterinary medicine. Given the role of empathic concern in caring for animals and for clients' satisfaction, but also as a risk factor for burnout in caring professions, further studies are needed.

#### **Introduction**

In recent years there has been a marked increase in interest in animal welfare, both in scientific research and in society, with the aim to minimize their suffering and to promote animals' positive emotions and welfare (i.e., Würbel, 2009; Hemsworth *et al.*, 2009). These issues appear to be particularly relevant for people who work with animals, especially for veterinarians, who need to take into account the current social view because it may have an impact on what treatments are

acceptable or not to animal owners, to the consumer and to the general public (Hazel et al., 2011). In particular, pet owners and society expect veterinarians to treat their patients with care and compassion and see them as the persons who can and should alleviate pain and suffering in animals (Martinsen, 2007). For example, according to one study sponsored by the American Veterinary Medical Association and the American Animal Hospital Association (Brown et al., 1999), both pet owners and non-pet owners evaluated veterinarians in the top three ratings for compassion, relative to seven other professions (physician, accountant, chiropractor, lawyer, dentist, teacher, and pharmacist). Moreover, in the same study, both veterinarians and students reported the desire to work with animals, to care for them and to help people among the main reasons for entering veterinary medicine. These findings confirm what suggested by Mitchener and Ogilvie (2002), namely that “veterinarians not only do care, but they are expected to care compassionately by their clients”.

Furthermore, especially in companion animal practice, veterinarians need to pay attention not only to the medical needs of the pet but also to the relationship between owners and their pets, taking into account and supporting their emotional needs (Mitchener & Ogilvie, 2002). Today pets play an integral role in people’s lives and most pet owners considers their pets as members of the family, forming with them long lasting and intense affectional bonds (Voith, 1985; Endenburg, 1995; Julius et al., 2012), which are considered the motivating force causing people to seek veterinary care for their animals (Martinsen, 2007; Mitchener & Ogilvie, 2002). Therefore, managing emotions and interacting with people in situations that require empathy are two important aspects of veterinary care (Timmins, 2006). For these reasons, Mitchener & Ogilvie (2002) considered veterinary medicine as one of the most caring of all profession, where vets have the responsibility to care for both the human client and the non-human patient.

Caring and compassion have their roots in empathy (Singer & Klimecki, 2014), a controversial concept whose definition may vary according to the context in which it is considered (Michalec, 2011). According to a psychological perspective, empathy is referred to as the capacity to understand and share the feelings of others (either conspecific or not) and it comprises both emotional and cognitive components: cognitive empathy includes abilities such as recognizing and understanding others’ emotion (Decety & Jackson, 2004; Taylor & Signal, 2005), self-other awareness and perspective taking (Baron-Cohen & Wheelwright, 2004; Decety & Jackson, 2004; Schulte-Rüther et al., 2008), whereas emotional empathy consists in the affective resonance with others’ emotion and the generation of an appropriate emotional response (e.g., Hoffman, 2000; de Vignemont & Singer, 2006). Although some researchers have privileged the affective side of empathy while others have taken a more cognitive approach, there is a general agreement that these two components cannot be easily separated as empathy is a complex, multi-componential

phenomenon (Mercer & Reynolds, 2002; Baron-Cohen & Wheelwright, 2004; Decety & Jackson, 2004).

Yet, within a medical context, empathy is often focused on the cognitive aspects and tends to exclude the affective component of sharing the emotional state of another (Halpern, 2003; Michalec, 2011).

In line with Baron-Cohen & Wheelwright (2004), for the purpose of the current study we conceptualized empathy taking a broad perspective, which couples the cognitive focus of clinical empathy and the emotional component underlined in the social-psychological research. Thus, we conceive empathy as the cognitive and emotional experience of another individual's emotional state. In spite of debates about definitions, empathy in health care professions has been reported to be a key component of the therapeutic relationship (Mercer & Reynolds, 2002) and a special professional skill that enhances patient-physician communication and helps diagnosis (Halpern, 2003).

This seems to be the case also for veterinary practice: Carney and colleagues (2012) defined veterinary medicine as “a combination of science and art”, referring to science as necessity to rely on research evidences, while “art” is the art of healing, whose main features are the ability to interpret the patient's state of mind and to exhibit empathy toward the animal. In line with this view, Martinsen (2007) suggested that a caring approach could be an additional tool to detect signs of suffering and pain in animals, since they cannot verbally communicate about their symptoms. As noticed by this author, diagnostics can be made without compassion, on the basis of a list of symptoms; however, a professional evaluation of the situation of the animal patient must include an understanding of the emotional state of the animal, which is facilitated by taking the animal's point of view or, in other words, by empathy. For instance, an essential prerequisite for the treatment of pain in animals is the ability to recognize painful conditions and it has been shown that empathy is positively related to the perception of pain in animals (Ellingsen et al. 2010) and that empathetic vets score animals' pain higher (Norrington et al., 2014).

Interestingly, human medicine and veterinary practice appear to share some other aspects related to empathy. For example, in human medicine, research has linked empathy, theoretically or empirically, to several attributes, such as good attitudes toward patients, a reduction in malpractice litigation, competence in history taking and performance of physical examinations, patients' and physicians' satisfaction, better therapeutic relationships and good clinical outcomes (see Hojat et al., 2002 for a review). Similarly, in veterinary medicine, it has been noticed that the ability to address clients' emotional needs can promote clients' satisfaction and compliance, preventing treatment failure and legal action (Timmins, 2006; McArthur & Fitzgerald, 2013). There is also evidence that medical training could negatively influence medical students' empathy, which tends

to decrease during medical education (see Michalec, 2011 for a review). This seems to occur during veterinary training as well, with studies underlining a decline in empathy toward animals in students (Paul and Podberscek, 2000; Levine et al., 2005; Colombo et al., in press), tough-minded and detached role models (O'Farrell, 1990; Blackshaw & Blackshaw, 1993; Paul & Podberscek, 2000), and anecdotal reports of a lack of interest in caring for the animal or for pet owners in practicing vets, who develop a purely technical approach to diagnosing and treating the animal (Martinsen, 2007).

Although results on medical and veterinary students are consistent in finding a decrease in empathy as the course proceeds, as far as we are aware, no study has been carried out on practicing vets and thus it is unclear if length of career may affect vets' empathy: in particular, a study by Handford and colleagues (2013) found an opposite trend in physicians, showing that clinical practice had a positive impact on empathy, with clinicians obtained a better performance than age-matched controls on the "eye test", a behavioural test for empathic accuracy.

Even if veterinary practice is heavily centered on 'caregiving', especially in primary-care companion animal practice, empathy in qualified vets has received very little attention and, to our knowledge, there are no studies evaluating the effect of length of career either on empathy towards animals or towards humans; it's worth noting that there is evidence of a correlation between these two kinds of empathy, however each one is affected by different factors and may have different developmental trajectories, so they deserve to be investigated separately (Paul, 2000).

Furthermore, a number of studies outlined that veterinary medicine is undergoing a process of feminization (Lofstedt, 2003; Irvine & Vermilya, 2010), so that more women than men enter the profession; however, no study has investigated gender differences on empathy in vets, although a clear and stable effect of gender emerges in the literature, with women scoring higher than men both in empathy towards animals (Paul & Podberscek, 2000; Signal & Taylor, 2007; Preylo & Arikawa, 2008; Ellingsen et al., 2010) and people (e.g., Davis, 1980; Baron Cohen & Wheelwright, 2004; Eisenberg et al., 1995; Preti et al., 2011). If female vets were more empathic than their male colleagues, given the ongoing feminization of veterinary medicine, this could promote a cultural change in this profession (Paul & Podberscek, 2000; Irvine & Vermilia, 2010), in particular improving sensitivity towards themes that are crucial for success in companion animal practice, such as attention towards the owner-pet bond, caring attitude towards pets (Mitchener & Ogilvie, 2002; Carney et al., 2012) and expression of empathic feeling towards pet-owners (McArthur & Fitzgerald, 2013).

The aim of this study was to investigate empathy towards animals and humans in veterinary professionals, assessing whether and to what extent gender and length of service influence them. To reach these goals we used two validated scales, already used in literature on empathy: the Animal

Empathy Scale (AES) developed by Paul (2000) and the Empathy Quotient developed by Baron-Cohen and Wheelwright (2004). To evaluate the possible effect of the length of career, we tested professionals with different years of clinical practice (i.e. ranging from 1 week to 20 years). Based on evidence coming from psychological and clinical literature, indicating that gender is a relevant variable in the level of empathy towards both animals and people, we hypothesised that female professionals would be more empathic than their male colleagues; however, since the literature on the relationship between empathy and length of career is still very limited, we made no specific predictions on the possible relationship between empathy towards animals and people and length of career.

## **Materials and methods**

### *Participants*

The initial sample comprised 107 veterinarians working in companion animal practice (45 males, 62 females), aged between 25 and 70 years, whose career length ranged between 1 week and 42 years (see Table 1).

All participants were enrolled in the professional association of veterinarians and they were informed about the study through phone calls or e-mails. The participation was voluntary and anonymous.

Two participants, one male and one female, missed to answer some questions in the whole questionnaire and thus were excluded from the results.

### *Procedure*

A researcher went by appointment to the veterinary clinic where the veterinarian worked, during closing time. Participants were asked to complete the questionnaire in a quiet room and to return it to the researcher, who was present in the room to answer to any potential question about the questionnaire items.

Veterinarians were told that the purpose of the survey was to gain knowledge about the relationship with animals and with people in veterinary medicine and that their responses would remain anonymous and would be used for scientific research only. We didn't explicitly mention that the questionnaire aimed at assessing empathy, in order to avoid a social desirability effect on responses; for the same reason, vets were told that there weren't right or wrong answers, as we were interested in knowing their authentic point of view. After concluding to fill in the questionnaire, they were fully debriefed about the purpose of the study and they read and signed an informed consent form and an authorisation to allow us to use the data, according to the national Privacy Law 675/96.

### *Questionnaire*

The whole questionnaire consisted of 3 parts. Part 1 aimed at obtaining information on participants' age, gender, marital status, length of career, specialization and background experience which could be relevant in affecting their responses (e.g., past or actual pet ownership, religion, eating habits - vegetarian or not -)

Part 2 comprised the **Animal Empathy Scale (AES)**, designed to measure empathy toward animals (Paul, 2000): this scale includes a total of 22 items, 11 representing unempathic sentiments and 11 empathic sentiments, with the majority of items emphasizing negative events and emotions; responses to each item are requested using a nine-point Likert-type scale, ranging from 'Agree very strongly' to 'Disagree very strongly', with agreements with empathic statements scoring high (maximum 9) and agreements with unempathic statements scoring low (minimum 1). The total Animal Empathy Scale score is calculated as the sum of the 22 responses: thus total score can range from a minimum of 22 to a maximum of 198, with higher scores indicating stronger levels of self-reported empathy (Paul 2000). Previous studies carried out on different samples showed that the AES has a good internal consistency, with Cronbach's alpha values ranging from 0.78 (Paul, 2000) to 0.834 (Colombo et al., in press).

Part 3 comprised the **Empathy Quotient (EQ)**, constructed and validated by Baron Cohen and Wheelwright (2004) to measure empathy towards people, with the aim of assess low levels of empathy as a feature of psychopathology and to detect slight individual differences in empathy in general population, such as gender differences. The cross-cultural validity of EQ in the Italian population was confirmed in a study carried out by Preti and Colleagues (2011). We used the Italian version of the questionnaire reported in the Italian translation of *The science of evil* (Baron Cohen, 2011), which was based on translation and back-translation and whose psychometric properties are reported in Allison et al.'s work (2011). The EQ scale includes 40 items to which participants have to indicate their agreement or disagreement according to four response options: 'strongly agree', 'slightly agree', 'slightly disagree', 'strongly disagree'. "Strongly agree" responses to empathic statements (20 items) and "Strongly disagree" responses to unempathic statements (20 items) score two points, while 'slightly agree' responses to empathic statements and "slightly disagree" responses to unempathic statements score one point. The remainder of the response options score 0. The EQ total score potentially ranges from 0 to 80, with higher scores indicating higher levels of self-reported perception of empathy toward people. The EQ is an extensively used tool and previous studies (i.e., Preti et al., 2011; Handford et al., 2013; Sucksmith et al., 2013) reported a very good internal consistency, with Cronbach's alpha values ranging from .79 (Preti et al., 2011) to .92 (Baron-Cohen & Wheelwright, 2004).

The AES and EQ scales were administered in a counter-balanced order.

### *Statistical analysis*

Data were cleaned of outliers (3 male subjects, less than 5%) by the following procedure: values were standardized and data diverging more than 2 standard deviations from the mean were excluded. Thus, the final sample consisted of 102 vets (41 males and 61 females).

Descriptive statistics for the overall sample and for males and females separately were first computed, dichotomizing categorical variables, forming yes/no factors. Then, a Categorical Principal Components Analysis (CATPCA) was performed for data reduction, so as to provide a readable representation of the sample. CATPCA is a method for reducing dimensionality of categorical data through the analysis of their correlation or dependence, maximizing the amount of variance accounted for with respect to the total variability of the data.

Total scores on the AES and EQ scales were computed as the sum of the scores of the respective items. The internal consistency of both scales was assessed using Cronbach's alpha, which proved to be good both for AES (.68) and EQ (.85).

Pearson correlation was used to assess the interrelation between empathy for animals and for people and between age and length of career.

Prior to inferential modeling, gender differences were tested, with independent samples tests, namely parametric t-tests for continuous variables and non-parametric Mann-Whitney U test for categorical ones. Then, a multivariate analysis of covariance (MANOVA) model was run to test for the effect of gender and length of career on AES and EQ total scores as response variables, since the two scales were significantly correlated and therefore required a bivariate model including both continuous and categorical explanatory variables. Before running the analysis, Box's *M* test for homogeneity of covariance matrices was checked and resulted not significant ( $p=0.463$ ), meeting a crucial assumption of the model.

All statistical analyses were performed using IBM Spss 22®.

## **Results**

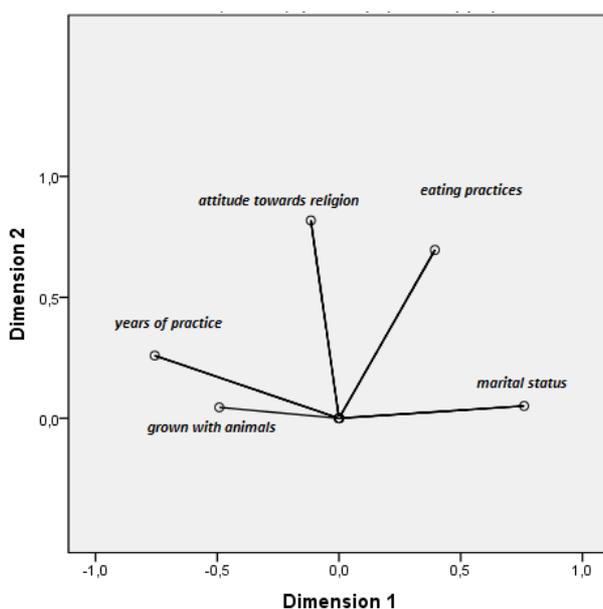
With respect to the first part of the questionnaire, descriptive statistics for the overall sample and for males and females separately are summarised in Table 3.4 with categorical variables dichotomized forming yes/no factors in order to obtain a neat representation of the sample. Male vets were on average 6 years older and hence more experienced (17.39 years of practice on average versus 12.8 years), had more post-degree specializations (43.9% versus 36.1%) and were more often married (65.9% versus 49.5%) than their female colleagues. Conversely, a larger percentage of female vets

owned pets (though both past and current pet-ownership were very common practices in the whole sample), expressed no religious beliefs, professing either atheism or agnosticism (42.6% versus 31.2%) and had a vegetarian or vegan diet (26.2% versus 7.3%)

**Table 3.4:** Descriptive statistics for socio-demographic and professional traits

	Age	Length of career	Specialization	Marital status	Pet-ownership in the past	Pet-ownership at present	Atheist/agnostic	Vegetarian/vegan
	(years)				(%)			
<i>males</i>	45,76 (9,57)	17,39 (10,22)	43.9	65.9	73.2	82.9	31.2	7.3
<i>females</i>	39,52 (9,53)	12,18 (9,32)	36.1	45.9	80.3	88.5	42.6	26.2
<i>overall</i>	42,05 (9,58)	14,27 (9,58)	39.2	53.9	77.5	86.3	37.2	19.4

Results from CATPCA showed that descriptive data formed two main dimensions: length of career, age, past pet-ownership and marital status tended to align along the first dimension, whereas life stances, in terms of religious beliefs or eating habits contributed most to the second dimension (see Figure 3.2).



**Figure 3.2:** Data dimensional reduction (CATPCA): proximity of traits of professionals in veterinary medicine

Inferential analysis for gender differences proved significant for age and length of career, while

male and female vets did not differ significantly on most of the professional or personal traits, let alone percentages in married status and meat consumption (Table 3.5).

**Table 3.5:** Gender differences for socio-demographic and professional traits

Variable		Sig.
<i>t</i> -test	<i>Age</i> **	0.002
	<i>Years of practice</i> **	0.009
Mann-Whitney - <i>U</i>	<i>Married</i> *	0.049
	<i>Specialization</i>	0.429
	<i>Pet owned in the past</i>	0.399
	<i>Pet owned currently</i>	0.423
	<i>No religious beliefs</i>	0.174
	<i>No meat consumption</i> *	0.011

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

There was a significant correlation between AES and EQ scores ( $rp=0.353, p<0.01$ ), therefore a multivariate analysis of covariance (Mancova) was performed in order to explore the potential influence of length of career, eating habits, religious beliefs, pet ownership, marital status and gender on empathy towards animals and towards people; age was excluded due to multicollinearity, for its high correlation to length of career ( $rp=0.92, p<0.001$ ), that was expected, since veterinary medicine is a lifetime profession.

No transformations for skewness were needed, thanks to the low values of the corresponding index (skewness: AES -0.151; EQ -0.032). Among categorical variables, only gender significantly affected the two empathy variables or their interaction and therefore all other variables were eliminated. After discarding the interaction between gender and length of career, as non significant [ $F(2,98) = 0.90, p=.41$ ], results from MANCOVA revealed a significant multivariate test both for gender [ $F(2, 98) = 5.848, p < .05$ ] and for length of career [ $F(2, 98) = 4.928, p < .01$ ]. So as to decompose the overall bivariate effect, Mancova estimation procedures proceeded to univariate analysis on each response, showing only gender as a significant predictor of AES [ $F(1, 99) = 11.520, p < .05, M_{female} = 154.92, M_{male} = 145.05$ ], unlike length of career [ $F(1, 99) = .740, p = .255$ ]. Conversely, length of career was a significant predictor of the increase in EQ [ $F(1, 99) = 8.949, p < .01$ , whilst gender was not [ $F(1, 99) = 2.717, p = .138$ ; females' mean score = 43.13; S.D. = 9.93; males' mean score = 42.09; S.D. = 11.48].

## Discussion

The aim of this study was to investigate empathy towards animals and humans in veterinary professionals, assessing whether and to what extent gender and length of service influence them.

The characteristics of our sample, showing a greater number of female than male vets among younger professionals, confirm the general remark of a dramatic increase in women presence in veterinary medicine (Lofstedt, 2003; Irvine & Vermilya, 2010) also in Italy.

Albeit the profusion of in-depth investigations on the phenomenon in educational and work studies (i.e., Rucker, 2002; Chieffo et al., 2008; Narver, 2007; Heath & Lanyon, 1996; Lincoln, 2010), its impact on the renewal of professional attitudes and profiles has often been unattended. In this regard, our results showed that female vets differed significantly from their male colleagues not only for the length of their career, but also in some categorical variables such as marital status, with more men than women being married, and eating habits, with a higher percentage of women adopting a vegetarian diet. The CATPCA showed that these variables characterized the sample along two main dimension, with marital status aligned with age and length of career along a “time dimension”, so that male were more likely to be married and to have longer careers (likely because of their older age), and with eating habits and religious beliefs contributing to a second dimension related to “life stances”. Furthermore, in line with results from previous studies carried out on general population, pet owners and veterinary students (Paul & Podberscek, 2000; Signal & Taylor, 2007; Preylo & Arikawa, 2008; Ellingsen et al., 2010; Colombo et al., in press), female vets scored higher than males on the Animal Empathy Scale, although both obtained quite high scores (cf. Colombo et al., in press).

Taken together, these results suggest that the feminization of veterinary profession is not only an inversion of the gender gap but it may also entail some renewal in the profile and attitudes of veterinarians; in particular, the fact that female vets were more likely to adopt a vegetarian diet and showed an higher level of empathy towards animals than male vets hints a more sensitive attitude towards animals at least in companion animal practice, especially in comparison to studies that described tough-minded and detached role models in veterinary medicine (O’Farrell, 1990; Blackshaw & Blackshaw, 1993; Paul & Podberscek, 2000). Furthermore, gender differences in empathy towards animals, with female vets being more empathic, don’t confirm what suggested by Hart and Melese d’Hospital (1989, cited in Paul & Podberscek, 2000), namely that male and female veterinary students may adopt the same attitude towards animals as the course proceeds. In fact, although a number of studies found a decline in veterinary students’ empathy towards animals from the first to the last year of course, females’ scores remained always significantly higher than males’ ones (Paul & Podberscek, 2000; Colombo et al., 2015) and our results prove that this difference remains also after entering the profession.

Moreover, interestingly we found that length of career did not affect empathy towards animals, suggesting only a stable effect of gender.

In recent years, a number of studies has underlined the necessity to adopt a more empathic and caring approach towards animals especially by vets working with pets, in order to improve both animal well-being (Martinsen, 2007; Carney et al., 2012; Norring et al., 2014) and professional success (Hazel et al., 2011; Mitchener & Ogilvie, 2012; Carney et al., 2012): our results appear to point out that this change is currently happening, fostered by the gender shift in veterinary practice. With respect to empathy towards people, we found no significant difference between male and female vets, whose scores were in a normal range (Baron-Cohen, 2011) and comparable to those reported for the Italian population (Preti et al., 2011); however an effect of length of career emerged, with more experienced vets scoring higher on EQ than their younger colleagues. This result is in line with that reported by Handford and colleagues (2013) in physicians, who found a linear trend related to medical practice and age in EQ scores, with older participants obtaining higher scores. Furthermore, these authors found that the medical group performed better than the control group on the eye task, a behavioural measure of empathy, and that, while in the control group performance declined with age, doctors didn't exhibit the same decrease. Given the lack of a control group, we cannot establish whether our results in the veterinarians' sample are due to a general developmental factor related to age, or if, as in physicians, clinical practice may be instrumental to maintain empathic abilities also in vets. However, this finding is interesting especially in the light of the studies that outline the importance of showing empathy towards the clients during companion-animal consultations in order to improve their satisfaction (Timmins, 2006; McArthur & Fitzgerald, 2013). Furthermore, Shaw and colleagues (2012) suggested that empathy enhanced vets' ability to build positive relationships with clients and found that it was related also to vets' satisfaction with the visit.

