

Human-Animal Relationships

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Human-Animal Relationships:

A Cross-Cultural Comparison of Human Attitudes
towards Animals

Bingtao Su

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A Cross-Cultural Comparison of Human Attitudes towards Animals

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to be defended in public on Monday 25th of June 2018 at 14.00 hours

by

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Chapter **1**

Introduction

1.1 Human-animal relationships

We are surrounded by animals in general (DeMello, 2012). Animals share our homes as companions whom often we treat as members of our family (Walsh, 2009); we eat animals or their products, and most of our shoes are made up of animal skins and fur (Miranda-de la Lama et al., 2017); we use medicines that have been tested on animals (Bayne & Turner, 2013); we visit zoos and aquariums in order to be entertained (Moss, Jensen, & Gusset, 2015); we protect and sometimes even share our yards with wild animals in danger (DeMello, 2012; Sandøe & Gamborg, 2017); we thank working animals (e.g., guide dog, police dog) for their help in our daily life (Alves, 2018). Simultaneously, animals require food and space, which might be suitable as human food and arable land to produce human food. In these but not limited to these ways, the human and nonhuman animal worlds are inexorably linked (DeMello, 2012; Scruton, 2006). Nearly every culture, from the ancient Egyptian and Chinese culture to the modern civilization of post-industrial Europe, has recognized that animals in general are significant for the material foundations and the ideological underpinning of human societies (DeMello, 2012). Therefore, understanding animals, including their emotional worlds, living conditions and requirements, as well as their relationship with humans, is of vital importance for the development of human society. Yet, animals in general and their relationships with humans are complex and multifaceted. Many factors such as emotions, environment, culture and sustenance would affect our understanding of animals (Rushforth & Moreau, 2013). Hence, finding a direct way to understand animals and human-animal relationships is becoming a necessity.

Companion animals, as one of the most important animal types, have more opportunities than other animal types in interacting with humans. These opportunities and direct interaction experiences may allow owners to better comprehend companion animals' behaviours, emotions, health conditions, energy requirements and benefits to humans. A broad list of research topics concerning the relationship between companion animals and owners has demonstrated the therapeutic, physiological and psychological benefits that companion animals bring to humans. For instance, companion animals are helpful to reduce humans' risk of blood pressure and heart disease, improve people's survival rates, increase their physical activity and provide emotional and social support. They are also helpful to reduce people's stress level, increase self-esteem in children and adolescents and decrease depression associated with spousal loss (Herzog, 2011; McNicholas et al., 2005; Serpell, 1991; Wells, 2007). In turn, companion animals also benefit from humans. People, especially those who have a high attachment to companion animals, often provide a healthy dietary, decent living environment and instant protection to companion animals. People's understanding of animal emotions can greatly improve companion animals' well-being (Su & Martens, 2017). Related to this approach are studies that focus on human-animal attachment, in which, for example, researchers study owners' attribution of emotions and the degree of

attachment to their companion animals (Martens, Enders-Slegers, & Walker, 2016; Su, Koda, & Martens, 2018). Companion animals' food and energy consumption is another area of research, and researchers have focused on animal obesity, food nutrition and environmental impacts (Bermingham, Thomas, Morris, & Hawthorne, 2010; Beynen, 2015; Linder & Freeman, 2010; Okin, 2017; Streeter & Wakshlag, 2015).

The mutual benefits and interactions between companion animals and humans are significantly important to help us understand animals' emotional world and deepening their bond with humans (even the bond between animals in general and humans). With the booming economy, improving living standards and the increasing aging population, a growing number of people start to own one or more companion animals. The importance of companion animals has occurred especially among empty-nesters and old people who are living alone (not living in community or group) (Winefield, Black, & Chur-Hansen, 2008). Companion animals are becoming to be regarded as friends and family members and start to function within the household. For instance, these companion animals can provide companionship, affection and psychosocial stimulus for their owners (Ryder, 1985). As we mentioned above, compared to non-owners, owners have more opportunities (e.g., observing, talking, playing, walking, feeding) to communicate with their animals and therefore it would be easier to understand their animals' behaviours, feelings, emotions and requirements (Martens et al., 2016). Hence, in this dissertation, we will focus on animals in general when we evaluate people's general attitudes toward animals in part I (chapter 2, 3 and 4), but only focus on companion animals when we discuss the specific relationships (i.e., the emotional and environmental relationships) between humans and animals in part II (chapter 5 and 6) and part III (chapter 7, 8 and 9).

1.2 Sustainable human-animal relationships

Sustainable refers to the maintenance or enhancement of resource productivity on a long-term basis (Chambers & Conway, 1992; Conroy & Litvinoff, 2013; Sum & Hills, 1998). In a narrow sense of the definition, the sustainable human-animal relationship means that the increasing resource productivity can satisfy the increasing resource consumption (e.g., food, water, space, entertainment, healthcare) by both humans and non-human animals (of all kinds) not only in the present but also in the future. Based on this, researchers can discuss how the human-animal relationship can be managed in a more sustainable way. The sustainable human-animal relationship consistently evokes ethical and sustainability-oriented questions, and requests more and better integrated knowledge (Andersson Cederholm, Björck, Jennbert, & Lönngrén, 2014). The resource consumption is only one aspect of the human-animal relationship, other aspects like the physical and psychological benefits, ethical judgments and environmental impacts are also key components of human-animal relationships. The term of "sustainable human-animal relationships", therefore, can further be explained as the environmentally sound,

psychologically, physically and socially beneficial, ethically acceptable and economically viable practices between humans and animals.

People's understanding of the sustainable human-animal relationship is perhaps inspired by the considerable amount of boundary crossing going on in the contemporary world, not just between humans and animals but involving all sorts of other categories as well, including humans and nature, society and culture (Martin, 1995). Therefore, a number of anthropologists have attempted explicitly to combine economic, ecological, emotional or symbolic perspectives when explaining human-animal relationships. Such integration has been especially evident in studies of farm animals and companion animals. However, farm animals as the main source of meat products to feed the world have less environmental impacts than companion animals that do not contribute to food resources but require food and space. Additionally, in contemporary society, people are often most familiar with animals as companion animals (Mullin, 1999). Over recent decades, companion animals have become increasingly common and important in human's lives. According to the data from the Vetnosis and The European Pet Food Industry Federation (FEDIAF), there were 223 million registered companion dogs and 220 million registered companion cats in the world in 2014. The vast majority of companion animal owners regard their animals as friends and family members. Therefore, improving the sustainable relationships between companion animals and owners becomes important to ensure both human society and pet ownership can be sustained in the future.

The sustainable human-animal relationship in this dissertation is an area regarding the correlation between people's ethical ideology and their attitudes toward animals in general, owners' attribution of emotions to their companion animals, and the food consumption by companion animals in China, the Netherlands and Japan. Notably, the meaning of the terms of "attribution" and "recognition" of emotions to companion animals is a debatable issue, but in this dissertation, we use "attribution" to explain owners' understanding of their companion animals' emotions. Different people are affected in various ways and have specific interests in the development of a better human and animal relationship in a country or in the world. Some people may evaluate human-animal relationships according to their moral concern for the well-being of animals. Others may be interested in the benefits (e.g., physical and psychological benefits, medical development) and the costs (e.g., resource consumption, environmental impacts) that animals bring to humans and society. These interests are partially contrasting and need to be reconnected to a comprehensive vision of a sustainable human-animal relationship: a developed model based on an ethical concern for animal welfare, a clear understanding of animals' emotional world, an affordable food system and a sustainable environment, which in our opinion are the most likely to accrue long-term benefits to both animals and human society. The challenges are thus to improve people's moral concern for animal welfare, balance the emotional and food

needs of humans and animals, and reduce the possible impacts that animals contribute to the environment.

People's moral concern for animals is commonly formulated in terms of concern for animal welfare. However, besides the welfare issue, although highly relevant in itself, the importance of animal values has to be recognized as well (Dol, 1999). The physical and psychological benefits that animals particularly companion animals bring to humans are the practical consequences for people's daily interaction with animals (Allen, Blascovich, Tomaka, & Kelsey, 1991; Headey, Grabka, Kelley, Reddy, & Tseng, 2002). These benefits are the reflection of animal values, which will improve people's ethical concern for animal welfare and promote the sustainable human-animal relationship. A better understanding of animals' emotional world, food requirement and their possible relationship with the environment is another strategy to promote the sustainable human-animal relationship. Humans' understanding of animal emotions can help them consider the reasons behind animals' different emotions, and then find ways to satisfy animals' emotional needs and promote an optimum animal welfare system. An affordable food system is generally related to a sustainable environment in the field of human-animal relationships. The destruction and damage of the environment pose a serious threat to human and animal survival on this planet (Jorgenson, 2003). Therefore, quantifying animals' food consumption and its impacts on the environmental degradation is critically helpful to further understand the challenges of a sustainable human-animal relationship.

1.3 Human-animal relationship studies in disciplines of anthrozoology and sustainability science

Today, humans, nonhuman animals, and the environment are remarkably interconnected and interdependent at a global level (Sriramarao et al., 2015). The human-animal study, sometimes known as anthrozoology, is an integrated field that explores the spaces that animals occupy in human cultural and social worlds and the interactions humans have with them (DeMello, 2012). Anthrozoology can act as a bridge between scholars from the social and natural science. How animals are treated in the human socialization process is an important area of anthrozoology research, and some anthrozoologists have focused on attitudes that people have toward animals and what variables those attitudes are correlated with. These findings are a key indicator of animal welfare and can influence the validation of animal life in economic or emotional terms, as well as human behaviour toward animals (Knight & Herzog, 2009; Ostovic, Mikus, Pavicic, Matkovic, & Mesic, 2017; Zinsstag, Schelling, Waltner-Toews, Whittaker, & Tanner, 2015). Therefore, Anthrozoology is often regarded as an appropriate label for research which considers human interactions with other animals.

However, Anthrozoology prioritizes the human angle and to all intents and purposes objectifies the animals involved (Hurn, 2010). Highlighting the human side of

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that relationship is one thing that can draw on classic surveys to understand human attitudes toward animals, but how can we ever understand the feelings and emotions of animals themselves? Until now, several approaches have been adopted to study animal emotions. For instance, researchers may observe animal behaviours, investigate the role of emotions in human beings and then examine whether the function is the same in humans and non-human animals, or whether the mechanisms underlying emotions are experienced by both humans and animals (Dawkins, 2000; Harding, Paul, & Mendl, 2004; Oatley, Keltner, & Jenkins, 2006; Panksepp, 2004). However, animals are not independent existences and as we mentioned above, the anthrozoology studies do want to understand animals in the context of human society and culture. Therefore, in this dissertation, we aim to study animal emotions in a new way, investigating whether companion animal owners can attribute emotions to their animals and how the degree of attachment influences such emotion attributions from a cultural perspective. By analysing the different cultural contexts, we can also explore how different cultures influence people's understanding of animal emotions and human-animal relationships in different countries.

The correlation between animals and the sustainable development of the environment is another important area of anthrozoology and sustainability science research. Sustainable development is a hot topic and achieving sustainability has become an issue of global concern as a result of the realization of the impacts the activities of humans have on the earth (Alshuwaikhat & Abubakar, 2008). Due to people's excess demand for resources, the global ecological footprint has exceeded its total bio-capacity, and the negative impacts of the ecological deficit have become increasingly significant. Household has been demonstrated as an important contributor to the ecological deficit and companion animals as an integrated part of the household increased household environmental burden without any doubt (Vale & Vale, 2009). The nexus of the relationship between the environmental degradation and animals' energy consumption has shown that companion animals' contribution of land use and greenhouse gas or carbon emission is significant and therefore deserves a special attention (Okin, 2017; Rushforth & Moreau, 2013; Swanson, Carter, Yount, Aretz, & Buff, 2013). However, quantitative environmental evaluation of food consumptions by companion animals suggests that the environmental impacts by companion dogs and cats are usually underestimated by researchers without market-wide knowledge of pet food and direct data on food consumption. It seems critical to understanding the resource consumption and the potential environmental impacts of companion animals by utilizing first-hand data from the pet food market and pet owners. Quantifying companion animals' daily food and energy requirement and investigating the relationship of resource consumptions between companion animals and households as well as between companion animals and nations are, therefore, of vital importance.

1.4 Context of the research

Animals have accompanied humans for thousands of years, forging a strong interdependence between humans and other species (De Waal, 2010). They have been part of the human social and psychological landscape since the origins of our species (Knight & Herzog, 2009). As we mentioned above, animals in general have many benefits to humans, and the human and animal worlds are inexorably linked in a complex way (DeMello, 2012; Scruton, 2006). Therefore, finding ways to protect animals and improve animal welfare becomes paramount if we want to achieve a sustainable human-animal relationship.

The welfare of animals in general, to some extent, is dependent on human care because people's attitudes toward animals can influence how animals are treated. Some people may use their abilities to harm and even kill animals for their own benefits, while some people with responsibilities and duties are capable of extending their sympathy to animals. Hence, investigating attitudes that people have toward animals in general and what variables those attitudes are correlated with is significantly important (Knight & Herzog, 2009; Ostovic et al., 2017; Zinsstag et al., 2015). Public attitudes toward animals are a key predictor of animal welfare. There are a variety of attitudes toward animals around the world and variables such as human demographics, geographic region, economy, the purpose of animal use and religion are demonstrated significantly correlated with people's attitudes toward animals (Driscoll, 1992; Phillips et al., 2012). For instance, the Western population, compared to some people from the Eastern countries, may show a greater concern for animals because of their higher awareness of animal welfare (Phillips et al., 2012); old people in developed countries may also show a greater concern for animals (especially companion animals) than young people because many old people live individually and need more companionship from companion animals. While these findings are both promising and intriguing, there is a problematic lack of a cultural analysis guiding much of this research. Ethical ideology as a cultural factor to explain differences in ethical judgments and behavior is likely to predict people's attitudes toward animals. Yet research into the relationship between ethical ideology and people's attitudes toward animals from ethical perspectives is still in its infancy and needs further investigation. In light of this, we will explore people's attitudes toward animals in China, the Netherlands and Japan, and how these attitudes related to ethical ideology from a cultural perspective (chapter 2, 3 and 4). By investigating such correlations in different countries, we want to further understand people's different attitudes toward animals and diversify approaches to improve animal welfare and sustainable human-animal relationships.

Understanding people's attitudes toward animals plays an important role in helping us comprehend animal welfare and human-animal relationships. However, if we want to achieve a sustainable human-animal relationship, we should also understand the mutual benefits between humans and animals. Previous research has documented

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that animals, especially companion animals, are significantly important to humans. For instance, companion animals (e.g., dogs and cats) can decrease depression and provide emotional and social support to their owners (Friedmann & Thomas, 1995; Wood et al., 2015). One possible reason is that most companion animals, in particular dogs and cats, are sentient beings and can understand humans' body language and even words. They can react to things, perceive things and some even have appetites and beliefs (Scruton, 2006). A better understanding of animal emotions can help us understand the manner in which other species make sense of their world. Therefore, research into animals' emotional worlds is highly desirable to achieve the sustainable human-animal relationship (Waller & Micheletta, 2013). Inspired by this, in this dissertation, after understanding people's attitudes toward animals, we will then investigate companion animal owners' attribution of emotions to their animals and the possible predictor variables (chapter 5 and 6). Notably, in this part (chapter 5 and 6), we will mainly focus on companion animals (i.e., dogs and cats) because they have more opportunities to interact with humans than other animal types, and these direct experience may allow owners to better understand animals' behavior associated with emotions. Another reason for studying animal emotions is that different people may have different attitudes toward and relationship with animals, and their different attitudes toward and relationship with animals may influence their understanding of animal emotions. In this part, we will investigate the knowledge of different variables that underpin owners' attribution of emotions to their animals and how the attribution of emotions is associated with the degree of attachment to companion animals (the human-animal bond). By understanding animals' emotional worlds, we aim to further improve animal welfare and extend the emotional benefits that animals bring to humans.

However, the positive relationship between companion animals and owners may not be an acceptable reason for ignoring their negative environmental impacts. Over the last few decades, the global community has witnessed a substantial growth in its economic development, which, in turn, has increased the global demand for energy (Rafindadi, 2016). Companion animals as a seemingly insignificant source of resource consumption, are often neglected by researchers and policymakers. However, the large number of companion dogs and cats, the high nutritional content of animal food and the increasing environmental degradation and ecological deficit around the world remind us that it is time to find out the environmental impacts of keeping a companion animal against the pleasure they bring. We therefore will look at the environmental impacts of food consumption by companion dogs and cats by investigating their dietary ecological paw print (EPP), greenhouse gas (GHG)/carbon emissions and energy consumption in chapter 7, 8 and 9. In this part, we will focus on companion animals because we suppose they would contribute to considerable impacts to the environment. They do not contribute to food resources but require food, which might be suitable for human food or food for production animals. Another reason is that many companion animal owners nurture their animals like their own family members and they know the

food requirement of their animals quite well (Serpell, 1996). Actually, there are very few studies aimed to analyze the relationship between companion animals' resource consumption and their impacts on the environment, although some researchers started to investigate dogs and cats' energy consumption and its correlation with the environment. To the best of our knowledge, our research in this part is the first study to quantify the dietary EPP and GHG emissions of companion dogs and cats in the Netherlands, China and Japan. Through this research, we want to make sense of the manner in which other species are related to the environmental world and provide some recommendations on how to balance animals' emotional benefits and their negative environmental impacts.

Acknowledging companion animals' negative impacts on the environment does not mean neglecting their emotional bond with humans. Finding strategies to balance the positive emotional connection and the negative environmental impacts between companion animals and owners is an excellent prelude to achieving the sustainable human-animal relationships.

1.5 The three study sites: the Netherlands, China and Japan

Cross-cultural tensions seem to exist between the Western countries and the Eastern countries. For example, animal welfare has been overlooked for a long time in China, which was unfortunate because animal welfare standards in China were lower than those of their Western counterparts (Davey, 2006). Therefore, animal cruelty in China has been commonly reported, which even led to worldwide criticisms. Whaling in Japan has been portrayed mostly as inhumane and unacceptable by the Western population, while the Japanese have argued that the practice is deeply ingrained in their culture and part of their heritage (Knight & Herzog, 2009). There have been many studies showing the controversies and inconsistencies regarding various animal welfare issues such as animal cruelty and people's attitudes toward animals between the Western and Eastern countries, and many of them reported that the different cultures might be the reasons behind these argumentations (Davey, 2006; Izmirlı & Phillips, 2011; Knight & Herzog, 2009; Trent, Edwards, Felt, & O'Meara, 2005). Yet, limited studies have focused on analyzing the correlation between different culture and specific animal issues, such as public attitudes toward animals and the attribution of emotions to animals, in a detailed and integrated way.

In this dissertation, the Netherlands is selected as being representative of the Western countries and China is selected as a representative of the Eastern countries. Japan is also included because Japanese people are open-minded to different cultures. They appreciate the Western values of diversity, equality and freedom and, simultaneously, respect the traditional Confucian and Buddhist values of harmony and humble behavior (Tan & Chee, 2005). Western populations' (e.g. Dutch people) attitudes toward animals are largely influenced by their values of rational thinking and

freedom (Chung, Eichenseher, & Taniguchi, 2008). They are more individualistic and their awareness of animal welfare is more likely to have been formed by concern for animal well-being, rather than being based on the cost-benefit analysis (Wuensch, Jenkins, & Poteat, 2002). Japanese people's attitudes toward animals are also influenced by Western values of animal rights. However, Japanese and Chinese people's attitudes toward animals are mostly correlated with their traditional culture of Confucianism and Buddhism (Tan & Chee, 2005). People in China and Japan are collectivistic. They understand animal issues in terms of complex interactions between dispositions of animals and contextual factors, and they might find it relatively difficult to separate animals from the situational context in which they occurred (Norenzayan & Nisbett, 2000). Additionally, their attitudes toward animals have also been influenced by Confucianism, which highlights the symbiosis between humans and animals, although humans are regarded as the lords of creation (Marinelli, Adamelli, Normando, & Bono, 2007). Buddhism, one of the most important religions, influences Chinese and Japanese social values, including attitudes toward animals (Barber, 2015; Li & Davey, 2013). Chinese and Japanese mainstream Buddhist philosophers regard animals as sentient beings with the potential for better rebirth and salvation in the cycle of death and rebirth. These cultural differences are immersed in the analysis of human-animal relationships in the present study.

1.6 Research objectives and research questions

An important step in improving animal welfare is to understand people's attitudes toward it. Previous research regarding people's awareness of animal welfare has revealed that European people showed more concern for animal welfare compared to that of many Asian populations (Davey, 2006; Phillips et al., 2012). However, very few studies quantified this difference in a specific way. The main aim of the present thesis is to investigate human-animal relationships from a cultural perspective. This dissertation contributes to the body of knowledge about the sustainable human-animal relationships in Europe (the Netherlands) and Asia (China and Japan). It analyzed public attitudes toward animals in general and the emotional and environmental relationship between companion animals and owners from cultural and economic perspectives. The corresponding research questions are:

What are the people's attitudes toward animals in general and how does this relate to people's ethical ideologies in China, the Netherlands and Japan?

Which emotions can owners attribute to their companion dogs and cats, and what are the correlations between the attribution of emotion and owners' degree of attachment to their dogs and cats?

What are the environmental impacts of food consumption by companion dogs and cats?

Answers to these questions are of socio-cultural and economic relevance, particularly when comparing people's ethical ideologies, their attribution of specific emotions and husbandry behaviors to their animals. Chinese and Japanese ethical ideology and social values are largely influenced by their culture of Confucianism and Buddhism, which advocate harmony, humility and magnanimous behavior, while the Western values highlight human (as well as animal) rights and freedom (Chung et al., 2008; Tan & Chee, 2005). Collectivism also plays a significant role in influencing Japanese and Chinese people's social values. They understand behavior in terms of complex interactions between dispositions of the person or other object and contextual factors, whereas Western populations are more individualistic and they often view social behavior primarily as the direct unfolding of dispositions (Norenzayan & Nisbett, 2000). The research questions will be answered after exploring the cultural differences between Asian countries and Western countries.