Taken together, results on empathy towards animals and towards people in our sample of Italian vets suggest a positive profile of the current status of veterinary medicine in the field of companion animal practice, characterized by professionals who report good levels of empathy both towards animals and towards people, meeting pet owners' and society expectations, that ask for caring and compassionate vets (Brown et al., 1999; Hazel et al., 2011; Timmins, 2006; Martinsen, 2007; Mitchener & Ogilvie, 2002; Carney et al., 2012). Furthermore, it is likely that the feminization of veterinary profession plays a role in the diffusion of a more empathic attitude towards animals in companion-animal practice. However, further studies, adopting also behavioural measures of empathy, are required to confirm these findings and to verify whether they can be generalized also to vets working in other areas of veterinary medicine, such as intensive farming or biomedical research and to other countries.

Finally, its worth noting that an empathic over-arousal in professional contexts that entail a daily exposure to suffering can be a source of pathological conditions such as compassion fatigue and

burn-out (i.e.; Hoffman, 2000). Even if some studies indicated that vets may be at risk of burnout (i.e., Mitchener & Ogilvie, 2002; Hatch et al., 2011) to our knowledge no study has investigated the relation between empathy, compassion fatigue and burnout in veterinary medicine, therefore future studies should address this issue, in order to understand to what extent empathy may be a professional tool and a source of job satisfaction for vets or, conversely, it may represent a risk factor for job-related pathological conditions.

### **3.5 Chapter conclusions**

Veterinary medicine represents an interesting context to study empathy towards animals, which is related to recognition of pain in animals, positive attitudes and humane behaviour towards them. However, according to a number of studies empathy towards animals seems to decline during veterinary education and veterinary students are reported to be less convinced about animal mind and sentience. Moreover, the available knowledge on empathy towards animals in practicing vets is almost lacking, despite the importance it has in curing and caring for their non-human patients. Finally, there is some evidence suggesting that, at least in companion animal practice, also empathy towards humans is a highly required skill for vets, improving vet-client relationship and clients' satisfaction, but studies on this issue are still very limited.

To my knowledge no study has been carried out in Italy either on veterinary students or on practicing vets: thus, it was unknown whether the findings obtained in other countries could be generalized also to our country and there were no data on how empathy towards animals varies after entering the veterinary profession.

The results of my work on Italian veterinary students confirmed that also in Italy empathy towards animals varies from the first to the last year of veterinary education, with fifth year students being less empathic and adopting a more instrumental attitude towards animals than first year students. However, students' scores on the Animal Empathy Scale were always quite high, although a clear and stable effect of gender emerged, with females scoring higher than males. Similar results were found also in the study on practicing vets working in companion animal medicine, where women reported higher levels of empathy towards animals than men; however, length of career didn't affect empathy towards animals, whose values were quite high in the whole sample, comparable to those of fifth-year veterinary students. Conversely, there was an effect of length of career on empathy towards people, with older vets scoring higher than their younger colleagues.

Interestingly, the characteristics of the sample of practicing vets confirmed the ongoing process of feminization noticed in veterinary medicine and, taken together, results draw a positive profile of

the companion-animal practice, with vets being empathic both towards animals and people, two aspects that are important both for animals' well-being and clients' satisfaction. This suggests a renewal of the profession, likely linked to the gender shift, characterized by attitudes that are quite distant from those of the "though-minded" and "detached" vets reported in studies carried out about twenty years ago.

Further studies are required to evaluate whether empathy may represent a risk for pathological conditions such as burnout or compassion fatigue in vets, and longitudinal studies are needed to confirm the role of veterinary education in the observed empathy decline.

## References

- Adams CL, Conlon PD and Long KC 2004 Professional and veterinary competencies: addressing human relations and the human-animal bond in veterinary medicine. *Journal of Veterinary Medical Education* 31 (1): 67-72
- Al-Fayez G, Awadalla A, Templer DI and Arikawa H 2003 Companion animal attitude and its family pattern in Kuwait. *Society & Animals* 11 (1): 17-28
- Apostol L, Rebeaga OL and Miclea M 2013 Psychological and socio-demographic predictors of attitudes toward animals. *Procedia – Social and Behavioral Sciences* 78: 521 – 525
- Arluke A 2004 The use of dog in medical and veterinary training: understanding and approaching student uneasiness. *Journal of Applied Animal Welfare Sciences* 7 (3): 197-204
- Arluke A and Hafferty F 1996 From apprehension to fascination with “dog lab” - the use of absolutions by medical students. *Journal of Contemporary Ethnography* 25 (2): 201-225
- Austin EJ, Evans P, Magnus B and O’Hanlon K 2007 A preliminary study of empathy, emotional intelligence and examination performance in MBChB students. *Medical Education* 41: 684 – 689
- Bandstra NF, Chambers CT, McGrath PJ and Moore C 2011 The behavioural expression of empathy to others’ pain versus others’ sadness in young children. *Pain*, 152: 1074-1082
- Baron-Cohen S and Wheelwright S 2004 The Empathy Quotient: an investigation of adults with Asperger Syndrome or High Functioning Autism, and normal sex difference. *Journal of Autism and Developmental Disorders* 34 (2): 163-175
- Baron-Cohen, S. (2011). *The science of evil: On empathy and the origins of cruelty*. Basic books.
- Barnett, J. L., & Hemsworth, P. H. (2009). Welfare monitoring schemes: using research to safeguard welfare of animals on the farm. *Journal of Applied Animal Welfare Science*, 12(2), 114-131.
- Berg K, Majdan JF, Berg D, Veloski J and Hojat M 2011 Medical students' self-reported empathy and simulated patients' assessments of student empathy: an analysis by gender and ethnicity. *Academic Medicine* 86 (8): 984-988
- Birke LI and Arluke A 2007 *The sacrifice: How scientific experiments transform animals and people*. Purdue University Press
- Blackshaw J., & Blackshaw A.W.(1993). Student perceptions of attitudes to the human-animal bond. *Anthrozoos* 6, 190-198
- Broom, D. M. (2014). *Sentience and Animal Welfare*. CABI.
- Brown JP, Silverman JD (1999). The current and future market for veterinarians and veterinary medical services in the United States. *Journal of the American Veterinary Medical Association* 215:161–183.
- Burks DJ and Kobus AM 2012 The legacy of altruism in health care: the promotion of empathy, prosociality and humanism. *Medical Education* 46: 317-325

- Butterfield ME, Hill SE and Lord CG 2012 Mangy mutt or furry friend? Anthropomorphism promotes animal welfare. *Journal of Experimental Social Psychology* 48 (4): 957-960
- Capner CA, Lascelles BD and Waterman-Pearson AE 1999 Current British veterinary attitudes to perioperative analgesia for dogs. *Veterinary Record* 145 (4): 95-99
- Carney HC, Little S, Brownlee-Tomasso D, Harvey AM, Mattox E, Robertson S, Rucinsky R and Manley DS 2012 AAEP and ISFM feline-friendly nursing care guidelines. *Journal of Feline Medicine and Surgery* 14: 337-349
- Chieffo, C., Kelly, A. M., & Ferguson, J. (2008). Trends in gender, employment, salary, and debt of graduates of US veterinary medical schools and colleges. *Journal of the American Veterinary Medical Association*, 233(6), 910-917.
- Colombo E.S., Pelosi A. and Prato-Previde E. (in press). Empathy towards animals and belief in animal-human-continuity in Italian veterinary students. *Animal Welfare*
- Conrad, D., & Kellar-Guenther, Y. (2006). Compassion fatigue, burnout, and compassion satisfaction among Colorado child protection workers. *Child abuse & neglect*, 30(10), 1071-1080.
- Daly B and Morton LL 2008 Empathic correlates of witnessing the inhumane killing of an animal: an investigation of single and multiple exposures. *Society and Animals* 16: 243 – 255
- Davis MH 1980 A multidimensional approach to individual differences in empathy. *Journal of the Siena Academy of Science - Catalogue of Selected Documents in Psychology* 10: 85-104
- Decety, J., & Jackson, P. L. (2004). The functional architecture of human empathy. *Behavioral and cognitive neuroscience reviews*, 3(2), 71-100.
- Decety J and Lamm C 2011 *Empathy versus Personal Distress: Recent Evidence from Social Neuroscience*. In: Decety J and Ickes W (eds) *The social neuroscience of empathy* pp. 199 – 213. MIT Press
- Derntl B, Hack RL, Kryspin-Exner I and Habel U 2013 Association of menstrual cycle phase to the core components of empathy. *Hormones and Behaviour* 63: 97-104
- de Vignemont F. & Singer T. (2006). The empathic brain: how, when and why?. *Trends in Cognitive Science*, 10 (10), 435-441.
- de Waal FBM 2008 Putting the altruism back into altruism: the evolution of empathy. *Annual Review of Psychology* 59: 279-300
- Drwecki BB, Moore CF, Ward SE and Prkachin KM 2011 Reducing racial disparities in pain treatment: the role of empathy and perspective taking. *Pain* 152: 1001-1006
- Dziobek I, Rogers K, Fleck S, Bahnemann M, Heekeren H.R., Wolf OT and Convit A 2008 Dissociation of cognitive and emotional empathy in adults with Asperger Syndrome using the Multifaced Empathy Test (MET). *Journal of Autism and Developmental Disorders* 38: 464-473.
- Eisenberg N., Carlo G., Murphy B. and Van Court P. (1995). Prosocial development in late adolescence: a longitudinal study. *Child Development*, 66, 1179-1197.

- Ellingsen K, Zanella AJ, Bjerkås E and Indrebo A 2010 The relationship between empathy, perception of pain and attitudes toward pets among Norwegian dog owners. *Anthrozoös* 23 (3): 231-243
- Endenburg, N. (1995). The attachment of people to companion animals. *Anthrozoös*, 8(2), 83-89.
- Halpern, J. (2003). What is clinical empathy? *Journal of general internal medicine*, 18(8), 670-674.
- Filippi M, Riccitelli G, Falini A, Di Salle F, Vuilleumier P, Comi G and Rocca MA 2010 The brain functional networks associated to human and animal suffering differ among omnivores, vegetarians and vegans. *PlosOne* 5 (5): e10847
- Fischer ML and Tamioso PR 2013 Perception and position of animals used in experimentation by students and teachers of different academic fields. *Estudos de Biologia* 35 (84): 85-98
- Fox J, Nie Z and Byrnes J 2014. sem: Structural Equation Models. R package version 3.1-5. <http://CRAN.R-project.org/package=sem>
- Hamood, W. J., Chur-Hansen, A., & McArthur, M. L. (2014). A qualitative study to explore communication skills in veterinary medical education. *International journal of medical education*, 5, 193.
- Handford, C., Lemon, J., Grimm, M. C., & Vollmer-Conna, U. (2013). Empathy as a function of clinical exposure-Reading Emotion in the Eyes. *PloS one*, 8(6), e65159.
- Harrison MA and Hall AE 2010 Anthropomorphism, empathy and perceived communicative ability vary with phylogenetic relatedness to humans. *Journal of Social, Evolutionary and Cultural Psychology* 4 (1): 34-48
- Hart LA and Melese-d'Hospital P 1989 The gender shift in the veterinary profession and attitudes toward animals: A survey and overview. *Journal of Veterinary Medical Education* 16: 27-30.
- Hatch, P. H., Winefield, H. R., Christie, B. A., & Lievaart, J. J. (2011). Workplace stress, mental health, and burnout of veterinarians in Australia. *Australian veterinary journal*, 89(11), 460-468.
- Hazel SJ, Signal T and Taylor S 2011 Can teaching veterinary and animal-science students about animal welfare affect their attitude toward animals and human-related empathy? *Journal of Veterinary Medical Education* 38 (1):74-83
- Heath TJ, Lanyon A 1996 A longitudinal study of veterinary students and recent graduates: 4. Gender issues *Australian Veterinary Journal* 74 (4): 305-308
- Heath TJ, Lynch-Blosse M, Lanyon A 1996 A longitudinal study of veterinary students and recent graduates: 1. Backgrounds, plans and subsequent employment. *Australian Veterinary Journal* 74: 291-296.
- Heiser, W. J., & Meulman, J. J. (1994). Homogeneity analysis: Exploring the distribution of variables and their onlinear relationships. In M. Greenacre & J. Blasius (Eds.), *Correspondence analysis in the social sciences: Recent developments and applications* (pp. 179-209). New York: Academic Press.

- Hellyer PW, Casey F, Lacy M, Salman MD, Wagner AE 1999 Attitudes of veterinary medical students house officers clinical faculty and staff toward pain management in animals. *Journal of American Veterinary Medical Association* 214: 238–244
- Hemsworth P.H., Barnett J.L. and Coleman G.J. (2009). The integration of human-animal relations into animal welfare monitoring schemes. *Animal Welfare*, 18, 335-345.
- Herzog, H. A. (1993). “The movement is my life”: the psychology of animal rights activism. *Journal of Social Issues*, 49(1), 103-119.
- Hills AM 1993 The motivational bases of attitudes toward animals. *Society & Animals* 1 (2): 111-128
- Hills AM 1995 Empathy and belief in the mental experience of animals. *Anthrozoös* 8: 132–142
- Hoffman M.L. (2000). *Empathy and moral development. Implications for caring and justice*. Cambridge University Press, Cambridge.
- Hojat M, Gonnella, JS, Nasca TJ, Mangione S, Vergare M and Magee M 2002. Physician empathy: definition, components, measurement, and relationship to gender and specialty. *American Journal of Psychiatry* 159 (9), 1563-1569
- Hojat M, Vergare MJ, Maxwell K, Brainard G, Herrine SK, Isenberg GA, Veloski J and Gonnella JS 2009. The devil is in the third year: a longitudinal study of erosion of empathy in medical school. *Academic Medicine* 84 (9): 1182-1191
- Huberty, Carl J.; Morris, John D. Multivariate analysis versus multiple univariate analyses. *Psychological Bulletin*, Vol 105(2), Mar 1989, 302-308
- Irvine, L., & Vermilya, J. R. (2010). Gender Work in a Feminized Profession The Case of Veterinary Medicine. *Gender & Society*, 24(1), 56-82.
- Jöreskog KG and Sörbom D 1984. LISREL VI Users guide (3<sup>rd</sup> edition). Scientific Software, Moorsville, IN
- Julius, H., Beetz, A., Kotrschal, K., Turner, D., & Uvnäs-Moberg, K. (2012). Attachment to pets. *An Integrative View of Human-Animal Relationships with Implications for Therapeutic Practice, Cambridge (MA)–Göttingen*.
- Knafo A, Zahn-Waxler C, Van Hulle C and Robinson JL 2008 The developmental origins of a disposition toward empathy: genetic and environmental contributions. *Emotion* 8 (6): 737-752
- Knight S, Vrij A, Cherryman J and Nunkoosing K 2004 Attitudes towards animals use and belief in animal mind. *Anthrozoös* 17 (1): 43-62
- Levine ED, Mills DS and Houpt KA 2005 Attitudes of veterinary students at one US college toward factors relating to farm animals welfare. *Journal of Veterinary Medical Education* 32 (4): 481-490
- Lincoln, A. E. (2010). The shifting supply of men and women to occupations: feminization in veterinary education. *Social Forces*, 88(5), 1969-1998.

- Lofstedt, J. (2003). Gender and veterinary medicine. *The Canadian Veterinary Journal*, 44(7), 533.
- Main DCJ 2010 Evolution of animal-welfare education for veterinary students. *Journal of Veterinary Medical Education* 37 (1): 30-35
- Martinsen S 2007 Training the animal doctor: caring as a clinical skill. *Alternatives to Animal Testing and Experimentation* 14 Special Issue: 269-272
- Maslach, C. (1993). *Burnout: A multidimensional perspective*.
- McArthur, M. L., & Fitzgerald, J. R. (2013). Companion animal veterinarians' use of clinical communication skills. *Australian veterinary journal*, 91(9), 374-380.
- McDermott, M. P., Tischler, V. A., Cobb, M. A., Robbé, I. J., & Dean, R. S. (2015). Veterinarian-Client Communication Skills: Current State, Relevance, and Opportunities for Improvement. *Journal of veterinary medical education*, 1-10.
- Mercer, S. W., & Reynolds, W. J. (2002). Empathy and quality of care. *British Journal of General Practice*, 52, S9-S11.
- Meyer I, Forkman B and Paul ES 2014 Factors affecting the human interpretation of dog behaviour. *Anthrozoös* 27 (1): 127-140
- Michalec L. (2011). Learning to cure, but learning to care? *Advances in Health Sciences Education*, 16, 109-130.
- Mitchner KL and Ogilvie GK 2002 Understanding compassion fatigue: keys for the caring veterinary healthcare team. *Journal of the American Animal Hospital Association* 38: 307-310
- Narver, H. L. (2007). Demographics, moral orientation, and veterinary shortages in food animal and laboratory animal medicine. *Journal of the American Veterinary Medical Association*, 230(12), 1798-1804.
- Neumann M, Edelhäuser F, Tauschel D, Fischer MR, Wirtz M, Woopen C, Haramati A and Scheffer C 2011 Empathy decline and its reasons: a systematic review of studies with medical students and residents. *Academic Medicine*, 86(8), 996-1009
- Norring M, Wikman I, Hokkanen AH, Kujala MV and Hänninen L 2014 Empathic veterinarians score cattle pain higher. *The Veterinary Journal* 200 (1): 186-190
- Nunes P, William S, Sa B and Stevenson K 2011 A study of empathy decline in students from five health disciplines during their first year of training. *International Journal of Medical Education* 2: 12-17
- O'Farrell V 1990 Students' stereotypes of owners and veterinary practitioners. *Veterinary Record* 127: 625.
- Paice E, Heard S and Moss F 2002 How important are role models in making good doctors? *British Medical Journal* 325 (7366): 707
- Paul ES 2000 Empathy with animals and with humans: are they linked? *Anthrozoös* 13 (4): 194-202

- Paul ES and Podberscek AL 2000 Veterinary education and students' attitudes towards animal welfare. *The veterinary record* 146: 269-272
- Phillips CJC 2014 Effects of field of study on university students' attitudes towards animal issues. *Animal Welfare* 23: 459 – 466
- Phillips CJC, Izmirli S, Aldavood SJ, Alonso M, Choe BI, Hanlon A, Handziska A, Illman G, Keeling L, Kennedy M, Lee GH, Lund V, Mejdell C, Pelagic VR and Rehn T 2012 Students' attitudes to animal welfare and rights in Europe and Asia. *Animal Welfare* 21(1): 87-100
- Pillai Riddell RR and Craig KD 2007 Judgments of infant pain: the impact of caregiver identity and infant age. *Journal of Pediatric Psychology* 32 (5): 501-511
- Porcher J 2006 Well-being and suffering in livestock farming: living conditions at work for people and animals. *Sociologie du travail* 48: e56-e70
- Porcher, J. (2011). The relationship between workers and animals in the pork industry: A shared suffering. *Journal of Agricultural and Environmental Ethics*, 24(1), 3-17.
- Preston SD and de Waal FBM 2002 Empathy: its ultimate and proximate bases. *Behavioral and Brain Sciences* 25 (1): 1-71
- Preti, A., Vellante, M., Baron-Cohen, S., Zucca, G., Petretto, D. R., & Masala, C. (2011). The Empathy Quotient: A cross-cultural comparison of the Italian version. *Cognitive Neuropsychiatry*, 16(1), 50-70.
- Preylo B.D. & Arikawa H. (2008). Comparison of vegetarians and non-vegetarians on pet attitude and empathy. *Anthrozoös*, 21 (4), 387-395.
- Prguda E and Neumann DL 2014 Inter-human and animal-directed empathy: A test for evolutionary biases in empathetic responding. *Behavioural Processes* 108: 80-86
- Rodan I, Sundahi E, Carney H, Gagnon A, Heath S, Landsberg G, Seksel K and Yin S 2011 AAFP and ISFM feline-friendly handling guidelines. *Journal of Feline Medicine and Surgery* 13: 364 – 375
- Roth-Hanania R, Davidov M and Zahn-Waxler C 2011 Empathy development from 8 to 16 months: early signs of concern for others. *Infant Behaviour & Development* 34: 447-458
- Rothgerber H 2014 A Comparison of attitudes toward meat and animals among strict and semi-vegetarians. *Appetite* 72: 98-105
- Rucker, M. J. (2002). Gender changes and the future of our profession. *Journal of veterinary medical education*, 29(2), 63-65.
- Serpell JA 2003 Anthropomorphism and anthropomorphic selection: Beyond the “cute response.” *Society & Animals* 11(1): 83–100
- Serpell JA 2005 Factors influencing veterinary students' career choices, and attitudes to animals. *Journal of Veterinary Medical Education* 32: 491-496

- Schulte-Rüther M, Markowitsch HJ, Shah NJ, Fink GR and Piefke M 2008 Gender differences in brain networks supporting empathy. *NeuroImage* 42: 393-403.
- Shaw, J. R., Adams, C. L., Bonnett, B. N., Larson, S., & Roter, D. L. (2012). Veterinarian satisfaction with companion animal visits. *Journal of the American Veterinary Medical Association*, 240(7), 832-841.
- Sherman BL and Serpell JA 2008 Training veterinary students in animal behavior to preserve the human–animal bond. *Journal of veterinary medical education* 35(4): 496-502.
- Shurtleff RS, Grant P, Zeglen ME, McCulloch WF and Bustad LK 1983. A nationwide study of veterinary students' attitudes on ethical issues. *Journal of Veterinary Medical Education*, 9: 93–96.
- Signal TD and Taylor N 2006 Attitudes to animals: Demographics within a community sample. *Society & Animals* 14(2): 147–157
- Signal TD and Taylor N 2007 Attitude to animals and empathy: Comparing animal protection and general community samples. *Anthrozoös* 20(2): 125–130
- Singer, T., & Klimecki, O. M. (2014). Empathy and compassion. *Current Biology*, 24(18), R875-R878.
- Steiger JH and Lind JC 1980. Statically – based tests fort he number of common factors. *Paper presented at the Annual Spring Meeting of the Psychometric Society in Iowa City, May 30.*
- Taylor H, Williams P and Gray D 2004 Homelessness and dog ownership: an investigation into animal empathy, attachment, crime, drug use, health and public opinion. *Anthrozoös* 17 (4): 353-368
- Taylor N and Signal TD 2005 Empathy and attitudes to animals. *Anthrozoös* 18 (1): 18-27
- Templer DI, Connelly HJ, Bassman L and Hart J 2006 Construction and validation of an animal-human continuity scale. *Social Behavior and Personality* 34 (7): 769-776
- Timmins, R. P. (2006). How does emotional intelligence fit into the paradigm of veterinary medical education?. *Journal of veterinary medical education*, 33(1), 71-75.
- Westbury HR and Neumann DL 2008 Empathy-related responses to moving film stimuli depicting human and non-human targets in negative circumstances. *Biological Psychology* 78: 66-74
- Würbel H 2009 Ethology applied to animal ethics. *Applied Animal Behaviour Science*, 118: 118-127
- Verbeke, W. A., & Viaene, J. (2000). Ethical challenges for livestock production: Meeting consumer concerns about meat safety and animal welfare. *Journal of Agricultural and Environmental Ethics*, 12(2), 141-151.
- Voith, V. L. (1985). Attachment of people to companion animals. *The Veterinary Clinics of North America. Small Animal Practice*, 15(2), 289-295.

Wemelsfelder, F., & Lawrence, A. B. (2001). Qualitative assessment of animal behaviour as an on-farm welfare-monitoring tool. *Acta Agriculturae Scandinavica, Section A-Animal Science*, 51(S30), 21-25.

Würbel H. (2009). Ethology applied to animal ethics. *Applied Animal Behaviour Science*, 118, 118-127.

## ***Chapter 4 –Animal Hoarding: a mental disorder related to anomalies in empathy towards animals?***

In psychopathology, a number of conditions entails a deficit either in the affective or in the cognitive component of empathy towards people: for instance, impairment in empathic abilities have been reported in sociopathy, conduct disorders, borderline and narcissistic personality disorder, autism spectrum disorders, stroke and traumatic brain injury (Decety & Jackson, 2004; Baron-Cohen, 2011). In particular, Baron-Cohen (2011), in his book “*The science of evil: on empathy and the origins of cruelty*”, suggested that antisocial, borderline and narcissistic personality disorders and autism spectrum disorders could be better understood and treated if classified as empathy-related disorders, since their core features is an impaired empathic ability. Interestingly the author mentioned also an opposite condition of “super-empathy”, which characterizes those people whose empathy levels are highly above the average and which might lead to pathological altruism, an other-oriented behaviour that derives from the aim to promote the welfare of another but results in negative consequences to the others or to the self (Oakley, 2011).

It’s worth noting that no official classification has recognized mental disorders specifically related to empathy towards animals; its impairment is implicitly reported only among diagnostic criteria for Conduct Disorder, as “cruelty to animals” (DSM-5, 2013).

However, empathy towards animals seems to be the core element of the Animal Hoarding Disorder, an almost unknown psychopathology that afflicts people who declare to feel the mission to save animals and own a great number of animals, but actually use them to support their own emotional needs and fail to satisfy animals’ basic needs, with dramatic consequences on animal welfare, household sanitary conditions and hoarder’s well-being (Patronek, 1999). Therefore, empathy towards animals is a crucial but controversial element in this mental disorder, that seems to arise from a very high level of empathy but has as a consequence egoism and cruelty, reflecting an absolute lack of empathy towards animals (Nathanson & Patronek, 2011).

Recently, in the new edition of DSM (The Diagnostic and Statistical Manual of Mental Disorder – 5, 2013), Animal Hoarding has been reported within the associated features supporting the diagnosis of “Hoarding Disorder”, thus classified as a special manifestation of this pathology.

Hoarding Disorder was included for the first time among the disorders described in the DSM two years ago and is defined by four main criteria:

- A. *Persistent difficulty discarding or parting with possessions, regardless of their actual value (this may be accompanied by excessive acquisition of items that are not needed or for which there is no available space).*
- B. *This difficulty is due to a perceived need to save the items and to distress associated to discarding them.*
- C. *The difficulty discarding possessions results in the accumulation of possessions that congest and clutter active living areas and substantially compromises their intended use.*
- D. *The hoarding causes significant distress or impairment in social, occupational, or other important areas of functioning (including maintaining a self environment for self and others).*

It's worth noting that the DSM doesn't specify the nature of the hoarded items and, considering animal hoarding as a special manifestation of hoarding disorder, it doesn't distinguish the hoarding of objects from the hoarding of animals, that are considered properties also in accordance with the law.

Yet, animals are sentient beings (Broom, 2014), thus they can't be regarded as "items that are difficult to discard"; moreover, the crucial features of animal hoarding is not the number of animals, but the hoarders' failure to recognize animals' needs and suffering (Patronek, 1999), which suggests a marked impairment in empathy that, along with worse sanitary conditions and poorer insight, make animal hoarding more serious than object hoarding (Frost et al., 2011).

Although animal hoarding has been object of a number of studies in the last fifteen years (see Colombo & Prato-Previde, 2014 and Frost et al., 2015 for a review), little is known about its aetiology and prevalence, with studies estimating from 700 to 2000 new cases per year in the USA (Patronek, 1999), where almost all the research about animal hoarding has been carried out so far; cases of animal hoarding have been reported also in Spain (Calvo et al., 2012), Serbia (Vučinić & Dimitrijević, 2007) and Australia (Joffe et al. 2014; Ockenden et al., 2014), but the problem is likely underestimated and still understudied. In particular, in Italy this disorder is poorly recognized and almost unknown and its prevalence has never been investigated so far, although media and press often report cases of animal hoarding, explaining them as cases of animal cruelty or "too much love for animals", as happened more than ten years ago in the USA, when the problem started to be studied (Arluke et al., 2002).

For these reasons, before the Italian version of DSM-5 was published, I wrote a critical review of the international literature on animal hoarding, which was published in Italian in *Ricerche di Psicologia*, in order to inform Italian mental health professionals about this disorder; in this review I discussed the phenomenon of animal hoarding in the light of findings about normal human-animal

relationships and empathy towards animals. Furthermore, my colleagues and I published a jargon-free book on animal hoarding, with the collaboration of experts from psychological, psychiatric, legal and veterinary disciplines. This book aimed at presenting the complexity of the phenomenon through press reports and research evidences, suggesting also new perspectives of interdisciplinary treatment of animal hoarding cases, not limited to the simple removal of the animals, as suggested by Patronek and colleagues (2006).

Either the review and the book are the first publications on animal hoarding in Italy and are presented in the following sections (for editorial reasons, I insert only an abstract and the cover of the book – see Figure 4.1).

## 4.1 Study 6 - Animal Hoarding: lifestyle, animal abuse or psychopathology? A critical review of the literature

Authors: Elisa Silvia Colombo & Emanuela Prato-Previde

Published in *Ricerche di Psicologia*

*ANIMAL HOARDING* – ACCUMULO DI ANIMALI:  
STILE DI VITA, MALTRATTAMENTO O PSICOPATOLOGIA?  
UNA RASSEGNA CRITICA DELLA LETTERATURA

ANIMAL HOARDING:  
LIFESTYLE, ANIMAL ABUSE OR PSYCHOPATHOLOGY?  
A CRITICAL REVIEW OF THE LITERATURE

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### Riassunto

L'*Animal Hoarding* o accumulo di animali si verifica quando un individuo possiede un numero di animali che eccede la sua capacità di prendersene cura in modo adeguato. Ne conseguono la compromissione della qualità di vita della persona e delle condizioni dell'abitazione in cui vive, nonché una forte sofferenza per gli animali, che vanno incontro a malattia, inedia e morte. Tale fenomeno è stato a lungo considerato uno "stile di vita" e, anche se oggi viene riconosciuto come una forma di maltrattamento degli animali, solo recentemente è divenuto oggetto di attenzione da parte della comunità scientifica, che ha fornito diversi modelli per inquadrarlo nell'ambito dei disturbi mentali. Poiché in Italia l'accumulo di animali è poco conosciuto e studiato, il presente lavoro si propone di presentarne le caratteristiche e le principali ipotesi esplicative presenti in letteratura, con particolare riferimento al Disturbo da Accumulo (*Hoarding Disorder*), di cui è attualmente considerato una variante, e al ruolo del trauma; vengono inoltre descritti i punti di forza e di debolezza degli interventi finora attuati per la gestione dei casi di accumulo di animali, con l'intento di promuovere un approccio multidisciplinare. Infine, è dato uno speciale risalto all'interpretazione del comportamento di accumulo di animali in relazione al rapporto normale tra esseri umani e animali, incoraggiando lo sviluppo di nuove ricerche che tengano in considerazione anche gli aspetti dell'attaccamento e dell'empatia nei confronti degli animali, che finora sono stati affrontati solo a un livello puramente descrittivo.

E.S. Colombo & E. Prato-Previde / *Ricerche di Psicologia* 4 (2013) 317-360

**Parole chiave:** accumulo di animali; Disturbo da Accumulo, relazione uomo-animale, caregiving compulsivo, maltrattamento animale.

### **Abstract**

Animal hoarding occurs when an individual owns a number of animals that exceeds his/her ability to provide satisfactory caregiving. This failure results in starvation, illness and death of the animals and impairs both the conditions of the household and the person's quality of life. For a long time animal hoarding has been considered as a "lifestyle" but now it is deemed a form of animal maltreatment, yet only recently the scientific community has started to study it as a mental disorder, providing some explanatory models. Since Animal Hoarding occurs also in Italy but is still little known and studied, the aim of this review is to describe its main features and to introduce the most frequent hypothesis about its aetiology, with particular reference to Hoarding Disorder and to the role of trauma; moreover, strengths and weaknesses of current interventions will be analyzed, in order to promote an interdisciplinary approach to the problem. Special emphasis will be given to understand animal hoarding behaviour in the light of the normal human-pet bond, suggesting new research directions which consider aspects such as attachment and empathy toward animals.

**Keywords:** Animal Hoarding, Hoarding Disorder, human-animal bond, compulsive caregiving, animal maltreatment.

### **Introduzione**

Il nostro ambiente sociale include non solo gli esseri umani, ma anche altri animali, con alcuni dei quali formiamo legami affettivi molto intensi, connotati da un forte attaccamento emotivo e da un atteggiamento di cura e protezione nei loro confronti, tipico delle cure parentali osservate nel contesto della relazione tra madre e bambino e legato alla capacità di provare empatia nei loro confronti (Archer, 1997; Würbel, 2009).

Come nella maggior parte dei rapporti sociali, anche in quello con gli animali da compagnia, le persone non si preoccupano solo del benessere degli altri individui, ma cercano anche di soddisfare anche i propri bisogni personali (Baron Cohen, 2011, p. 155; Silk e House, 2011).

Il rapporto affettivo con gli animali è quindi normalmente vantaggioso sia per le persone, che ne ricavano benefici in termini di benessere fisico (Anderson et al., 1992; Friedmann e Thomas, 1995) e psicologico (Allen et al., 2002), sia per gli animali, che ricevono protezione, cibo e cure (Archer, 1997).

Tuttavia, esistono condizioni in cui prevale l'interesse personale e altre in cui l'eccessiva preoccupazione per gli animali compromette il be-

nessere della persona; in questi casi, il legame con gli animali da compagnia, come qualsiasi altro tipo di legame sociale (Silk e House, 2011), può diventare disfunzionale.

Un fenomeno del tutto particolare, caratterizzato da un rapporto con gli animali estremamente anomalo, che comporta distorsioni dell'attaccamento e dell'empatia nei loro confronti, è quello dell'Accumulo di Animali o *Animal Hoarding*, diventato oggetto di attenzione da parte della comunità scientifica solo negli ultimi quindici anni e tuttora poco compreso e variamente interpretato come uno stile di vita, una forma di maltrattamento degli animali o una psicopatologia vera e propria.

### **Il legame affettivo tra uomo e animali: attaccamento ed empatia**

Il possedere animali da compagnia, prendendosi cura di loro, è un comportamento così ampiamente diffuso tra gli esseri umani da aver portato gli scienziati a supporre l'esistenza di un meccanismo biologico alla base della possibilità di formare legami di attaccamento interspecifici (Serpell, 1987; Archer, 1997; Prato Previde et al., 2006; Bradshaw e Paul, 2010).

Diversi studi etologici hanno proposto che il comportamento di cura associato al legame di attaccamento rappresenti una risposta innata evocata da una serie di caratteristiche infantili (tra cui, fronte larga, occhi grandi, viso rotondo, movimenti goffi e alcuni tipi di segnali vocali), che agirebbero quindi come facilitatori sociali, rendendo i giovani più attraenti per gli adulti, innanzitutto per i loro genitori (Lorenz, 1943; Archer, 1997; Archer e Morton, 2011; Bradshaw e Paul, 2010).

Le donne sono generalmente più attratte dalle caratteristiche infantili rispetto agli uomini (Sprengelmeyer et al., 2009; Archer e Morton, 2011) e ciò costituirebbe una prova dell'origine evolutiva di questo fenomeno in relazione alle cure parentali (de Waal, 2008; Bradshaw e Paul, 2010).

L'efficacia dei tratti infantili nell'innescare i comportamenti di accudimento (aumentando quindi il successo evolutivo della specie) è tale che queste caratteristiche si presentano con una struttura analoga nei giovani di diverse specie di uccelli e mammiferi (Lorenz, 1943) e sono in grado di elicitare le cure parentali anche da parte di adulti appartenenti a specie diverse dalla propria (Archer, 1997): infatti, gli esseri umani giudicano attraenti non solo i bambini, ma anche, ad esempio, i pulcini di un giorno di età, i gattini e i cuccioli (Archer, 1997; Archer e Morton, 2011); inoltre, i volti non umani con caratteristiche infantili sono considerati altrettanto attraenti dei volti dei bambini, soprattutto da parte delle donne (Archer e Morton, 2011).

Proprio la somiglianza tra i connotati infantili degli esseri umani e quelli di altre specie animali sarebbe quindi all'origine della possibilità di un attaccamento interspecifico: una prova a favore di questo argomento è il fatto che preferiamo, come animali da compagnia, le specie che mantengono anche in età adulta tratti infantili (ad esempio cani e gatti), promuovendo inoltre tali caratteristiche neoteniche in modo attivo nella selezione artificiale delle razze (Archer, 1997).

Il comportamento di cura, ovvero l'insieme delle azioni finalizzate alla nutrizione e alla protezione di un altro individuo, è considerato l'emblema dei comportamenti prosociali, volti cioè a promuovere il benessere dell'altro e basati sull'empatia (de Waal, 2008; Bradshaw e Paul, 2010), definita come la capacità di identificare ciò che un altro individuo sta pensando o provando e di rispondere a quei pensieri e sentimenti con un'emozione corrispondente (Baron Cohen, 2011, p. 14).

Anche l'empatia, come l'attrazione per le caratteristiche infantili, risulta essere maggiore nelle donne che negli uomini, sia nei confronti delle altre persone (Davis, 1980; Baron-Cohen e Wheelwright, 2004) che nei confronti degli animali (Hills, 1993; Signal e Taylor, 2007; Ellingsen et al., 2010), probabilmente poiché anche questa capacità ha avuto origine nel contesto delle cure parentali, sotto forma di quel contagio emotivo che permette alla madre di cogliere immediatamente i bisogni del figlio e di rispondervi nel modo più adeguato (de Waal, 2008).

Quando si attiva in risposta a condizioni di sofferenza, l'empatia può determinare, oltre che un comportamento prosociale, anche un forte disagio personale (de Waal, 2008; Wetsbury e Neumann, 2008), limitato grazie ad alcuni meccanismi difensivi, strutturatisi nel corso della filogenesi della nostra specie (Hoffman, 2000; Pallotta, 2008) e legati innanzitutto agli effetti di somiglianza e di familiarità; tali meccanismi agiscono favorendo l'empatia verso chi si presenta simile a noi nell'aspetto o nel comportamento e verso coloro che conosciamo o con cui abbiamo condiviso esperienze (Hoffman, 2000).

Sulla base dell'effetto di somiglianza, è stato proposto che l'empatia verso gli animali possa costituire un "effetto psicologico collaterale" dell'empatia verso gli umani, determinato da caratteristiche degli animali che somigliano a quelle caratteristiche umane in grado di elicitare l'empatia tra le persone (Würbel, 2009): ad esempio, la modalità di espressione delle emozioni di base è comune alla maggior parte dei mammiferi (Darwin, 1872), nei quali espressioni facciali e vocalizzazioni mostrano una relazione universale tra la struttura e il contesto emotivo (Morton, 1977; Owings e Morton, 1998; Bloom e Friedman, 2013).

Accanto agli effetti di somiglianza e familiarità vi sono poi alcuni meccanismi di regolazione dell'empatia che entrano in gioco in maniera specifica quando l'individuo è esposto in modo prolungato alla sofferenza altrui.

Questi meccanismi, basati sull'abituazione alla sofferenza e sul distacco emotivo, sono stati inizialmente osservati studiando l'empatia verso le persone, in particolare in coloro che lavorano quotidianamente prendendosi cura di individui sofferenti, come medici, infermieri e psicoterapeuti (Hoffman, 2000), e sono stati successivamente evidenziati anche in relazione all'empatia verso gli animali, in veterinari (Mitchener e Ogilvie, 2002) e operatori degli allevamenti intensivi (Bock et al., 2007). In particolare, Bock e collaboratori (2007) hanno osservato che la tendenza a mantenere un atteggiamento distaccato nei confronti degli animali da parte degli operatori degli allevamenti intensivi si manifestava più facilmente all'aumentare del loro numero, probabilmente perché provare empatia verso troppi individui potrebbe risultare in un vero e proprio esaurimento emotivo, paragonabile alla condizione nota come "fatica da compassione", che costituisce una frequente causa di burn-out nelle professioni di aiuto (Mitchener e Ogilvie, 2002; Pallotta, 2008).

Attrazione ed empatia sono quindi le motivazioni principali alla base del nostro rapporto con gli animali da compagnia e possono essere pensate come modalità di risposta a stimoli specifici, quali le caratteristiche infantili e le emozioni, che suscitano comportamenti prosociali verso gli altri individui e che risentono di un effetto di genere, per cui si manifestano con maggiore intensità nelle donne rispetto agli uomini. Fattori quali l'esposizione alla sofferenza, la numerosità degli individui coinvolti ed il grado in cui vengono percepiti come simili a noi o familiari modulano la frequenza e l'intensità della preoccupazione per il benessere altrui: talvolta, possono verificarsi distorsioni della relazione con gli animali in cui il corretto funzionamento di questi sistemi di regolazione appare compromesso.

### **L'Accumulo di Animali**

L'accumulo di Animali o *Animal Hoarding* si verifica quando un individuo possiede un gran numero di animali, generalmente da alcune dozzine fino a centinaia (Patronek, 1999), che supera la capacità della persona di garantire loro gli standard minimi di nutrimento, igiene e cure veterinarie. In questi casi inoltre, l'individuo spesso non riconosce le condizioni di deterioramento in cui versano gli animali (malattie, inedia e morte) e l'ambiente domestico (sovraffollamento severo, mancanza di igiene), né

si mostra consapevole degli effetti negativi che l'accumulo di animali ha sul proprio benessere e su quello degli altri individui che gli vivono accanto (Patronek e HARC, 2001). Ne derivano perciò problemi legati alla salute, alla sicurezza e al funzionamento sociale e lavorativo (Patronek, 1999; HARC, 2002).

È importante evidenziare come il fenomeno non sia definito solo dal numero di animali presenti nell'abitazione, che diventa infatti motivo di preoccupazione solo se il proprietario non riesce a prendersene cura in modo adeguato (Patronek, 1999; Avery, 2005; Steketee et al., 2011).

La maggior parte dei dati disponibili nella letteratura scientifica si riferisce agli Stati Uniti, dove nel 1997 è stato istituito l'Hoarding of Animal Research Consortium (HARC), un gruppo interdisciplinare composto da psicologi, psichiatri, medici veterinari, sociologi e operatori nel settore della tutela degli animali, con lo scopo di promuovere la ricerca scientifica sul tema. Ad oggi, in Italia non sono stati condotti studi sull'argomento e non si conosce quindi l'incidenza del disagio che, negli USA, è stata stimata tra i 700 e i 2000 casi all'anno (Patronek, 1999).

In uno studio pionieristico sull'accumulo di animali, Patronek (1999) ha osservato che gli animali oggetto di accumulo sono per lo più gatti (65%) e cani (60%), seguiti da animali da reddito (11%) e uccelli (11%), sebbene tra le specie accumulate possano essere comprese anche quelle selvatiche, tra cui animali esotici come lucertole, serpenti velenosi e alligatori (Worth e Beck, 1981; Patronek, 1999; 2001; Berry et al., 2005); nella maggior parte dei casi, gli accumulatori si concentrano solo su una o due specie (Patronek, 1999).

Gli animali possono essere acquisiti in modo attivo, se gli accumulatori se li procurano attraverso annunci, rifugi e raccogliendo i randagi per la strada (HARC, 2000; Patronek et al., 2006), oppure la quantità di animali può aumentare in modo passivo, perché l'individuo non li sterilizza o accoglie quelli che gli vengono affidati da altre persone (Patronek, 1999; Frost et al., 2011).

È stato calcolato che, in media, ogni accumulatore possiede circa 39 animali, tuttavia alcuni arrivano ad averne anche più di 100, rinchiusi non solo in appartamenti e case, ma anche in auto o roulotte (Patronek, 1999). In uno studio di Berry e collaboratori (2005), su 46 casi identificati tramite le segnalazioni dei media è stato osservato un numero di cani e gatti variabile da uno a 400; considerando i singoli casi, sono stati trovati fino a 500 animali da reddito, 400 gatti, 262 animali esotici, 218 cani, 200 uccelli, 138 conigli e 130 cavalli. Il caso più ampio comprendeva 500 bovini e 60 cavalli, seguito da un caso con 400 gatti e 4 cani, mentre il caso più modesto coinvolgeva 5 cani e 3 gatti, a riprova del fatto che non ci si può

basare esclusivamente sul numero di animali per definire il problema, determinato invece soprattutto dal modo in cui vengono accuditi.

A questo proposito, Patronek (1999) riporta che nell'80% dei casi gli animali erano in pessime condizioni di salute, e spesso, in una percentuale che varia tra il 33,9% (Berry et al., 2005) e il 59,3% (Patronek, 1999) dei casi, è presente almeno un animale morto, in stato di decomposizione oppure imbalsamato (Worth e Beck, 1981).