1.7 Methodology

This dissertation reports on an analyzation about the sustainable human-animal relationship. It is placed within the fields of Sustainability Science and Anthrozoology, which requires integrated knowledge and aims to explore the spaces animals occupy in human society and the interactions humans have with them (DeMello, 2012). The sustainable human-animal relationship is a multifaceted issue and related to ethical and sustainability-oriented questions (Andersson Cederholm et al., 2014). It seeks to produce trans-disciplinary knowledge on the interactions across humans, animals, nature, society and culture (Martin, 1995). Therefore, the Integrated Assessment may help to increase insights into the sustainable relationship between humans and animals.

Integrated Assessment is a holistic research approach to analyze complicated issues by combining knowledge from various disciplines (De Ridder, Turnpenny, Nilsson, & Von Raggamby, 2007). The driving forces, predictor variables and the possible consequences are highly correlated in human-animal relationships. The attempts to combine emotional, ecological, cultural, economic and symbolic perspectives are, therefore, necessary when we explaining the relationships between humans and animals. Such integration is evident in this dissertation because we provide an integrated analysis of the cultural differences, moral concerns, emotional attributions and ecological impacts in order to build a scientific foundation for the understanding of sustainable human-animal relationships.

The research framework which is developed in this dissertation is considered to be a method within the Integrated Assessment as it explicitly focuses on not only the multifaceted interactions between humans and animals but also the surrounding

Chapter 1

cultural, social and environmental systems. We use two online questionnaires to collect data from companion animal owners as well as the general public in China, Japan and the Netherlands because we want to understand animals and human-animal relationships in the context of human society and social values. We want to investigate how people perceive animals and evaluate their multifaceted relationships (e.g., the emotional and environmental relationships) with animals from a cross-cultural comparison perspective. For this, the ethical ideology, the degree of attachment and the attribution of emotions to companion animals, the ecological paw print and carbon/greenhouse gas emissions of food consumption by companion animals are introduced in order to measure people's attitudes toward and emotional and environmental relationships with animals.

The scales like the Ethics Position Questionnaire, Animal Attitude Scale, Animal Issue Scale and the Pet Bonding Scale, which are strongly correlated with culture and social values and often used to measure people's opinion on animals, are employed in this dissertation. The "ecological footprint" (EF), the greenhouse gas (GHG) emissions, carbon emissions and energy consumptions as four indicators of the environmental degradation are commonly used by researchers in the field of sustainability science in order to assess the local, national and global sustainability of the environment. Therefore, the definitions and calculation equations of the EF, carbon and GHG emissions, as well as the energy consumption are ascertained in this dissertation. We further use statistical analysis to quantify people's attitudes toward animals and the specific relationships between companion animals and owners. The details of the data collection and statistical method are explained in separate chapters.

1.8 Outline of the thesis

This dissertation focuses on human-animal relationships from three different perspectives in order to explore public attitudes toward animals (in general), the emotional and environmental relationships between companion animals and owners in China, the Netherlands and Japan.

The 1st chapter (introduction) highlights the important role of animals and companion animals, and summarizes the sustainable human-animal relationships and their possible predictor variables (e.g., culture, ideologies, awareness of animal welfare and development stages) in different countries. A brief introduction to the methodology, research aims and the structure of this dissertation is also introduced in this chapter.

The 2nd, 3rd and 4th chapters explore public attitudes toward animals in general and how ethical ideologies and their interaction with human demographics relate to public attitudes toward animals in China (chapter 2), the Netherlands (chapter 3) and Japan (chapter 4). The Animal Attitude Scale and Animal Issue Scale are used to measure public attitudes toward animals and the Ethics Position Questionnaire is used to assess people's ethical ideologies (idealism and relativism). Each chapter describes

the specific findings in one country and the comparisons of different findings in different countries are also presented and discussed.

The 5th and 6th chapters analyze how companion dog and cat owners attribute emotions to their animals, and how owners' degree of attachment relates to their attribution of emotions to their animals in China, Japan and the Netherlands. The Pet Bonding Scale is used to assess owners' degree of attachment to their animals. Six primary (anger, joy, sadness, disgust, fear and surprise) and four secondary emotions (shame, jealousy, disappointment and compassion) are included in this section in order to explain owners' attribution of emotions and responsive emotions to their animals. Chapter 5 presents findings from China and chapter 6 presents findings from Japan. Findings from the Netherlands are included and compared in each chapter.

The 7th, 8th and 9th chapters investigate the environmental impacts of food consumption by companion dogs and cats in China, the Netherlands and Japan, by calculating their dietary ecological paw print, carbon (or greenhouse gas) emissions and energy requirement.

The 10th chapter summarizes the conclusion of this dissertation and comes back to the research questions. The implications, contributions and limitations of the thesis, and the possible future studies are also presented.

PART I

People's General Attitudes toward
Animals

Chapter **2**

Public attitudes toward animals and the
influential factors in contemporary China

“We need, in a special way, to work twice as hard to help people understand that the animals are fellow creatures, that we must protect them and love them as we love ourselves.”

César Chávez

ABSTRACT

The relationship between public attitudes toward animals and human demographics has been well documented during the last few decades, but how human ethical ideologies influence public attitudes toward animals and animal welfare has been rarely investigated, especially in developing countries, such as China. The present study introduced two scales (Animal Issue Scale [AIS] and Animal Attitude Scale [AAS]) to investigate Chinese people’s attitudes toward animals and their relations to ethical ideologies (idealism and relativism), which classified people into four ethical positions: situationists, subjectivists, absolutists and exceptionists. Moreover, it also showed how ethical ideologies and their interaction with human demographics influence respondents’ attitudes toward animals. The results of an online questionnaire (n=504) distributed in China suggest that compared with middle-aged and old respondents, the young demonstrated significantly more positive attitudes toward animals. Absolutists showed the most positive attitudes toward animals, while subjectivists showed the least positive attitudes toward animals. People’s attitudes toward animals were positively affected by idealism, which confirms previous findings in developed countries. However, people’s attitudes toward animals were negatively affected by relativism, which is inconsistent with findings in developed countries showing that ethical relativism failed to influence attitudes toward animals. Our results indicate that the same mechanisms underlying the effect of ethical idealism on attitudes toward animals might work in different countries to increase awareness on animal welfare. However, the mechanisms of how ethical relativism influences attitudes toward animals might differ between developed and developing countries.

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2.1 Introduction

Public attitudes toward animals and the influential factors are of central concern in the fields of human-animal relationships and animal welfare (Serpell 2004, Spooner, et al. 2012). In recent years, a growing body of survey-based research has revealed that most people showed positive attitudes to animals as animals had many measurable benefits to both humans and society, such as enhancing physical and psychological well-being, reducing loneliness and depression, improving animal diversity and promoting sustainable nature and society development (Blazina, et al. 2011, Goldmeier 1986, Sharkin & Knox 2003, Wrobel & Dye 2003). From another point of view, how public attitudes toward animals are presented, which is influenced by human culture and knowledge, can contribute to animals' healthy dietary and decent living environment, and eventually the construction of an optimum animal welfare system. Therefore, it is clear that a better understanding of public attitudes toward animals, as well as what effects the influential factors have on these attitudes, are of fundamental importance to both animals and humans.

There are a variety of attitudes toward animals around the world and multitudinous reasons exist behind each attitude. Key drivers of these attitudes may include the geographic living region, economy, human demographic, purpose of animal using, human culture and religion (Driscoll 1992, Phillips, et al. 2012). For instance, European students have more concern for animal welfare than Asian students, whilst compared with northern European students, students from communist Asian and Europe countries have more concern about killing animals (Phillips, et al. 2012). Additionally, children and adults often show different views toward animals. Humanistic, moralistic, naturalistic and ecologicistic are the four prevalent attitudes among 12-14 years children (Eagles & Muffitt 1990), while adults often show confused attitudes toward animals. Individuals may have different attitudes in terms of how people use animals. For example, using animals for luxury garments is the most unacceptable behaviour, and educational use of animals is the most acceptable activity (Driscoll 1992), while attitudes toward farm animals should depend on the situation and the measurement model (Hansson & Lagerkvist 2014). People usually have more favourable attitudes towards popular animals than unpopular animals (Prokop & Tunncliffe 2010). Companion animal owners often show better knowledge of and more positive attitudes toward both popular and unpopular companion animals than non-owners (Costa, et al. 2014). Culture can also influence people's attitudes toward animals. In India and Nepal, primates are viewed as sacred; while in China and Japan, primates are mythical creatures (Lee & Priston 2005). All these studies explained the possible factors that could influence public attitudes toward animals, and most of them also mentioned the role of human demographics, such as age, gender, education and occupation (Herzog Jr, et al. 1991, Kellert 1985, Kellert 1985, Kellert & Berry 1980, Kellert & Berry 1987, Signal & Taylor 2006).

However, only very few studies analysed the link between ethical ideologies and attitudes toward animals (Galvin & Herzog 1992a, Wuensch & Poteat 1998). Forsyth's (1980) Ethics Position Questionnaire (EPQ) was often used to measure people's ethical ideologies. The EPQ was divided into two subscales: ethical idealism and ethical relativism. Individuals who score high on the idealism subscale think that ethical behaviour will always lead to positive consequences, while individuals who score high on the relativism subscale reject the universal moral principles and believe that moral decisions should be based on personal or situational analysis (Forsyth 1980, Galvin & Herzog 1992a). Forsyth (1980) also classified people into four possible ethical positions: situationists (high idealism and high relativism), subjectivists (low idealism and high relativism), absolutists (high idealism and low relativism) and exceptionists (low idealism and low relativism) (Figure 2.1). Situationists accept the belief that it is permissible to deviate from moral rules when better results can be attained by doing so. Absolutists admit that moral rules should be followed, even if there may be benefits to deviating from them. Subjectivists accept the inevitability of occasional negative outcomes because different individuals have different views about moral principles. Exceptionists endorse the statement that the morality of an action depends on the consequences produced by it (Ameh & Odusami 2010, Galvin & Herzog 1992a). He proposed that absolutists rated animal experiments as more unethical than did individuals in any of the other ethical categories (Forsyth & Pope 1984).

According to the EPQ, Galvin and Herzog (1992a) found a significant correlation between people's ethical ideologies and their attitudes toward animals. They suggested that positive attitudes to animals and their welfare were positively linked with ethical idealism. This study was conducted in developed countries where people already have high awareness of animal welfare. We question whether the links between ethical ideologies and attitudes to animals could be low in a country where the awareness of animal welfare is poor, since a low link between ideologies and attitudes to animals could explain the poor awareness in such countries. We selected China to be representative of such a country because awareness to animal welfare is supposed to be low. The present study aims at capturing the correlations between ethical ideologies and attitudes towards animals in contemporary China and at checking if people's attitudes to animals are linked to demographic factors in China in the same way as in other countries.

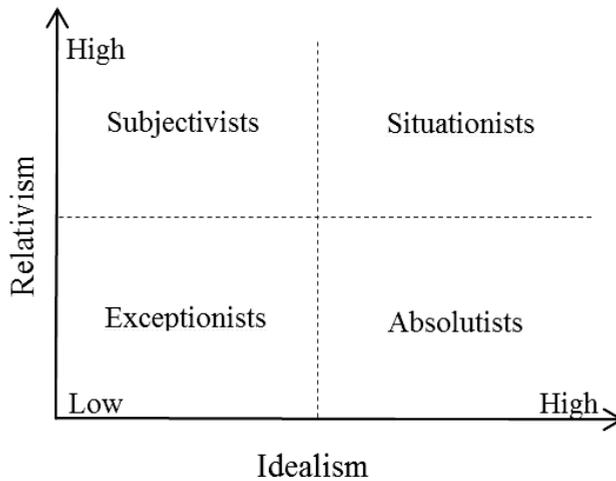


Figure 2.1 Ethical positions according to idealism and relativism (from Forsyth (1980))

2.2 Methods

2.2.1 Questionnaire

Research into public ethical ideologies and attitudes toward animals in contemporary China was conducted in November 2015. During this period, an online survey was carried out by means of simple random sampling (Kirk 2011, Tillé 2006) in Chinese people. One limitation of this study was that only 6.5% surveys were from rural areas probably due to the relatively less access to internet, people’s reluctance to respond and their relative lower education level. Consequently, the sample population does not represent the general Chinese population.

The questionnaire consisted of four sections. Demographic details and some other basic information were asked in the first section, which include age, gender, highest level of education, animal protection/nature conservation/human health organization participation, composition of household, place of residence, the sort of house, the importance of religion/spirituality, the main source of inspiration, household income, pet ownership, pet species, meat eating and zoo (aquarium) visiting frequency.

In the second section, the Ethics Position Questionnaire (EPQ) was used to measure the differences in personal moral philosophy (Forsyth 1980, Galvin & Herzog 1992a) in China. The EPQ is a 20-item Likert scale, which was divided into two subscales, one was designed to measure ethical idealism and the other was for ethical relativism. Respondents were asked to respond to statements using the 9-point EPQ ranging from 1 (completely disagree) to 9 (completely agree). In addition, two cut-off values of 7.26

(the mean score of idealism subscale) and 6.07 (the mean score of relativism subscale) were introduced to classify participants as high or low in idealism and relativism. This procedure produced four possible ethics positions: situationists, subjectivists, absolutists and exceptionists (Forsyth 1980, Galvin & Herzog 1992a). Examples of questions include: "One should never psychologically or physically harm another person"; "What is ethical varies from one situation and society to another"; "Different types of morality cannot be compared as to 'rightness'."

In the third section, Animal Issue Scale (AIS) (Meng 2009), which includes eight animal issues (use of animals, animal integrity [destruction], killing animals, [deprive] animal welfare, experimentation on animals, changes in animals' genotypes, animals and the environment [harm animals for environment], and societal attitudes toward animals [harm animals for social issues]), was introduced to respondents in order to assess their attitudes toward animals. There are 43 questions in AIS and each question is rated on a five-point scale ranging from 1 (extremely acceptable) to 5 (extremely unacceptable). A high score on a question indicates a low level of acceptability of the issues (Phillips, et al. 2012). Typical items include: "Using animals for work"; "Killing young animals that are dependent on their parents"; "Controlling wildlife populations by killing."

In the fourth section, the Animal Attitudes Scale (AAS) (Herzog Jr, et al. 1991) was used to further measure public attitudes toward animals. Due to its scientific content and concise design, the AAS was chosen for this research. The current AAS, a 20-item Likert-scale, was simplified from a 29-item scale by using factor analysis (Herzog Jr, et al. 1991). Most items are scored from 1 (strongly agree) to 5 (strongly disagree), while items of 1,3,4,7,10,11,17,19 and 20 are reverse scored from 1 (strongly disagree) to 5 (strongly agree). The AAS score is the sum of the 20-item scores. A high score reflects a high awareness of animal protection. Examples of questions include: "1. It is morally wrong to hunt wild animals just for sport"; "5. There is nothing morally wrong with hunting wild animals for food"; "20. The use of animals in rodeos and circuses is cruel".

2.2.2 Statistical analysis

Public ethical ideologies and attitudes toward animals in contemporary China were analysed with IBM SPSS 21 Statistical software. The data used in this study were either normally distributed or translated into normal distribution, and the Levene test showed homogeneity of the variances. A multivariate analysis (MANOVA, with Fisher's LSD correction) was performed to determine respondents' ethical ideologies and demographics that may affect their attitudes toward animals. Following an initial analysis, the residual data distribution was examined and where necessary transformed to approximate a normal distribution (Izmirli & Phillips 2011, Phillips, et al. 2012). The model for data responses included ethical ideologies, gender, age, highest level of

education, animal protection/nature conservation/human health organization participation, composition of household, place of residence, the sort of house, the main source of religion/spirituality, pet ownership and species, household income, meat eating and zoo (aquarium) visiting frequency. Only ethical idealism, ethical relativism, gender and age were considered in this paper because idealism and relativism were the two targeted variables in the modelling here. Gender and age were utilized to gauge the influence of basic human demographics and their interaction with ethical ideologies on public attitudes toward animals. Notice that the Bonferroni correction was also employed in the tests to control for type I errors due to repeated testing (Cabin & Mitchell 2000, Martens, et al. 2016). In order to find out which variables determined public attitudes toward animals, stepwise linear regression was implemented to relate response in AIS and AAS to participants' demographics and their basic information (eg animal protection/nature conservation/human health organization participation, pet ownership and household income), following the model described above and using an alpha value of 0.05 for variables to enter the model. All the non-explanatory variables were removed from the results (McDonald 2009).

2.3 Results

2.3.1 Response rates

A total of 504 responses were obtained from 527 people among a panel which includes 5630 people throughout China who have provided their e-mail addresses and received our invitation email with a unique hyperlink of our questionnaire. The mean age of all respondents (41.7% female and 58.3% male) was 39.97 years with a SD of 13.31. The majority of completed surveys (93.5%) were returned from urban areas, while only 6.5% surveys were from rural areas. Additionally, several other variables were studied in this research, such as pet ownership (33.3% of respondents owned a dog, 17.1% owned a cat, 13.5% owned fish, 5.4% owned birds, 4.2% owned reptiles, 0.8% owned rodents, 4.2% owned poultry and 0.2% owned ponies and horses), animal protection/nature conservation/human health organization participation (22.6% of respondents had belonged or donated to an organization involved in improving the welfare of animals; 48.8% were involved in conservation of the natural environment; 32.9% were concerned with improving human rights or health) and household income (9.4% respondents' household incomes were on the level of the minimum wage or below the minimum wage in China, 34.5% respondents' household incomes were on the average income in China, 41.3% respondents' household incomes were twice of the average income in China, 13.9% respondents' household incomes were more than twice the average income in China, and 1.0% gave no answer).

2.3.2 The EPQ

In this research, respondents scored slightly higher on the idealism scale ($M = 7.26, SD = 1.21$) than did Forsyth respondents ($M = 6.35, SD = 1.17$), and slightly lower ($M = 6.07, SD = 1.33$) than Forsyth's ($M = 6.18, SD = 1.13$) on the relativism scale. Compared to young respondents, middle-aged and old respondents had a higher score on the idealism scale; while the young had a higher score on the relativism scale than the middle and the old. However, the differences of ethic levels of both idealism and relativism scales between male and female respondents were not significant ($t = 0.49, p = 0.63$; $t = 0.49, p = 0.63$) (Figure 2.2). 32.6% of respondents in the current research were situationists, followed by exceptionists (26.0%) and absolutists (23.6%), while only 17.8% of respondents were subjectivists.

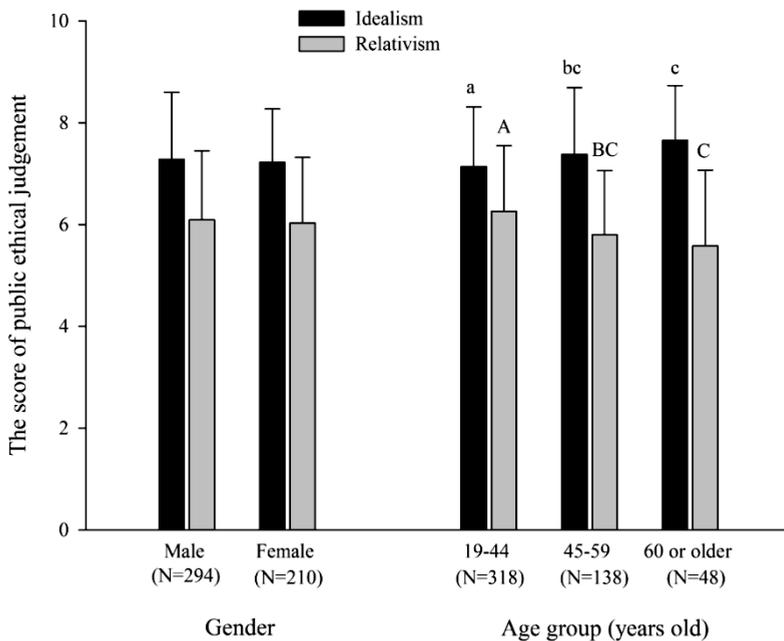


Figure 2.2 The score of Chinese public ethical judgement

Note: a, b and c indicate significant difference amongst three age groups of people in idealism scale; A, B and C indicate significant difference amongst three age groups of people in relativism scale.

2.3.3 The AIS and AAS

The participants in this study showed an average score of 135.69 ($SD = 18.10$) out of 215 on the AIS and 63.07 ($SD = 7.83$) out of 100 on the AAS. The AIS scores of absolutists, situationists, subjectivists and exceptionists were 140.57 ± 16.99 ,

136.29±20.39, 130.89±18.00 and 134.74±15.67, while the AAS scores of the four ethical positions were 65.35±9.83, 63.53±7.70, 61.19±6.56 and 62.19±6.50.

2.3.4 The influence of ethical ideologies and demographics on public attitudes toward animals

Ethical ideologies

Respondents' ethical idealism and relativism significantly affected their attitudes toward animals (according to their AIS and AAS scores) (Table 1a, Table 1b). When having a higher idealism score, respondents showed more positive attitudes toward animals, and this resulted in more negative attitudes toward "killing animals", "deprive animal welfare", "harm animals for environment" and "harm animals for social issues". When having a higher level of ethical relativism, respondents showed less positive attitudes toward animals, resulting in a higher acceptability of "use of animals", "animal integrity destruction", "killing animals", "deprive animal welfare", "changes in animals' genotypes", "harm animals for environment" and "harm animals for social issues" (Table 2.1, Table 2.2). Absolutists showed the most positive attitudes toward animals, while subjectivists showed the least positive attitudes toward animals. However, there was no interaction between ethical idealism and relativism on attitudes toward animals, although we found that the correlations between attitudes toward animals (measured by AIS and AAS, respectively) and ethical ideologies were stronger for ethical idealism ($r = 0.153$, $r = 0.151$) than for ethical relativism ($r = -0.120$, $r = -0.101$) (both $p < 0.001$) (not presented in Table).

Human demographics

Young respondents had more positive attitudes toward animals than the middle and the old. This difference can also be reflected by young respondents' lower acceptability of "use of animals", "animal integrity destruction", "killing animals", "experimentation on animals", "changes in animals' genotypes" and "harm animals for environment" (Table 2.1, Table 2.2). Gender as an independent variable did not influence respondents' attitudes toward animals; although a gender by age interaction effect was found that only young female respondents showed significant negative attitudes toward "changes in animals' genotypes" (Table 2.1, Table 2.2).