Per quanto riguarda le caratteristiche delle persone che accumulano animali, Patronek (1999) ha osservato che, su 54 casi, il 76% degli accumulatori erano donne, il 46% aveva un'età pari o superiore a sessant'anni e solo l'11% aveva meno di quarant'anni; nel 72,2% dei casi si trattava di persone single, divorziate o vedove. Questi dati confermano quelli di uno studio precedente, condotto su 34 casi di persone che possedevano più di dieci animali, segnalate al dipartimento di igiene pubblica della città di New York e alla Società Americana per la Prevenzione della Crudeltà sugli Animali, in cui gli autori (Worth e Beck, 1981) riportano che il 70% del campione era rappresentato da donne non sposate, proprietarie di gatti. La maggior percentuale di donne viene confermata anche in un terzo studio (HARC, 2002), nel quale su 71 casi di accumulatori di animali le donne rappresentavano l'83% del campione. Frost (2000) ha ipotizzato che quest'effetto di genere possa «avere a che fare con *sensazioni di vulnerabilità*», tuttavia una spiegazione alternativa potrebbe fare riferimento alla maggior predisposizione del genere femminile all'empatia e all'attrazione per le caratteristiche infantili tipiche della maggior parte degli animali da compagnia e soprattutto di cani e gatti (Archer, 1997), che infatti sono le specie più coinvolte nelle situazioni di accumulo (Patronek, 1999).

### ***Il profilo dell'accumulatore di animali: tre categorie***

Il profilo dell'accumulatore che sembra emergere a partire dai dati presentati, tende a ricalcare la figura della "gattara", ovvero una donna, anziana, sola, che si concentra di solito su una o due specie animali, per lo più cani o gatti (Patronek e HARC, 2001).

Tuttavia, nell'identificare gli accumulatori di animali è necessario non farsi guidare da stereotipi fuorvianti, in quanto la letteratura mostra che il comportamento è in realtà trasversale a tutte le condizioni demografiche e socioeconomiche (Worth e Beck, 1981; Patronek e HARC, 2001): tra loro sono stati infatti scoperti, oltre a un ampio spettro di individui svantaggiati dal punto di vista socioeconomico, anche persone che svolgono attività lavorative comuni e socialmente riconosciute, come infermieri, pubblici ufficiali, professori e veterinari, alcuni dei quali possono condurre una

doppia vita, mostrandosi molto riservati e mantenendo una carriera di successo (Patronek e HARC, 2001).

Non sempre, quindi, si tratta di individui soli ma, anzi, possono essere ben integrati nella società e talvolta vivono con persone che dipendono da loro, tra cui bambini, disabili o anziani (Patronek, 1999; Arluke e Killeen, 2009).

Dalla letteratura emergono inoltre diverse tipologie di accumulatori di animali, che si differenziano per una serie di fattori, ognuno dei quali può presentarsi in modo lieve o intenso: la presenza di problemi medici o psicologici; il grado di integrazione sociale; il rischio per gli animali; le modalità di acquisizione degli animali (attiva o passiva); il livello di empatia; il livello di attaccamento; la negazione del problema e, infine, l'atteggiamento verso l'autorità.

Patronek e collaboratori (2006) hanno quindi proposto tre categorie di base:

- 1) Il *caregiver sopraffatto*: si tratta di una persona generalmente sola, con un forte attaccamento nei confronti degli animali e che, a causa di difficoltà improvvise (malattie, problemi economici, perdita di una persona cara) non riesce più a prendersi cura di loro, ma non sa come uscire da questa situazione. Acquisisce gli animali in modo passivo e la sua autostima è strettamente legata al ruolo di caregiver. Tende ad avere problemi di salute mentale quali disturbi dell'umore e in molti casi necessita di un tutore. Manifesta un certo grado di consapevolezza dei propri problemi nella cura degli animali e un pensiero più aderente alla realtà rispetto alle altre tipologie di accumulatore di animali (*animal hoarder*). Sebbene tenda a minimizzare il problema, rispetta le autorità e si mostra collaborativo.
- 2) Il *salvatore*: sente di avere la "missione" di salvare gli animali, che determina una compulsione inevitabile ad acquisirne in maniera attiva (ad esempio adottandoli nei rifugi o attraverso volantini). È convinto di essere l'unico in grado di prendersi cura degli animali e mostra un forte attaccamento nei loro confronti, perciò, dopo averli salvati, non ne permette l'adozione e arriva ad accumularne una quantità tale da non riuscire ad accudirli. Teme la morte e si oppone all'eutanasia. Evita le autorità ed impedisce loro l'accesso al suo spazio privato, non è collaborativo. Non è necessariamente solo, anzi può avere un coinvolgimento attivo nella società e una rete di aiutanti che gli offrono animali da adottare: infatti, tra gli accumulatori possono esserci persone che lavorano nei rifugi per animali o nelle cliniche veterinarie, che pensano di poter salvare tutti gli animali portandoli a casa con sé (Reinisch, 2008).

3) Lo *sfruttatore*: si tratta della categoria più problematica, in cui l'*animal hoarding* si associa a caratteristiche sociopatiche o a disturbi di personalità, per lo più di tipo narcisistico o antisociale. Queste persone accumulano animali per soddisfare un bisogno personale e non mostrano empatia né verso gli animali né verso le persone. Non provano senso di colpa, rimorso e non hanno coscienza sociale, perciò si mostrano indifferenti al disagio che causano. Negano il problema, hanno un estremo bisogno di controllo e credono di avere competenze superiori a chiunque altro. Sono persone affascinanti e carismatiche, astute e manipolative, egoiste e narcisistiche. Si procurano animali in modo attivo e pianificano strategie per evadere i controlli, ad esempio distribuendo gli animali tra altri *hoarder* e amici.

A queste tipologie, se ne affiancano altre due, considerate come situazioni di allarme che possono evolvere in un comportamento di accumulo di animali: l'accumulatore principiante e l'accumulatore allevatore.

L'*accumulatore principiante* è colui che prova a garantire agli animali gli standard minimi di cure prescritte dalla legge e appare consapevole dei problemi che incontra; tuttavia la sua capacità di fornire cure adeguate tende a peggiorare. L'*accumulatore allevatore*, invece, inizialmente alleva animali per le esposizioni o per venderli, ma nel tempo incontra sempre più difficoltà a prendersene cura in modo adeguato. Di solito non tiene gli animali nella propria abitazione, perciò le condizioni di vita della persona non sono compromesse come quelle degli animali. Ha solo una moderata consapevolezza circa lo stato in cui versano gli animali e le proprie capacità di prendersene cura, perciò continua ad allevarli (Patronek *et al.*, 2006).

#### ***Perché si diventa accumulatori di animali? Le motivazioni alla base del comportamento***

Alla base del normale rapporto tra esseri umani e animali sono state evidenziate alcune motivazioni, tra cui l'empatia e l'attaccamento emotivo, l'interesse strumentale nei confronti degli animali e le convinzioni personali circa il fatto che gli animali siano esseri senzienti (Hills, 1993; Archer, 1997).

Le stesse motivazioni guidano anche il comportamento degli accumulatori di animali, seppur con alcune differenze quantitative e qualitative.

Nella maggior parte degli accumulatori, in particolar modo nelle tipologie del "caregiver sopraffatto" e del "salvatore", vi è un forte attaccamento emotivo nei confronti degli animali (Patronek *et al.*, 2006), come dimostra il fatto che, nel tentativo di spiegare il proprio comportamento, queste persone fanno spesso riferimento all'amore che provano per gli

animali e al ruolo di “genitore” o caregiver che assumono nei loro confronti (Patronek e Nathanson, 2009). Sebbene l’attaccamento emotivo sia un aspetto normale del nostro rapporto con gli animali da compagnia, nelle situazioni di accumulo esso si instaura nei confronti di un numero di animali molto più ampio rispetto alla norma<sup>1</sup>, e si struttura in modo immediato, al punto che qualsiasi animale appena incontrato viene facilmente visto come proprio e la persona si sente in dovere di prendersene cura (Arluke e Killeen, 2009, p. 205).

Gli accumulatori tendono inoltre ad antropomorfizzare gli animali in misura maggiore rispetto ai comuni proprietari di animali: Steketee e collaboratori (2011) hanno osservato che l’81% degli *animal hoarder*, (rispetto al 27% dei proprietari) tendeva ad attribuire loro le stesse caratteristiche e la stessa intelligenza degli esseri umani e a considerare gli animali come parte della propria famiglia, riferendosi a loro come ai propri “bambini”.

Ne derivano spesso un senso di responsabilità distorto e un forte bisogno di controllo sugli animali, per cui l’accumulatore sente di dover acquisire animali e di non potersi separare da loro, per far sì che non gli accada qualcosa di male (Patronek, 1999; HARC, 2000). In molti accumulatori, soprattutto in quelli appartenenti alla tipologia del “salvatore”, questi aspetti sono fortemente legati al tema della morte: queste persone considerano il deterioramento delle proprie condizioni di vita come un sacrificio necessario all’aiutare creature bisognose, che altrimenti potrebbero morire (Arluke e Killeen, 2009, p. 209) e alcuni affermano esplicitamente di voler creare un rifugio che non preveda l’eutanasia (Berry et al., 2005).

È quindi presente un vero e proprio l’impulso a salvare gli animali, che viene vissuto come un dovere, determina un forte senso di colpa se viene disatteso, ed è legato alla preoccupazione costante che qualcosa di tragico potrebbe accadere agli animali se non venissero aiutati (ad esempio essere investiti da un’auto o finire in laboratori dove si pratica la vivisezione; Arluke e Killeen, 2009, p. 204).

Tuttavia, gli animali, proprio in quanto esseri viventi, sono per loro natura mortali e il rapporto con loro implica necessariamente una separazione più o meno tardiva, accrescendo ulteriormente negli accumulatori l’an-

<sup>1</sup> Dal rapporto Assalco-Zoomark del 2012 si può calcolare, sui dati riferiti all’Europa, una media di circa 3 animali da compagnia (esclusi rettili e pesci) per proprietario; lo stesso rapporto evidenzia che il 41,7% delle famiglie italiane possiede animali da compagnia: di queste, il 29,8% ne ha uno solo, il restante 11,9% ne ha più di uno; tra chi ha più di un animale, il 30,9% ne ha 2, il 13% ne possiede 3 e solo una minima percentuale eccede questo numero. In base a questi dati, appare adeguato considerare nella norma un numero massimo di animali da compagnia pari a 3.

sia rispetto ai temi del controllo e della responsabilità (Patronek e Nathanson, 2009).

Gli accumulatori vedono quindi la possibilità di perdere i propri animali come una tragedia, e arrivano a minacciare di uccidere o di suicidarsi di fronte a questa eventualità (Arluke e Killeen, 2009); reazioni emotive intense, di rabbia o angoscia, legate al pensiero della perdita o della separazione, sono infatti tipiche di questi individui (Patronek e HARC, 2001; Frost et al., 2011), che spesso risultano incapaci di separarsi anche dai corpi degli animali morti e li conservano perciò all'interno dell'abitazione (Patronek, 1999; HARC, 2002; Nathanson, 2009). Proprio in base alle reazioni estreme di angoscia e rabbia associate alla separazione, Frost (2000) ha interpretato la tendenza degli accumulatori di animali ad ignorare i problemi derivanti dall'acquisizione di sempre più animali e a convincersi che questi stiano bene come una modalità di evitamento delle sensazioni spiacevoli che deriverebbero dal dare in adozione i randagi o dal riconoscere lo stato di grave malessere dei propri animali.

Gli aspetti legati all'attaccamento emotivo e alla preoccupazione per gli animali sono invece meno esplicativi nel caso dell'accumulatore "sfruttatore", per il quale le motivazioni alla base del comportamento di accumulo di animali potrebbero essere legate al bisogno di dominare o di ricavarne un profitto economico (soprattutto nel caso di personalità anti-sociali), o alla tendenza a ricercare relazioni che confermino il proprio valore, in cui gli altri individui hanno il ruolo di auto-oggetti, utili a fornire ascolto e adorazione (nei narcisisti; Patronek et al., 2006; Baron Cohen, 2011, cap. 3).

Tuttavia, come sottolineato da alcuni studiosi (Arluke e Killeen, 2009, p. 192; Patronek et al., 2006), in tutte le categorie di accumulatori gli animali hanno anche un ruolo strumentale, funzionale al mantenimento del senso d'identità e dell'autostima, legate all'assunzione del compito di caregiver e continuamente rinforzate dalla percezione di relazioni positive con esseri senzienti e totalmente dipendenti dall'individuo (Patronek e Nathanson, 2009). L'autostima deriva in parte dal senso di autoefficacia per l'esercizio del controllo sugli animali (soprattutto nell'accumulatore - sfruttatore), in parte dal veder riconosciuta, nell'affetto dimostrato dagli animali, la propria capacità di caregiver (Patronek e Nathanson, 2009; Vaca Guzman e Arluke, 2005), ma anche e soprattutto dalle modalità d'interazione tipiche del rapporto uomo-animale: gli animali infatti sono intensamente concentrati sulla persona, non giudicano né criticano e non possono opporsi all'interpretazione che si dà dei loro sentimenti e bisogni (Patronek e Nathanson, 2009).

Infine, gli animali sono spesso associati a un senso di sicurezza, in virtù della loro capacità di fornire conforto emotivo e amore incondizionato, all'interno di relazioni percepite come meno pericolose rispetto a quelle con le persone (Reinish, 2008; Nathanson, 2009).

### ***Scuse e giustificazioni degli accumulatori di animali***

Poiché gli animali e la loro cura sono alla base dell'identità e dell'autostima di chi li accumula, riconoscere un fallimento riguardo a questi aspetti avrebbe effetti devastanti (Arluke e Killeen, 2009); gli accumulatori utilizzano quindi numerose scuse e giustificazioni per proteggere il proprio senso di sé.

Vaca Guzman e Arluke (2005) hanno evidenziato le seguenti scuse, che consistono nell'ammissione del comportamento sbagliato, negando o minimizzando però la piena responsabilità:

- 1) Difficoltà del compito: il compito è troppo difficile, l'individuo si sente sopraffatto ma riconosce di avere troppi animali e di non essere in grado di accudirli.
- 2) Convinzione che la propria volontà non sia del tutto libera: spesso gli accumulatori riferiscono di essere guidati nel loro comportamento da una forza misteriosa, frequentemente descritta come un eccessivo amore per gli animali.
- 3) "Il capro espiatorio": la responsabilità del comportamento è attribuita ad altri, ad esempio a coloro che abbandonano o perdono i propri animali o alla comunità che non aiuta i randagi.

Gli stessi autori riportano anche le giustificazioni più frequentemente utilizzate dagli accumulatori di animali, che si differenziano dalle scuse in quanto rifiutano la possibilità che il comportamento sia sbagliato:

- 1) Negazione: l'individuo nega che le proprie azioni siano immorali, strane o indecorose, spesso sostenendo che gli animali sono adeguatamente accuditi e amati, come dimostra il fatto che gli animali sono felici e ricambiano l'affetto ricevuto.
- 2) "Il buon samaritano": l'individuo considera gli aspetti negativi come parte di azione virtuosa più ampia, perciò le azioni sbagliate vengono giustificate tramite un fine lodevole. Spesso ad esempio gli accumulatori riferiscono di voler creare un rifugio per animali in cui non si pratica l'eutanasia (Berry et al., 2005; Vučinić e Dimitrijević, 2007). In particolare, l'alternativa della morte viene usata come un forte argomento in favore del tenere gli animali in condizioni terribili, evidenziando come per gli accumulatori la morte sia una prospettiva impensabile, per cui qualsiasi altra possibilità, per quanto terribile, è considerata migliore per gli animali.

3) Screditare la fonte delle critiche: l'individuo sposta l'attenzione sul comportamento di chi disapprova le sue azioni, spesso manifestando la convinzione paranoica di essere perseguitato o vittima del sistema.

Tra le diverse scuse e giustificazioni proposte, quelle del “buon samaritano” e del “capro espiatorio” portano a considerare anche il modo in cui alcuni aspetti disfunzionali della società possano facilitare e mantenere il fenomeno: in molte zone degli USA, così come in Italia<sup>2</sup>, il randagismo e l'abbandono costituiscono un grave problema. In questo contesto, gli accumulatori di animali diventano una risposta ad un problema sociale, per cui i membri della comunità, sulla base della reputazione che un individuo ha di prendersi cura di molti animali, gli affidano quelli indesiderati, evitando così il senso di colpa per l'abbandono e, negli USA, il rischio dell'eutanasia per l'animale (Frommer e Arluke, 1999; Arluke e Kelleen, 2009).

**Accumulo e sofferenza degli animali: una forma di maltrattamento, non un semplice “stile di vita”**

Sebbene il comportamento di accumulo di animali derivi spesso dall'intento di prendersene cura o di salvarli, nella maggior parte dei casi queste situazioni evolvono in una vera e propria forma di maltrattamento, per cui, pur mancando l'intenzionalità di far loro del male, gli animali vanno incontro a sofferenze intense e prolungate (Nathanson, 2009).

È stato sottolineato che, negli USA, l'accumulo rappresenta una delle maggiori cause di sofferenza per gli animali, al punto che gli accumulatori determinano più danni, dolore e morte agli animali rispetto agli episodi di crudeltà da parte di chi deliberatamente abusa di loro (Avery, 2005; Arluke e Killeen, 2009). Ciò ha portato a considerare l'accumulo una forma di crudeltà passiva nei confronti degli animali (Vaca-Guzman e Arluke, 2005), che sono infatti tenuti per mesi o anni in condizioni di grave trascuratezza e deprivazione, dovute al fatto che spesso gli accumulatori ignorano le cure fondamentali per gli animali, al punto da non garantire loro un adeguato apporto di acqua e cibo e non fornendo loro cure veterinarie per i problemi che insorgono. Di conseguenza, gli animali sono gravemente emaciati, con seri problemi fisici e comportamentali e spesso muoiono (Avery, 2005; Arluke e Killeen, 2009).

<sup>2</sup> Il Ministero della Salute italiano ([http://www.salute.gov.it/portale/temi/p2\\_6.jsp?lingua=italiano&id=1062&area=cani&menu=abbandono](http://www.salute.gov.it/portale/temi/p2_6.jsp?lingua=italiano&id=1062&area=cani&menu=abbandono)) riporta la presenza di circa 600.000 cani vaganti sul territorio nazionale, descrivendo il randagismo come un fenomeno fuori controllo, che ha raggiunto livelli drammatici.

Tuttavia, data la riservatezza degli accumulatori, che nascondono le condizioni degli animali e del luogo in cui vivono, e a causa dell'eccentricità del loro comportamento, in passato e per gran parte del ventesimo secolo, l'accumulo di animali è stato considerato uno stile di vita bizzarro e interpretato come "un eccessivo amore per gli animali" (Arluke e Killeen, 2009); questa lettura del fenomeno è tuttora frequente, soprattutto da parte dei mass media (Patronek, 1999; Arluke, 2002) ed è incoraggiata dal fatto che gli accumulatori stessi tendono a difendere il proprio comportamento come una scelta di vita, affermando il diritto alla propria libertà (Reinisch, 2008).

Considerando però le condizioni di negligenza e di sofferenza estrema in cui versano gli animali, e spesso anche le persone che vivono con gli accumulatori (Patronek et al., 2006), in nessun caso sembra opportuno archiviare questo fenomeno come un semplice "stile di vita" (Avery, 2005): in queste situazioni infatti, il principio di autodeterminazione entra necessariamente in conflitto con le leggi che assicurano che persone e animali non si trovino in condizioni di abuso, trascuratezza o di mancanza di sicurezza e igiene (Nathanson, 2009).

Nel mondo scientifico c'è perciò accordo nel sostenere che chi vive circondato da animali malati e moribondi, escrementi e sporcizia ha oltrepassato il limite del disturbo mentale (Lockwood, 1994; Avery, 2005; Nathanson, 2009; Frost et al., 2011).

### **L'accumulo di animali come psicopatologia: i primi modelli esplicativi**

Nel corso degli anni, sono stati proposti modelli alternativi per comprendere l'accumulo di animali in termini di disturbo psicologico, basati sull'esperienza dei professionisti o sullo studio di casi clinici, che non si escludono a vicenda e possono fornire ipotesi circa i meccanismi sottostanti al comportamento dei diversi tipi di accumulatori.

Si tratta di spiegazioni complesse, che coinvolgono un ampio numero di fattori psicologici, sociali e culturali, e da considerarsi provvisorie, poiché lo stato attuale della ricerca sul fenomeno è limitato e tuttora in evoluzione (Arluke e Killeen, 2009). In ogni caso, ciascuno dei modelli proposti presenta delle limitazioni, suggerendo come l'accumulo di animali possa oltrepassare le classiche categorie diagnostiche e presentarsi in comorbidità con altre patologie.

### ***L'accumulo di animali come forma di Dipendenza***

Lockwood (1994) ha proposto che gli accumulatori di animali soffrano di una forma di dipendenza, evidenziando alcuni aspetti in comune con la dipendenza da sostanze (Avery, 2005), tra cui:

- Pensieri “fissi” relativi alla sostanza;
- Ripetizione del comportamento di abuso;
- Negligenza di sé e dell’ambiente;
- Alibi per il comportamento;
- Idee di persecuzione;
- Presenza di facilitatori/complici;
- Negazione della dipendenza;
- Isolamento dalla società;
- Scarso controllo degli impulsi.

Non ci sono tuttavia ricerche che abbiano confrontato in maniera sistematica l’abuso di sostanze con l’accumulo di animali, perciò il modello della dipendenza resta ad oggi solo un’ipotesi.

#### ***Un Disturbo delirante?***

Secondo il DSM IV, il Disturbo Delirante è un disturbo psicotico caratterizzato principalmente da deliri non bizzarri (cioè concernenti situazioni che ricorrono nella vita reale) che durano almeno un mese.

Tra i vari sottotipi, in quello “di grandezza” si ha la convinzione delirante del soggetto di avere un esagerato valore, potere, conoscenze o una speciale identità; nel sottotipo “di persecuzione” il soggetto ha la convinzione di essere trattato male (lui stesso o qualche persona intima). Quando prevalgono più convinzioni deliranti si ha il “Tipo misto”.

Gli accumulatori di animali presentano le seguenti caratteristiche proprie del Disturbo Delirante, di cui potrebbe costituire una forma altamente specifica, concernente gli animali (Frost, 2000):

- Mancanza di consapevolezza: convinzione forte e persistente di garantire cure adeguate agli animali, nonostante l’evidenza del contrario. Incapacità di rendersi conto delle condizioni invivibili dell’abitazione, per gli animali e per se stessi.
- Deliri di persecuzione: paranoie rispetto alle intenzioni degli altri, in particolar modo di coloro che agiscono a tutela degli animali.
- Deliri di grandezza: convinzione di essere in possesso di una speciale abilità di comunicare con gli animali ed entrare in empatia con loro.

Sebbene questo modello possa spiegare alcuni dei comportamenti osservati negli accumulatori animali, mancano anche in questo caso studi che ne abbiano accertato la validità in contesti sperimentali.

#### ***L’accumulo di animali come conseguenza di un lutto complicato***

È stato proposto che l’accumulo di animali rappresenti una reazione alla perdita traumatica e non risolta di una persona amata (Patronek, 1999; Patronek e HARC, 2001). Il comportamento di accumulo derivereb-

be quindi da una condizione di Lutto complicato, in cui gli animali rappresentano una soluzione temporanea, che permette di trarre sollievo attraverso la costruzione di un mondo che offre, all'apparenza, sicurezza e reciproco accudimento (Nathanson, 2009).

Il lutto complicato può inoltre insorgere anche dopo la morte di un animale, soprattutto quando è presente un forte attaccamento nei suoi confronti o quando l'animale rappresenta un sostituto di una figura importante (Keddie, 1977); in particolare, soprattutto quando l'attaccamento all'animale ha una funzione difensiva, come spesso avviene nel caso di difficoltà nelle relazioni umane, la morte dell'animale spesso viene negata e può determinare questa condizione (Rynearson, 1978).

Questo modello può spiegare alcuni aspetti dell'accumulo di animali, tra cui la presenza di animali morti nelle abitazioni, che potrebbe essere dovuta alla negazione, al delirio o alla condizione di dissociazione che spesso si associano al lutto complicato (Nathanson, 2009), e la costante preoccupazione relativa alla morte osservata in molti accumulatori; tuttavia, non può considerarsi esaustivo, in quanto non sempre negli accumulatori di animali il comportamento patologico insorge in seguito ad una perdita.

### **L'accumulo di animali come variante del Disturbo da Accumulo**

Attualmente, l'accumulo di animali è considerato una variante del Disturbo da Accumulo o *Hoarding Disorder* (Frost et al., 2011), che si riferisce all'acquisizione di un gran numero di beni (solitamente oggetti, ma la definizione non tiene conto della natura di ciò che viene accumulato) di cui l'individuo non riesce a liberarsi, rendendo gli spazi di vita disordinati e ingombrati al punto tale che non possono più essere utilizzati per le funzioni per cui erano predisposti, interferendo così significativamente con lo svolgimento delle normali attività della vita quotidiana e causando un disagio significativo (Frost e Hartl 1996; Frost e Steketee, 1998; Grisham et al., 2007).

Nel DSM IV, il Disturbo da Accumulo non costituisce una categoria diagnostica separata e alcuni dei suoi aspetti vengono menzionati solo tra i sintomi del Disturbo Ossessivo Compulsivo di Personalità, dove si osserva l'“*incapacità di eliminare oggetti consumiti o senza valore, anche quando non hanno un valore affettivo*”.

Tuttavia, Mataix-Cols e collaboratori (2010), alla luce degli studi più recenti, hanno proposto una serie di criteri che definiscono il Disturbo da Accumulo come una categoria diagnostica separata nel DSM V:

- A) Difficoltà persistente a gettare via o a separarsi dai propri averi, perfino da quelli apparentemente inutili o di valore limitato, dovuto al forte bisogno di conservare oggetti, al disagio e/o all'indecisione associata all'eliminare;
- B) I sintomi determinano l'accumulo di un gran numero di oggetti, che riempiono e ingombrano l'abitazione, il posto di lavoro o altri ambienti personali (ufficio, veicoli, cortili) e impediscono l'utilizzo normale degli spazi. Se tutti gli spazi abitabili sono privi di confusione è solo grazie agli sforzi degli altri (membri della famiglia, autorità) di tenere liberi tali spazi.
- C) I sintomi causano disagio clinicamente significativo o il deterioramento del funzionamento sociale, lavorativo o di altre aree importanti (incluso il mantenimento di un ambiente sicuro per sé e per gli altri).
- D) I sintomi di accumulo non sono dovuti ad una condizione medica generale (es., lesioni cerebrali, patologie cerebrovascolari).
- E) I sintomi di accumulo non sono riferibili ai sintomi di un altro disturbo mentale (es., accumulo dovuto ad ossessioni nel Disturbo Ossessivo Compulsivo, a mancanza di motivazione nel Disturbo Depressivo Maggiore, a deliri nella Schizofrenia o in altri disturbi psicotici, a deficit cognitivi nelle Demenze, a interessi ristretti nel Disturbo autistico o all'accumulo di cibo nella sindrome di Prader-Willi).

È inoltre importante specificare se il comportamento è accompagnato da "acquisizione eccessiva", ovvero dall'acquisto o furto di oggetti che non sono necessari o per i quali non c'è spazio disponibile.

Infine, occorre valutare il livello di consapevolezza dell'individuo, che può essere "buono o discreto", se l'individuo riconosce che le convinzioni e i comportamenti relativi all'accumulo (difficoltà ad eliminare oggetti, al disordine o all'acquisizione eccessiva) sono problematici, oppure "scarso", se l'individuo è per lo più convinto che la propria condotta non rappresenti un problema, nonostante l'evidenza del contrario; si parla di "delirio" quando manca completamente la consapevolezza del disturbo.

In particolare, tre caratteristiche appaiono centrali nella definizione del Disturbo da Accumulo: difficoltà a separarsi dagli oggetti (scartarli o eliminarli); eventuale presenza di acquisizione eccessiva; disordine e ingombro, dovuti alla presenza di cumuli di oggetti. Ognuno di questi aspetti può manifestarsi con diversi livelli di gravità in un dato individuo (Steketee et al., 2003; Cromer et al., 2007).

L'accumulo di animali è stato osservato in circa un terzo dei casi in cui si riscontra un Disturbo da Accumulo di oggetti (Frost et al., 2000) e sembra soddisfarne i criteri diagnostici di base (Frost et al., 2011):

- 1) Difficoltà con la separazione e acquisizione eccessiva: gli accumulatori di animali hanno difficoltà a separarsi dai propri animali, perfino da quelli morti. La rimozione degli animali causa un disagio intenso, come nel caso degli accumulatori di oggetti (HARC, 2002; Patronek, 1999). Può essere presente l'acquisizione eccessiva, se gli accumulatori si procurano animali in modo attivo.
- 2) Disordine/disorganizzazione dell'ambiente: Patronek (1999) osserva come il 78% del campione di accumulatori di animali da lui studiato presentasse abitazioni gravemente disordinate e insane, ingombrate al punto tale da impedire i movimenti, l'accesso ai mobili, alla cucina o al bagno. Spesso si osserva accumulo di oggetti, tra cui cibo e spazzatura, associato all'accumulo di animali (Worth e Beck, 1981; HARC, 2002).
- 3) Disagio e deterioramento del funzionamento: anche nei casi di accumulo di animali, le condizioni dell'abitazione impediscono le normali attività della vita quotidiana e comportano rischi per la salute (Patronek, 1999; HARC, 2000; Patronek e Nathanson, 2009).

Nonostante gli aspetti comuni tra l'accumulo di oggetti e l'accumulo di animali, Patronek e Nathanson (2009) suggeriscono che i due comportamenti siano manifestazioni di disturbi psicologici diversi, evidenziando come gli animali, in quanto esseri senzienti, non possano essere paragonati agli oggetti "inutili o di valore limitato", che risultano difficili da "eliminare", menzionati nei criteri diagnostici del Disturbo da Accumulo. Infatti i criteri non considerano che esseri viventi possano essere oggetto di accumulo, né la sofferenza che ne deriva e la relazione dinamica che s'instaura con loro.

Gli stessi autori osservano anche che, sebbene nel caso di accumulo di animali sussistano le condizioni di base per la diagnosi di Disturbo da Accumulo, almeno alcune di queste hanno cause diverse rispetto all'accumulo di oggetti: il disordine, l'ingombro e il deterioramento dell'ambiente nell'accumulo di animali non deriverebbero infatti dai cumuli di oggetti o spazzatura, che inoltre, seppur presenti, non hanno alcuno speciale valore per gli accumulatori di animali; tali situazioni sarebbero invece secondarie alla gran quantità di animali e agli oggetti a loro legati, e dipenderebbero soprattutto dall'incapacità di accudire adeguatamente gli animali, piuttosto che dall'eccessiva acquisizione e dalla difficoltà a gettare gli oggetti: emblematico è il caso di una donna che accumulava vecchie stufe, lavatrici e mobili, per utilizzarli come cucce per i suoi 52 cani (Vučinić e Dimitrijević, 2007).

Rispetto all'accumulo di oggetti, l'accumulo di animali si differenzia anche rispetto a:

- *Epidemiologia*: due studi epidemiologici sull'accumulo di oggetti hanno riportato una percentuale del disturbo significativamente più alta tra gli uomini che fra le donne (Samuels et al., 2008; Iervolino et al., 2009), mentre un terzo studio non ha evidenziato differenze di genere (Mueller et al., 2009). Per quanto riguarda l'accumulo di animali i dati disponibili sono invece concordi nel documentare un effetto di genere, per cui il comportamento risulta più frequente tra le donne rispetto agli uomini (Worth e Beck, 1981; Patronek, 1999; Steketee et al., 2011).
- *Età di esordio*: studi sull'accumulo di oggetti hanno osservato che l'età di esordio si colloca generalmente nella fanciullezza o nella prima adolescenza (Frost e Gross, 1993), fra gli 11 e i 15 anni (Tolin et al., 2010), con un'età media stimata intorno ai 13.4 anni (Grisham et al., 2006). Per quanto riguarda il Disturbo da Accumulo di animali, l'esordio sembra essere più tardivo, collocandosi tipicamente nella tarda età adulta (Patronek, 1999; HARC, 2002). Tale differenza potrebbe però essere dovuta al fatto che bambini e adolescenti non hanno abbastanza controllo sul proprio ambiente da poter accumulare animali, perciò la sintomatologia si manifesta solo dopo il raggiungimento dell'indipendenza (Frost et al., 2011).
- *Conseguenze sulla salute e sulla qualità di vita*: i cumuli di oggetti, presenti anche nei casi di accumulo di animali, possono determinare un rischio di incendio, ad esempio quando materiali infiammabili sono impilati vicino a stufe o fornelli, complicato dal fatto che il volume degli oggetti aumenta il divampare delle fiamme e blocca le vie di fuga. Il disordine e l'ingombro aumentano anche il rischio di cadute, soprattutto negli anziani. Poiché il disordine impedisce il normale utilizzo degli spazi per lo svolgimento di attività di base, il disturbo interferisce con la capacità dell'individuo di lavorare, interagire con gli altri e svolgere attività fondamentali, tra cui mangiare, lavarsi, muoversi per la casa e dormire (Grisham et al., 2006; Tolin et al., 2010). Aumenta inoltre l'esposizione alla polvere e ai batteri, in quanto la casa non può essere adeguatamente pulita, e può esserci il rischio di contaminazioni a causa di cibi avariati (Frost et al., 2000). Tali aspetti permangono e si manifestano in modo più grave quando l'accumulo coinvolge gli animali, al punto che le condizioni delle abitazioni raggiungono i livelli dello squallore, presente solo in un numero minore di casi di accumulo di oggetti (Frost et al., 2011). Frost e collaboratori (2000; 2011) riportano che la quasi totalità degli accumulatori di animali vive in condizioni insane, contro l'81% di coloro che accumulano solo oggetti. Oltre che dalla presenza degli animali, tra cui spesso si annoverano alcuni cadaveri (Patronek, 1999; Berry et al.,

2005), tali condizioni sembrano derivare da una serie di convinzioni relative al modo in cui gli animali debbano essere accuditi e allevati, che ha a che fare con la necessità che siano “liberi”, per cui non vengono educati né vengono loro imposte regole relative al cibo, al gioco, al riposo e persino ai luoghi dove urinare e defecare; inoltre gli accumulatori non mettono limiti rispetto all'utilizzo della propria casa da parte degli animali (ad esempio limitando l'accesso ad alcune aree), arrivando in questo modo ad avere alcuni locali inutilizzabili, spesso intrisi di escrementi (Arluke e Killeen, 2009; Frost et al., 2011; Steketee et al., 2011).

A causa dello stato di grave incuria in cui versano gli animali, si osserva inoltre un elevato rischio di zoonosi (Reinish, 2008; Steketee et al., 2011), tra cui Rabbia, Tigna e bartonellosi o “Malattia da graffio di gatto” (Avery, 2005). I rischi per la salute sono aggravati anche per la concentrazione di ammoniaca nell'aria, derivante dall'urina degli animali, che oltre una certa concentrazione può causare irritazioni agli occhi e alle vie respiratorie (Reinish, 2008). Ad esempio Arluke e collaboratori (2002) riportano un caso in cui i livelli di ammoniaca erano di 152 ppm: una concentrazione pari a 300 ppm è considerata pericolosa per la salute e per la vita, mentre 25 ppm rappresentano la massima concentrazione a cui un lavoratore può esporsi durante la propria giornata lavorativa (Reinisch, 2008; Arluke e Killeen, 2009, p. 180).

Nel caso di accumulo di animali quindi le condizioni igienico-sanitarie delle abitazioni sono peggiori, e rappresentano un rischio maggiore per la salute dell'individuo e per quella pubblica.

Infine, tipica dei casi di accumulo di animali è la negligenza personale, che include scarsa nutrizione, mancanza di igiene e di cure mediche e isolamento sociale, ed è diffusa soprattutto tra gli anziani (Reinish, 2008; Nathanson, 2009).

L'isolamento sociale si riscontra nella maggior parte degli accumulatori, che spesso trascorrono gran parte del loro tempo cercando di nascondere le proprie condizioni e i propri luoghi di vita dalla vista degli altri, per la vergogna e la paura di essere disprezzati (Frost e Hristova, 2011). Gli accumulatori di animali vengono spesso descritti come “tranquilli e riservati”, a disagio con le persone, al punto che arrivano a coprire le finestre, erigere alti cancelli e raramente escono di casa o rispondono al telefono e al campanello, divenendo noti per la loro chiusura, ostilità e sospettosità verso gli altri (Arluke e Killeen, 2009).

- *Prognosi e intervento*: la prognosi del disturbo è diversa se l'accumulo riguarda solo oggetti oppure sono coinvolti anche animali. In particolare, nei casi di accumulo di animali si osserva una percentuale di reci-

divismo molto alta: nello studio condotto da Patronek (1999), il 60% del campione era costituito da recidivi, mentre altri studi valutano la percentuale di recidive tra il 50% (Arluke et al., 2002; Berry et al., 2005) e il 100% (Patronek et al., 2006). Inoltre, anche gli interventi risultano più difficoltosi; ad esempio, in uno studio di Frost e collaboratori (2000), solo il 6,3% degli accumulatori di animali aveva un atteggiamento cooperativo, contro il 43,3% di chi accumulava oggetti: alcuni accumulatori di animali possono anche mostrarsi aggressivi verso chi interviene a tutela degli animali, arrivando a veri e propri atti di violenza (Reinisch, 2008). Infine i costi degli interventi in caso di accumulo di animali risultano molto onerosi, arrivando a decine di migliaia di dollari, poiché oltre alle spese per la pulizia e la disinfestazione delle abitazioni, implicano spese aggiuntive per le cure veterinarie e la custodia degli animali (Patronek e HARC, 2001).

Alla luce di quanto emerge dalla letteratura, l'accumulo di animali può essere considerato una variante del Disturbo da Accumulo, in quanto ne rispetta i criteri diagnostici di base (Mataix-Cols et al., 2010; Frost et al., 2011), tuttavia, a causa della forte sofferenza degli animali, della distorsione della relazione con loro, dei problemi connessi all'igiene e alla salute pubblica e della prognosi peggiore rispetto ai casi di accumulo di oggetti, presenta aspetti di gravità maggiore rispetto all'accumulo di oggetti (Patronek, 1999; Frost et al., 2000).

### ***Il Disturbo da Accumulo è un Disturbo Ossessivo Compulsivo?***

Bolman e Katz, nel 1966, sono stati i primi a utilizzare la definizione di "accumulo compulsivo" per descrivere il comportamento di accumulo di oggetti, differenziandolo dalla normale tendenza a conservare e collezionare oggetti (Maier, 2004).

I primi studi sistematici sul comportamento di accumulo hanno poi osservato che l'accumulo di oggetti compare in diversi disturbi psicologici, ma si manifesta più comunemente in relazione al Disturbo Ossessivo Compulsivo (DOC), dove si presenta nel 15%-30% dei casi (Frost e Gross, 1993; Frost *et al.*, 1995).

Anche dal punto di vista fenomenologico, l'accumulo somiglia al DOC: spesso infatti la difficoltà ad eliminare gli oggetti è determinata dalla paura di perdere cose importanti, che appare simile ad un'ossessione, alla quale seguono comportamenti compulsivi volti ad evitare di eliminare alcuni dei propri averi ed il disagio che ne deriverebbe. Per queste ragioni l'accumulo è stato inizialmente considerato una variante di DOC ed il termine "accumulo compulsivo" è stato perciò utilizzato in riferimento a questo disturbo (Frost e Gross, 1993).

Studi successivi hanno però evidenziato alcune importanti differenze tra l'accumulo e il DOC (Mataix-Cols et al., 2010; Pertusa et al., 2010):

- mentre nel DOC il comportamento di accumulo risulta egodistonico ed è determinato principalmente da ossessioni prototipiche (e.g., fobia da contaminazione, pensieri superstiziosi, profonda sensazione di incompletezza o bisogno di conservare per mantenere un ricordo di tutte le esperienze di vita), percepite come pensieri intrusivi o alieni, o è il risultato dell'evitamento persistente di compulsioni onerose (e.g., non eliminare al fine di evitare lavaggi interminabili o rituali di controllo), negli accumulatori, i pensieri rispetto ai propri averi non creano disagio (Rachman et al., 2009, p. 521), non determinano la necessità di mettere in atto dei rituali ma, anzi, l'individuo ricava piacere e gratificazione dall'attività di accumulo, che risulta quindi egosintonica.
- Nel DOC, non è solitamente presente acquisizione eccessiva; se presente, gli oggetti sono acquisiti o comprati in risposta ad un'ossessione specifica (e.g., bisogno di raccogliere oggetti con una certa forma o consistenza dalla strada, bisogno di comprare oggetti in un numero ben preciso, o di comprare oggetti che sono stati accidentalmente toccati così da evitare che altri ne risultino contaminati se dovessero toccarli) e non per un genuino desiderio di possedere l'oggetto, come avviene invece nell'accumulo compulsivo.
- Reazione di fronte all'eliminazione: di fronte al dover eliminare uno dei propri averi, gli accumulatori provano angoscia o rabbia, piuttosto che ansia; i pazienti ossessivi-compulsivi invece riferiscono una grande ansia di fronte a situazioni che preferirebbero evitare.
- Un gran numero di individui con seri problemi di accumulo non manifesta sintomi di DOC: l'accumulo si manifesta infatti anche indipendentemente dal DOC (e.g. Chiu et al., 2003) ed è stato dimostrato, in una meta-analisi di 21 studi su 5000 individui con DOC, che l'accumulo è un fattore indipendente, sia in età adulta che pediatrica (Bloch et al., 2008) e può presentarsi da solo o in associazione a disturbi in Asse I e in Asse II (Pertusa et al., 2010).
- Limitata efficacia dei trattamenti usati per il DOC in caso di accumulo compulsivo (Steketee e Frost, 2003).

I dati disponibili suggeriscono quindi che l'accumulo compulsivo debba essere considerato una sindrome separata rispetto al DOC, sebbene vi sia un'elevata comorbidità tra i due disturbi (Mataix-Cols et al., 2010).

### ***Comorbidità frequenti nel Disturbo da Accumulo***

Oltre che con il Disturbo Ossessivo Compulsivo, il Disturbo da Accumulo può presentarsi in comorbidità soprattutto con i seguenti disturbi:

- Disturbi di personalità: non è stata stabilita una correlazione con un disturbo specifico, tuttavia negli accumulatori è stata osservata un'alta prevalenza di disturbi in Asse II, tra cui Disturbo Ossessivo-Compulsivo di personalità, evitante, dipendente, paranoide, schizotipico, istrionico, borderline (Frost et al., 2000b; Mataix-Cols et al., 2000; Samuels et al., 2002; Seedat e Stein, 2002), narcisistico e antisociale (Patronek et al., 2006).
- Disturbo del controllo degli impulsi: Maier (2004) afferma che gli accumulatori hanno abitudini di acquisizione patologiche e considera il comportamento di accumulo un deficit del controllo degli impulsi piuttosto che una compulsione; l'accumulo di oggetti si associa infatti spesso allo shopping compulsivo (Frost et al., 2002; Steketee e Frost, 2003).

### **Substrati neurali e correlati neuropsicologici del comportamento di accumulo**

I substrati neurali dell'accumulo sono stati ampiamente studiati in animali che lo manifestano naturalmente come parte del proprio repertorio comportamentale (es. roditori, uccelli). Tali studi hanno evidenziato il ruolo delle strutture limbiche sottocorticali (nucleus accumbens, area tegmentale ventrale, amigdala, ippocampo, talamo e ipotalamo) e della corteccia prefrontale ventromediale (si veda Mataix-Cols et al., 2011, per una rassegna).

Il comportamento di accumulo compare anche tra i criteri diagnostici della demenza frontotemporale (Neary et al., 1998) in cui si osservano, in seguito alla degenerazione delle aree prefrontali dorsolaterali, un'eccessiva dipendenza dagli stimoli ambientali, caratterizzata da imitazione, prensione e utilizzazione, e la compromissione delle capacità di pianificazione: in questi casi l'accumulo non è pianificato e non è diretto verso oggetti specifici (Lhermitte et al., 1986; Neary et al., 1998; Volle, 2002), a differenza di quanto si osserva in pazienti con lesioni frontali vetro-mediali.

Volle e collaboratori (2002), ad esempio, hanno descritto il caso di un paziente che, in seguito a un danno frontale che coinvolgeva la corteccia orbitofrontale e il giro frontale superiore e mediale bilaterali, manifestava un comportamento di accumulo di elettrodomestici, quindi molto selettivo e finalizzato, diverso da quello comunemente osservato in pazienti con lesioni prefrontali dorsolaterali; il paziente, inoltre, era in grado di pianificare le strategie e le azioni necessarie a procurarsi gli oggetti, sebbene questo avesse conseguenze inappropriate e disturbasse la sua vita quotidiana. È noto tuttavia che pazienti con lesioni alla corteccia orbitofronta-

le, nel prendere decisioni risultano insensibili alle conseguenze delle proprie azioni, sebbene siano razionalmente consapevoli della possibilità di risultati dannosi (Cohen et al., 1999).