The interaction of ethical ideologies and human demographics

The interaction of idealism and gender did not influence respondents' attitudes toward animals. However, the effect of ethical idealism on decreasing the acceptability of "harm animals for social issues" was stronger in the absence of male respondents

(ethical idealism × gender). Vice versa, the accelerating effect of female respondents on the negative attitudes toward “harm animals for social issues” was stronger at absolutists and situationists (a higher level of ethical idealism) than exceptionists and subjectivists (a lower level of ethical idealism) (Table 2.1, Table 2.2). Additionally, the accelerating effect of female respondents on attitudes toward “killing animals” was more negative in exceptionists and absolutists (a lower level of ethical relativism) than in situationists and subjectivists (a higher level of ethical relativism) (ethical relativism × gender). A decreasing trend of ethical relativism with the decreased age, increased respondents’ positive attitudes toward animals (only according to their AIS score) and negative attitudes toward “animal integrity destruction” and “killing animals” (ethical relativism × age) (Table 2.1, Table 2.2).

We found age by ethical idealism by ethical relativism interaction affected respondents’ attitudes toward specific animal issues. Young absolutists showed the most negative attitudes toward “deprive animal welfare”, while old subjectivists showed the least negative attitudes toward “deprive animal welfare” (age × ethical idealism × ethical relativism) (Table 2.1, Table 2.2). The interaction of age, gender and ethical relativism also influenced respondents’ attitudes toward animals (according to their AIS and AAS scores). Female absolutists and exceptionists showed more negative attitudes toward “killing animals” and “experimentation on animals”, although their age was younger, realized more positive attitudes toward animals (age × gender × ethical relativism) (Table 2.1, Table 2.2).

2.3.5 Place of residence

We also investigated whether there is a relationship between respondents’ attitudes toward animals and their living places because the gap between urban and rural areas is one of the most significant characteristics in contemporary China. However, we found neither living areas nor its interaction with ethical ideologies and human demographics influenced respondents’ attitudes toward animals (according to their AIS and AAS scores) (not presented in Table).

2.3.6 Other important determinants of the AIS and AAS

We identified a number of participants’ demographic variables that influenced their attitudes toward animals (according to their AIS score). Results showed that the respondents whose household income was twice or more than twice of the average income in China averaged 11.40 points below those whose household income was on the level of average or below the average income in China. Our results also showed that those reporting that they owned a pet had higher scores than those who did not, and

these differences were based on the different animal species: 24.95 points by owning a dog and 26.08 by owning a rodent (Table 2.3).

In order to further explore the influential factors behind respondents' attitudes toward animals, we considered all the possible demographic variables that might influence respondents' AAS score (used to measure their attitudes toward animals). Results showed that respondents who owned a dog as their pet had 5.68 higher points of AAS score than those who did not own a dog. The respondents who belonged or donated to an organization involved in improving animal welfare had an average of 4.87 more points of AAS score than those who did not, whilst for the people who belonged or donated to organizations concerned with improving human rights or health normally had an AAS score 5.58 points lower, on average, than those who did not belong or donate to these issues. Household income was another factor that influenced public attitudes toward animals. Participants whose household income was twice or more than twice of the average income in China averaged 4.22 points below those whose household income was on the level of average or below the average income in China (Table 2.4).

Table 2. 1 Summary of multivariate testing for the effects of ethical idealism, ethical relativism, gender and age on public attitudes toward animals (measured by Animal Attitude Scale and Animal Issue Scale)

	Idealism (I)		Relativism(R)		Gender (G)		Age (A)		I x G		R x G		G x A		I x R x A		R x G x A			
	F	p	F	p	F	p	F	p	F	p	F	p	F	p	F	p	F	p		
AAS	9.36	<0.01	5.42	0.02	0.37	0.55	10.28	<0.01	0.08	0.77	1.58	0.21	0.65	0.53	1.11	0.33	0.02	0.98	2.96	0.05
AIS	6.58	0.01	16.02	<0.01	0.42	0.52	13.90	<0.01	0.85	0.36	2.64	0.11	3.23	0.04	0.78	0.46	1.36	0.26	3.26	0.04
1	0.92	0.34	7.84	<0.01	0.86	0.35	7.82	<0.01	0.20	0.65	0.69	0.41	1.46	0.23	0.29	0.75	0.59	0.55	0.83	0.44
2	0.05	0.83	23.93	<0.01	0.30	0.58	7.58	<0.01	1.69	0.19	1.59	0.21	4.67	0.01	0.38	0.68	0.06	0.95	2.44	0.09
3	7.86	<0.01	8.35	<0.01	0.48	0.49	10.51	<0.01	0.18	0.67	6.36	0.01	4.96	<0.01	0.39	0.68	1.38	0.25	4.71	<0.01
4	18.57	<0.01	4.59	0.03	0.49	0.49	2.44	0.09	2.07	0.15	0.17	0.68	2.10	0.12	0.06	0.94	3.17	0.04	1.22	0.30
5	0.08	0.77	1.84	0.18	0.06	0.81	8.72	<0.01	0.71	0.40	0.62	0.43	0.12	0.88	0.74	0.48	0.79	0.46	3.21	0.04
6	1.00	0.32	10.21	<0.01	0.77	0.38	6.79	<0.01	0.35	0.55	2.20	0.14	1.71	0.18	3.22	0.04	1.43	0.24	0.83	0.44
7	10.27	<0.01	4.11	0.04	0.32	0.57	14.16	<0.01	0.32	0.57	0.87	0.35	1.66	0.19	1.21	0.30	0.54	0.58	1.93	0.15
8	7.93	<0.01	7.12	<0.01	1.03	0.31	1.93	0.15	5.06	0.03	0.42	0.52	2.22	0.11	1.75	0.17	0.96	0.38	1.94	0.15

Note: df (I) = 1; df (R) = 1; df (G) = 1; df (A) = 2; df (I x G) = 1; df (R x G) = 1; df (I x R) = 1; df (I x R x A) = 2; df (R x G x A) = 2; df (G x A) = 2; df (I x R x A) = 2; df (R x G x A) = 2. The two-way (I x R, I x A), three-way (I x R x G, I x G x A) and four-way (I x R x G x A) interactions were not significant at all and removed from the final analyses. Animal Attitude Scale is abbreviated as AAS while Animal Issue Scale is abbreviated as AIS. The numbers of 1-8 represent the eight sections of AIS: 1-use of animals, 2-animal integrity destruction, 3-killing animals, 4-deprive animal welfare, 5-experimentation on animals, 6-changes in animal genotypes, 7-harm animals for environment and 8-harm animals for social issues.

Table 2. 2 Attitudes toward animals (measured by Animal Issue Scale) in different gender, age groups and ethical positions of Chinese people

		60 years and older												
		45-59 years						19-44 years						
		Exc	Sub	Abo	Sit	Exc	Sub	Abo	Sit	Exc	Sub	Abo	Sit	
Male														
AAS	63.89±6.70	60.85±6.28	66.70±9.24	64.45±6.99	60.96±6.64	61.20±3.80	64.00±11.59	62.29±7.76	54.38±5.63	59.00±6.25	65.60±9.80	60.33±7.48		
AIS	135.4±16.8	132.7±19.2	144.7±17.4	136.6±18.0	128.1±15.9	125.1±15.5	136.8±19.4	137.2±16.9	121.38±7.1	115.7±19.4	137.9±13.6	119.8±30.2		
1	10.95±2.14	10.33±2.42	10.57±2.54	10.20±2.28	10.00±1.80	9.07±1.58	10.15±2.41	9.12±2.47	9.50±1.31	9.67±2.08	9.87±1.92	8.56±2.56		
2	18.39±2.55	17.44±2.98	18.90±3.07	17.33±3.70	16.68±2.58	16.67±3.33	17.81±4.09	16.12±4.39	16.88±2.42	14.00±3.46	18.27±2.71	14.78±4.66		
3	16.45±3.00	16.38±3.29	18.43±2.93	17.47±3.13	15.52±2.69	16.00±2.54	16.85±3.31	18.41±3.52	14.13±2.17	14.33±2.31	16.47±3.66	14.22±3.87		
4	19.18±3.46	19.42±3.30	22.07±2.23	21.33±3.06	18.64±3.80	18.60±3.02	21.54±2.73	21.00±1.70	18.38±1.69	17.33±2.52	22.33±2.32	19.56±5.73		
5	14.08±2.65	13.08±3.37	13.73±3.31	12.87±2.99	12.76±2.37	12.20±2.96	12.23±2.70	13.53±3.47	11.63±2.13	13.00±2.65	12.33±1.84	10.56±2.79		
6	15.03±2.87	14.85±4.18	16.03±4.12	14.02±3.57	15.08±3.54	14.20±3.17	14.38±3.72	14.82±3.73	14.63±2.07	13.00±1.73	15.07±4.64	13.78±4.60		
7	20.58±2.85	20.42±3.72	22.20±3.34	21.48±3.92	18.80±3.08	18.87±4.16	21.31±3.52	21.12±3.89	17.25±1.04	16.33±3.22	19.93±3.35	18.33±5.45		
8	20.76±3.02	20.73±3.61	22.80±3.10	21.92±3.54	20.64±3.43	19.47±3.38	22.50±3.31	23.12±3.31	19.00±2.07	18.00±3.00	23.67±1.84	20.00±5.45		
Female														
AAS	62.81±5.05	63.42±7.29	66.57±10.30	65.58±7.35	62.00±8.00	56.63±7.05	64.07±6.23	58.67±9.63	62.25±6.45	51.00±-	62.33±12.26	60.00±0.00		
AIS	137.3±15.2	136.6±14.0	144.83±17.0	143.5±20.5	139.2±12.7	117.9±19.0	135.4±13.3	129.2±20.3	144.0±11.4	108.0±-	139.3±17.0	116.5±5.0		
1	11.33±2.07	10.81±2.37	10.61±2.48	10.78±2.57	11.00±1.87	10.50±3.16	10.33±2.02	9.07±2.84	11.75±1.71	7.00±-	9.67±2.73	9.00±1.41		
2	18.52±2.34	17.65±2.78	18.13±3.73	18.42±3.48	19.41±2.37	15.63±2.00	18.07±4.01	17.07±3.65	20.25±4.27	14.00±-	17.83±1.94	11.50±0.71		
3	17.19±2.67	17.45±2.99	18.39±3.22	18.64±3.28	17.41±2.58	15.63±2.77	17.27±2.49	17.47±3.89	19.25±4.03	9.00±-	17.33±3.78	13.50±2.12		
4	18.96±3.25	20.68±3.00	22.35±2.64	21.11±3.64	20.59±2.03	17.13±4.42	21.47±2.48	21.13±3.68	20.25±1.26	20.00±-	21.67±1.97	18.00±4.24		
5	14.27±2.13	13.29±2.71	13.52±4.53	14.33±3.09	14.18±2.43	10.63±1.30	12.47±3.38	12.00±3.72	12.75±2.99	10.00±-	12.33±3.83	13.50±2.12		
6	15.81±3.11	14.00±3.18	16.35±3.08	15.64±3.39	14.59±3.10	12.13±2.36	12.60±3.91	13.27±4.59	15.50±1.73	10.00±-	17.33±4.18	12.00±4.24		
7	20.25±3.31	21.26±3.60	22.43±3.13	22.08±4.22	19.88±2.83	17.00±3.16	21.00±3.53	19.53±3.54	20.50±1.92	17.00±-	20.83±3.66	18.50±0.71		
8	20.98±3.28	21.42±2.95	23.04±3.18	22.50±3.72	22.12±2.03	19.25±4.71	22.20±3.12	19.67±4.10	23.75±3.59	21.00±-	22.33±2.73	20.50±3.54		

Note: respondents were divided into 3 age groups, which was based on the standards that enacted by the world health organization in 2010. High values indicate low levels of acceptance. Exc = Exceptionists, Sub = Subjectivists, Abo = Absolutists, itS = Situationists. Animal Attitude Scale is abbreviated as AAS (20-100) while Animal Issue Scale is abbreviated as AIS (43-215). The numbers of 1-8 represent the eight sections of AIS: 1-use of animals (5-25), 2-animal integrity destruction (6-30), 3-killing animals (5-25), 4-deprive animal welfare (5-25), 5-experimentation on animals (5-25), 6-changes in animal genotypes (5-25), 7-harm animals for environment (6-30) and 8-harm animals for social issues (6-30).

Table 2. 3 Important variables to the score of Animal Issue Scale (AIS) in China

Y: The attitudes toward animals (df=104)	Unstandardized Coefficients		t	p
	B	Std. Error		
(Constant)	135.30	8.99	15.06	< 0.01
X ₁ : What is your gross household income per month? average or below the average income in China (1) – twice or more than twice of the average income in China (2)	-11.40	4.32	-2.64	0.01
X ₂ : What pets do you have? dogs: no (0) – yes (1)	24.95	5.14	4.86	< 0.01
X ₃ : What pets do you have? rodents: no (0) – yes (1)	26.08	11.36	2.30	0.02

Table 2. 4 Important variables to the score of Animal Attitudes Scale (AAS) in China

Y: The attitudes toward animals (df=104)	Unstandardized Coefficients		t	p
	B	Std. Error		
(Constant)	66.73	3.84	17.36	< 0.01
X ₁ : Do you belong or donate to an organization or charity involved in or concerned with improving the welfare of animals? yes (1) – no (2)	-4.87	1.61	-3.02	< 0.01
X ₂ : Do you belong or donate to an organization or charity involved in or concerned with improving human rights or health? yes (1) – no (2)	5.58	1.62	3.45	< 0.01
X ₃ : What is your gross household income per month? average or below the average income in China (1) – twice or more than twice of the average income in China (2)	-4.22	1.58	-2.67	< 0.01
X ₄ : What pet (s) do you have? Dogs: no (0) – yes (1)	5.68	1.90	3.00	< 0.01

2.4 Discussion

The aim of this study was to investigate how ethical ideologies and their interaction with human demographics influence public attitudes toward animals in China. In contrast with previous research (Galvin & Herzog 1992a) reporting that the correlation between ethical ideologies and attitudes toward animals was significant on idealism but not on relativism, our results indicate largely independent effect of both ethical idealism and relativism on public attitudes toward animals. Specifically, respondents who scored higher on ethical idealism and scored lower on ethical relativism in general had higher scores on both animal issue scale (AIS) and animal attitude scale (AAS), independent of gender and age. This finding demonstrates that the belief of ethical behaviour will always lead to good results and the existence of universal moral principles can improve respondents' positive attitudes toward animals. Overall, the majority of Chinese people showed positive attitudes toward animals. Young respondents had higher scores of AIS

and AAS than middle-aged and old respondents and the older the person, the lower the AIS and AAS scores were.

2.4.1 Ethical ideologies and attitudes toward animals

We confirmed that people's moral idealism significantly influenced their attitudes toward animals (Bègue & Laine 2016, McPhedran 2009). The more those individuals (situationists and absolutists) considered their ethical behaviour would always lead to desirable consequences, the more they appreciated animals. Perhaps this association is most likely due to the idealist's reluctance to overlook animal suffering. For an idealist, the existence of any animal suffering renders the activities immoral, regardless of the benefits to be derived from activities (Wuensch & Poteat 1998). Another possible explanation is that ethical idealism is related to empathy, which would be helpful to increase people's concern for other creatures, although the direct support for this hypothesis is not available (Galvin & Herzog 1992a).

In contrast to a previous investigation reporting that no significant correlation existed between ethical relativism and attitudes toward animals in the United States (Galvin & Herzog 1992a), our research indicates significant effects of ethical relativism on Chinese public attitudes to animals. This could be due to the fact that more pressing concern in contemporary intellectual scene is relativism (Sankey 2015). Therefore, the implications of ethical relativism become wider and even play a role in influencing public attitudes toward animals, although we found respondents' attitudes toward animals were based more on their ethical idealism than relativism. Chinese people's lower awareness of animal welfare may also account for this difference. Many Chinese people can accept animal (e.g., rodents) suffering in research experiments when considering the specific benefits that experiments bring. For those people, they think no universal ethical principles exist in the world, which directly result in their tolerant attitudes to animal use. These attitudes may also derive from the old Confucianism that animals could be sacrificed for humans in order to pray for good harvest (Blakeley 2003).

Additionally, our results also reveal that a high level of ethical relativism could lead to relatively negative attitudes toward animals, suggesting that situationists and subjectivists generally had low awareness of animal welfare. Those individuals reject the possibility of relying on universal moral principles. Hence, they are more likely to forgive certain types of ethical straying (animal suffering in medical experiments) according to their own moral principles (Sivadas, et al. 2003). For instance, one would regard animal experiments as valuable due to their sacrifice in medical research (Knight, et al. 2009).

Looking more closely at ethical ideologies, subjectivists tended to show less favourable attitudes toward animals than did any of the other categories, while absolutists found them more favourable than did individuals in any other ethical category. Probably the combination of an assumed single moral principle assumed to

lead to perfect achievement provides absolutists the positive attitudes toward animals and animal welfare, and consequently, they appear willing to assert themselves against any unnatural behaviour of animals. Subjectivists contrasts considerably with that of absolutists due to their belief that the best activities do not lead to the best results. They tend to assess situations according to multi-principles and might be more open to different situations. Therefore, they showed more tolerant attitudes toward animal use, such as animal experiments. Another possible explanation is that absolutists envision themselves as standing on the moral high ground, while subjectivists might accept anything that they regard as reasonable (Banas & Parks 2002). Therefore, it is plausible that absolutists showed absolutely positive attitudes toward animals, while greater tolerance of animal suffering (e.g., animal experiments) was associated with subjectivists.

2.4.2 Human demographics and attitudes toward animals

In most surveys on attitudes toward animals, gender is often found to be a correlated factor (Binngießer, et al. 2013, Herzog Jr, et al. 1991, Prokop & Tunnicliffe 2010). However, male and female respondents did not show any significant differences about their attitudes regarding animals in this research, which is in contrast to a previous report that women were more likely to have a positive attitude toward animals than men in the United States (Herzog Jr, et al. 1991). This previous finding about the different attitudes to animals between women and men might be due to the fact that women are regarded as more concerned with animal welfare than men (Wuensch & Poteat 1998). A further reason may lie in personality differences that men are less likely to have sympathetic reactions to animals than women, which directly result in their lower awareness of animal welfare. These differences are probably derived from men's lower levels of belief in the mental abilities of animals than women (Knight, et al. 2003). However, our results in the current research may arguably relate more closely to people's increasingly good morality and high concern for animal welfare, regardless of male or female respondents. Additionally, Chinese women and men's deep-rooted concept that animals should be respected as essential part of society may also contribute to their similar attitudes toward animals (Blakeley 2003). It is therefore not surprising that there are no gender differences among Chinese respondents.

Respondents' attitudes toward animals significantly became less positive with the increasing age and the older the person, the less the positive attitudes to animals. This finding partly parallels a previous work by Signal and Taylor (2006) who demonstrated a minimal negative correlation between age and attitudes toward animals in Australia, although this correlation was not significant. Several explanations may account for this result. First, older respondents are more likely to emphasize the practical value of animals than younger respondents (Ormandy & Schuppli 2014). Their attitudes toward animals are based more on their thinking and reasoning than emotions

and feelings about right and wrong. Therefore, utilitarian intentions may exist among old people because they think animals can be sacrificed for medical achievement and people's progress (Kellert & Berry 1980). Second, animal welfare is a new phenomenon in China, so younger generations are more aware of it and show more positive attitudes toward animals (Littlefair 2006). Third, younger people in China have better education opportunities and more knowledge related to animal welfare than older people (Davey 2006).

In addition, due to the imbalanced sample (only 6.5% of the respondents were from rural areas), we were not able to demonstrate the significant different attitudes toward animals between urban and rural areas. Given the relative limited number of rural areas respondents in this study, this finding needs to be viewed with caution. Actually, the gap between rural and urban areas is one of the most crucial characteristics in contemporary China. Hence, further studies are needed in the future to better address this topic.

2.4.3 The interaction of ethical ideologies and human demographics on attitudes toward animals

In this research, we found some interaction effects of ethical ideologies and gender on respondents' attitudes toward animals. These findings imply that gender plays a role in influencing respondents' attitudes to specific animal issues when it interacts with idealism or relativism, although we did not find any impact of gender itself on attitudes to animals. This might be explained by the relationship between gender and ethical ideology: men are more inclined than women to base their judgements on justice (relativism) rather than emotions (idealism), and vice versa (Galvin & Herzog 1992a). Additionally, the ethical relativism by age interaction effect on respondents' attitudes toward animals was found significant only according to their AIS score, indicating that AIS, which include 43 items, might be more comprehensive in measuring public attitudes toward animals than AAS, which include 20 items. This result also implies that absolutists and exceptionists' positive attitudes to animals decreased with the increase of their age; the older the absolutists and exceptionists, the less the positive attitudes to animals.

The interaction of gender and age only affected respondents' attitudes toward the section of "changes in animals' genotypes". However, our results established a clear link between respondents' overall attitudes toward animals and the interaction of gender, age and ethical relativism, providing additional evidence of the validity of ethical relativism. Although we found no dramatic different interactions between idealism and relativism, it appears that the interactions of idealism, relativism and age on respondents' attitudes toward "deprive animal welfare" are pronounced different, indicating that young absolutists are inclined to show the most negative attitudes toward "deprive animal welfare". This might simply be the result of the fact that

younger absolutists might be more reluctant to engage in immoral activities (e.g. animal experiments and animal suffering) when moral principles are made (Forsyth 1992).

2.4.4 The influence of pet ownership and organisation participation on attitudes toward animals

A further aim of this study was to figure out which variables determined public attitudes toward animals in China. We confirmed what many previous studies already showed: companion animal owners were more likely to show intensive relationships with animals than non-owners (Fidler, et al. 1996, Paul & Serpell 1993, Walker, et al. 2014). These results may be explained by the fact that companion animal owners have more opportunities to interact with animals than non-owners. Furthermore, findings in this research also reveal that animal protection organisation participation increased the positive attitudes toward animals, while the human health organisation participation decreased the positive attitudes toward animals. The former finding might stem from participants' relatively frequent interactions with animals and nature in animal protection organisation. However, the latter might be due to their working characteristics that using animals in experiments to promote medical development and improve human health.