Volle e collaboratori (2002) considerano il comportamento un esempio di “collezionismo forzato”, definito come un comportamento eccessivamente finalizzato o dipendente dagli stimoli, che comporta una ricerca attiva degli oggetti, che vengono collezionati e conservati, dovuto a un controllo inibitorio frontale inefficiente. Evidenze a sostegno di questa ipotesi si hanno anche da studi sui deficit neuropsicologici associati al comportamento di accumulo, che evidenziano una maggiore impulsività e la difficoltà ad inibire risposte automatiche (Grisham et al., 2007).

Il ruolo della corteccia prefrontale ventromediale è inoltre confermato anche nella sintomatologia di accumulo non dovuta a danni cerebrali noti, attraverso studi di *neuroimaging* (Cohen et al., 1999; Volle et al., 2002; si veda Mataix-Cols et al., 2011 per una rassegna).

Lesioni focali o processi degenerativi che coinvolgono le regioni prefrontali o le strutture sottocorticali coinvolte nei circuiti frontali-sottocorticali possono inoltre determinare cambiamenti di personalità; in particolare, la sindrome orbitofrontale determina comportamenti antisociali, caratterizzati da disinibizione, labilità emotiva e impulsività (Harlow, 1868; Neary et al., 1998; Chow, 2000), caratteristiche evidenziate anche negli accumulatori (Patronek et al., 2006; Reinish, 2008; Arluke e Killeen, 2009; Patronek e Nathanson, 2009; Frost et al., 2011).

Inoltre, alcune delle aree coinvolte nel comportamento di accumulo fanno parte anche del circuito dell'empatia: la corteccia prefrontale mediale è coinvolta nella rappresentazione dei pensieri e dei sentimenti degli altri e nell'attribuzione della valenza emotiva agli eventi; la corteccia orbitofrontale è coinvolta nella capacità di giudizio sociale e nel valutare se qualcosa è doloroso; la corteccia cingolata si attiva sia quando si prova dolore che quando si osserva il dolore provato da altri (si veda Baron-Cohen, 2011, cap. 2 per una rassegna).

Attualmente, non sono disponibili dati relativi ai substrati neurali e ai correlati neuropsicologici dell'accumulo di animali. Tuttavia, Harlow (1868), nella descrizione del famoso caso di Phineas Gage, un uomo sopravvissuto ad una lesione prefrontale bilaterale molto estesa, dovuta ad una barra di ferro che gli aveva attraversato il cranio, aveva osservato l'insorgere nel paziente di una insolita passione per gli animali e per i bambini.

Al di là di questo aneddoto, è possibile che le aree cerebrali coinvolte nell'accumulo di oggetti siano coinvolte anche nell'accumulo di animali, determinando un'eccessiva dipendenza dagli stimoli che innescano l'im-

pulso all'accudimento, quali le caratteristiche infantili osservate nella maggior parte degli animali da compagnia, in assenza di un controllo frontale efficiente, nonché alterazioni dell'empatia.

### ***Disturbo da Accumulo e Demenza***

Hwang e collaboratori (1999) hanno osservato che il 20% dei casi di accumulo di oggetti coinvolge una demenza.

Anche per quanto riguarda l'accumulo di animali, il fatto che spesso, a seguito degli interventi di sequestro degli animali, molti accumulatori vengano affidati a un tutore o destinati ad altre forme di situazioni di vita controllate, implica che vi sia un'incapacità di prendere decisioni razionali e di gestire le proprie questioni personali, suggerendo una componente del disturbo legata a condizioni psichiatriche o neurologiche (Patronek, 1999). In particolare, Patronek (1999), osservando come in circa un quarto dei casi da lui studiati gli accumulatori fossero risultati incapaci di condurre una vita autonoma, ha proposto che l'accumulo di animali possa rappresentare un segnale d'allarme per gli stadi più precoci di una demenza.

Il modello della demenza potrebbe anche spiegare le condizioni di estrema negligenza personale e di squallore che si riscontrano sistematicamente negli accumulatori di animali (Reinish, 2008; Nathanson, 2009; Frost et al., 2011) e che concorrono a definire la cosiddetta "Sindrome di Diogene" (Clark et al., 2005; Snowden et al., 2007), caratterizzata da estrema negligenza personale, squallore domestico e ritiro sociale, accompagnati da accumulo e mancanza di preoccupazione rispetto alle proprie condizioni di vita.

Tale sindrome si osserva per lo più in anziani che vivono da soli, e più frequentemente tra le donne (Clark et al., 1975) ed è stata attribuita alla disfunzione dei lobi frontali (Neary et al., 1998), alla reazione ad eventi stressanti in persone con disturbi di personalità e al disturbo ossessivo compulsivo (vedi Montero-Odasso et al., 2005): in questi individui sono stati documentati alcuni indicatori di una disfunzione frontale, che includono il ritiro sociale, la mancanza di consapevolezza e la mancanza di empatia (Snowden et al., 2007).

Mataix-Cols e collaboratori (2010; 2011) propongono tuttavia di differenziare l'accumulo su base biologica nota, secondario a patologie (es., demenze) o lesioni cerebrali, in cui l'eziologia del comportamento problematico è evidente e documentabile attraverso esami strumentali, dai casi in cui questo comportamento si manifesta in individui senza una componente neurologica conosciuta.

### **Ipotesi sull'eziopatogenesi del Disturbo da Accumulo: il ruolo del trauma**

Ad eccezione delle forme in cui il comportamento di accumulo dipende da patologie o lesioni cerebrali o rappresenta la manifestazione di un Disturbo Ossessivo Compulsivo, le cause del Disturbo da Accumulo non sono note e coinvolgono verosimilmente una molteplicità di fattori.

Dalla letteratura emerge che, rispetto a chi non manifesta il disturbo, gli accumulatori di oggetti riportano una maggior incidenza di eventi stressanti o traumatici, tra cui perdita dei beni, portati via con la forza, maltrattamenti o attività sessuali forzate nell'infanzia e in età adulta; questi eventi si associano anche temporalmente all'esordio dei sintomi (Hartl et al., 2005; Grisham et al., 2006; Cromer et al., 2007; Tolin et al., 2010). Inoltre, gli individui diagnosticati come accumulatori che hanno subito almeno un evento di vita traumatico, manifestano una sintomatologia del disturbo di accumulo significativamente più severa rispetto agli accumulatori che non hanno mai vissuto esperienze traumatiche (Cromer et al., 2007).

La presenza di un trauma come fattore scatenante è inoltre suggerita dal senso di sicurezza che gli accumulatori ricavano dai propri averi, siano essi oggetti o animali (Frost e Hartl, 1996; Hartl *et al.*, 2005; Nathanson, 2009): poichè gli accumulatori tendono a differenziarsi dai controlli soprattutto nella frequenza dei traumi che riflettono abusi fisici o sessuali, è possibile che gli oggetti, o gli animali, risultino sicuri in contrapposizione alle persone, associate invece agli episodi di abuso (Hartl et al., 2005; Cromer et al., 2007; Rynearson, 1978; Nathanson, 2009; Patronek e Nathanson, 2009). Il trauma potrebbe anche spiegare la necessità di controllo degli hoarder: proteggendo i propri beni, proteggono infatti il proprio sistema di sicurezza (Cromer et al., 2007).

Alla luce di questi dati, diverse ricerche hanno preso in considerazione il ruolo del trauma o di eventi di vita stressanti nel Disturbo da Accumulo.

Nell'accumulo di oggetti, alcuni individui riferiscono l'esordio del comportamento in risposta ad un evento stressante, mentre altri ne descrivono uno sviluppo lento e progressivo nel corso della loro vita, evidenziando una predisposizione all'accumulo che si manifesta precocemente e che si aggrava col tempo (Grisham et al., 2006; Tolin et al., 2010). In particolare, è più facile che gli individui con età di esordio più avanzata riportino un evento stressante prima dell'esordio dei sintomi, rispetto a quelli con un'età di esordio più precoce (Grisham et al., 2005; 2006).

Grisham e collaboratori (2006) suggeriscono che nel primo caso si possa trattare di una risposta alla difficoltà di trovare una strategia adeguata ad affrontare lo stress, mentre nel caso di un esordio precoce l'accu-

mulo potrebbe essere la manifestazione di un tratto di personalità duraturo, di caratteristiche temperamentali o di problemi nell'elaborazione delle informazioni (deficit neuropsicologici relativi all'attenzione e alle capacità di categorizzazione e pianificazione).

È stato inoltre proposto che, quando l'esordio del Disturbo da Accumulo è precoce e l'individuo non riesce ad individuare un evento scatenante, ciò potrebbe dipendere dal mancato ricordo di uno evento stressante accaduto nell'infanzia, un fenomeno noto come "amnesia infantile" (Grisham, 2006) oppure da uno stress di tipo continuo e prolungato, legato a modalità di caregiving inadeguate (Rynearson, 1978; Cassidy e Mohr, 2001; Lee, 2006).

### ***Il trauma infantile nell'accumulo di animali: disturbi dell'attaccamento e caregiving compulsivo***

Gli studi che hanno indagato in maniera specifica il trauma in relazione all'eziopatogenesi dell'accumulo di animali hanno confermato il ruolo centrale del trauma infantile o "cumulativo" (Patronek e Nathanson, 2009; Steketee et al., 2011), definito come una forma cronica di abuso o di negligenza da parte dei genitori, che si differenzia quindi dai traumi acuti (Khan, 1963), presentandosi come un pattern ripetuto, cronico, di interazioni dannose tra genitori e bambino, che diventa tipico della relazione.

Steketee e collaboratori (2011) hanno condotto uno studio confrontando le risposte di proprietari di un gran numero di animali (20 o più), adeguatamente accuditi, e di accumulatori, in un'intervista semistrutturata volta a indagare informazioni biografiche, esperienze come proprietario di animali, comportamenti, credenze ed emozioni rispetto agli animali, relazioni familiari attuali e passate, salute e problemi psicologici.

La differenza più significativa tra i due campioni era la presenza di un "ambiente domestico caotico" nell'infanzia degli accumulatori, caratterizzato da uno stile di vita disorganizzato e confuso, in cui un genitore o altri membri della famiglia causavano scompiglio in casa, compromettendo la qualità di vita. Tali circostanze erano dovute a un elevato livello di conflittualità, abuso di sostanze e divorzio; inoltre, gli accumulatori riportano più problemi di attaccamento rispetto ai controlli e relazioni familiari peggiori, caratterizzate da rabbia, sentimenti feriti, negligenza e perfino abusi, esperienze che anche altri studi hanno registrato con un'alta frequenza nei campioni di accumulatori di animali (Frost, 2000; HARC, 2002; Patronek e Nathanson, 2009; Frost et al., 2011).

Diverse ricerche hanno dimostrato che cure parentali non adeguate nelle prime fasi della vita possono determinare alterazioni dello sviluppo

a livello biologico (Mathew et al., 2002), in particolare rispetto alle strutture cerebrali coinvolte sia nel comportamento di accumulo che nell'empatia e nella cognizione sociale, e psicologico, per il mancato accesso del bambino a quelle interazioni positive con il caregiver fondamentali per lo sviluppo dell'identità, del senso di autoefficacia, dell'autostima e delle capacità emotive ed empatiche (Stern 1977; Tronick, 1989; Hoffman, 2000), che risultano di conseguenza compromesse.

Ad esempio, uno studio PET condotto su un campione di bambini di un orfanotrofio della Romania, trascurati dal punto di vista emotivo, ha trovato una riduzione dell'attività metabolica nella corteccia orbitofrontale rispetto ai bambini di controllo (Chugani et al., 2001).

Inoltre, è stato osservato che i bambini trascurati durante l'infanzia, mostrano alterazioni nello sviluppo dell'elaborazione delle espressioni facciali emotive, al punto che hanno difficoltà a distinguere espressioni emotive diverse (capacità alla base dell'empatia) e hanno un bias percettivo verso i volti tristi (Pollack e Tolley-Schell, 2003).

Tra il 50% e il 90% dei pazienti con un disturbo di personalità riporta una storia di abuso o negligenza durante l'infanzia, che è associata anche alla presenza di singoli tratti di personalità disfunzionali, tra cui l'impulsività (Brodsky et al., 2001); è stato osservato che negli adulti non depressi ma con disturbi di personalità, una storia di trauma infantile sia legata ad una tendenza ad attribuire a volti neutri una connotazione emotiva intensa, per cui, in condizioni ambigue, si osserva un bias negativo nell'elaborazione dell'informazione emotiva, attribuibile all'alterazione delle funzioni sensoriali e di quelle sottese dalla corteccia limbica e prefrontale (Lee, 2006).

L'ambiente domestico "caotico" descritto nell'infanzia degli accumulatori di animali condizioni appare simile all'accudimento patogeno a cui sono sottoposti i bambini che sviluppano un Disturbo Reattivo dell'Attaccamento, in cui si osservano, come descritto nel DSM IV, "una persistente trascuratezza verso i bisogni fisici o emotivi fondamentali del bambino, o ripetuti cambiamenti della figura che principalmente si prende cura del bambino, che impedisce la formazione di legami stabili".

In queste situazioni, quando il caregiver si dimostra minaccioso, imprevedibile o terrificante, il bambino sviluppa spesso un attaccamento disorganizzato, poiché non riesce ad organizzare una strategia adatta ad ottenere protezione dal caregiver (Cassidy e Mohr, 2001); l'abuso infantile è l'esempio più drammatico di comportamento terrificante da parte di un genitore, tuttavia anche un genitore a sua volta spaventato o depresso a causa di eventi traumatici o lutti può avere un simile effetto sul bambino,

che non sente di potersi affidare al genitore per ricevere protezione e sicurezza (Main e Hesse, 1990).

In risposta a queste modalità di accudimento, il bambino sviluppa nel tempo un atteggiamento controllante, come strategia per limitare i danni della relazione disfunzionale; inoltre, la disorganizzazione si ripercuote a livello cognitivo, sottoforma di problemi nelle capacità di ragionamento (Cassidy e Mohr, 2001). L'indisponibilità del caregiver e i suoi atteggiamenti riducono inoltre le possibilità del bambino di beneficiare delle esperienze necessarie per sviluppare la capacità di rappresentarsi gli stati mentali propri e altrui, compromettendo l'empatia, le capacità di riconoscimento delle emozioni e quindi le abilità alla base di relazioni adulte sane (Cassidy e Mohr, 2001).

In conseguenza a stili di attaccamento disfunzionali è inoltre frequente che si strutturi una modalità di relazione nota come "caregiving compulsivo", che persiste in età adulta (Rynearson, 1978) ed è caratterizzata da un timore estremo della separazione e dal fatto che l'individuo assume sempre il ruolo di colui che offre cure, senza riceverne in cambio (Rynearson, 1978; West e Keller, 1991), aspetti centrali anche nel comportamento degli accumulatori di animali.

Il caregiving compulsivo si sviluppa in persone che hanno sperimentato come l'unico possibile legame affettivo sia quello in cui si assume il ruolo di caregiver (Bowlby, 1977), per cui durante l'infanzia l'individuo impara a inibire il proprio sistema di attaccamento, in modo da evitare esperienze sgradevoli; al suo posto vengono attivati altri sistemi di comportamento, quale appunto caregiving, in risposta ad eventi che minacciano di attivare risposte di attaccamento: ne risulta un'inversione di ruoli che presenta le caratteristiche di un trauma cumulativo/ripetuto, dovuto all'esperienza ripetuta di un genitore indisponibile. In altre parole, il caregiving compulsivo è una strategia di adattamento che durante l'infanzia offre la possibilità di ottenere la vicinanza dei genitori: la struttura di questo legame viene appresa e replicata in età adulta, dove costituisce un modello per relazioni (West e Keller, 1991).

Assumere il ruolo di caregiver è inoltre una strategia difensiva che permette di passare da un ruolo passivo, che genera timore, ad uno attivo, in cui si mantiene il controllo sulla relazione, piuttosto che subirla (West e Keller, 1991). Spesso tale comportamento è rivolto verso individui percepiti come deboli, che all'inizio possono accogliere le cure offerte, arrivando tuttavia presto a sentirsi sopraffatti quando perdono la propria indipendenza e la possibilità di scelta (Rynearson, 1978; Patronek e Nathanson, 2009).

È stato inoltre osservato che circostanze evolutive anomale o frustrazioni infantili possono determinare un forte attaccamento agli animali da compagnia, con i quali si strutturano relazioni patologiche per la loro natura difensiva, dove, a causa della sfiducia acquisita verso gli esseri umani, gli animali vengono preferiti alle persone in quanto percepiti come leali, capaci di amore incondizionato e di assumere contemporaneamente il ruolo di fonte ed oggetto di cura (Rynearson, 1978). A questo proposito Nathanson (2009) ha osservato che l'esordio dell'accumulo di animali si osserva spesso in seguito ad un'affinità dell'individuo per gli animali nell'infanzia o nella giovane età adulta, che si accompagna ad un attaccamento emotivo molto intenso agli animali, ai quali non è raro che venga attribuito un valore maggiore rispetto agli altri membri della famiglia (Patronek e Nathanson, 2009).

Alla luce di queste considerazioni, è possibile che quando la tendenza al caregiving compulsivo si accompagna ad esperienze positive con gli animali, questi vengano scelti come oggetti di cura preferenziali, in virtù della loro incapacità di opporsi alla volontà della persona, determinando così un terreno fertile per l'insorgere di un problema di accumulo di animali.

L'esperienza di una relazione protettiva e confortevole con un animale nell'infanzia può infatti fornire un imprinting indelebile, al punto che nell'età adulta, di fronte a relazioni in cui l'attaccamento è problematico, il prendersi cura in maniera compulsiva degli animali può diventare il mezzo primario per mantenere o costruire il senso di sé (Patronek e Nathanson, 2009), come dimostra il fatto che, sebbene gli accumulatori spesso non siano in grado di accudire i propri animali, difendono strenuamente il ruolo di caregiver, affermando il proprio intento di salvare gli animali e capacità di accudimento superiori a chiunque altro (Vaca Guzman e Arluke, 2005; Patronek et al., 2006; Arluke e Killeen, 2009.).

La validità degli approcci che prendono in considerazione il trauma infantile e i disturbi dell'attaccamento nello sviluppo dell'accumulo di animali è inoltre sostenuta dal fatto che spesso gli accumulatori manifestano disturbi associati alla mancanza di legami essenziali nel corso della prima infanzia e all'attaccamento, tra cui disturbi di personalità di tipo borderline, narcisistico e antisociale e paranoide (Patronek et al., 2006, p. 23; Baron Cohen, 2011, cap. 3).

### **Quali possibilità d'intervento nell'accumulo di animali?**

La natura complessa dei casi di accumulo di animali li rende difficili da indagare e da risolvere, in quanto prevedono il coinvolgimento di più

servizi, per la salute mentale, la salute pubblica, la tutela degli animali e della fauna selvatica, la tutela degli anziani, dei bambini, le forze dell'ordine e i servizi sociali: ne deriva che la gestione di questi casi è spesso faticosa dal punto di vista procedurale, lenta e particolarmente costosa (Patronek e HARC, 2001).

Generalmente, le prime segnalazioni arrivano dai vicini di casa, che si lamentano per le scarse condizioni igieniche in cui vivono gli accumulatori, odori forti e sgradevoli, e talvolta per l'abbaiare dei cani, mentre raramente vengono evidenziate le condizioni di trascuratezza poiché gli animali sono nascosti all'interno dell'abitazione (Patronek e HARC, 2001; Arluke e Killeen, 2009).

Dal momento che nei casi di accumulo è riconosciuto il maltrattamento degli animali, gli interventi a favore degli animali sono insolitamente più efficaci rispetto a quelli a tutela delle persone ed è più facile organizzare il loro salvataggio. Spesso infatti l'intervento a favore della persona è limitato dal fatto che solo pochi accumulatori soddisfano i criteri per l'incompetenza mentale o rappresentano un pericolo immediato per la comunità, perciò non viene riconosciuta la necessità di un intervento di tipo medico o psicologico; inoltre, la mancanza d'intenzionalità da parte degli accumulatori (ad eccezione dei casi di accumulatore-sfruttatore) rende difficile il perseguirli dal punto di vista penale con l'accusa di reati di crudeltà verso gli animali (Avery, 2005).

L'intervento ha generalmente luogo qualora vengano accertate le condizioni per il maltrattamento di animali o un pericolo per la sicurezza e l'igiene pubblica e consiste generalmente nel sequestro degli animali, mentre solo di rado l'accumulatore è condannato alla reclusione, al pagamento di multe o, come sarebbe più opportuno, invitato a intraprendere un percorso di cura (Patronek, 1999; Avery, 2005; Patronek et al., 2006).

Il sequestro degli animali è però una procedura complicata e costosa e inoltre, c'è accordo in letteratura nel ritenere che interventi di tipo esclusivamente punitivo non riescono a limitare l'alto tasso di recidivismo, vicino al 100% (Berry et al., 2005; Patronek e HARC, 2001; Patronek et al., 2006), a dimostrazione che intervenire solo sull'ambiente mediante l'approccio "via gli animali, via il problema" (Nathanson, 2009) non cambia il comportamento della persona e il problema persiste.

È infatti necessario tenere in considerazione che, nell'accumulo di animali, le condizioni dell'ambiente domestico e degli animali rappresentano un sintomo, la cui causa è da ricercarsi negli aspetti psico-sociali alla base del fenomeno.

Risulta quindi di primaria importanza il saper riconoscere la presenza di una psicopatologia (Avery, 2005; Reinisch, 2008), che può presentarsi

con diversi livelli di gravità e con caratteristiche che variano nelle diverse tipologie di accumulatori, sulla base delle quali andrebbero strutturati diversi tipi di intervento: dal cercare di costruire una relazione, collaborando al raggiungimento di una soluzione condivisa, al sequestro degli animali, fino a persecuzioni aggressive per i crimini contro gli animali.

Ad esempio, nel caso dello “sfruttatore” è spesso essenziale l’azione legale, che può rendersi necessaria anche con il “salvatore”, che risulta difficile da persuadere; al contrario, il “caregiver sopraffatto” è generalmente collaborativo, perciò è più opportuno cercare una soluzione condivisa, minacciando un’azione legale solo per prevenire il recidivismo (Patronek et al., 2006).

Alcuni accumulatori possono inoltre avere un comportamento irrazionale o disturbi di personalità che rendono difficili le negoziazioni e suggeriscono una prognosi negativa in caso di intervento, mentre altri possono avere demenze o altri disturbi cerebrali, che tendono a peggiorare nel tempo. Inoltre, temi complessi quali la libertà personale, le scelte di vita, la capacità mentale e i diritti sulla proprietà privata complicano ulteriormente la gestione dei casi di accumulo.