2.4.5 Limitations of this study

Although the present study did achieve some success by measuring Chinese people's attitudes toward animals and their relations to ethical ideologies, it is clear that some other variables remain unexplained, such as the frequency of meat eating and zoo (aquarium) visiting. In addition, due to the way of information collection, unbalanced distribution of participants was involved in this research (e.g. the number of urban respondents was much higher than that of rural respondents). This may explain why we did not find significant differences between rural and urban areas. Additionally, this limitation also inspires us that face-to-face interview is needed in our follow-up research in order to reduce sampling errors.

2.5 Conclusion and Animal welfare implications

Our results provided evidence that favourable attitudes toward animals were positively affected by ethical idealism, which is consistent with previous surveys reporting that public attitudes toward animals in the United States are positively associated with idealism (Galvin & Herzog 1992a, Nickell & Herzog 1996). However, attitudes toward animals were negatively affected by ethical relativism in China, which is inconsistent with above surveys showing that ethical relativism was not related to attitudes toward animals in the United States (Galvin & Herzog 1992a, Nickell & Herzog 1996). All these

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studies indicate that the same mechanisms underlying the effect of ethical idealism on attitudes toward animals might work in different countries to increase awareness on animal welfare. However, the mechanisms of how ethical relativism influence attitudes toward animals might differ between developed and developing countries.

The present study highlights the significant positive relationship between ethical idealism and attitudes to animals, as well as the significant negative relationship between ethical relativism and attitudes to animals in China. This result implies that individuals who think their ethical behaviour will always lead to positive consequences and who believe in the existence of universal moral principles generally have high awareness of and positive attitudes toward animal welfare. Therefore, further consideration of how to balance and prioritize ethical idealism and relativism in order to improve people's positive attitudes toward animals is necessary. The findings of the correlation between ethical ideologies and attitudes toward animals can serve as a motivational platform on studies of how to increase Chinese people's awareness on animal welfare. Finally, as this is the first study of the correlation between ethical ideologies and attitudes toward animals in China, further research concentrated on this correlation toward specific animals, such as companion animals, is needed to design, test and refine in the future.

Chapter 3

How ethical ideologies relate to public attitudes toward animals: The Dutch case

“The greatness of a nation can be judged by the way its animals are treated.”

Mahatma Gandhi

Abstract

Ethical ideologies, which include dimensions of idealism and relativism, are often involved in the process of decision-making regarding operational and economic research. However, the study of the role of ethical ideologies concerning public attitudes toward animals has been largely neglected. The present study analyzed how ethical ideologies and their interaction with human demographics relate to public attitudes toward animals in the Netherlands. The Ethics Position Questionnaire (EPQ) was used to assess respondents' ethical ideologies and their relationship with attitudes toward animals, which were measured by the Animal Issue Scale (AIS) and the Animal Attitude Scale (AAS). The results demonstrated that respondents' gender and age were both significantly associated with attitudes toward animals, although gender showed a stronger correlation than age. Absolutists and situationists tended to show greater concern for animals than did exceptionists and subjectivists. Public attitudes toward animals were found to be significantly related to idealism; this confirms previous findings in the United States and China. Consistent with some previous findings in the United States, no significant correlation between relativism and public attitudes toward animals was found among Dutch respondents. However, this finding is inconsistent with findings in China indicating that relativism was negatively related to people's attitudes toward animals. Our study indicates that the correlation between idealism and attitudes toward animals is the same in different countries, while the correlation between relativism and attitudes toward animals differs between developed and developing countries.

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3.1 Introduction

It is well-documented that human demographic and personality factors are associated with people's attitudes toward animals. A growing body of evidence shows the relationship between a person's attitudes toward animals and their gender (Driscoll 1995, Herzog, et al. 2015, Herzog, et al. 1991, Pifer, et al. 1994), age (Ascione 1992, Kavanagh, et al. 2013, Kellert 1985), household income (Signal & Taylor 2006), humane education (Ascione & Weber 1996, Furnham, et al. 2003, Nicoll, et al. 2008), pet ownership (Driscoll 1992, Martens, et al. 2016, Serpell 1996), religion (Bowd & Bowd 1989, Driscoll 1992, Gilhus 2006), as well as geographic region (Phillips, et al. 2012, Pifer, et al. 1994). However, research into the correlation between public attitudes toward animals and ethical ideologies is still in its infancy and needs further investigation (Bègue & Laine 2017).

In the past two decades, a few studies have explored the relationship between ethical ideology and people's attitudes toward animals (Galvin & Herzog 1992a, Nickell & Herzog 1996, Su & Martens 2017, Taylor & Signal 2005, Wuensch, et al. 2002). The Ethics Position Questionnaire (EPQ) (Forsyth 1980) is often used to measure people's ethical ideology, and has increasingly become a methodological cornerstone in studies of ethical decision-making. The EPQ is divided into two ethical dimensions: idealism and relativism (Forsyth 1980). Idealism refers to the extent to which one believes that ethical behavior will always lead to desirable consequences, while relativism refers to the extent to which people accept the belief that moral decisions should be based on universal principles (Banas & Parks 2002, Forsyth 1980, Galvin & Herzog 1992a, Wuensch & Poteat 1998). Individuals who score high on the idealism dimension think that ethical actions will always lead to good results, while individuals who score high on the relativism dimension believe that moral decisions should be based on local principles and situational analysis, rather than universal principles (Forsyth 1980, Galvin & Herzog 1992a, Wuensch & Poteat 1998). Based on the idealism and relativism scores, Forsyth (1980) further proposed that individuals can be classified into four ethical categories: situationists (high idealism and high relativism), absolutists (high idealism and low relativism), subjectivists (low idealism and high relativism), and exceptionists (low idealism and low relativism).

Building on this classification, Forsyth and Pope (1984) demonstrated that public attitudes toward animals or animal experiments are related to their ethical perspectives. For instance, absolutists regarded animal experiments as more unethical than did individuals in any other ethical category. Studies conducted in the United States have investigated the role of idealism and relativism, showing that individuals who scored higher on idealism often showed greater moral concern for ways of using animal, while individuals who scored higher on relativism often showed less moral concern for animal use (Wuensch & Poteat 1998). Similar results were also found in a recent study conducted in China (Su & Martens 2017). These findings indicate that both

idealism and relativism are associated with attitudes toward animals. However, other investigations conducted in the United States have demonstrated significant correlations between ethical idealism and attitudes toward animals, but nonsignificant correlations between ethical relativism and attitudes toward animals, suggesting that ethical relativism is not a useful concept in this respect (Galvin & Herzog 1992a, Nickell & Herzog 1996). Thus, there is a need to answer the question how ethical ideologies relate to attitudes toward animals in different countries with different cultures.

We assume that idealism may be positively related to people's concern for animal welfare in different countries, since the absolute nature of idealistic individuals' moral principles always have crucial implications for their concern for others, including animals (Park 2005). However, whether the correlation between relativism and attitudes toward animals is also the same in different countries, particularly when comparing developed and developing countries, still needs further investigation. People from developed countries already have a high awareness of animal welfare, and their attitudes toward animals are likely to have been formed by concern for animal well-being, rather than being based on a cost-benefit analysis (Wuensch, et al. 2002). We therefore assumed that relativism would not be a reliable predictor of attitudes toward animals in developed countries. However, a Chinese study demonstrated a significant correlation between relativism and attitudes toward animals (Su & Martens 2017). With the booming economy, Chinese people's awareness of animal welfare seems to be counteracted by their pursuit of technological innovation. Some Chinese people's awareness of animal welfare is considered to be poor, and their attitudes toward animals are more likely to be based on the specific benefits that can be derived from using animals. Therefore, we hypothesized that the correlation between relativism and attitudes toward animals would be stronger in developing countries than in developed countries. In view of the cultural difference between developed countries (e.g., Netherlands) and certain developing countries (e.g., China), we hypothesized that human demographics and their interaction with ethical ideology might also link to attitudes toward animals, differently. Additionally, since animal welfare is a new concept in China, and younger people are more aware of it than older people (Su & Martens 2017), we hypothesized that age would play a more important role in Chinese people's attitudes toward animals, than in those of Dutch people.

In the present study, we wanted to find out how ethical ideologies (idealism and relativism) and their interaction with human demographics relate to attitudes toward animals among Dutch people. Additionally, as Dutch people have a greater awareness of animal welfare than Chinese people, and this high awareness in the Netherlands could explain the strong link between ideologies and attitudes toward animals, we examined whether the correlation between ethical ideologies and attitudes toward animals differed between Dutch and Chinese people, by utilizing the same questionnaire that was used in China (Su & Martens 2017). Religion (Bowd & Bowd 1989, Driscoll 1992, Gilhus 2006), pet ownership (Costa, et al. 2014, Martens, et al.

2016) and meat consumption (Kenyon & Barker 1998, Loughnan, et al. 2010, Povey, et al. 2001) have been demonstrated to be important factors in attitudes toward animals. In order to verify the reliability of these reports, we investigated whether such variables also relate to attitudes toward animals among Dutch people. Since few of the studies of the correlation between ethical ideology and attitudes toward animals that have been published in the literature specifically explain the differences and key drivers of such correlations between different countries, the current study can serve as a starting point for understanding attitudes toward animals and their associated factors in different countries, and can also help to diversify approaches to alter human-animal relationships.

3.2 Methods

3.2.1 Participants and procedure

In brief, an online questionnaire was distributed throughout the Netherlands in November 2015. This study adhered to the ethical guidelines of Taylor & Francis policy, and was conducted under protocols approved by Maastricht University's Ethical Review Committee Inner City faculties (ERCIC). In total, 506 responses were obtained from 581 people (among a panel which included 897 people throughout the Netherlands) who provided their e-mail addresses and received the invitation email with a unique hyperlink to our questionnaire. All the respondents in the present study were 18 years or older and participated in the "Golden Standard" panel, which was developed by the MOA (Center for Information Based Decision Making and Marketing Research) in collaboration with CBS (Statistics Netherlands) in the Netherlands. The mean (\pm *SD*) age of all respondents (51.2% male and 48.8% female) was 48.48 (\pm 16.78) years. The respondents were representative of the Dutch population aged 18 years or older with respect to gender and age (see results section). Utilizing a standard "forward-backward" translation procedure, the English version of the questionnaire was translated into Dutch, and two Dutch-speaking researchers who had not seen the English version translated it back into English. The re-translated version was found to closely match the original one. In the questionnaire, we explained the purpose of our study to the participants and stated that all information they provided would be kept completely confidential, and that personal information would not be released to or viewed by anyone other than the researchers involved in this project. The Ethics Position Questionnaire, Animal Issue Scale, and Animal Attitude Scale were presented to each respondent in randomized order. Background information on the respondents' is in Table 3.1.

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Table 3. 1 Background details of the respondents.

	<i>n (%)</i>
<i>Gender</i>	
Male	259 (51.2)
Female	247 (48.8)
<i>Age</i>	
Young (19–44years)	196 (38.7)
Middle-aged (45–59 years)	152 (30.0)
Old (60 years and older)	158 (31.2)
<i>Highest Level of Education</i>	
Less than grade 12	11 (2.2)
Middle school	146 (28.9)
High school	69 (13.6)
College or technical school	224 (44.3)
University	52 (10.3)
<i>Place of Residence</i>	
Urban areas	307 (60.7)
Rural areas	199 (39.3)
<i>Housing Type</i>	
Apartment	143 (28.3)
Semi-detached house	302 (59.7)
Detached house	61 (12.1)
<i>Main Source of Inspiration</i>	
Buddhism	29 (5.7)
Judaism	3 (0.6)
Islam	4 (0.8)
Christianity	114 (22.5)
Taoism	4 (0.8)
Other	19 (3.8)
<i>Pet Ownership</i>	
Yes	249 (49.2)
No	257 (50.8)
<i>Pet Species</i>	
Cat	139 (27.5)
Dog	103 (20.4)
Fish	43 (8.5)
Birds	26 (5.1)
Reptiles	8 (1.6)
Rodents	34 (6.7)
Chickens, pigeon, gees or other poultry	10 (2.0)
Ponies and horses	5 (1.0)
Other	4 (0.8)
<i>Meat-eating Frequency</i>	
Never	18 (3.6)
Once a week or less	35 (6.9)
2–3 days a week	125 (24.7)
4–6 days a week	244 (48.2)
Every day	84 (16.6)
<i>Visiting Zoo/Aquarium</i>	
Once a month or more	15 (3.0)

Once every six months	50 (9.9)
Once every year	119 (23.5)
Once every two years or less	233 (46.0)
Never	89 (17.6)

Note: Respondents were divided into three age groups based on the standards proposed by the World Health Organization in 2010.

3.2.2 Questionnaire

In the first part of the questionnaire, respondents were asked to supply some background information, including gender, age, highest attained level of education, place of residence, housing type, main source of inspiration, pet ownership and pet species, meat consumption, and frequency of visiting zoos/aquariums.

In the second part of the questionnaire, the Ethics Position Questionnaire (EPQ) was used to determine the respondents' dominant ethical ideologies (Rawwas 1996). Cronbach's alpha for the EPQ in the present study was 0.898. The EPQ is a 20-item questionnaire which yields four ethical positions (absolutists, exceptionists, situationists, and subjectivists) based on two 10-item subscale scores for idealism and relativism (Forsyth 1980). The idealism dimension asks respondents to indicate their degree of agreement with items like "One should never psychologically or physically harm another person" and "The dignity and welfare of the people should be the most important concern in any society." Typical items for relativism include "What is ethical varies from one situation and society to another" and "No rule concerning lying can be formulated; whether a lie is permissible or not permissible totally depends upon the situation." Respondents were asked to respond to statements using 9-point Likert scales, ranging from 1 (completely disagree) to 9 (completely agree). The mean scores of the idealism subscale (7.27) and the relativism subscale (6.07) in the present study were used as cut-off values to classify respondents as high or low in idealism and relativism, respectively.

In the third part of the questionnaire, the Animal Issue Scale (AIS) (Meng 2009) was used to measure respondents' attitudes toward animals. Cronbach's alpha for the AIS in the present study was 0.922. The AIS, a 43-item scale, includes eight sections (use of animals, disrupting animal integrity, killing animals, compromising animal welfare, experimenting on animals, changing animals' genotypes, animals and the environment [harming animals to protect the environment], and societal attitudes toward animals [harming animals for social purposes]). Respondents were asked to respond to each question on a 5-point Likert scale, ranging from 1 (extremely acceptable) to 5 (extremely unacceptable). A higher score on the AIS indicates greater concern for the welfare of animals (Phillips, et al. 2012). Examples of items include: "Using animals for work"; "Marking animals by branding or ear notching"; "Depriving animals of their needs for food and water"; "Controlling wildlife populations by killing."

In the fourth part of the questionnaire, the Animal Attitudes Scale (AAS) (Herzog, et al. 1991) was introduced to further examine respondents' attitudes toward

animals. Cronbach's alpha for the AAS in the present study was 0.875. The AAS is a 20-item questionnaire, which was chosen because of its concise design and scientific content. Items 1, 3, 4, 7, 10, 11, 17, 19, and 20 are scored from 1 (strongly disagree) to 5 (strongly agree), while the other items are reverse-scored, from 1 (strongly agree) to 5 (strongly disagree) according to their meanings. A higher score on the AAS reflects greater concern for the welfare of animals. Examples of questions include: "4. Wild animals, such as mink and raccoons, should not be trapped and their skins made into fur coats"; "8. I think it is perfectly acceptable for cattle and dogs to be raised for human consumption"; "18. The production of inexpensive meat, eggs, and dairy products justifies maintaining animals under crowded conditions."

3.2.3 Statistical analysis

How ethical ideologies and their interaction with human demographics are associated with public attitudes toward animals in the Netherlands was analyzed with IBM SPSS 24 Statistical software (Armonk, NY, USA). Given that the data in this study were either normally distributed or converted to normal distribution by log₁₀ transformation, and the Levene test showed homogeneity of variances, a multivariate analysis (MANOVA) was performed (after log₁₀ transformation) to determine respondents' ethical ideologies and demographics that may be associated with their attitudes toward animals. In order to reduce type-I errors due to repeated testing, Fisher's procedure was applied in the analyses across three groups, and REGWQ correction was used wherever necessary to find the differences across more than three groups. The model for data responses included idealism, relativism, gender, age, highest level of education, place of residence, housing type, main source of inspiration, pet ownership and pet species, meat consumption, and frequency of visiting zoos/aquariums. Only idealism, relativism, gender, and age were considered in this research, as idealism and relativism were the two variables targeted by our modelling. Gender and age were used to measure how demographics related to respondents' attitudes toward animals. Fisher's r-to-z transformation was performed wherever necessary to find the difference between two groups regarding correlations. In order to identify variables associated with respondents' attitudes toward animals, backward linear regression was carried out to relate responses regarding attitudes toward animals to demographics and other basic information, such as the main sources of spiritual inspiration, companion animal species and meat eating frequency. An alpha value of 0.05 was used for variables to be entered into the models.

3.3 Results

3.3.1 EPQ

In this study, respondents' mean score for idealism was 7.27 ($SD = 1.36$), while the mean score for relativism was 6.07 ($SD = 1.35$). The scores for idealism and relativism in the current study were similar to the results of a recent survey conducted in China ($M_{idealism} = 7.26$, $SD = 1.21$, $t_{(1008)} = 0.22$, $p = 0.83$, $M_{relativism} = 6.07$, $SD = 1.33$, $t_{(1008)} = 0.10$, $p = 0.92$). We did not find any significant differences between male and female respondents regarding either idealism or relativism. The mean idealism score of middle-aged respondents (7.50 ± 1.28) was higher than that of young respondents (6.66 ± 1.25) and lower than that of older respondents (7.81 ± 1.26) (both $p < 0.05$). As for the score for relativism, the older respondents (6.39 ± 1.50) scored higher than the young (5.96 ± 1.90) and middle-aged ones (5.90 ± 1.34) (both $p < 0.01$). Situationists made up the largest share of participants (39.3%), followed by absolutists (38.7%) and exceptionists (16.8%). Subjectivists (5.1%) were the smallest group in the present study.

3.3.2 Do respondents' ethical ideologies and demographics relate to their attitudes toward animals?

Ethical Ideologies: The multivariate test yielded a significant correlation between respondents' idealism and their attitudes toward animals (according to AAS and AIS scores). Respondents with higher scores for ethical idealism showed greater concern for animal welfare and for the specific animal welfare issues of "use of animals," "disrupting animal integrity," "killing animals," "compromising animal welfare," "experimenting on animals," "changing animals' genotypes," "harming animals to protect the environment" and "harming animals for social purposes" (Table 3.2). Absolutists and situationists showed greater moral concern for animal welfare than exceptionists and subjectivists. Yet we did not find any significant correlations between relativism and respondents' attitudes toward animals (Table 3.2).

Human Demographics: Respondents' gender was significantly associated with their attitudes toward animals (according to AAS and AIS scores), as women showed greater concern for the welfare of animals than men (Table 3.2). This difference was also reflected by women's greater sensitivity to the treatment of animals, including "use of animals," "killing animals," "compromising animal welfare," "experimenting on animals," "changing animals' genotypes," "harming animals to protect the environment" and "harming animals for social purposes" (Table 3.2). Age was also associated with respondents' attitudes toward animals, but this was only reflected by the AIS score. Middle-aged respondents expressed greater concern for animal welfare and the specific animal welfare issues of "compromising animal welfare",

“experimenting on animals”, “changing animals’ genotypes”, and “harming animals for social purposes” than young and older respondents (Table 3.2).

3.3.3 Interaction between ethical ideologies and demographics

The interaction between relativism and age was not associated with respondents’ attitudes toward animals (according to their AIS and AAS scores). However, the correlation between relativism and the acceptability of “killing animals” was stronger when middle-aged respondents were removed from the analysis (ethical relativism × age). We found that the idealism by relativism by age interaction was significantly associated with respondents’ attitudes toward animals (only according to their AAS scores), with middle-aged absolutists showed the greatest concern for animal welfare, while young and older subjectivists showed the least concern for animal welfare (Table 3.2).

Table 3. 2 Summary of multivariate analysis of the effects of ethical idealism, ethical relativism, gender, and age on public attitudes toward animals (measured by Animal Attitude Scale [AAS] and Animal Issue Scale [AIS]).

	Idealism (I)		Relativism(R)		Gender (G)		Age (A)		R×A		I×R×A	
	F	p	F	p	F	p	F	p	F	p	F	p
AAS	12.46	<0.01	2.11	0.15	26.89	<0.01	2.78	0.06	1.29	0.28	3.69	0.03
AIS	31.86	<0.01	0.16	0.69	23.72	<0.01	3.66	0.03	0.97	0.38	0.50	0.61
Use of animals	3.80	0.05	0.34	0.56	3.95	0.05	1.12	0.33	0.47	0.63	2.90	0.06
Disrupting animal integrity	18.21	<0.01	0.92	0.34	3.17	0.08	2.36	0.10	0.17	0.85	0.47	0.62
Killing animals	19.54	<0.01	0.38	0.54	12.73	<0.01	0.08	0.93	3.37	0.04	0.62	0.54
Compromising animal welfare	24.18	<0.01	0.01	0.91	14.01	<0.01	3.33	0.04	0.74	0.48	1.08	0.34
Experimenting on animals	14.39	<0.01	0.09	0.76	13.71	<0.01	3.22	0.04	1.11	0.33	0.09	0.91
Changing animals’ genotypes	3.96	0.05	1.14	0.29	22.44	<0.01	5.19	<0.01	1.49	0.23	0.04	0.96
Harming animals to protect the environment	18.01	<0.01	0.61	0.43	14.91	<0.01	2.60	0.07	0.04	0.96	1.04	0.35
Harming animals for social purposes	25.92	<0.01	0.06	0.81	4.86	0.03	9.55	<0.01	0.46	0.63	0.10	0.91

Note: *df* (I) = 1; *df* (R) = 1; *df* (G) = 1; *df* (A) = 2; *df* (R×A) = 2; *df* (I×R×A) = 2. The two-way (I×A, I×R, I×G, R×G, G×A), three-way (I×R×G, I×G×A, R×G×A,) and four-way (I×R×G×A) interactions that were not significant were removed from the final analyses.