Per questi motivi, si rivelano dunque fondamentali il supporto e il trattamento psicologico/psichiatrico (Avery, 2005; Reinisch, 2008) che, sebbene non esistano linee guida standard, dovrebbero indagare la presenza di una componente organica nella genesi del disturbo, identificare e trattare le comorbidità (tra cui ansia sociale, disfunzione cognitiva, depressione, Disturbo Ossessivo Compulsivo, demenza, schizofrenia,...) e strutturare un intervento altamente individuale, al fine assicurare una buona compliance e garantire esiti efficaci per le persone e gli animali coinvolti (Patronek et al., 2006). Anche una valutazione a casa dell’accumulatore può inoltre fornire informazioni cruciali (Reinisch, 2008).

È infine di primaria importanza per lo psicologo esplorare la relazione tra l’accumulatore e i suoi animali, basandosi sulle conoscenze rispetto al ruolo e al significato degli animali da compagnia nel contesto delle normali relazioni tra uomo e animale, per esaminare in che modo queste diventino disfunzionali al punto da sfociare nell’*hoarding*, affrontando gli aspetti legati all’acquisizione eccessiva e alla negazione del fallimento nel fornire cure adeguate e delle sue conseguenze (Nathanson, 2009).

Soprattutto in presenza di un sequestro degli animali, che gli accumulatori vivono come un’esperienza fortemente traumatica (Arluke e Killeen, 2009), per evitare ulteriori comportamenti criminali o recidive del comportamento, è infatti essenziale riconoscere l’importanza che gli animali hanno nella vita dell’individuo e può essere utile permettergli di tenere con sé almeno alcuni animali, sterilizzati, anche per aumentare la

collaborazione e l'adesione al trattamento psicologico (Lockwood, 1994). Tutto ciò deve però essere accompagnato da programmi di monitoraggio a lungo termine e di supporto per gli accumulatori, che prevedano la collaborazione tra veterinari, servizi a tutela degli animali, servizi di igiene pubblica e mentale, forze di polizia e sistema legale (Avery, 2005).

Qualora gli assistenti sociali, i membri delle associazioni per la protezione degli animali o i servizi per la tutela dell'igiene pubblica vengano a conoscenza della situazione di accumulo prima della denuncia alle autorità, se adeguatamente formati, possono intervenire informando l'accumulatore dei rischi a cui va incontro e cercando la sua collaborazione nel trovare strategie alternative. L'atteggiamento dev'essere propositivo e non coercitivo. Se coinvolti a seguito di un intervento delle autorità, tali operatori possono invece avere un ruolo di supporto nella gestione della crisi e della cura del paziente, anche sfruttando le risorse della comunità e facilitando un approccio interdisciplinare (Nathanson, 2009).

La gestione di questi casi pone tuttavia un dilemma etico per i professionisti coinvolti, soprattutto per quelli che agiscono a tutela della persona la quale, in seguito alla denuncia alle autorità, potrebbe perdere gli animali dai quali dipende fortemente dal punto di vista emotivo, arrivando a minacciare il suicidio di fronte a questa possibilità. Gli operatori possono quindi temere che, svelando le condizioni delle abitazioni e degli animali, possano sacrificare la fiducia e il rapporto faticosamente ottenuti. Anche per questi motivi sarebbe dunque fondamentale intervenire in modo da garantire un adeguato supporto psicologico all'accumulatore, che possa mitigare le potenziali perdite (Nathanson, 2009).

Un'altra figura importante è quella del medico veterinario, che ricopre un ruolo essenziale soprattutto per la cura e il recupero degli animali oggetto di accumulo, sia dopo il loro eventuale sequestro che nelle fasi di follow-up, qualora venga consentito all'accumulatore di tenere alcuni animali, per monitorarne le condizioni.

Reinish (2008) suggerisce che il veterinario, se adeguatamente informato sui meccanismi alla base della patologia di accumulo, possa contribuire ad identificare gli accumulatori, riconoscendo gli animali coinvolti in queste situazioni: in particolare, visite di singoli animali che presentano ripetutamente parassiti o patologie contagiose possono essere indicative di una loro reclusione in condizioni di scarsa igiene. Spesso inoltre gli accumulatori non vogliono o non possono garantire le vaccinazioni di routine, il controllo dei parassiti e la sterilizzazione e raramente si presentano con animali anziani, che tipicamente manifestano problematiche quali tumori o disturbi cardiaci a lungo trascurati (Reinisch, 2008). Infine, generalmente chi accumula non vuole affermare quanti animali possiede, o

non è in grado di farlo, e mostra interesse nel cercare di salvare sempre più animali (Reinisch, 2008).

Tuttavia, la maggior parte di queste persone trascura i propri animali o agisce in modo da ingannare il veterinario, rivolgendosi a più professionisti per diminuire i sospetti e rendendo poco probabile che questi riesca a riconoscerli.

In caso di dubbio è comunque opportuno che il veterinario visiti il luogo in cui vivono gli animali, per accertarne le condizioni (Lockwood, 1994; Reinisch, 2008): interfacciandosi con l'accumulatore per la cura degli animali, prima o dopo l'identificazione del caso, il veterinario potrebbe essere la persona che ne conquista la fiducia, agevolando gli altri interventi.

I veterinari, così come le organizzazioni a tutela degli animali, dovrebbero inoltre fare attenzione a non favorire involontariamente gli accumulatori, avvisandoli quando un animale ha bisogno di una casa o regalando campioni gratuiti che possono aiutare la persona ad acquisire ancora più animali (Reinisch, 2008).

È stata infatti evidenziata una crescente tendenza degli accumulatori a presentarsi come direttori di rifugi per animali e associazioni animaliste (Berry et al., 2005): talvolta si tratta davvero di persone che intraprendono progetti di questo tipo, ma più spesso si tratta di giustificazioni per il proprio comportamento (Vaca Guzman e Arluke) e sarebbe perciò consigliabile fare opportuni controlli prima di dare animali in adozione.

### **Conclusioni e nuove direzioni di ricerca**

Sebbene nel mondo scientifico ci sia accordo nel ritenere l'accumulo di animali un disturbo psicologico, i meccanismi su cui si basa non sono ancora del tutto compresi.

La comunità scientifica ha iniziato ad occuparsi di questo fenomeno solo in tempi piuttosto recenti e in modo poco sistematico, per lo più basandosi sui resoconti degli operatori coinvolti nella gestione dei casi (e.g., Patronek, 1999), sulla consultazione di archivi (e.g., Avery, 2005; Berry et al., 2005) o sull'esperienza clinica dei professionisti chiamati ad intervenire nei problemi di accumulo di animali (e.g., Nathanson, 2009; Patronek e Nathanson, 2009); escludendo i resoconti di casi singoli (e.g., Arluke e Killeen, 2009), solo due studi hanno tratto informazioni direttamente dagli accumulatori di animali, attraverso interviste libere (Worth e Beck, 1981) o semistrutturate (Steketee et al., 2011).

Sarebbe quindi innanzitutto necessario ottenere più dati direttamente dalle persone che manifestano il problema, per indagarne in modo appro-

fondito la storia di vita e l'esperienza di eventi traumatici, la personalità, la presenza di disturbi in asse I e II ed eventuali problemi neurologici.

Anche le ipotesi sui possibili circuiti neurali coinvolti si riferiscono agli studi condotti su campioni di accumulatori di oggetti e di persone con compromissioni dell'empatia e dell'elaborazione emotiva, ma questi aspetti non sono mai stati indagati direttamente negli accumulatori di animali.

Mancano inoltre ricerche che abbiano confrontato gli accumulatori di animali con i comuni proprietari di animali da compagnia, cercando di comprendere l'accumulo di animali analizzando i meccanismi alla base del rapporto normale tra l'uomo e gli animali da compagnia: l'unico studio in questa direzione ha confrontato gli accumulatori con i proprietari di almeno venti animali (Steketee et al., 2011), che però non sono rappresentativi del comune proprietario di animali e non sembrano quindi costituire un campione adatto per indagare la presenza e la tipologia di eventuali distorsioni del rapporto uomo-animale negli accumulatori.

Attraverso studi che confrontino gli accumulatori di animali con i proprietari di un numero medio di animali da compagnia, selezionati in modo da controllare variabili quali l'età, il genere e la tipologia di animali coinvolti, potrebbero essere indagate soprattutto le differenze nel legame con gli animali, a partire dall'attaccamento e dall'empatia nei loro confronti: la centralità di questi aspetti non solo per il rapporto normale tra uomo e animali, ma anche per l'accumulo di animali, è suggerita anche dal fatto che questo disturbo si manifesta con una frequenza significativamente maggiore nelle donne, notoriamente più attratte dalle caratteristiche infantili (Sprenghelmeyer et al., 2009; Archer e Morton, 2011) e maggiormente predisposte all'empatia (Davis, 1980; Baron Cohen e Wheelwright, 2004).

A questo proposito, si potrebbe valutare l'ipotesi che l'attaccamento immediato agli animali, osservato negli accumulatori, sia dovuto ad una maggiore sensibilità alle caratteristiche infantili tipiche degli animali da compagnia; allo stesso modo, l'attaccamento verso un ampio numero di animali e la volontà di salvarli, potrebbe dipendere da una maggiore empatia nei loro confronti, dovuta al malfunzionamento di alcuni meccanismi di regolazione, tra cui la somiglianza e la familiarità (si pensi al fatto che molti accumulatori, spinti dal desiderio di salvare gli animali, non si curano del rischio di esporre altre persone, tra cui i propri familiari, a situazioni pericolose o indesiderate e si mostrano insensibili alle loro lamentele), o ad errori nell'elaborazione delle emozioni espresse dagli animali, per cui stimoli quali espressioni facciali e vocalizzazioni verrebbero interpretate in modo sistematicamente negativo (inducendo così la perso-

na a considerarli sempre bisognosi di aiuto), come osservato nelle persone che, come molti accumulatori di animali, hanno subito un trauma infantile o presentano disturbi di personalità (Pollak e Tolley-Schell, 2003; Dick et al., 2008).

Anomalie nel funzionamento dell'empatia potrebbero inoltre spiegare perchè, dopo l'acquisizione degli animali, gli accumulatori siano insensibili ai loro bisogni: è infatti possibile che, a fronte di una compromissione dei meccanismi di somiglianza e familiarità, siano invece preservati i sistemi di abitudine alla sofferenza e di distacco emotivo, che impediscono la fatica da compassione e si attivano proprio quando ci si confronta con un gran numero di individui in condizioni di forte disagio (Hoffman, 2000; Mitchner e Ogilvie, 2002; Bock et al., 2007).

Studi che consentano una maggior comprensione del legame tra gli accumulatori e i loro animali, uniti all'indagine degli aspetti legati alla psicopatologia e ad eventuali disturbi neurologici e neuropsicologici, consentirebbero di strutturare interventi realmente efficaci nei casi di accumulo di animali, di fornire un adeguato supporto psicologico agli accumulatori e di comprendere meglio il funzionamento dell'empatia.

Ricerche di questo tipo permetterebbero inoltre di definire meglio le caratteristiche delle diverse categorie di *animal hoarder*, aiutando in particolar modo a comprendere se il profilo dello "sfruttatore", in cui sembrano mancare l'empatia, l'attaccamento e la preoccupazione per gli animali che caratterizzano le altre tipologie di accumulatore, possa sovrapporsi a quello di altre forme di psicopatologia, come il Disturbo di Personalità Antisociale, per le quali si rende spesso necessaria l'azione legale come unica possibilità d'intervento (Baron Cohen, 2011, cap. 3 e 6); analogamente, basandosi sui dati finora disponibili, oggi potrebbero rientrare in questa categoria coloro che traggono profitti dalla cattiva gestione di allevamenti e rifugi per animali, trasformando impropriamente forme di criminalità in un disagio psicologico, con il rischio di fornire giustificazioni improprie per ridurre eventuali sanzioni.

Infine, poiché in Italia non esistono ricerche scientifiche sul fenomeno, sarebbe interessante condurre inizialmente alcune ricerche di tipo epidemiologico, in collaborazione con le ASL e le forze dell'ordine, al fine di stimare la prevalenza del disturbo nel nostro paese, inquadrandolo anche all'interno del contesto socio-culturale italiano. Rispetto agli USA, a cui si riferisce la maggior parte dei dati sull'accumulo di animali presente in letteratura, potrebbero infatti emergere alcune differenze, ad esempio in relazione alle norme sul randagismo, che in Italia non prevedono l'eutanasia degli animali nei rifugi a loro dedicati; questo fattore potrebbe influenzare l'atteggiamento degli accumulatori nei confronti di chi agisce a

tutela degli animali e potrebbe placare l'ansia rispetto al tema della morte, riscontrata in molti accumulatori americani, modificando almeno in parte la manifestazione del fenomeno.

## **4.2 “A dangerous Noah’s ark: Animal Hoarding between press reports and scientific research”**

Edited by Elisa Silvia Colombo, Paola D’amico and Emanuela Prato-Previde

Book published by *Cosmopolis*

### **Book summary**

Press and media often describe people who hoard a great number of animals in their home, resulting in animal abuse due to the lack of proper care for animals and impairment in sanitary conditions. Animal Hoarding is a pathological condition well-known in the USA and starts to gain attention also in Italy, thanks to its inclusion among mental disorders mentioned in the DSM-5. With the contribution of experts in psychological, psychiatric, legal, ethological and veterinary sciences, the book deals with themes such as the diagnostic criteria of animal hoarding, the underlying psychological and neuropsychological mechanisms, its relation with animal abuse and normal human-animal bond, legal consequences of animal cruelty and the possibility to cure and rehabilitate both people and animals. Furthermore, three main categories of animal hoarders are described and the phenomenon of “lager shelters” is discussed as a possible consequence of this mental disorder.

This is the first essay on animal hoarding disorder published in Italy and analyzes this theme in the light of the international scientific literature and through the narration of cases derived from the Italian press.

Conclusions highlight the need for further research on animal hoarding, aimed at investigating its prevalence and aetiology and the efficacy of psychotherapy in its treatment.



Figure 4.1: The book cover

### 4.3 Chapter conclusions

Animal hoarding is characterized by the accumulation of a large number of animals and a failure to provide minimal standards of care to them (nutrition, veterinary care, satisfaction of their ethological needs) and to act on the suffering of the animals and on the deterioration of the environment conditions due to severe overcrowding and lack of hygiene. This behaviour has been recently recognized as a mental disorder and it is described in the DSM-5 as a special manifestation of Hoarding Disorder, which usually refers to the hoarding of objects.

However, animals are sentient beings and animal hoarding, differently from object hoarding, seems to be related mainly to the lack of empathy towards animals and the inability to recognize their suffering, therefore its diagnostic classification is still a matter of debate. However, there is agreement on considering animal hoarding more serious than object hoarding, for three reasons: the severe impairment in sanitary conditions that results from the large number of animals (often sick or even dead), the presence of excrements in the household and the risk for zoonosis; the frequent lack of insight; the impairment of empathic abilities.

The literature show that more women than men suffer from this disorder, mainly in the middle age, and that cats and dogs are the most hoarded animals. In particular, three types of animal hoarders

have been described: the “overwhelmed caregiver”, the “rescue hoarder” and the “exploiter hoarder”: the former two share a strong emotional attachment to their animals and a deep grief associated with parting with them, while the latter lack these two crucial features, exploiting them mainly for economical reasons, therefore it may not fit the diagnostic criteria for animal hoarding but rather it may be classified as antisocial personality disorder.

Since this phenomenon has started to be investigated only recently, little is known about the underlying psychological mechanism and the aetiology of the pathology, that may be linked to traumatic experiences in childhood or adulthood (i.e. insecure attachment, abuse, abandonment, loss or death of a loved one). Furthermore, some aspects of the normal human-animal bond such as attachment and an increased self-esteem derived from animals may be found also in animal hoarding, where they become extreme and rigid in their expression, impairing both animal and human welfare. Furthermore, women tend to be usually more empathic and to form stronger attachment bonds with animals than men, and this might explain why more women than men suffer from animal hoarding disorder.

However this interpretation is speculative and further studies are needed to better understand the psychological and neurobiological mechanisms of animal hoarding. In particular, studies investigating psychological and neuropsychological profile of animal hoarders, comparing them with normal pet-owners are highly required. Furthermore, although animal hoarding has been considered an example of pathological altruism (Nathanson & Patronek, 2011), no study has investigated empathy towards animals and its potential aberrations in animal hoarders.

In Italy, my work is the first offering an overview on the current status of research on animal hoarding and it would be interesting to carry out also epidemiological studies, in order to evaluate the prevalence of this disorder and its characteristics in our country.

## References

- Allen, K., Blascovich, J., & Mendes, W.B. (2002). Cardiovascular reactivity and presence of pets, friends and spouses: the truth about cats and dogs. *Psychosomatic Medicine*, 64, 727-739.
- American Psychiatric Association (2001). *DSM IV-TR, Manuale diagnostico e statistico dei disturbi mentali*. Text Revision, Milano: Masson.
- American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders (DSM-5®)*. American Psychiatric Pub.
- Anderson, W.P., Reid, C.M., & Jennings, G.L. (1992). Pet ownership and risk factors for cardiovascular disease. *Medical Journal of Australia*, 157, 298- 301.
- Archer, J. (1997). Why do people love their pets?. *Evolution and Human Behavior*, 18, 273-259.
- Archer, J., & Monton, S. (2011). Preferences for infant facial features in pet dogs and cats. *Ethology*, 117, 217-226.
- Arluke, A., Frost, R., Steketee, G., Patronek, G., Luke, C., Messner, E., Nathanson, J., & Papazian, M. (2002). «Press reports of animal hoarding», *Society and Animals*, 10, 1–23.
- Arluke, A., & Killeen, C. (2009). *Inside animal hoarding – The case of Barbara Erickson and her 552 dogs*. West Lafayette, Indiana: Purdue University Press.
- Assalco – Zoomarck (2012). Rapporto sull'alimentazione e cura degli animali da compagnia.
- Avery, L. (2005). From helping to hoarding to hurting: when the acts of “Good Samaritans” become felony animal cruelty. *Valparaiso University Law Review*, 39(4), 815-858.
- Baron-Cohen, S. (2011). *The science of evil: on empathy and the origins of cruelty*. New York: Basic Books.
- Baron-Cohen, S., & Wheelwright, S. (2004). The Empathy Quotient: an investigation of adults with Asperger Syndrome or High Functioning Autism, and normal sex difference. *Journal of Autism and Developmental Disorders*, 34(2), 163-175.
- Berry, C., Patronek, G., & Lockwood, R. (2005). Long-term outcomes in animal hoarding cases. *Animal Law*, 11, 167-194.
- Bloch, M.H., Landeros-Weisenberger, A., Rosario, M.C., Pittenger, C., & Leckman, J.F. (2008). Meta-analysis of the symptom structure of obsessive–compulsive disorder. *American Journal of Psychiatry*, 165(12), 1532–1542.
- Bloom, T., & Friedman, H. (2013). Classifying dogs' (Canis familiaris) facial expressions from photographs. *Behavioral Processes*, 96, 1-10.
- Bock, B.B., Van Huik, M.M., Prutzer, M., Kling Eivellard, F., & Dockes, A. (2007). Farmers' relationship with different animals: the importance of getting close to the animals. Case studies of French, Swedish and Dutch cattle, pig and poultry farmers. *International Journal of Sociology of Food and Agriculture*, 15(3), 108-125.

- Bolman W.M., & Katz, A.S. (1996) Hamburger hoarding: a case of symbolic cannibalism resembling Whitico psychosis. *The Journal of Nervous and Mental Disease*, 142, 424–428.
- Bowlby, J. (1977). The making and breaking of affectional bonds. *British Journal of Psychiatry*, 130, 201-210.
- Bradshaw, J.W.S., & Paul, E.S. (2010). Could empathy for animals have been an adaptation in the evolution of Homo sapiens? *Animal Welfare*, 19(S), 107- 112.
- Brodsky, B.S., Oquendo, M., Ellis, S.P., Haas, G.L., Malone, K.M., & Mann, J.J. (2001). The relationship of childhood abuse to impulsivity and suicidal behavior in adults with major depression. *The American Journal of Psychiatry*, 158, 1871–1877.
- Broom, D. M. (2014). *Sentience and Animal Welfare*. CABI.
- Calvo, P., Duarte, C., Bowen, J., Bulbena, A., & Fatjó, J. (2014). Characteristics of 24 cases of animal hoarding in Spain. *Animal Welfare*, 23(2), 199-208.
- Cassidy, J., & Mohr, J.J. (2001). Unsolvable fear, trauma, and psychopathology: theory, research and clinical considerations related to disorganized attachment across the life span. *Clinical Psychology: Science and Practice*, 8(3), 275- 298.
- Chow, T.W. (2000). Personality in Frontal Lobe Disorders. *Current Psychiatry Reports*, 2, 446-451.
- Chiu, S.N., Chong, H.C., & Lau, S.P.F. (2003). Exploratory study of hoarding behaviour in Hong Kong. *Hong Kong Journal of Psychiatry*, 13, 23-30.
- Chugani, H.T., Behen, M.E., Muzik, O., Juhász, C., Nagy, F., & Chugani, D.C. (2001). Local brain functional activity following early deprivation: a study of post institutionalized Romanian orphans. *Neuroimage*, 14, 1290–1301.
- Clark, A.N., Mankikar, G.D., & Gray, I. (1975). Diogenes syndrome: a clinical study of gross neglect in old age. *Lancet*, 15, 366-368.
- Cohen, L., Angladette, L., Benoit, N., & Pierrot-Deseilligny, C. (1999). A man who borrowed cars. *The Lancet*, 353(9146), 34.
- Cromer, K.R., Schmidt, M.B., & Murphy, D.L. (2007). Do traumatic events influence the clinical expression of compulsive hoarding? *Behaviour Research and Therapy*, 45, 2581–2592.
- Darwin, C. (1872/1965). *The expression of the emotions in man and animals*. Chicago: University of Chicago Press.
- Davis, M.H. (1980). A multidimensional approach to individual differences in empathy. *JSAS Catalogue of Selected Documents in Psychology*, 10, 85-104.
- Decety, J., & Jackson, P. L. (2004). The functional architecture of human empathy. *Behavioral and cognitive neuroscience reviews*, 3(2), 71-100.
- de Waal F.B.M. (2008), Putting the altruism back into altruism: the evolution of empathy. *Annual Review of Psychology*, 59, 279-300.