3.3.4 Main predictors of AIS and AAS scores

We considered a number of possible demographic variables that might relate to the AIS scores, from the information we collected from the Dutch respondents (see Table 3.3 for influential variables). According to the backward elimination multiple regression analysis, the AIS scores of respondents who considered their inspiration to come from Christianity were on average 14.46 points lower than those of respondents who did not. Female respondents' AIS scores were 11.43 points higher than those of their male equivalents. The AIS score of dog owners was 9.85 points higher than that of non-dog owners (Table 3.3).

Table 3.3 Important variables influencing the Animal Issue Scale (AIS) score in the Netherlands.

Y: Attitudes toward Animals (<i>df</i> = 79)	Unstandardized Coefficients		Standardized Coefficients	<i>t</i>	<i>p</i>
	<i>B</i>	<i>SE</i>	Beta		
(Constant)	103.95	19.08		5.45	0.00
X ₁ : What's your gender? Male (1); female (2)	11.43	3.99	0.31	2.86	0.01
X ₂ : What's your age? 19–44 years (1); 45 years and above (2)	3.34	2.51	0.15	1.33	0.19
X ₃ : What's your highest level of education? High school or lower (1); college/technical school, university or above (2)	-1.09	1.57	-0.08	-0.70	0.49
X ₄ : Do you belong or donate to an organization concerned with improving the welfare of animals? Yes (1); no (2)	-0.76	4.81	-0.02	-0.16	0.88
X ₅ : Do you belong or donate to an organization concerned with conservation of the natural environment? Yes (1); no (2)	4.55	5.02	0.13	0.91	0.37
X ₆ : Do you belong or donate to an organization concerned with improving human rights or health? Yes (1); no (2)	0.93	4.32	0.03	0.22	0.83
X ₇ : What does your household look like? Single/couple without children (0); single/couple with children (1)	2.70	1.76	0.16	1.53	0.13
X ₈ : Is your current place of residence in an urban area (1); or a rural area (2)	4.77	3.89	0.13	1.23	0.23
X ₉ : In what sort of house do you live? Apartment or semi-detached house (1); detached house or villa (2)	10.41	5.91	0.21	1.76	0.08
X ₁₀ : Do you have a garden? Yes (1); no (2)	7.64	5.58	0.15	1.37	0.18
X ₁₁ : What is your main source of spiritual inspiration? Buddhism: no (0); yes (1)	-6.01	5.13	-0.14	-1.17	0.25
X ₁₂ : What is your main source of spiritual inspiration? Christianity: no (0); yes (1)	-14.46	4.88	-0.36	-2.96	0.01

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X ₁₃ : What's your gross household income per month? Average or below the average income in the Netherlands (1); twice or more than twice the average income in the Netherlands (2)	0.01	1.32	0.00	0.01	0.99
X ₁₄ : What pets do you have? Cats: no (0); yes (1)	6.95	4.80	0.19	1.45	0.15
X ₁₅ : What pets do you have? Dogs: no (0); yes (1)	9.85	4.25	0.26	2.32	0.02
X ₁₆ : What pets do you have? Fish: no (0); yes (1)	-5.50	5.17	-0.13	-1.06	0.29
X ₁₇ : What pets do you have? Birds: no (0); yes (1)	-2.10	5.83	-0.04	-0.36	0.72
X ₁₈ : What pets do you have? Rodents: no (0); yes (1)	0.32	5.99	0.01	0.05	0.96
X ₁₉ : What pets do you have? Chickens, pigeon, geese: no (0); yes (1)	-10.52	10.90	-0.15	-0.97	0.34
X ₂₀ : What pets do you have? Ponies, horses: no (0); yes (1)	2.86	28.63	0.02	0.10	0.92
X ₂₁ : How often do you eat meat (including fish) every week? Once a week or never (1); 2 or more days a week (2)	-5.50	5.41	-0.12	-1.02	0.31
X ₂₂ : How often do you visit a zoo or aquarium? Once every six months or more (1); once every year or less (including never) (2)	-1.26	2.10	-0.08	-0.60	0.55

Note: "Standardized coefficients" refer to the partial effect of one predictor after adjusting for the others.

Based on the relationships between respondents' AAS scores and the possible influential factors (see Table 3. 4), we found that the AAS scores of respondents whose main source of inspiration was Christianity was 10.42 points lower than those of respondents who did not report Christianity as their main source of inspiration. Female respondents' mean AAS score was 8.91 points higher than that of male respondents (Table 3.4).

Table 3. 4 Important variables influencing the Animal Attitudes Scale (AAS) score in the Netherlands.

Y: Attitudes toward animals (<i>df</i> = 79)	Unstandardized Coefficients		Standardized Coefficients	<i>t</i>	<i>p</i>
	<i>B</i>	<i>SE</i>	Beta		
(Constant)	71.03	15.67		4.53	0.00
X ₁ : What's your gender? Male (1); female (2)	8.91	3.28	0.33	2.72	0.01
X ₂ : What's your age? 19–44 years (1); 45 years and older (2)	-1.27	2.06	-0.08	-0.62	0.54
X ₃ : What's your highest level of education? High school or lower (1); college/technical school, university or above (2)	-0.95	1.29	-0.09	-0.73	0.47
X ₄ : Do you belong or donate to an organization concerned with improving the welfare of animals? Yes (1); no (2)	-3.55	3.95	-0.13	-0.90	0.37

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X ₅ : Do you belong or donate to an organization concerned with conservation of the natural environment? Yes (1); no (2)	3.32	4.12	0.13	0.81	0.42
X ₆ : Do you belong or donate to an organization concerned with improving human rights or health? Yes (1); no (2)	0.86	3.55	0.03	0.24	0.81
X ₇ : What does your household look like? Single/couple without children (0); single/couple with children (1)	1.24	1.45	0.10	0.86	0.39
X ₈ : Is your current place of residence in an urban area (1) – or a rural area (2)	0.15	3.19	0.01	0.05	0.96
X ₉ : In what sort of house do you live? Apartment or semi-detached house (1); detached house or villa (2)	6.63	4.85	0.18	1.37	0.18
X ₁₀ : Do you have a garden? Yes (1); no (2)	-1.83	4.58	-0.05	-0.40	0.69
X ₁₁ : What is your main source of spiritual inspiration? Buddhism: no (0); yes (1)	-0.63	4.21	-0.02	-0.15	0.88
X ₁₂ : What is your main source of spiritual inspiration? Christianity: no (0); yes (1)	-10.42	4.01	-0.35	-2.60	0.01
X ₁₃ : What's your gross household income per month? Average or below the average income in the Netherlands (1); twice or more than twice the	-0.61	1.08	-0.08	-0.57	0.57
X ₁₄ : What pets do you have? Cats: no (0); yes (1)	0.66	3.94	0.03	0.17	0.87
X ₁₅ : What pets do you have? Dogs: no (0); yes (1)	2.68	3.49	0.10	0.77	0.45
X ₁₆ : What pets do you have? Fish: no (0); yes (1)	-1.65	4.25	-0.05	-0.39	0.70
X ₁₇ : What pets do you have? Birds: no (0); yes (1)	-3.26	4.79	-0.09	-0.68	0.50
X ₁₈ : What pets do you have? Rodents: no (0); yes (1)	-3.54	4.92	-0.10	-0.72	0.48
X ₁₉ : What pets do you have? Chickens, pigeon, geese:	-9.87	8.95	-0.20	-1.10	0.26
X ₂₀ : What pets do you have? Ponies, horses: no (0);	14.40	23.51	0.12	0.61	0.54
X ₂₁ : How often do you eat meat (including fish) every week? Once a week or never (1); 2 or more days a week (2)	-6.34	4.44	-0.18	-1.43	0.16
X ₂₂ : How often do you visit a zoo or aquarium? Once every six months or more (1); once every year or less (including never) (2)	-0.32	1.73	-0.03	-0.19	0.85

Note: "Standardized coefficients" refer to the partial effect of one predictor after adjusting for the others.

3.4 Discussion

The aim of this study was to investigate how ethical ideologies and their interaction with human demographics relate to attitudes toward animals, as well as whether the correlation between ethical ideologies and attitudes toward animals is the same in different countries. Our findings showed a significant correlation between idealism and attitudes toward animals, while no significant correlation was found between relativism and attitudes toward animals. This result parallels those of previous studies conducted in developed countries (Galvin & Herzog 1992a, Nickell & Herzog 1996), while partly

contrasting with a recent study conducted in China, which reported that public attitudes toward animals were positively associated with idealism and negatively with relativism (Su & Martens 2017). Hence, our findings indicate that whereas the correlation between ethical idealism and attitudes toward animals appears to be similar in different countries, the correlation between ethical relativism and attitudes toward animals seems to differ between developed and developing countries.

3.4.1 Ethical ideology

Our results showed that respondents' concern for animal welfare was positively associated with their ethical idealism. The more individuals believed that positive behavior will lead to good consequences, the more they appreciated animals. This finding is in line with previous research showing that ethical idealism relates to attitudes toward animals in both developed (Bègue & Laine 2017, Galvin & Herzog 1992a, Wuensch & Poteat 1998) and developing countries (Su & Martens 2017). Considering that idealistic individuals are concerned about others' welfare and believe in the absolute value of moral standards based on their unselfish concern for others (Park 2005), it is not surprising that greater concern for animal welfare has always gone together with a higher level of idealism. Idealistic individuals' belief that harming others is always avoidable may also apply to their concern for animals (Forsyth 1992, Park 2005).

We found that the correlation between ethical relativism and attitudes toward animals was not statistically significant, which confirms previous studies conducted in the United States (Galvin & Herzog 1992a, Nickell & Herzog 1996). However, our result is inconsistent with a previous Chinese study, which demonstrated that the more individuals disagree with the existence of universal moral principles, the more they endorse the view that animals can be sacrificed for human and societal purposes (Su & Martens 2017). This difference between China and Western countries might be accounted by their different cultural backgrounds. Although Chinese Confucianism, which is still influential in contemporary China, requires people to respect animals, it appears that animals are assumed to have value because they are resources to satisfy human needs (Blakeley 2003). Therefore, Chinese peoples' awareness of the concept of "animal welfare" is considered to be low and they are considered to be more rational in explaining their attitudes toward animals. The economic policies in modern Chinese society may also contribute to individuals' relativist attitudes toward animals. Since 1987, economic success has become the central task of social development in China (Zhu & Feng 2008). Individuals' awareness of animal welfare has been overlooked in the vigorous pursuit of technological innovation and quick profits. This has led to some Chinese people's more tolerant attitudes toward animal experiments, which inevitably involve animal suffering and the reduction of animal welfare. Therefore, it is plausible that some Chinese people think there are no universal principles regarding specific

animal species, such as laboratory animals. Generally speaking, most people from developed countries are more aware of animal welfare and show great concern for animals (Friedmann 2013, Martens, et al. 2016, Pifer, et al. 1994). Their attitudes toward animals may stem from their concern for animal welfare, rather than from a cost-benefit analysis. In those countries, the existence of animals might be regarded as more valuable than the benefits that they bring. As a result, the correlation between relativism and attitudes toward animals can be ignored.

Another interesting finding is that the majority of our respondents held absolutist or situationist ethical beliefs (i.e., high scores on idealism). Additionally, we confirmed that idealism is an important determinant of attitudes toward animals (Nickell & Herzog 1996). Absolutists and situationists in the present study showed greater concern for animals than subjectivists and exceptionists, although the situationists scored higher on the relativism scale than exceptionists. One possible reason is that absolutists and situationists are less likely to compromise on their values than subjectivists and exceptionists who view ethical judgement from a more relativistic perspective (Galvin & Herzog 1992a). For instance, subjectivists and exceptionists may consider that the costs of animal use (in terms of animal welfare) are justified by the benefits to humans, as they often base their attitude on ethical cost-benefit analyses (Wuensch, et al. 2002). Accordingly, their attitudes toward animals are not as favorable as those of absolutists and situationists. This result can also be supported by a previous finding, which showed that idealism was more highly related to belief in caring as an ethical principle than relativism (Nickell & Herzog 1996). Our findings confirm that the correlation between idealism and people's concern for animals was much stronger than that between relativism and concern for animals (Wuensch & Poteat 1998). They also imply that idealists can have high scores on both idealism and relativism, but that idealists tend not to base their attitudes on cost-benefit analysis (Wuensch, et al. 2002), which means that they question whether the alternative can lead to the best results, and reject absolute rules. This might explain idealists' greater concern for animals.

3.4.2 Human demographics and their interaction with ethical ideologies

Our results indicate that respondents' gender and age were independently related to their attitudes toward animals, although gender played a more important role in this relationship than age. We also confirmed that women show greater concern for animals than men (Bègue & Laine 2017, Erlanger & Tsytarev 2012, Martens, et al. 2016). This may be because women are socialized from birth in a caring and nurturing role, while men are brought up to be more utilitarian (Herzog Jr, et al. 1991). This may mean that women's attitudes toward animals are characterized by humanistic orientation, whereas men's attitudes are more utilitarian and tend to be more "thing oriented" (Hills 1989, Kellert & Berry 1987). However, a previous Chinese study reported that gender was not related to attitudes toward animals (Su & Martens 2017). Both Chinese women

and men's deep-rooted idea that animals should be respected as an essential part of society may play a more important role in their attitudes toward animals than differences in personality between women and men. Hence, it is not surprising that gender failed to associate with attitudes toward animals in China.

The concept of animal welfare was first highlighted by ethological researchers at universities by the end of 1960s and 1970s in European countries (in China by the end of 1980s and 1990s) (Bayne, et al. 2015, Niggli 2007), as a result of which age was strongly correlated with attitudes toward animals in both the Netherlands and China. Additionally, we found that middle-aged Dutch respondents showed the greatest moral concern for animals, which is inconsistent with previous findings from China, in which the young respondents showed greater concern for animals than middle-aged and older ones. Animal welfare as a new phenomenon in China has attracted the attention of the younger generations, as a result of which they are more aware of it and express greater concern for it (Littlefair 2006). In the Dutch sample examined in the present study, there were more middle-aged than younger and older respondents who belonged to or donated to organizations involved in improving animal welfare, which means that middle-aged respondents have more direct access to the knowledge about animals shared in their communities. We assume this may have contributed to their greater concern for animals.

Although we found no significant interactions between idealism and relativism, it appears that idealism and relativism coupled with age predicts a significant amount of variation in attitudes toward animals, indicating that middle-aged absolutists and situationists are likely to express a greater concern for animals.

3.4.3 Religion and pet ownership

In contrast to some recent studies, which reported that religion was not a significant predictor of public attitudes toward animals (and animal products) (Izmirli & Phillips 2011, Phillips, et al. 2012), our results demonstrate a significant negative correlation between Christianity as a source of inspiration and attitudes toward animals. Specifically, respondents who reported that inspiration source was Christianity showed less concern for animals than those who reported otherwise. This finding is partly in line with a previous study reporting negative correlations between concern for animal welfare and Christianity (Menache 1997). Our results also demonstrate that respondents who owned a dog as their companion animal showed more concern for animal welfare. This result parallels a recent study by Martens, et al. (2016), which demonstrated a strong attachment between companion dogs and their owners, suggesting that pet (in particular dog) ownership is an important predictor of public attitudes toward animals.

3.5 Conclusion and implications

The present study, as well as previous studies conducted in the United States, found that relativism is not associated with public attitudes toward animals, suggesting that views about whether universal moral principles exist or not do not influence Dutch and American people's attitudes toward animals. However, these findings are in contrast with a recent survey in China showing that relativism is negatively associated with public attitudes toward animals. We assume that this difference may relate to the generally greater awareness of animal welfare in developed countries against the poorer awareness in developing countries. These results also reveal that people from developing countries show more tolerant attitudes toward animal use than people from developed countries. Additionally, our research also confirmed that public attitudes toward animals were positively associated with idealism in both developed and developing countries (Galvin & Herzog 1992a, Nickell & Herzog 1996, Su & Martens 2017). This finding implies that individuals who think their ethical behavior will always lead to positive consequences generally show greater concern for animals.

In addition to idealism and relativism, we also found significant correlations between public attitudes toward animals and demographics (gender and age), with gender showing a stronger correlation (Galvin & Herzog 1992a, Herzog, et al. 2015, Herzog 2007, Herzog Jr, et al. 1991). This finding is inconsistent with a previous finding from China showing that the relationship between human demographics and attitudes toward animals was significant for age but not for gender (Su & Martens 2017). Here we have shown, by comparing attitudes toward animals among individuals from different countries, that idealism and age may be universally correlated with attitudes toward animals, while relativism and gender may not. We therefore predict that an understanding of individual ethical ideologies and their interaction with human demographics, from cultural and social perspectives, is vital to improving people's awareness of animal welfare in different countries.

Chapter 4

How ethical ideologies relate to public attitudes toward animals: The Japanese case

“You can judge a man's true character by the way he treats his fellow animals.”

Paul McCartney

Abstract

How ethical ideologies relate to public attitudes toward nonhuman animals is an increasingly prominent topic, yet it has been largely unstudied, particularly in Asian countries such as Japan. Using the “Ethics Position Questionnaire” (EPQ), “Animal Attitude Scale” (AAS) and “Animal Issue Scale” (AIS) in the present study, we examined how ethical ideologies and human demographics relate to public attitudes toward animals from a Japanese cultural perspective. The results of a questionnaire ($N = 900$) distributed throughout Japan indicate that public attitudes toward animals were positively associated with idealism and negatively associated with relativism. These findings are similar to those from China, but partly in contrast with those from the United States, where relativism was unrelated to attitudes toward animals. Our findings add to a growing recognition of how individual philosophy relates to public attitudes toward animals in Asian countries.

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4.1 Introduction

The Ethics Position Questionnaire (EPQ), developed by Forsyth (1980), measures individual ethical ideology. The EPQ is based on an individual's attitude toward ethics in relation to idealism and relativism (Wiid, et al. 2014). Idealism refers to the extent to which one considers that ethical behavior will lead only to positive results, while relativism refers to the degree to which individuals do not base their personal moral philosophies on universal ethical rules (Forsyth 1980, MacNab, et al. 2011). To date, a considerable number of investigators have used the EPQ to better understand the mysteriousness of idealism and relativism in terms of business-related ethical issues, such as ethical decision making (Barnett, et al. 1994, Ramasamy & Yeung 2013), consumer ethics and markets (Al-Khatib, et al. 2005, Erffmeyer, et al. 1999), as well as management control systems (Douglas & Wier 2005). As an important complementary perspective, ethical ideology was also used in the field of human-nonhuman animal relationships. There are some researchers who have investigated the role of idealism and relativism regarding public attitudes toward animals and animal research in the United States (mainly conducted in universities) (Galvin & Herzog 1992a, Gavin & Herzog 1992b) and China (Su & Martens 2017). Results from these studies demonstrate that support for animal rights and opposition to research on animals were positively associated with idealism in both countries. However, relativism was negatively related to Chinese people's attitudes toward animals, but was not related to American university students' attitudes toward animals in the southern United States (with the exception of Wuensch & Poteat's study showing a negative correlation between relativism and support for animal rights). Therefore, the question of how ethical ideologies, particularly ethical relativism, relate to attitudes toward animals in different countries needs to be answered.

A previous study showed that the relationship between ethical relativism and attitudes toward animals may differ between developed and developing countries (Su & Martens 2017). However, we suppose, besides the different levels of development, other variables including the cultural difference, society condition, geographical location, human demographics, and people's awareness of animal welfare may also influence the correlation between ethical ideology and attitudes toward animals in different countries. Yet investigations on such correlations and their influential factors from a cross-cultural perspective are still lacking, although there is a growing need for such research because of people's increasing awareness of animal welfare. In the present study, we selected Japan, a developed Asian country, because its development conditions are similar to those of Western countries such as the United States, but its culture is perceived as similar to those in other Eastern countries such as China (De Visser 2008, Kim 2009, Phillips & McCulloch 2005, Weber & Gerth 1953).

The Japanese ethical ideology is largely influenced by its culture of Confucianism, Buddhism and traditional Shintoism. Confucianism and Buddhism also

influence Chinese people's ethical social values. Confucian and Buddhist values advocate harmony, humility and magnanimous behavior (Tan & Chee 2005), which are different than Western values that highlight human rights and freedom (Chung, et al. 2008). However, sacrificing animals in religious rituals to pray for a good harvest is a Chinese and Japanese tradition (Blakeley 2003, Kondo & Sato 1999). Therefore, it is plausible that Chinese and Japanese people's attitudes toward animals are more likely to be based on the specific benefits that can be derived from using animals. Collectivism also plays a significant role in influencing Japanese, as well as Chinese people's ethical and social values. Japanese and Chinese people's mentality, including their attitudes toward animals, is holistic. They focus attention on the situation in which animals are used and ascribing causality by reference to the relationship between animals and their situation. While Western mentality about attitudes toward animals is analytic, focusing attention on animals themselves and ascribing causality based on rules about it (Norenzayan & Nisbett 2000). Therefore, the fundamental attribution error is much harder to demonstrate with Japanese and Chinese people than with Western populations (Choi, et al. 1999, Norenzayan & Nisbett 2000). Compared to Chinese and Japanese people, American people are more individualistic, and their attitudes toward animals are more likely to have been formed by concern for animal well-being, rather than being based on the cost-benefit analysis (Wuensch, et al. 2002). Hence, we hypothesized that the correlation between relativism and attitudes toward animals would be stronger in Japan and China than in the United States. Considering that the absolute nature of idealistic individuals' moral principles always has crucial implications for their concern for others, including animals (Park 2005), we assumed that idealism may be positively related to people's concern for animal welfare in different countries.

Due to the commonly reported behavior of whaling, Japan is sometimes criticized by their Western counterparts (Davey 2006, Hirata 2005). Additionally, Japanese people are used to distinguishing private and public relationships. They often show strong attachment to companion animals, but not to wild animals or laboratory animals. Therefore, identifying Japanese people's authentic attitudes toward animals and the potential predictors such as human demographic, traditional culture, as well as individual ethical perspective, is of interest to help understand animal welfare in Japan. The purpose of the present study was to investigate how ethical ideologies and human demographics relate to public attitudes toward animals from a Japanese cultural perspective. We also aimed to find out whether the correlation between ethical ideologies and attitudes toward animals is the same between Japan and other Western countries and to what extent the culture, social condition and awareness of animal welfare influence these correlations. Human demographic (sex and age), religion, companion animal ownership and meat consumption have been demonstrated to be important factors in attitudes toward animals (Kenyon & Barker 1998, Loughnan, et al. 2010, Povey, et al. 2001). In order to verify the reliability of these reports, we examined whether such variables also relate to attitudes toward animals among Japanese people.

4.2 Materials and Methods

4.2.1 Participants

Data were collected by an online questionnaire in 2016 in Japan. The online questionnaire was conducted via Rakuten Research, one of the biggest research companies in Japan, by means of simple random sampling (Tillé 2006). A total of 900 participants (male: 49.6%, female: 50.4%) were obtained throughout Japan. These participants are representative of the Japanese population aged 20 years or older with respect to sex and age. Participants' demographic information is presented in table 4.1.

4.2.2 Materials

Using the Human-Animal Interactions Questionnaire, we wanted to investigate how ethical ideology and human demographics are related to Japanese people's attitudes toward animals, as well as whether these correlations are influenced by culture and social conditions. Utilizing a standard translation/back-translation procedure, the English version of the questionnaire was translated into Japanese, and two Japanese-speaking researchers who had not seen the English version translated it back into English, independently. The translated versions of the questionnaire were thoroughly tested in order to assure comprehensibility and equivalence. The final re-translated version was also compared with the original wordings, to confirm the accuracy and the quality of the English translation. The comparison of the original and the re-translated version of the questionnaire did not yield major differences.

The questionnaire consisted of four sections. In the first section, participants provided demographic and personal information: sex, age, organization participation (animal protection, natural conservation and human health), composition of household, attitudes to religion, their main source of spiritual inspiration, their meat consumption, and whether or not they owned companion animals and, if so, which ones.

In the second section, the "Ethics Position Questionnaire" (EPQ) (Forsyth 1980), which includes an ethical idealism subscale (10 items) and ethical relativism subscale (10 items), was designed to measure participants' idealism and relativism, respectively. Cronbach's alpha was 0.910 for the idealism scale and 0.890 for the relativism scale in this study. Typical items of idealism include "The existence of potential harm to others is always wrong, irrespective of the benefits to be gained" and "If an action could harm an innocent other, then it should not be done". Typical items of relativism include "There are no ethical principles that are so important that they should be a part of any code of ethics" and "Whether a lie is judged to be moral or immoral depends on the circumstances surrounding the action". Participants were asked to indicate their agreement or disagreement with each item using a nine-point Likert format ranging from 1 (completely disagree) to 9 (completely agree). A higher

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Table 4. 1 Basic information of respondents

	N	%
Sex		
Male	446	49.6
Female	454	50.4
Age		
20-29years	61	6.8
30-39 years	262	29.1
40-49 years	312	34.7
50-59 years	157	17.4
60 years and older	108	12.0
Organization participation		
Improving the welfare of animals	38	4.2
Conservation of the natural environment	58	6.4
Improving human rights or health	61	6.8
Attitudes to religion		
Important	114	12.7
Unimportant	786	87.3
Main source of inspiration		
Buddhism	75	8.3
Judaism	1	0.1
Islam	4	0.4
Christianity	20	2.2
Taoism	2	0.2
Shintoism	23	2.6
Companion animal ownership		
Yes	248	27.6
No	652	72.4
Companion animal species		
Cat	75	8.3
Dog	135	15.0
Fish	48	5.3
Birds	24	2.7
Reptiles	14	1.6
Rodents	9	1.0
Meat eating frequency		
Never	14	1.6
Once a week or less	65	7.2
2-3 days a week	297	33.0
4-6 days a week	349	38.8
Every day	175	19.4

Note: N = 900.

score on the idealism subscale indicates a greater belief that ethical behavior always leads to good results, while a higher score on the relativism subscale indicates a greater belief that moral decisions should be based on specific conditions rather than universal principles (Galvin & Herzog 1992a).

The “Animal Attitude Scale” (AAS) (Herzog, et al. 1991), a commonly used

measure of attitudes toward animals, was introduced in the third section of the questionnaire. Cronbach's alpha for the AAS in the present study was 0.833. The AAS scale consisted of 20 items scored from 1 (strongly disagree) to 5 (strongly agree), 9 of which are reverse coded. The total score of AAS indicates the extent of participants' attitudes toward animals, and a higher score means a greater concern for animal welfare.

In the fourth section, the "Animal Issue Scale" (AIS) (Meng 2009), a 43-item instrument, was used to further measure individuals' attitudes toward animals. Cronbach's alpha for the AIS in the present study was 0.952. The 43 items were originally based on the major human concerns about our use of animals. These are use of animals, disrupting animal integrity, killing animals, compromising animal welfare, experimenting on animals, changing animals' genotypes, harming animals to protect the environment and harming animals for social purposes. Each concern was represented by approximately five questions. The questions were chosen to be of international, not regional concern, and to be mutually exclusive (Izmirli & Phillips 2011, Phillips, et al. 2012). Participants were asked to respond to statements using a five-point scale ranging from 1 (extremely acceptable) to 5 (extremely unacceptable). A higher score on AIS indicates a greater concern for animal welfare.

4.2.3 Procedure

900 responses were obtained from 1087 people among a panel which included 14,197 people throughout Japan who had provided their e-mail addresses to Rakuten Research, and received our invitation email with the hyperlink to our questionnaire. Participants were asked to visit the website of our questionnaire and click "submit" when they completed all the questions. In the questionnaire, we explained the purpose of our study (to know how people treat and interact with animals in their direct environment) to the participants and stated that all information they provided would be kept completely confidential, and that personal information would not be released to or viewed by anyone other than the researchers involved in this project. If they were interested in our research, they could start to fill in the questionnaire. Otherwise, they could reject or ignore our invitation. By filling in our questionnaire, participants could get some Rakuten Super Points as a reward.

4.2.4 Statistical analysis

Data were analyzed with SPSS 24 statistical software. Data were either normally distributed or converted to a normal distribution by log10 transformation, and the Levene test showed homogeneity of variances. A simultaneous multiple regression analysis was performed to predict Japanese people's attitudes toward animals in relation to idealism, relativism, sex, pet ownership, cat ownership and meat eating

frequency. An alpha value of .05 was used for variables to be entered into the models. All the non-explanatory variables were removed automatically from the results (McDonald 2009).

4.3 Results

4.3.1 The scores of AAS and AIS

The average score of AAS in the present study was 59.51 ($SD = 8.11$) out of 100, and the average score of AIS was 150.31 ($SD = 24.50$) out of 215. Female participants showed higher scores on both AAS and AIS than their male equivalents (both $p < .001$). We did not find any significant differences across different age groups of participants regarding either AAS score or AIS score (Table 4.2).

Table 4. 2 The scores of the Animal Attitude Scale (AAS) and Animal Issue Scale (AIS)

	Sex (M±SD)		t	p	d	Age (M±SD)					F	p	η ²
	Female	Male				20-29 years	30-39 years	40-49 years	50-59 years	60 years and older			
AAS	61.62±7.86	57.37±7.80	-8.16	<.001	0.54	58.80±8.87	59.73±8.10	59.88±7.43	58.58±8.84	59.69±8.47	0.86	=.489	0.00
AIS	156.01±22.99	144.51±24.65	-7.24	<.001	0.48	146.82±27.95	150.70±24.33	152.09±23.84	148.08±25.48	149.44±23.15	1.10	=.357	0.01

Note: $df = 898$

4.3.2 EPQ

Participants' average score for idealism was 6.29 ($SD = 1.17$), while their average score for relativism was 5.56 ($SD = 1.02$). The score of female participants' idealism was higher than that of male participants ($p < .001$), but there were no significant sex differences in relativism. The idealism score of participants who were 20 to 29 years old was lower than those who were 30 years or older ($p < .001$), while the relativism score of participants who were 30 to 39 years old was higher than those who were 60 years or older ($p < .001$) (See Figure 4.1). Our results also showed that participants' idealism scores were positively related to their relativism scores ($r = 0.357, p < .001$).

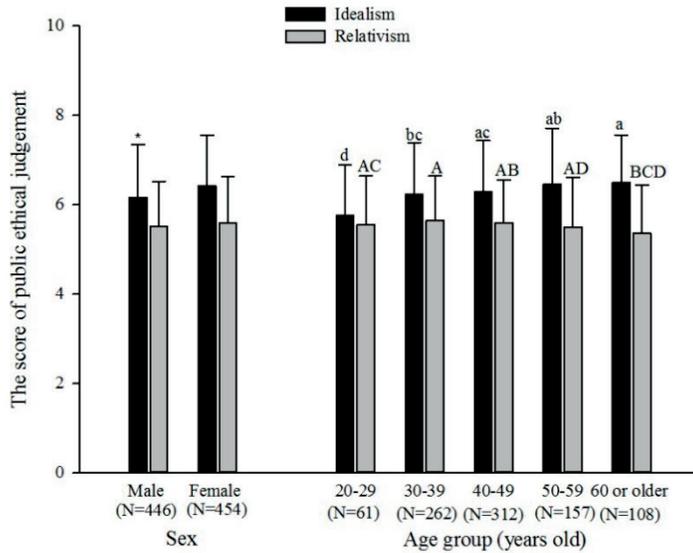


Figure 4. 1 The score of Japanese public ethical judgement

Note: An asterisk indicates significant difference between male and female respondents in idealism; a, b, c and d indicate significant difference amongst age groups of respondents in idealism scale; A, B, C and D indicate significant difference amongst age groups of respondents in relativism scale.

4.3.3 Predictors of AAS and AIS scores

Human demographics and ethical ideologies

There was a significant correlation between sex and attitudes toward animals. We did not find any significant correlations between age and participants' attitudes toward animals. Results showed that both idealism and relativism were significantly associated with participants' attitudes toward animals. Participants with higher idealism scores showed greater concern for animal welfare. However, participants with higher relativism scores showed less concern for animal welfare (Table 4.3, 4.4).

Other predictors of AAS and AIS scores

According to the multiple regression analysis, the scores of the AAS were also related to several other variables, including companion animal ownership, the companion animal species owned, and meat eating frequency. Companion animal guardians had a higher AAS score than non-guardians. Participants who owned a cat showed a higher AAS score than those who did not. Additionally, participants who never ate meat or only ate once a week scored higher than participants who ate meat two days a week or more (Table 4.3).

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Based on the relationship between participants' AIS scores and the possible predictors, we found that the AIS score of companion animal guardians was higher than non-guardians. The meat eating frequency was also associated with participants AIS score. The average AIS score was higher for participants who never ate meat or only ate once a week, than for participants who often ate meat (Table 4.4).

Table 4. 3 Predictors of scores on the Animal Attitude Scale (AAS) in Japan

Y: The attitudes toward animals (<i>df</i> = 899)	Unstandardized	Standardized	Zero-order	<i>t</i>	<i>p</i>
	Coefficients	Coefficients			
	<i>B</i>	Beta			
(Constant)	61.45			23.25	< .001
X ₁ : Ethical idealism	1.05	0.15	0.132**	4.61	< .001
X ₂ : Ethical relativism	-1.16	-0.15	-0.086**	-4.46	< .001
X ₃ : Sex: male (1) – female (2)	3.64	0.23	0.263**	7.29	< .001
X ₄ : Pet ownership: no (0) – yes (1)	1.54	0.09	0.194**	2.43	= .015
X ₅ : Cat ownership: no (0) – yes (1)	5.70	0.20	0.263**	5.54	< .001
X ₆ : Meat eating frequency: once a week or never (1) – 2 days a week or more (2)	-2.81	-0.10	-0.176**	-3.20	= .001

Note: Unstandardized and standardized coefficients refer to the partial effect of one predictor after adjusting for the others. $R^2 = 0.169$, Adj. $R^2 = 0.163$. Zero-order correlation test: ** $p < .01$.

Table 4. 4 Predictors of scores on the Animal Issue Scale (AIS) in Japan

Y: The attitudes toward animals (<i>df</i> = 899)	Unstandardized	Standardized	Zero-order	<i>t</i>	<i>p</i>
	Coefficients	Coefficients			
	<i>B</i>	Beta			
(Constant)	137.92			16.80	< .001
X ₁ : Ethical idealism	4.58	0.20	0.218**	6.49	< .001
X ₂ : Ethical relativism	-1.65	-0.07	0.011	-2.04	= .042
X ₃ : Sex: male (1) – female(2)	9.85	0.20	0.235**	6.34	< .001
X ₄ : Pet ownership: no (0) – yes (1)	5.38	0.10	0.141**	2.73	= .007
X ₅ : Cat ownership: no (0) – yes (1)	5.07	0.06	0.136**	1.58	= .114
X ₆ : Meat eating frequency: once a week or never (1) – 2 days a week or more (2)	-6.93	-0.08	-0.146**	-2.54	= .011

Note: Unstandardized and standardized coefficients refer to the partial effect of one predictor after adjusting for the others. $R^2 = 0.122$, Adj. $R^2 = 0.116$. Zero-order correlation test: ** $p < .01$.

4.4 Discussion

This study investigated how individual ethical ideology and human demographics relate to public attitudes toward animals in Japan. Results showed that individual differences in idealism and relativism were significantly linked to attitudes toward animals. More specifically, the more that individuals endorsed their ethical behavior will lead to positive results, the more they appreciated animals; while the more that individuals emphasized their moral decisions should be based on situational analysis, the more they depreciated animals. This finding confirms a previous Chinese study reporting that public attitudes toward animals were positively related to idealism, and negatively related to relativism (Su & Martens 2017). However, some previous studies of the correlation between ethical ideologies and American university students' attitudes toward animals have yielded a positive relationship with idealism, but no relationship with relativism (Galvin & Herzog 1992a, Gavin & Herzog 1992b, Nickell & Herzog 1996). Considering that Asian people are more collectivistic and not concerned with foundations or universal laws, while Western populations are more individualistic and concerned with universal rules when explaining events (Norenzayan & Nisbett 2000, Takano & Osaka 1999), we think the correlation between relativism and attitudes toward animals is different between Western and Asian countries.

4.4.1 Human demographics

In this study, we found that sex emerged as a statistically significant factor in relation to participants' attitudes toward animals, which parallels previous research conducted in Western countries showing that attitudes toward animals were more positive among women than men (Bowd & Bowd 1989, Furnham, et al. 2003, Herzog 2007, Martens, et al. 2016, Walker, et al. 2014). These various findings collectively offer some additional insight regarding men's relatively low awareness of animal welfare and poor record of the concern for animal welfare. Compared to men, Japanese women are more other-centered and spend more time at home with their children (Grossman 1998, Triandis, et al. 1995). Therefore, women tend to use similar ways of treating their children to treat their companion animals (Erlanger & Tsytzarev 2012). We did not find any correlation between age and attitudes toward animals in Japan. This finding is inconsistent with previous findings from China, in which the young participants showed greater concern for animals than middle-aged and older ones (Su & Martens 2017). One possible explanation is that the concept of animal welfare was accepted by Japanese people in 1970s, and continues to influence people's attitudes toward animals in contemporary Japan (Bayne, et al. 2015, Niggli 2007). It may be that, as a result, different age groups of participants developed a similar awareness of animal welfare and animal rights in Japan. However, animal welfare as a new phenomenon in China has attracted the

attention of the younger generations, as a result of which they are more aware of it and express greater concern for it (Littlefair 2006).

4.4.2 Ethical ideology

Our results indicate that the correlation between relativism and attitudes toward animals is the same in Japan and China, but different between Japan and the United States, although both Japan and the United States are developed countries. We consider the cultural influence, geographical location, as well as people's awareness of animal welfare, might be the key drivers of the relationship between relativism and public attitudes toward animals in different countries.

Confucianism, a representative of the traditional culture and prevailing philosophy of many Asian countries, influences both Chinese and Japanese social values, including public attitudes toward animals. In Confucianism, humans are regarded as the lord of creation and animals can be sacrificed for the survival of human beings (Blakeley 2003, Kondo & Sato 1999). Japanese and Chinese people are more collectivistic than Western population. They understand behavior in terms of complex interactions between dispositions of the object and contextual factors, whereas Western people often neglect the situational constraints and view behavior primarily as the direct unfolding of dispositions. Therefore, it is plausible that Chinese and Japanese people may think their attitudes toward animals (e.g., killing animals) should be based on situational analysis, which explains the influence of relativism on attitudes toward animals in these two countries. In addition to Confucianism, Buddhism and traditional Shintoism also contribute to Japanese social values. The doctrines of Buddhism and Shintoism highlight the reciprocal care and compassion relationships between humans and animals (Kagawa-Fox 2010, Kondo & Sato 1999). However, Japanese people relate to animals emotionally and with little knowledge about animal characteristics, which directly leads to their lower awareness of animal welfare (Miura, et al. 2000). The limited scientific knowledge about animal issues in Japan and China also result in their lower awareness of animal welfare, compared to their Western counterparts (Davey 2006, Kellert 1991). Therefore, considering the values of animal welfare, Chinese and Japanese people's attitudes toward animals might be more depending on their evaluation of benefits, cost and possible risks that animals bring to humans and society. Notably, the import of Western culture did contribute to Japanese society, including people's awareness of animal welfare. However, Western cultural values are not exhibited in the correlation between ethical relativism and attitudes toward animals in the present study.

Further analysis reveals that the higher the score of idealism, the greater the concern for animal welfare; while the lower the score of relativism, the higher the concern for animal welfare. These findings imply that the combination of the belief that one should apply universal moral principles and the belief that moral behaviors will lead

to perfect achievements promotes the great concern for animal welfare (Su & Martens 2017).

4.4.3 Other predictors of public attitudes toward animals

Our finding reveals that companion animal ownership (particularly cat ownership) was a significant predictor of attitudes toward animals, although companion animal ownership in Japan (34.3%) was lower than that in the United States (68.0%). This finding explains a previous study by Miura, et al. (2002), who suggested that attitudes toward animals among the Japanese public largely focused on companion animals. Similar findings were also reported by Kagawa-Fox (2010), who demonstrated that Japanese companion animal guardians showed a strong attachment to their animals. In accordance with a previous study conducted in the UK reporting that meat consumption is morally troublesome as it violates concerns for animal welfare (Loughnan, et al. 2010), our result demonstrates that respondents who never eat meat or only eat once a week showed more concern for animal welfare than respondents who often eat meat. Concern about the treatment of animals might be the reason that participants ate less meat (Loughnan, et al. 2010, Stockburger, et al. 2009).

4.5 Conclusion

Understanding the correlation between individual ethical ideology and attitudes toward animals is vital for improving people's awareness of animal welfare and sustainable human-animal relationships. The current study provides evidence that Japanese people's attitudes toward animals were positively associated with idealism and negatively associated with relativism. Further, it provides evidence that sex was related to respondents' attitudes toward animals. The correlation between idealism and attitudes toward animals parallels previous studies in China and in the United States (Su & Martens 2017, Wuensch & Poteat 1998). Considering that idealistic individuals are concerned about others' welfare and believe in the absolute value of moral standards based on their unselfish concern for others (Park 2005), it is not surprising that greater concern for animal welfare has always gone together with a higher level of idealism. Yet findings in relation to relativism differed between Asian and Western countries, in that in both Japan and China relativism was negatively related to animal welfare attitudes, whereas in the United States, relativism was unrelated to university students' attitudes toward animals (Nickell & Herzog 1996). We assume these different findings may be related to the different culture and different awareness of animal welfare between Asian and Western countries (e.g., the United States). Japanese and Chinese people do respect animals, yet it appears that animals are assumed to have value because they are resources to satisfy human needs (Blakeley 2003). Therefore, Chinese and Japanese people are considered to be more collectivistic, focusing attention on the contextual

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factors when explaining their attitudes toward animals. However, in the United States, the existence of animals might be regarded as more valuable than the benefits that they bring. As a result, the correlation between relativism and attitudes toward animals can be ignored. Given that the available studies in the United States were conducted in the universities, which could not fully represent the general American people, further studies with general respondents in the United States or other Western countries are therefore needed to confirm and clarify the relationship between ethical ideologies and attitudes toward animals.

PART II

The Emotional Relationship Between
Companion Animals and Owners

Chapter 5

How Chinese companion animal caretakers' attachment influences their attribution of emotions to their animals

“When animals express their feelings they pour out like water from a spout. Animals' emotions are raw, unfiltered, and uncontrolled. Their joy is the purest and most contagious of joys and their grief the deepest and most devastating. Their passions bring us to our knees in delight and sorrow.”

Marc Bekoff, 2008

"If having a soul means being able to feel love and loyalty and gratitude, then animals are better off than a lot of humans."

James Herriot, 1998

Abstract

It is well documented that in developed countries, companion animal caretakers often show strong attachments to their animals. However, very little research has incorporated caretakers' attachment to companion animals in developing countries such as China. This research analyzed the correlation between the attachment level of Chinese dog and cat caretakers and their attribution of emotions to their animals. The results indicate a trend that respondents frequently attributed primary emotions to companion animals rather than secondary emotions. Respondents who had frequent and multiple interactions with their companion animals scored higher on the “Pet Bonding Scale” (PBS). The degree of attachment significantly influenced caretakers' (particularly female caretakers) attribution of responsive emotions to companion animals. This study is one of the first to investigate the role of attachment in emotion attribution in an under-researched population and can therefore act as a baseline for follow-up research.

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5.1 Introduction

A better understanding of nonhuman animal emotion is highly desirable in the disciplines of animal welfare science and evolutionary psychology (Waller & Micheletta 2013). Previous literature has suggested that emotions can be classified into primary and secondary ones (Becker-Asano & Wachsmuth 2010, Marg 1995). Primary emotions are supposed to be innate and elicited as an immediate response to a stimulus (Becker-Asano & Wachsmuth 2010), while secondary emotions are the product of cognitive processing (Becker & Wachsmuth 2006). A characteristic of primary emotions (e.g., fear, anger, joy, sadness, surprise and disgust) is that they can be perceived across a wide range of animal species according to their facial displays and muscle movements (Darwin 1965). In contrast, secondary emotions (e.g., shame, jealousy, disappointment and compassion) are generally restricted to relatively mature humans and perhaps other primates (Morris, et al. 2008, Preston & De Waal 2002).