- Dick, M., Habel, U., Slodczyk, J., Schlummer, J., Backes, V., Schneider, F., & Reske, M. (2009). Negative bias in fast emotion discrimination in borderline personality disorder. *Psychological Medicine*, 39, 855-864.
- Ellingsen, K., Zanella, A.J., Bjerkås, E., & Indrebø, A. (2010). The relationship between empathy, perception of pain and attitudes toward pets among Norwegian dog owners. *Anthrozoös*, 23(3), 231-243.
- Friedmann, E., & Thomas, S.A. (1995). Pet ownership, social support, and one-year survival after acute myocardial infarction in the Cardiac Arrhythmia Suppression Trial (CAST). *American Journal of Cardiology*, 76, 1213-1217.
- Frommer, S., & Arluke, A. (1999). Loving them to death: the blame-displacing strategy of animal shelter workers and surrenderers. *Society and Animals*, 7, 1- 16.
- Frost, R.O. (2000). People who hoard animals. *Psychiatric Times*, 17, 25-29. Frost, R.O., & Gross, R.C. (1993). The hoarding of possessions. *Behaviour Research and Therapy*, 31, 367-381.
- Frost, R.O., & Hartl, T.L. (1996). A cognitive-behavioral model of compulsive hoarding. *Behaviour Research and Therapy*, 34(4), 341-350.
- Frost, R.O., Hartl, T.L., Christian, R., & Williams, N. (1995). The value of possessions in compulsive hoarding: patterns of use and attachment. *Behavioural Research and Therapy*, 33, 897-902.
- Frost, R.O., & Hristova, V. (2011). Assessment of hoarding. *Journal of Clinical Psychology*, 67(5), 456-466.
- Frost R.O., Patronek, G., Arluke A. and Steketee G. (2015). The hoarding of animals: an update. *Psychiatric Times*.
- Frost, R.O., Patronek, G., & Rosenfield, E. (2011). Comparison of object and animal hoarding. *Depression and Anxiety*, 28, 885-891
- Frost, R.O., & Steketee, G. (1998). Hoarding: clinical aspects and treatment strategies. In M. Jenike, L. Baer, & W. Minichiello (Eds.), *Obsessive Compulsive Disorders: Theory and Management*, pp. 533-554. Philadelphia, PA: Mosby Yearbook, Inc.
- Frost, R.O., Steketee, G., & Williams, R. (2000). Hoarding: a community health problem. *Health and Social Care in the Community*, 8(4), 229-234.
- Frost, R.O., Steketee, G., Williams, L.F., & Warren, R. (2000b). Mood, personality disorder symptoms, and disability in obsessive-compulsive hoarders: a comparison with clinical and nonclinical controls. *Behaviour Research and Therapy*, 38, 1071-1081.
- Frost, R.O., Steketee, G., & Williams, L. (2002). Compulsive buying, compulsive hoarding, and obsessive-compulsive disorder. *Behavior Therapy*, 33(2), 201- 214.
- Furby, L. (1978). Possessions in humans: An exploratory study of its meaning and motivation. *Social Behavior and Personality*, 6, 49-65.

- Grisham, J.R., Brown, T.A., Liverant, G.I., & Campbell-Sills, L. (2005). The distinctiveness of compulsive hoarding from obsessive-compulsive disorder. *Journal of Anxiety Disorders*, 19(7), 767-779.
- Grisham, J.R., Brown, T.A., Savage, C.R., Steketee, G., & Barlow, D.H. (2007). Neuropsychological impairment associated with compulsive hoarding. *Behaviour Research and Therapy*, 45(7), 1471-1483.
- Grisham, J.R., Frost, R.O., Steketee, G., Kim, H., & Hood, S. (2006). Age of onset of compulsive hoarding. *Anxiety Disorders*, 20, 675-686.
- Grisham, J.R., Frost, R.O., Steketee, G., Kim, H., Tarkoff, A., & Hood, S. (2009). Formation of attachment to possessions in compulsive hoarding. *Journal of Anxiety Disorders*, 23, 357-361.
- Grisham, J.R., Steketee, G., & Frost, R.O. (2008). Interpersonal problems and emotional intelligence in compulsive hoarding. *Depression and Anxiety*, 25, E63-E71.
- Harlow, J.M. (1868). "Recovery after Severe Injury to the Head." *Bulletin of the Massachusetts Medical Society*. Re-printed in *History of Psychiatry*, 4(14), 274-281 (1993).
- Hartl, T.L., Duffany, S.R., Allen, G.J., Steketee, G., & Frost, R.O. (2005). Relationships among compulsive hoarding, trauma and attention-deficit/hyperactivity disorder. *Behaviour Research and Therapy*, 43, 269-276.
- Hills, A. (1993). The motivational bases of attitudes toward animals. *Society and animals*, 1(2), 111-128.
- Hoarding of Animals Research Consortium – HARC (2002). Health implications of animal hoarding. *Health & Social Work*, 27, 126-136.
- Hoffman, M.L. (2000). *Empathy and moral development. Implications for caring and justice*. Cambridge: Cambridge University Press.
- Hwang, J., Tsai, S., Yang, C., Liu, K., & Lirng, J. (1999). Hoarding behavior in dementia: a preliminary report. *American Journal of Geriatric Psychiatry*, 6, 285-289.
- Iervolino, A.C., Perroud, N., Fullana, M.A., Guipponi, M., Cherkas, L., Collier D.A., & Mataix-Cols, D. (2009). Prevalence and heritability of compulsive hoarding: a twin study. *The American Journal of Psychiatry*.
- Joffe, M., O'Shannessy, D., Dhand, N. K., Westman, M., & Fawcett, A. (2014). Characteristics of persons convicted for offences relating to animal hoarding in New South Wales. *Australian veterinary journal*, 92(10), 369-375.
- Keddie, K.M. (1977). Pathological mourning after the death of a domestic pet. *The British Journal of Psychiatry*, 131, 21-25.
- Khan, M. (1963). The Concept of Cumulative Trauma. *Psychoanalytic study of the Child*, 18, 286-306.
- Leckman, J.F., Mataix-Cols, D., & Rosario-Campos, M.C. (2005). Symptom dimensions in obsessive-compulsive disorder: Developmental and evolutionary perspectives. In J.S. Abramowitz

& A.C. Houts (Eds.), *Concepts and controversies in Obsessive– Compulsive Disorder*, Chap. 1 (pp. 3–26). SpringerVerlag.

Lee, R. (2006). Childhood trauma and personality disorder: toward a biological model. *Current Psychiatry Reports*, 8, 43-52.

Lhermitte, F, Pillon, B, & Serdaru, M. (1986). Human autonomy and the frontal lobes. Part I: imitation and utilization behavior: a neuropsychological study of 75 patients. *Annals of Neurology*, 19, 326-334.

Lockwood, R., & Cassidy, B. (1988). Killing with kindness? *Humane Society News*, (Summer), 14-18.

Lockwood, R. (1994). The psychology of animal collectors. *American Animal Hospital Association Trends Magazine*, 9, 18-21.

Lorenz, K. (1943). Der angeborenen formen möglicher erfahrung. *Zeitschrift für Tierpsychologie*, 5, 235-409.

Maier, T. (2004). On phenomenology and classification of hoarding: a review. *Acta Psychiatrica Scandinavica*, 110, 323–337.

Main, M., & Hesse, E. (1990). Parents' unresolved traumatic experiences are related to infant disorganized attachment status: Is frightened and/or frightening parental behavior the linking mechanism? In M.T. Greenberg, D. Cicchetti, & E. M. Cummings (Eds.), *Attachment in the preschool years: Theory, research, and intervention* (161-182). Chicago: University of Chicago Press.

Mataix-Cols, D., Baer, L., Rauch, S., & Jenike, M. (2000). Relation to factor analysed symptom dimensions of obsessive–compulsive disorder to personality disorders. *Acta Psychiatrica Scandinavica*, 102, 199-202.

Mataix-Cols, D., Frost, R.O., Pertusa, A., Clarck, L.A., Saxena, S., Leckman, J.F., Stein, D.J., Matsunaga, H., & Wilhelm, S. (2010). Hoarding Disorder: a new diagnosis for DSM-V? *Depression and Anxiety*, 27, 556- 572.

Mataix-Cols, D., Pertusa, A., & Snowden, J. (2011). Neuropsychological correlates of hoarding: a practice-friendly review. *Journal of Clinical Psychology: in session*, 67(5), 467-476.

Mathew, S.J., Coplan, J.D., Smith, E.L., Scharf, B.A., Owens, M.J., & Nemeroff, C.B. (2002). Cerebrospinal fluid concentrations of biogenic amines and corticotropin-releasing factor in adolescent non-human primates as a function of the timing of adverse early rearing. *Stress*, 5, 185-193.

Mitchener, K.L., & Ogilvie, G.K. (2002). Understanding compassion fatigue: keys for the caring veterinary healthcare team. *Journal of the American Animal Hospital Association*, 38, 307-310.

Montero-Odasso, M., Schapira, M., Duque, G., Chercovsky, M., Fernández-Otero, L., Kaplan, R., & Camera, L.A. (2005). Is collectionism a diagnostic clue for Diogenes syndrome? *International Journal of Geriatric Psychiatry*, 20, 709-711.

- Morton, E.S. (1977). On the occurrence and significance of motivation-structural rules in some bird and mammal sounds. *American Naturalist*, 111, 855-869.
- Mueller, A., Mitchell, J.E., Crosby, R.D., Glaesmer, H., & de Zwaan, M. (2009). The prevalence of compulsive hoarding and its association with compulsive buying in a German population based sample. *Behaviour Research and Therapy*.
- Nathanson, J.N. (2009). Animal Hoarding: slipping into the darkness of comorbid animal and self-neglect. *Journal of Elder Abuse and Neglect*, 21(4), 307- 324.
- Nathanson, J., & Patronek, G. (2011). Animal hoarding: How the resemblance of a benevolent mission becomes actualized as egoism and cruelty. In Oakley, B., Knafo, A., Madhavan, G., & Wilson, D. S. (Eds.). (2011). *Pathological altruism*. Oxford University Press:107-115.
- Neary, D., Snowden, J.S., Gustafson, L., Passant, U., Stuss, D., Black, S., Freedman, M., Kertesz, A., Robert, P.H., Albert, M., Boone, K., Miller, B.L., Cummings, J., & Benson, D.F. (1998). Frontotemporal lobar degeneration: a consensus on clinical diagnostic criteria. *Neurology*, 51, 1546-1554.
- Oakley, B., Knafo, A., Madhavan, G., & Wilson, D. S. (Eds.). (2011). *Pathological altruism*. Oxford University Press.
- Ockenden EM, De Groef B, Marston L. (2014) Animal hoarding in Victoria Australia: an exploratory study. *Anthrozoos*, 27: 33-47.
- Owings, D., & Morton, E.S. (1998). *Animal vocal communication: a new approach*. Cambridge, UK: Cambridge University Press.
- Pallotta, N.R. (2008). Origin of adult animal rights lifestyle in childhood responsiveness to animal suffering. *Society and animals*, 16, 149-170.
- Patronek, G.J. (1999). Hoarding of animals: an unrecognized public health problem in a difficult to study population. *Public Health Reports*, 114, 81-87.
- Patronek, G.J., & HARC (2001). The problem of animal hoarding. *Municipal Lawyer*, May/June, 19, 6-9.
- Patronek, G.J., Loar, L., & Nathanson, J.N. (2006). *Animal Hoarding: structuring interdisciplinary response to help people, animals and community at risk*. Hoarding of Animals Research Consortium.
- Patronek, G., Nathanson, J. (2009). A theoretical perspective to inform assessment and treatment strategies for animal hoarders. *Clinical Psychology Review*, 29, 274-281.
- Pertusa, A., Frost, R.O., Fullana, M.A., Samuels, J., Steketee, G., Tolin, D., Saxena, S., Leckman, J.F., & Mataix-Cols, D. (2010). Refining the diagnostic boundaries of compulsive hoarding: a critical review. *Clinical Psychology Review*, 30, 371-386.
- Pierce, J., Kostova, T., & Dirks, K.T. (2003). The state of psychological ownership: Integrating and extending a century of research. *Review of General Psychology*, 7, 84-107.

- Pollak, S.D., & Tolley-Schell, S. (2003): Selective attention to facial emotion in physically abused children. *Journal of Abnormal Psychology, 112*, 323-338.
- Prato Previde, E., Fallani, G., & Valsecchi, P. (2006). Gender differences in owners interacting with pet dogs: an observational study. *Ethology, 112*, 64-73.
- Rachman, S., Elliott, C., Shafran, R., & Radomsky, A. (2009). Separating hoarding from OCD. *Behavior Research and Therapy, 47*, 520-522.
- Reinisch, A.I. (2008). Understanding the human aspects of animal hoarding. *The Canadian Veterinary Journal, 49* (12), 1211-1214.
- Rynearson, E.K. (1978). Humans and pets and attachment. *The British Journal of Psychiatry, 133*, 550-555.
- Samuels, J., Bienvenu, O.J., III, Riddle, M.A., Cullen, B.A.M., Grados, M.A., & Liange, K.Y. (2002). Hoarding in obsessive-compulsive disorder: results from a case-control study. *Behaviour Research and Therapy, 40*, 517-528.
- Samuels, J.F., Bienvenu, O.J., Grados, M.A., Cullen, B., Riddle, M.A., Liang, K., Eaton, W.W., & Nestadt, G. (2008). Prevalence and correlates of hoarding behavior in a community-based sample. *Behaviour Research and Therapy, 46*, 836-844.
- Seedat, S., & Stein, D.J. (2002). Hoarding in obsessive-compulsive disorder and related disorders; a preliminary report of 15 cases. *Psychiatry and Clinical Neurosciences, 56*, 17-23.
- Serpell, J.A. (1987). Pet keeping in non-western societies: some popular misconceptions. *Anthrozoos, 1*, 166-174.
- Signal, T.D., & Tailor, N. (2007). Attitude to animals and empathy: comparing animal protection and general community samples. *Anthrozoös, 20*(2), 125- 130.
- Silk, J.B., & House, B.R. (2011). Evolutionary foundations of human prosocial sentiments. *PNAS, 108*(2), 10910-10917.
- Snowdon, J., Shah, A., & Halliday, G. (2007). Severe domestic squalor: A review. *International Psychogeriatrics, 19*, 37-51.
- Sprengelmeyer, R., Perrett, D.I., Fagan, E.C., Cornwell, R.E., Lobmaier, J.S., Sprengelmeyer, A., Aasheim, H.B.M., Black, I.M., Cameron, L.M., Crow, S., Milne, N., Rhodes, E.C., & Young, A.W. (2009). The cutest little baby face: a hormonal link to sensitivity to cuteness in infant faces. *Psychological Science, 20*, 149-154.
- Steketee, G., Frost, R.O., & Kim, H.J. (2001). Hoarding by elderly people. *Health Social Work, 26*, 176-184.
- Steketee, G., & Frost, R. (2003). Compulsive hoarding: Current status of the research. *Clinical Psychology Review, 23*(7), 905-927.
- Steketee, G., Frost, R. O., & Kyrios, M. (2003). Cognitive aspects of compulsive hoarding. *Cognitive Therapy and Research, 27*, 463-479.

- Steketee, G., Gibson, A., Frost, R.O., Alabisio, J., & Arluke, A. (2011). Characteristics and antecedents of people who hoard animals: an exploratory comparative interview study. *Review of General Psychology, 15*(2), 114-124.
- Stern, D. (1977). *The first relationship: infant and mother*. Harvard University Press.
- Tolin, D.F., Kiehl, K.A., Worchunsky P., Book, G.A., & Maltby, N. (2009). An exploratory study of the neural mechanisms of decision making in compulsive hoarding. *Psychological Medicine, 39*, 325-336.
- Tolin, D.F., Meunier, S.A., Frostz, R.O., & Steketee, G. (2010). Course of compulsive hoarding and its relationship to life events. *Depression and Anxiety, 27*, 829-838.
- Tronick, E.Z. (1989). Emotions and emotional communication in infants. *American Psychologist, 44*(2), 112-119.
- Vaca Guzman, M., & Arluke, A. (2005). Normalizing passive cruelty: the excuses and justifications of animal hoarders. *Anthrozoös, 18*, 338-357.
- Volle, E., Beato, R., Levy, R., & Dubois, B. (2002). Forced collectionism after orbitofrontal damage. *Neurology, 58*, 488-490.
- Vučinić, M., & Dimitrijević, I. (2007). Body condition and physical care scales in three cases of dog hoarding from Belgrade. *Acta Veterinaria (Beograd), 57*(5- 6), 553-561.
- West, M.L., & Keller, A.E.R. (1991). Parentification of the child: a case study of Bowlby's compulsive care-giving attachment pattern. *American Journal of Psychotherapy, XLV*(3), 425-431.
- Westbury H.R., & Neumann, D.L. (2008). Empathy-related responses to moving film stimuli depicting human and non-human targets in negative circumstances. *Biological Psychology, 78*, 66-74.
- Worth, D., & Beck, AM. (1981). Multiple ownership of animals in New York City. *Transactions and Studies of the College of Physicians of Philadelphia, 3*, 280-300.
- Würbel, H. (2009). Ethology applied to animal ethics. *Applied Animal Behaviour Science, 118*, 118-127.

## ***Concluding remarks and future directions***

Most of the studies on empathy has focused on empathy among conspecifics and, in particular, on human ability to feel empathy towards other humans. There is evidence that empathy is related to some important social skills, such as human emotion recognition and prosocial behaviour, and it likely evolved in the context of parental care, explaining why women are usually more empathic than men. Empathy towards people has been widely investigated in the field of human medicine, where it represents a controversial aspect, since it is considered an important and useful skill in medical practice but tends to decline during medical training. Furthermore, empathy is considered so important for social interaction that its impairment is considered a sign of psychopathology and a number of mental disorders entails deficits in empathy towards people.

Conversely, inter-specific empathy, namely human ability to feel empathy towards non-human animals has been little studied, although it is considered related to animal welfare and to the interpretation of animal behaviour and its importance has been suggested especially in the context of animal-related job, such as farming or veterinary medicine. Moreover, anomalies in empathy towards animals have been noticed in animal hoarding disorder, a mental disorder that has received attention in the United States and that in Italy exists but is almost unknown.

My research is a starting point for the investigation of empathy towards animals and its role in contexts that mirror those where the importance of empathy towards humans has been proved: animals' emotions recognition, veterinary medicine and empathy-related mental disorders, in this case animal hoarding disorder. Although these issues may seem different and to some extent unrelated, they represent three aspects of a common theme and may offer new insight on empathy towards non human-animals, its role, its practical applications and also its anomalies.

Emotion recognition is considered an important ability at the basis of the cognitive component of empathy and there is evidence of a positive relation between empathic concern and human emotion recognition from facial expressions. Although facial expression are crucial to human emotional communication, research on human ability to recognize animal emotions from visual signals is still very limited. In order to address this issue, in *Study 1* we chose to focus on dog (*Canis familiaris*) emotions because of its long history of domestication, its high diffusion in human society and the growing evidence of dog ability to emotionally communicate with humans. Evaluating the effect of empathy towards animals, expertise in dog behaviour and gender on people's ability to recognize dog emotional facial expressions, we found that empathy may not be related to the ability to recognize animal emotions from visual signals (at least with respect to the dog and its facial expressions). Conversely, we found a significant effect of expertise, suggesting that dog emotion

recognition may be an experience-dependent cognitive mechanism. In particular, a specific education on dog behaviour seems to be necessary to recognize fear, which was poorly recognized not only by people who had never owned a dog, but also by dog owners and vets, who daily interact with dogs: this finding is of some concern and has practical consequences, since understanding that a dog is afraid is important not only for dog welfare but also to avoid that fear results into aggressions. Further studies are needed to better understand people's ability to recognize dog emotional signals and the effect of empathy towards animals on this ability using different stimuli, such as photographs of the whole body postures or video-clips combining both vocal and visual signals.

Another interesting finding emerged is the lack of agreement and the poor performance even among experts in dog's behaviour, at least on the interpretation of some facial expressions: this result is in line with some studies aimed at assessing emotional states in animals, included dogs, which show that the understanding of animal emotions requires to combine behaviour with other indexes, such as physiological measures. Therefore, in *Study 2* and *3* we focused on the issue of evaluating dog emotions in a non-invasive way. In particular, we carried out the first two studies on dogs using Infra-Red Thermography (IRT), to detect emotions in dogs; since an increase in eye temperature was noticed both in response to a negative and a positive stimulus, results showed that IRT could be a useful tool to assess emotional arousal but not to discriminate emotional valence (i.e., positive or negative), whose interpretation cannot disregard behavioural indexes. Further studies based on multiple objective measures of dog emotions could allow to understand which indexes may better describe positive and negative emotional states in animals and, in particular, in dogs.

With respect to the role of empathy towards animals in veterinary medicine, our results resemble those emerged for empathy towards people in human medicine: in fact, according with the results of studies carried out in USA and UK, in *Study 4* we found that last year veterinary students were less empathic than their first year colleagues, suggesting a decline in empathy towards animals during veterinary education that resembles findings on medical students. However, levels of empathy towards animals in the last year of course were rather high.

Furthermore, examining for the first time the effect of length of career in veterinary companion-animal practice on both empathy towards animals and people, we found an effect of years of practice only on empathy towards people, which was higher among older professionals, suggesting a role of clinical practice in improving empathy, as reported in one previous study on physicians. Mean levels of empathy towards animals were comparable to those of last year veterinary students. Yet, since both studies had a cross-sectional design, further longitudinal studies are required to verify the impact of veterinary education and practice on empathy towards animals and people.

Interestingly, both in students and in practicing vets we found evidence of a gender effect, so that females were more empathic than males.

Taken together the results offer a positive profile of veterinarians, who seem to be able to show empathy both towards animal-patients and human-clients, meeting the expectations of society. These findings suggest a renewal of the profile of veterinarians, different from the stereotype of a though-minded a detached professional reported by studies carried out about twenty years ago, and likely related to the on-going process of feminization of the veterinary professions.

Finally, although official classifications of mental disorders do not mention disorders specifically related to anomalies in empathy towards non-human animals, the review of the available international literature on animal hoarding shows that an aberration of empathy towards animals seems to be a crucial aspect of this mental disorder. Although the DSM – 5 considers animal hoarding as a special manifestation of hoarding disorder, which is usually referred to the tendency to accumulate objects, this classification is still matter of debate. Given that the central features of animal hoarding are a declared love for animals, along with the inability to properly care for animals and to recognize their suffering, which often result in animal abuse, this disorder could be better understood and treated if regarded as a mental disease related to anomalies in empathy towards non-human animals. As research on animal hoarding in Italy is almost lacking, further studies are required to evaluate the prevalence and the characteristics of this phenomenon in Italy and to investigate the underlying psychological and neural mechanisms. These studies might also have an interesting practical impact in reducing the risk of relapse with benefits for individuals, animals and society.

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