Over the past few decades, a growing number of studies have been conducted in developed countries on people's attribution of emotions to animals and people's attitudes toward animals (Anderson 2007, Martens, et al. 2016, Walker, et al. 2014, Walsh 2009). However, studies into people's degree of attachment and their attribution of emotions to animals in countries such as China remain in the initial stages of development. In Chinese culture, particularly in Confucianism, animals have been respected as an essential part of human society since they are the main source of food, clothes and health care for the majority of population. Animal cruelty - such as suffering, deprivation or killing of animals - is regarded as morally problematic (Blakeley 2003). However, in Chinese traditions, animals also play a key role in formal ritual activities and divination. For example, suckling pigs have been used as gifts to express gratitude and respect to the spirits of mountains and rivers (Blakeley 2003). Therefore, animals can be sacrificed for human beings, although Confucianism theories highlight the importance of animal protection. Daoism, a native folk religion in China, advocates morals and universal love. In their doctrines, humans are encouraged to learn from nonhuman animals (Li & Davey 2013). Moreover, humans should protect animals as animals have the same feelings as humans. This probably reflects earlier recognitions of animal emotion in China. Additionally, as one of the most important religions in China, Buddhism emphasizes the equality of all living creatures, including humans and nonhuman animals (Barber 2015, Li & Davey 2013). It is therefore plausible that people's attitudes toward animals might be positive in traditional China (Walsh 2009).

However, as a result of the collapse of economy, animal welfare has been overlooked during the early forty years of the new China. This situation was unfortunate because animal welfare standards in China were much lower than those of their Western counterparts (Davey 2006). Therefore, animal cruelty in China has been commonly reported, which even led to worldwide criticisms. In 1988, wildlife protection

law of the People's Republic of China was enacted, which represented a positive step toward animal protection and animal welfare, although until very recently, "animal welfare" has been a wholly novel concept to most of the Chinese people (D'Silva & Turner 2012). Notably, the Chinese booming economy and the rising societal awareness of human rights, in recent years, have begun to stimulate people's consideration of animal rights and welfare. However, awareness of animal emotions and human-animal attachment in China appears to be less common than that in Western countries. In this paper, we examine people's attributions of emotions and their feelings of attachment to animals in contemporary China.

Research into human-animal relationships has demonstrated that companion animal caretakers are more likely to believe in the existence of emotional experiences in their animals than non-caretakers (Walker, et al. 2014). Companion animal caretakers often attribute more complex emotions to their dogs, while attributing more basic emotions to cats (Darwin 1965, Martens, et al. 2016). Animals' age negatively influences the mutual emotional interactions between companion animals and caretakers, because old animals' lower quality of life often leads to diminished emotional bonds (Marinelli, et al. 2007). Human demographics, such as gender and age, were also considered as influential factors for the attribution of emotions to animals. For instance, women generally have higher levels of belief in the mental abilities of animals than men (Knight, et al. 2003), while younger people more frequently attribute some emotions (e.g., anger, fear) to their companion animals than older people (Martens, et al. 2016). These studies reveal that companion animal ownership, animal species, demographics of humans and animals can influence the attribution of emotions in developed countries. However, very little research analyzed how people's degree of attachment influences their attribution of emotions to animals (Marinelli, et al. 2007, Martens, et al. 2016). These studies were conducted in developed countries where people already have extensive awareness of animal welfare. We question whether a low degree of attachment as well as limited attribution of emotions would be present in a country where the awareness of animal welfare is poor. We selected China to be representative of such a country because public awareness to animal welfare is supposed to be low (Davey 2006, Li & Davey 2013).

This research aimed at investigating the Chinese companion animal caretakers' attribution of their animals' emotions, as well as how their degree of attachment (measured by the "Pet Bonding Scale") might correlate with their attribution of emotions to their companion cats or dogs. We also explored the knowledge of demographic variables (both human and animals) that underpin companion animal caretakers' attribution of emotions to their animals in contemporary China, as diverse factors influence people's attachment to their animals in developed countries (Martens, et al. 2016, Walsh 2009, Woodward & Bauer 2007).

5.2 Methods

5.2.1 Participants

We conducted an online survey amongst a group of Chinese dog and/or cat caretakers from 557 people among a sampling frame of 3006 people throughout the mainland of China in July 2015 by means of cluster sampling. Cluster sampling, a viable sampling design for collecting reference data, is often used when heterogeneous groupings are evident in a statistical population (Stehman 1997). In order to keep the answers consistent, we asked respondents to report about only one dog or cat, even if they owned several. For those caretakers owning more than one companion animal, we required their responses to be based on the companion animal they had owned the longest (as did Martens, et al. 2016). In total, 503 completed surveys were received. Respondents' basic information was reflected in table 5.1.

Table 5. 1 The basic information of respondents

	N (%)
Animal species	Dog = 373 (74.2); Cat = 130 (25.8).
Gender	Male = 240 (47.7); Female = 263 (52.3).
Age (M = 38.6, SD = 11.5)	18-29 years = 118 (23.5); 30-39 years = 164 (32.6); 40-49 years = 116 (23.1); 50-59 years = 80 (15.9); 60 years and older = 25 (5.0).
Organization participation	Improving the welfare of animals = 259 (51.5); Conservation of the natural environment = 351 (69.8); Improving human rights or health = 252 (50.1).
Household composition	Single without children = 93 (18.5), Single with children = 8 (1.65), Couple without children = 38 (7.6), Couple with children = 360 (71.65).
Existence of a private garden	Yes = 187 (37.2); No = 316 (62.8).
Attitudes to religion	Important = 223 (44.3); Unimportant = 226 (44.9); No answer = 54 (10.7).
The main source of inspiration	Christianity = 69 (30.9); Judaism = 2 (0.9); Islam = 7 (3.1); Buddhism = 155 (69.5); Taoism = 36 (16.1); Other = 2 (0.9).
Household income per month (RMB¥)	< 1700 = 2 (0.4), 1700-3900 = 16 (3.2), 3900-8300 = 95 (18.9), 8300-16600 = 238 (47.3), > 16600 = 148 (29.4).

Note: The income classification was calculated by integrating the income in both rural and urban areas in China, data were from National Statistics Bureau in PRC (<http://www.stats.gov.cn/>) in 2014.

5.2.2 Materials

Using The Emotions of Pets Questionnaire (Martens, et al. 2016), we wanted to reveal any correlation between Chinese companion animal caretakers' attribution of emotions and their degree of attachment to their animals. Notably, the use of the term "attachment" to companion animals is a debatable issue (Kobak 2009), but in this paper, the "attachment" (measured and established by PBS score) means the emotional bonds between companion animals and their caretakers.

Respondents were asked to supply their basic information (e.g., age, gender,

household composition, household income), the information about their companion animals' basic characteristics (e.g., species, breed, gender, size, age), as well as their husbandry practices (e.g., How often and how much do you feed your dog or cat?; Where does your dog/cat sleep?; Who is taking care of your dog/cat when you are not around?).

The Pet Bonding Scale (PBS, Cronbach's alpha = 0.949) (Angle, et al. 1994), which includes 25 questions, was used to assess a caretaker's degree of attachment to their companion animal. Respondents were asked to respond to statements using the five-point PBS ranging from 0 (strongly disagree) to 4 (strongly agree). The sum of PBS scores indicates the level of caretakers' attachment to their companion animals, whereby a high score reflects strong attachment. Examples of questions include: "My pet understands my feelings"; "I miss my pet when I am not around"; and "My pet has feelings."

Finally, six primary (anger, joy [happiness], fear, surprise, disgust and sadness) and four secondary (shame, jealousy, disappointment, compassion) emotions (Ekman 2003) were presented to the participants. They were asked whether they had witnessed these emotions expressed by their companion animals, and if they thought that these animal emotions had been influenced by their own behavior (responsive emotions). Ratings were made on a 3-point Likert-type scale (1 = never, 2 = sometimes, and 3 = often). The option of "No idea" was treated as missing data.

5.2.3 Statistical analysis

The correlation between respondents' attribution of (responsive) emotions and the degree of attachment to companion animals, were analyzed with SPSS 24 statistical software. Given that the data in this study followed a normal distribution and the Levene test showed homogeneity of variances, a t-test was performed to investigate the differences in total attachment scores between males and females (both animals and caretakers), while a one-way ANOVA was carried out to investigate the differences in total attachment scores across three age groups of animals and five age groups of caretakers. In order to reduce type-I errors due to repeated testing, the Fisher's procedure was employed in the analyses across three groups, and REGWQ correction was applied in the analyses across more than three groups. Pearson correlation analysis was conducted to investigate the correlations of the degree of attachment and the total score of emotion attribution to companion animals, between dog and cat caretakers, as well as male and female caretakers. In order to know the difference between correlations for two groups, Fisher's r-to-z transformation was performed. All results are based on two-tailed tests assuming equal variances; the values of $p < 0.05$ were considered significant. Stepwise linear regression was used to relate the degree of caretaker attachment (measured by PBS) to the following: responses from among different human demographics, forms of mutual interactions between caretakers and

animals, and how respondents take care of their animals. An alpha value of 0.05 was used for forwards and backwards regression of variables. All non-explanatory variables were removed from results in order to determine the optimum model (Martens, et al. 2016, McDonald 2014). Notably, stepwise regression was regarded as problematic because it could result in inappropriate selection of predictors, and this selection procedure might influence the final model (Derksen & Keselman 1992, James & McCulloch 1990). In order to address this problem and simultaneously reduce type-I errors, we only considered predictors appearing in the final model as influential variables (Petraitis, et al. 1996). Additionally, using this method may also increase type-II errors, but given the relative large sample size in the present study, this risk should be reduced (Bradbury, et al. 2000).

5.3 Results

5.3.1 Which emotions did caretakers attribute to their companion animals?

Companion animals were perceived to frequently express the primary emotions of joy and surprise, while they were perceived to rarely express the primary emotions of disgust, sadness, and secondary emotions of shame, jealousy and disappointment (Table 5.2). We did not find any significant differences between the attribution of emotions for companion dogs and cats (with the exception of anger, which was more frequently attributed to companion dogs than cats).

Table 5. 2 Attribution of emotions to companion animals

1=never; 2=sometimes; 3=often	Mean	SD
Anger	1.87	0.57
Joy	2.87	0.40
Sadness	1.59	0.75
Disgust	1.49	0.79
Fear	1.90	0.64
Surprise	2.09	0.80
Shame	1.54	0.88
Jealousy	1.58	0.88
Disappointment	1.59	0.84
Compassion	1.81	0.99

5.3.2 Does gender or age of companion animals influence the attribution of emotions?

Respondents who owned a male dog, compared to those owning a female, were more likely to attribute surprise (for male dogs $M = 2.17$, $SD = 0.72$; for female dogs $M = 1.94$, $SD = 0.92$; $t(371) = 2.68$, $p = 0.01$, $d = 0.28$) and compassion (for male dogs $M = 1.90$, $SD = 0.88$; for female dogs $M = 1.64$, $SD = 1.11$; $t(371) = 2.53$, $p = 0.01$, $d = 0.26$) to

their companion animals. No significant differences in emotion attributions by caretakers were found according to either the gender, or age group of companion cats.

5.3.3 Does gender or age of caretakers influence the attribution of emotions to companion animals?

Female respondents were more likely to attribute sadness (for female respondents $M = 1.70$, $SD = 0.70$; for male respondents $M = 1.48$, $SD = 0.79$; $t(501) = 3.25$, $p < 0.01$, $d = 0.30$), jealousy (for female respondents $M = 1.68$, $SD = 0.86$; for male respondents $M = 1.47$, $SD = 0.88$; $t(501) = 2.75$, $p < 0.01$, $d = 0.24$), disappointment (for female respondents $M = 1.67$, $SD = 0.85$; for male respondents $M = 1.51$, $SD = 0.82$; $t(501) = 2.05$, $p = 0.04$, $d = 0.19$) and compassion (for female respondents $M = 1.91$, $SD = 0.96$; for male respondents $M = 1.70$, $SD = 1.02$; $t(501) = 2.37$, $p = 0.02$, $d = 0.21$) to their companion animals than male respondents. Disgust was more frequently attributed by respondents aged 18-49 years (for respondents aged 18-29 years $M = 1.53$, $SD = 0.75$; for respondents aged 30-39 years $M = 1.52$, $SD = 0.73$; for respondents aged 40-49 years $M = 1.53$, $SD = 0.86$) than those aged 60 years and older ($M = 1.00$, $SD = 0.65$, $F(4, 498) = 2.76$, $p = 0.03$, $\eta^2 = 0.02$), whilst disappointment was more commonly attributed by respondents aged 30-59 years (for respondents aged 30-39 years $M = 1.66$, $SD = 0.74$; for respondents aged 40-49 years $M = 1.61$, $SD = 0.87$; for respondents aged 50-59 years $M = 1.68$, $SD = 0.87$) than the 60 years and older group ($M = 1.16$, $SD = 0.85$, $F(4, 498) = 2.51$, $p = 0.04$, $\eta^2 = 0.02$).

5.3.4 Demographic Correlates of the PBS

The average PBS score of all the respondents in this study was 78.25 ($SD = 12.91$) out of 100. Dog caretakers showed a higher attachment to their dogs ($M = 79.22$, $SD = 12.74$) than cat caretakers to their cats ($M = 75.48$, $SD = 13.03$, $t(501) = 2.86$, $p < 0.01$, $d = 0.29$).

Companions of Dogs

We considered 35 possible variables that might influence the PBS score, from the information we collected from dog caretakers (see Table 5.3 for influential variables). According to stepwise multiple regression analysis, the PBS score of respondents who were members of, or had donated to, an organization involved in improving human rights or health was 4.98 points higher than the respondents that did not. Caretakers who had a garden had a PBS score 2.98 points higher than those who did not.

The relationship between PBS scores and how respondents take care of their dogs showed that caretakers who liked watching their dogs had an average of 28.18 more points than those who did not. Respondents who considered their relationship

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with their dogs to be “good” had a PBS score 6.81 points higher, on average, than those who felt they had a bad relationship. The average PBS score of respondents who thought their behavior looked like their dog had 3.94 more points than those who did not. Furthermore, the results also showed that those reporting that their dogs often communicated with them had higher scores than those who thought their dogs never communicated with them, and these differences were based on the different ways of interacting: 5.20 points by barking and 5.99 points by sniffing or recognizing their caretaker’s smell. Caretakers who could tell their dog’s illness by smell averaged 2.67 points higher than those who could not. Finally, the size of dogs was another correlation element influencing caretakers’ attachments to their dogs. Average PBS score was 2.53 points lower for large companion dogs (more than 25kg) than for small dogs (less than 10kg) (Table 5.3).

Table 5. 3 Important variables for the PBS scores of dog caretakers

Y: PBS for dogs (df=171)	Unstandardized Coefficients		Standardized Coefficients	Zero-order coefficients	t	p
	B	Std. Error	Beta			
(Constant)	71.83	10.61			6.77	0.000
X ₁ : Does your pet communicate with you by sniffing/recognizing your smell? no (0) – yes (1)	5.99	1.24	0.29	0.259**	4.82	0.000
X ₂ : Do you like watching your pet? yes (0) – no (1)	-28.18	6.43	-0.26	-0.183**	-4.38	0.000
X ₃ : Do you belong to an organization involved in improving human rights or health? yes (0) – no (1)	-4.98	1.47	-0.20	-0.165**	-3.39	0.001
X ₄ : Does your pet communicate with you by barking? no (0) – yes (1)	5.20	1.16	0.27	0.241**	4.50	0.000
X ₅ : I consider my relationship with my pet to be: bad (1)–good (2)	6.81	1.99	0.21	0.336**	3.42	0.001
X ₆ : Can you tell your pet is ill by its smell? yes (1) – no (2)	-2.67	0.96	-0.16	-0.218**	-2.79	0.006
X ₇ : How big is your dog? Small (1) – large (2)	-2.53	1.00	-0.15	0.074	-2.53	0.012
X ₈ : Do you think your pet behaved like you? no (0) – yes (1)	3.94	1.46	0.16	0.326**	2.70	0.008
X ₉ : Do you have a garden? no (0) – yes (1)	2.98	1.32	0.13	-0.073	2.27	0.025

Note: “Standardized coefficients” refer to the partial effect of one predictor after adjusting for the others. Zero-order correlation test: ** p<.01.

Companions of Cats

Based on the relationships between the degree of attachment to companion cats and how caretakers take care of them, as well as caretakers’ demographics variables (see Table 5.4), we noticed that caregivers who agreed that they looked like their cat in behavior had 19.16 points higher on the PBS score than those who did not.

Respondents who were the main caregiver of companion cats averaged 19.03 points above those who were not the main caregiver of their cats.

Furthermore, respondents who thought that their cats communicated by looking at them averaged 8.36 points higher than those who did not think their cats communicated in this way. The PBS score of respondents who gave their cats more than 50 grams of food each day had 6.97 more points than those who fed less than 50 grams per day. Caretakers who used shelters or kennels to take care of their cats when they were not around scored 7.48 points higher than those who did not. Household composition was another factor that influenced the PBS scores of cat caretakers, such that the score of respondents who were single/couple with children was on average 8.35 points higher compared to respondents who were single/couple without children (Table 5.4).

Table 5. 4 Important variables for the PBS scores of cat caretakers

Y: PBS for cats (df=50)	Unstandardized Coefficients		Standardized Coefficients	Zero-order coefficients	t	p
	B	Std. Error	Beta			
(Constant)	48.11	9.61			4.71	0.000
X ₁ : Do you think your pet behaved like you? no (0) – yes (1)	19.16	2.19	0.71	0.530**	8.50	0.000
X ₂ : Are you the main care-giver of the pet? yes (0) – no (1)	-19.03	4.43	-0.33	-0.331**	-4.25	0.000
X ₃ : Does your pet communicate with you? by looking at you? no (0) – yes (1)	8.36	1.96	0.33	0.257**	4.13	0.000
X ₄ : On average, how many grams of food do you give your cat each day? Less than 50 grams (1) – 50-100 grams or more than 100 grams (2)	6.97	1.88	0.29	0.149	3.43	0.001
X ₅ : How does your household look like? Single/couple without children (0) – single/couple with children (1)	8.35	2.48	0.25	-0.053	2.96	0.002
X ₆ : Who is taking care of your cat when you are not around? – shelter or kennel: yes (1) – no (0)	-7.48	3.02	-0.20	0.141	-2.38	0.017

Note: “Standardized coefficients” refer to the partial effect of one predictor after adjusting for the others. Zero-order correlation test: ** p<.01.

5.3.5 Is there a correlation between the degree of attachment (overall PBS score) and the attribution of emotions to companion animals?

There was a significant correlation between caretakers’ degree of attachment (measured by PBS score) and their attribution of sadness, surprise, shame, jealousy or compassion to companion animals (all *p* < 0.05). Furthermore, our results also indicated significant correlations between the degree of attachment and female caretakers’ attribution of surprise, shame and compassion (all *p* < 0.05). For male caretakers, this correlation was significant for the attribution of sadness, jealousy and compassion (all *p*

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< 0.05). The correlations between dog caretakers' degree of attachment and their recognition of sadness, surprise, shame and compassion in their dogs were found to be significant (all $p < 0.05$), whilst for cat caretakers, this correlation was significant for joy, surprise and compassion (all $p < 0.05$) (see Table 5.5 for correlation coefficients).

Based on the results of Fisher's r -to- z transformation, we found that correlations between the degree of attachment and attributions of emotions did not differ greatly between the male and female caretakers (with the exception of surprise, $p < 0.05$) or between dog and cat caretakers (with the exception of joy, $p < 0.05$).

5.3.6 Is there a correlation between the degree of attachment (overall PBS score) and the attribution of responsive emotions to companion animals?

The overall relationship between caretakers' degree of attachment (measured by PBS score) and the attribution of responsive emotions was statistically significant for anger, joy, surprise, shame, jealousy, disappointment and compassion (all $p < 0.05$). Additionally, significant correlations were also found between caretakers' degree of attachment and the attribution of the responsive emotions of joy, shame, jealousy and compassion to companion cats (all $p < 0.05$). For dogs and their caretakers, this correlation was significant only for the attribution of surprise and compassion (all $p < 0.05$). The relationship between female caretakers' degree of attachment and their attribution of responsive emotions to companion animals was significant for joy, surprise, shame, jealousy and compassion (all $p < 0.05$), whilst this correlation was significant only for anger ($p < 0.05$) in male respondents (see Table 5.5 for correlation coefficients).

Table 5. 5 Correlation coefficients of the PBS score and the attribution of (responsive) emotions to companion animals

	Emotions					Responsive emotions				
	Overall correlation	Female caretakers	Male caretakers	Dog caretakers	Cat caretakers	Overall correlation	Female caretakers	Male caretakers	Dog caretakers	Cat caretakers
Anger	0.04	0.03	0.042	0.01	0.07	0.11*	0.07	0.14*	0.08	0.13
Joy	0.07	0.11	0.025	0.02	0.28**	0.15**	0.16**	0.12	0.09	0.26**
Sadness	0.13**	0.11	0.14*	0.16*	0.03	0.04	0.041	0.01	0.03	0.01
Disgust	0.08	0.04	0.11	0.09	0.01	0.07	0.06	0.08	0.06	0.09
Fear	0.021	0.022	0.005	0.057	-0.055	0.067	0.110	0.009	0.025	0.14
Surprise	0.16**	0.26**	0.05	0.15*	0.18*	0.17**	0.28**	0.06	0.20*	0.09
Shame	0.13**	0.14*	0.12	0.12*	0.15	0.09*	0.15*	0.01	0.04	0.19*
Jealousy	0.11*	0.04	0.16*	0.09	0.14	0.13**	0.15*	0.09	0.08	0.27**
Disappointment	0.06	0.05	0.05	0.05	0.05	0.10*	0.10	0.09	0.08	0.13
Compassion	0.14**	0.14*	0.13*	0.12*	0.23**	0.14**	0.17**	0.09	0.12*	0.18*

Note: Pearson correlation test: ** $p < .01$, * $p < .05$

5.4 Discussion

The aim of this study was to investigate Chinese companion animal caretakers' attribution of their animals' emotions, as well as what influence their degree of attachment has on this emotion attribution. Results indicate that the degree of caretakers' attachment significantly influenced their attribution of some certain (responsive) emotions onto companion animals. This finding is in accordance with previous studies conducted in developed countries (Hare & Woods 2013, Martens, et al. 2016, Rizzolatti, et al. 2001), although the awareness of animal welfare of people in developed countries is higher than that of Chinese people. One possible explanation for this similar result might be that Chinese people's contemporary understanding of animal emotions stems from their philosophical traditions ranging from Taoism to Buddhism, in which animals are regarded as an essential component of nature and generally has the same feeling as humans (Li & Davey 2013).

5.4.1 Emotions Attributed and Species Differences

Our results suggest a trend that respondents frequently attributed primary emotions to companion animals rather than secondary emotions, confirming that primary emotions were more easily attributed by caretakers. This finding parallels the results of an earlier study by Morris, et al. (2008), who proposed that primary emotions were experienced more frequently than secondary emotions amongst companion animals. Our results also reveal that the secondary emotion of compassion was frequently attributed by our respondents, which is inconsistent with earlier findings by Martens, et al. (2016), who reported that respondents commonly attributed the secondary emotion of jealousy to their companion animals. One possible reason is that compassion is often regarded as an essential component of spiritual attitudes, which derives from Chinese cultural traditions of Confucianism and Buddhism (Fam, et al. 2004). It is therefore plausible that caretakers may think their animals can express such emotion. Additionally, in order to decrease the number of stray dogs, only one dog per household was allowed in some cities (e.g., Qingdao) of China. However, many families in developed countries have more than one dog or cat (Grier 2010, Sussman 1985), and jealousy often occurs between two or more animals (Tam & Smith 2014), it is not surprising that jealousy is attributed frequently to companion animals in developed countries.

Our results demonstrate that the gender of companion dogs influenced respondents' attribution of surprise and compassion to their dogs, although the age of companion dogs did not influence respondents' attribution of emotions to their dogs. We found no difference in how caretakers attribute emotions to companion cats, according to cats' gender or age, which is in contrast to a previous study (Marinelli, et al. 2007) showing that animals' age could influence the emotional interactions between

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companion animals and caretakers. Possibly, the lack of evidence for this association in our results might be explained by the lower number of cat caretakers.

5.4.2 The Influence of Caretaker Demographics

Consistent with recently published work by Martens, et al. (2016), who reported that companion animal caretakers recognized primary and secondary emotions of their companion animals, our results also demonstrate that many companion animal caretakers witnessed their animals' different emotions. Around half of the respondents showed positive attitudes to religions (particularly Buddhism), and more than half of the respondents had experiences of improving animal welfare or the natural environment, which means that they have more direct access to the information and knowledge of animals and animal emotions shared in their doctrines or communities. This may also contribute to their recognition of animal emotions. Additionally, our findings imply that most of the secondary emotions were more frequently attributed by female caretakers than male caretakers (as did Walker, et al. 2014). One explanation is that males may not have learned to express or recognize emotions as clearly as females (Brody 1985) and the other is that sex differences do vary markedly across different emotion studies (Stevens & Hamann 2012). Our findings also demonstrate that respondents' age played a role in influencing their recognition of animal emotions of disgust and disappointment: the older the person, the lower the level of the perception of disgust and disappointment. This might be caused by the fact that animal emotion is a new research topic in China. Therefore, younger generations are more aware of it, while older generations tend to view the utilitarian values of animals as more important than animal emotions. This finding supports the expectations of differences in emotional recognition between old and young people (Sze, et al. 2012).

5.4.3 Determinant variables of the PBS

A further aim of this study was to figure out which variables determined people's degree of attachment to their companion animals. Our findings demonstrate that dog caretakers were more attached to their dog than cat caretakers to their cat, which may be explained by the higher level of mutual understanding between humans and dogs, compared to that of humans and cats (Bekoff 2005). Another interesting finding was that caretakers with a private garden had a higher level of attachment to their animals than those who did not. This might be due to the fact that most of these caretakers were housewives from wealthy families in China, and they had more time to interact with their animals, which could accelerate their mutual understanding and foster good relationships (Fox & Gee 2016, Woodward & Bauer 2007). Additionally, our results reveal that respondents who were living with their children had a higher level of attachment to their animals than those without children. One possible explanation

would be that parents living with children would have more knowledge of animals to satisfy their children's appetite for knowledge. Furthermore, it is plausible that small animals have less demand (e.g., food) than large animals. Therefore, it is not surprising that in our research, respondents who owned a small dog showed a higher level of attachment to their dogs than respondents who owned a large dog.

5.4.4 Caretaker Attachment and Attribution of Emotions

Our investigations indicate the existence of significant correlations between respondents' attachment level and their attribution of certain emotions to their companion animals. However, these correlations were not very strong, although a higher level of attachment was related to caretakers having a stronger willingness to attribute several emotions to companion animals. These results may be due to the long-standing neglect of animal welfare in China, although Chinese people culturally consider animals as important and their awareness of animal welfare has indeed increased in the past two decades (Littlefair 2006). Probably due to sampling error, we found that the correlation between the degree of attachment and the attribution of emotions to companion animals did not differ greatly between either male and female caretakers, or dog and cat caretakers, which is partly in accordance with a study reporting that respondents' gender was not a significant factor influencing the relationship between attachment level and emotional attribution to companion animals (Martens, et al. 2016). Additionally, the correlations between dog caretakers' attachment level and their attribution of shame and sadness to their dogs were significant, while we did not find such correlations among cat caretakers. Given the relative limited number of cat caretakers in this study (25.8%), this finding needs to be viewed with caution.

5.4.5 Caretaker Attachment and Attribution of Responsive Emotions

Results indicate that respondents who attributed emotions to their animals generally believed that their behaviors could influence their animals' emotions, which confirms the findings by Martens, et al. (2016). Our research, and that of Martens et al., reveal that interspecies understanding and responding of emotions might exist, such as between humans and nonhuman animals. Significant positive correlations between the degree of attachment and the attribution of six out of ten responsive emotions exist among female respondents, suggesting that female caretakers may have a high sensitivity for responsive emotions. One possible explanation is that women have high levels of belief in the mental abilities of animals (Knight, et al. 2003).

5.4.6 Limitations of this study

Although the present research gained some insights by measuring caretakers' degree of attachment to companion animals, several sources of error exist in this study. For instance, due to the information collection method, unbalanced distributions existed amongst the participants (e.g., the number of dog caretakers was approximately three times higher than cat caretakers). This may have influenced the number of insignificant differences found in certain results. In addition, the sample population is a cluster sample that may not accurately represent the general Chinese population.

5.5 Conclusion

The present study followed a similar approach to that of previous studies conducted in developed countries (Mariti, et al. 2012, Martens, et al. 2016, Morris, et al. 2008). All these studies indicate that companion animal ownership or the degree of attachment can influence the attribution of emotions to companion animals. In addition, many studies (Darwin 1965, Martens, et al. 2016, Morris, et al. 2008) have demonstrated that animal species played a central role in influencing respondents' attribution of emotions to companion animals in developed countries (e.g., respondents were more likely to attribute some emotions to their dogs than cats), whilst in the present Chinese study the influence of animal species was very small. This may be due to people's different level of animal welfare between developed and developing countries. Compared to the populations in developed countries, most of the Chinese people have a lower awareness of animal welfare. Another possible explanation is that in Chinese culture, people's attitudes toward dogs and cats are not significantly different as both animals stand for good things, for example, the dog is the symbol of loyalty, while the cat represents wealth.

Findings from the present study imply that Chinese companion animal caretakers have a high attachment to their animals, which means that a good relationship between companion animals and their caretakers exists in contemporary China. This research represents a positive step towards advancing the topic of animal welfare, as a higher attachment to companion animals may lead to a better understanding of animal protection and a higher awareness of animal welfare. Therefore, identifying the emotional relationships between companion animals and their caretakers, and eventually promoting the development of an optimal animal welfare measurement system in China, are the main goals for any future studies we conduct in this area of research.

Chapter 6

How Japanese companion dog and cat owners' degree of attachment relates to the attribution of emotions to their animals

“Lacking a shared language, emotions are perhaps our most effective means of cross-species communication. We can share our emotions, we can understand the language of feelings, and that's why we form deep and enduring social bonds with many other beings. Emotions are the glue that binds.”

Marc Bekoff, 2008

Abstract

Recently, studies in the United States and European countries have shown that the degree of attachment is associated with the attribution of emotions to companion animals. These studies imply that investigating the degree of attachment to companion animals is a good way for researchers to explore animal emotions and then improve animal welfare. Although a promising area of study, in Japan, no empirical studies have examined the correlation between the degree of attachment and the attribution of emotions to companion animals. In this research, we aimed to assess companion animal owners' attribution of six primary (anger, joy, sadness, disgust, fear and surprise) and four secondary (shame, jealousy, disappointment and compassion) emotions to their dogs and cats, as well as how the degree of attachment related to such attribution of emotions from a Japanese cultural perspective. The “Pet Bonding Scale” (PBS), which is used to determine the level of bonding between humans and animals, was introduced to measure respondents' degree of attachment to their companion animals. The results of a questionnaire (N = 546) distributed throughout Japan showed that respondents attributed a wide range of emotions to their animals. Companion animals' primary emotions, compared to secondary emotions, were more commonly attributed by their owners. The attribution of compassion and jealousy was reported at a high level (73.1% and 56.2%, respectively), which was surprising as compassion and jealousy are generally defined as secondary emotions. All participants were highly attached to their companion animals, and this attachment was positively associated with the attribution of emotions (9/10) to companion animals (all $p < 0.05$). This study is one of the first to investigate animal emotions by analyzing the bonding between companion animals and owners in Japan, and it can therefore provide knowledge to increase Japanese people's awareness of animal welfare.

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6.1 Introduction

Human attribution of companion animal emotions is commonly used in an attempt to improve animal welfare (Finlayson, et al. 2016, Hemsworth, et al. 2015, Mendl & Paul 2004). An important ethical issue in animal welfare arises through the widely held opinions that most animals have emotional experiences. If animals experience disappointment and fear due to an inability to perform their natural behavior patterns or, more directly, due to animal cruelty, then this has moral importance and, in turn, may have a major influence on animal welfare (Dawkins 2000, Kujala, et al. 2017). Therefore, a better understanding of animal emotions is an important step toward promoting optimum animal welfare. Emotion is the mental state expressed by animals, and it reflects animals' psychological reality (Reisenzein 2007). A direct attempt to explore animal emotions is to attribute their emotions from human perspectives. However, the question of whether animals experience the same range of emotions as humans has long been argued (Bekoff 2000, Dawkins 2000, Ekman 2003). Emotions can be classified into primary (e.g., anger, joy, sadness, disgust, fear, surprise) and secondary (e.g., shame, jealousy, disappointment, compassion) ones (Damasio 1994, Demoulin, et al. 2004, Ekman 1992, Harmon-Jones, et al. 2016). Primary emotions are, more than any secondary emotions, accessible to observation (Demoulin, et al. 2004). A growing number of studies have revealed that primary emotions are experienced by both humans and animals (Cortes, et al. 2005, De Waal 2011), while secondary emotions are unique to mature humans and perhaps other primates, at least as presently understood (Preston & De Waal 2002, Viki & Abrams 2003).

Several approaches have been adopted to study animal emotions (Dawkins 2000). For instance, researchers may investigate the role of emotions in human beings and then examine whether the function is the same in humans and non-human animals (Oatley, et al. 2006), or whether the mechanisms underlying emotions are similar in humans and non-human animals (Dawkins 2000, Oatley, et al. 2006). In this research, we aimed to study animal emotions in a new way, investigating whether companion animal owners can attribute emotions to their animals and how the degree of attachment influences such emotion attributions from a cultural perspective. During the last several decades, many scales have been designed and developed to assess people's attachment to animals (Anderson 2007). After comparison with other scales, the "Pet Bonding Scale" (PBS) (Anderson 2007) was introduced in the present study to measure companion animal owners' degree of attachment and its correlation with the attribution of emotions to their animals in Japan. The concise design, simple language, specific purpose and explicit meaning of each statement of the PBS allow it to be more easily understood by respondents and enable us to arrive at a single aggregated outcome (Anderson 2007, Martens, et al. 2016). Additionally, compared to the lay public, companion animal owners would be a better choice when approaching animal emotions because their direct experience in interacting with animals may allow them to

better comprehend animals' behavior associated with emotions (Kujala, et al. 2017, Morris, et al. 2008).

To date, some studies conducted in Western countries have reported that companion animal owners can attribute a wide range of emotions to their animals (Bekoff 2002, Konok, et al. 2015, Martens, et al. 2016, Morris, et al. 2008). Female owners are more likely to attribute emotions to their animals than are male owners (Martens, et al. 2016, Su & Martens in press), while companion animal owners are more likely to attribute emotions to their dogs than to their cats (Martens, et al. 2016). Nevertheless, no significant differences in such emotion attributions have been found between companion dogs and cats in China, where people have a relatively low awareness of animal welfare (Su & Martens in press). Therefore, it is plausible that the attribution of emotions to companion animals might differ between different countries with varying awareness of animal welfare. However, in addition to human demographics and the different awareness of animal welfare, other variables, such as the degree of attachment to animals, traditional culture and ideological condition, might also influence companion animal owners' attribution of emotions to companion animals. We selected Japan as the representative of this study since Japanese people are open-minded to different cultures. They appreciate the Western values of human rights and freedom and, simultaneously, respect the traditional Confucian and Buddhist values of harmony and humble behavior (Tan & Chee 2005).

The relationships between humans and animals in Japan are largely influenced by its mentality of collectivism, traditional culture of Animistic Shinto, Confucianism and Buddhism, as well as the Western values of human rights and freedom (Kagawa-Fox 2010). Japanese people are collectivistic and not concerned with foundations or universal laws. They understand animal emotions in terms of complex interactions between dispositions of animals and contextual factors, and they might find it relatively difficult to separate animal emotions from the situational context in which they occurred (Norenzayan & Nisbett 2000). Therefore, the fundamental attribution error is much harder to demonstrate with Japanese people than Western people (Choi, et al. 1999). Regarding traditional Japanese culture, Shintoism advocates reciprocal care and compassionate relationships between humans and animals. In addition to Shinto ideology, Japanese attitudes toward animals and animal emotions have been influenced by Confucianism, which highlights the symbiosis between humans and animals, although humans are regarded as the lords of creation (Kondo & Sato 1999). Animals are often portrayed as being appreciative of and dutiful to humans in Japanese folklore and fables (Kagawa-Fox 2010, Knight 2005), which reflects the earlier attribution of emotions to animals in Japan. Buddhism, one of the most important religions, influences Japanese social values, including attitudes toward animals. Japanese mainstream Buddhist philosophers regard animals as sentient beings with the potential for better rebirth and salvation in the cycle of death and rebirth. The memorial service for dead companion animals is indicative of Japanese tradition, since premodern and

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many modern Japanese people believe animals have souls, emotions and feelings, even after their death (Ambros 2012).

The primary purpose of this research was to examine Japanese companion animal owners' attribution of emotions to their dogs and cats. Additionally, we aimed to investigate how the degree of attachment influences the attribution of emotions to companion animals from Japanese cultural perspectives. Considering that many previous studies conducted in Western countries have demonstrated how human demographics and the communications between animals and owners influence the relationship between humans and animals (Knight, et al. 2003, Marinelli, et al. 2007, Martens, et al. 2016), we assume such variables would also influence the degree of attachment to companion animals in Japan. Therefore, we examined the role of these variables in the relationship between companion animals and their owners.

6.2 Methodology

6.2.1 Materials

Using the Emotions of Pets Questionnaire, we wanted to investigate how the degree of attachment of Japanese owners of companion dogs and cats relates to the attribution of emotions to their animals.

The questionnaire consisted of four sections. The first section covered demographic information including age, gender, educational level, companion animal species, animal protection/nature conservation/human health organization participation, the existence of a private garden, attitudes toward religion, and the main source of inspirations.

In the second section, respondents were asked to supply information about their companion animals' basic characteristics (e.g., gender, size, age, neutered status and owners' perceptions of their animals' health condition), as well as their husbandry practices (e.g., how often do you brush your dog? Where does your pet sleep?). Additionally, respondents were asked if they were the main caregivers of their pets, whether they have other pets, how many years they have owned their pets, and why they have chosen to have pets.

The "Pet Bonding Scale" (PBS) (Angle, et al. 1994), a 25-item Likert scale, was introduced in the third section. The PBS is a five-point scale ranging from 0 (strongly disagree) to 4 (strongly agree). The sum of the PBS scores indicates the degree of owners' attachment to their companion animals, and a high score reflects a strong attachment. Examples of questions include "I like to spend a lot of time with my pet"; "I can tell secrets to my pet"; and "I keep pictures of my pet." Furthermore, respondents were also asked how their pets communicated with them (e.g., meowing/barking, body language, touching, scratching, looking, sniffing) and how they communicated with their companion animals (e.g., watching, touching, petting).

In the fourth section, a list of six primary (anger, joy [happiness], fear, surprise, disgust and sadness) and four secondary (shame, jealousy, disappointment, compassion) emotions was given to the participants. They were asked whether they had witnessed any (or all) of these emotions expressed by their companion animals. Ratings were made on a three-point Likert scale (1 = never, 2 = sometimes, and 3 = often). A high score indicates a strong attribution of emotion to companion animals.

6.2.2 Procedure

Data were collected from Japanese dog and/or cat owners using paper-based and online (n = 400) questionnaires. The paper questionnaires were conducted using the authors' networks. By means of snowball sampling (Goodman 1961), 146 Japanese dog and cat owners filled in our questionnaire. The online questionnaire was conducted via Cross Marketing, one of the pioneer research companies in Japan, by means of simple random sampling (Tillé 2006). The invitation email with the hyperlink to our questionnaire was sent to participants and they were asked to visit the website of our questionnaire and click "submit" when they complete all the questions. A total of 400 dog and cat owners were obtained from 1841 people throughout all the 47 prefectures of Japan. The response rates for the two survey methods were 100% and 21.7%, respectively. The inclusion criteria were as follows: 1) volunteers who were older than 18 years and who agreed to attend the study and 2) volunteers who were the main caregivers of their companion dogs/cats. To keep the answers consistent, participants were asked to respond for only one dog or cat. For those owners who owned more than one companion animal, we asked them to respond according to the animal they had owned the longest (Martens, et al. 2016). In the questionnaire, we explained the purpose of our study to the participants and stated that all information they provided would be kept completely confidential. Personal information would not be released to or viewed by anyone other than the researchers involved in this project.

6.2.3 Statistical analysis

The correlations between respondents' attribution of emotions and the degree of attachment to companion animals were analyzed with SPSS version 24 statistical software. Mann-Whitney U testing was performed to examine the different attribution of emotions between dogs and cats. Pearson correlation analysis was conducted to explore the relationships between the degree of attachment and the attribution of emotions to companion animals. Cocor, a software package, was utilized to determine the difference in correlations between dog and cat owners, as well as between male and female owners (Diedenhofen & Musch 2015). All results are based on two-sided tests, and values of $p < 0.05$ were considered significant. Considering that the PBS scores in this study followed a normal distribution, a stepwise linear regression was

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used to relate the degree of attachment (measured by PBS) to demographics and other basic information, such as animal welfare organization participation, the relationship with pets, how owners communicated with their pets (e.g., by watching, by taking care of pets) and how pets communicated with their owners (e.g., by looking, by touching). An alpha value of 0.05 was used for forwards and backwards regression of variables. To ensure that the observed correlations were not caused by autocorrelation, the Durbin-Watson statistic was used. Values of 2.0 were considered to have no autocorrelation, while values approaching 0 indicate positive autocorrelation and values approaching 4 indicated negative autocorrelation (Wood, et al. 2016). Stepwise regression was regarded as problematic because it could result in an inappropriate selection of predictors and the final model can vary according to the selection procedure chosen (Derksen & Keselman 1992, James & McCulloch 1990). Therefore, we only considered predictors appearing in the final model as influential variables in order to address these problems and simultaneously reduce type-I errors (Petraitis, et al. 1996). Additionally, using this method may also increase type-II errors, but given the relatively large sample size in the present study, this risk should be reduced (Bradbury, et al. 2000).

6.3 Results

6.3.1 Human demographics

In total, 546 completed surveys (50.5% from men, 49.5% from women) were received. The mean (\pm) age of all participants was 48.66 (\pm 13.87) years. Companion animals' basic information is reflected in Table 6.1. We compared our data from the two survey methods (i.e., paper-based and online questionnaires) in the present study, and the results showed no significant difference in the final results except that the participants from the paper-based questionnaire ($M = 77.53$) had slightly higher PBS scores than participants from the online questionnaire ($M = 73.57$, $p = 0.01$). Therefore, we combined the data from the two surveys in the following analyses.

Table 6. 1 Companion animals' basic information

	Dog: N (%)	Cat: N (%)
Animal species	344 (63.0)	202 (37.0)
Gender		
Male	198 (58.4)	90 (44.6)
Female	141 (41.6)	111 (55.0)
Missing data	5 (1.5)	1 (0.5)
Age		
< 5 years	73 (21.2)	64 (31.7)
5 – 10 years	151 (43.9)	66 (32.7)
> 10 years	120 (34.9)	72 (35.6)

6.3.2 The attribution of emotions to companion animals

More than half of the respondents reported that they could often or sometimes attribute primary emotions of joy (96.2%), surprise (85.9%), anger (80.6%), fear (75.7%), sadness (61.9%) and disgust (57.7%) and secondary emotions of compassion (73.1%) and jealousy (56.2%) to their companion animals. According to the Mann-Whitney U test, emotions of joy and sadness were more frequently attributed to dogs than to cats (Fig 6.1). Our results also showed that female owners were more likely to attribute emotions of anger, joy, disgust, fear, surprise, jealousy and disappointment to their companion animals than male owners were (not presented in the figure).

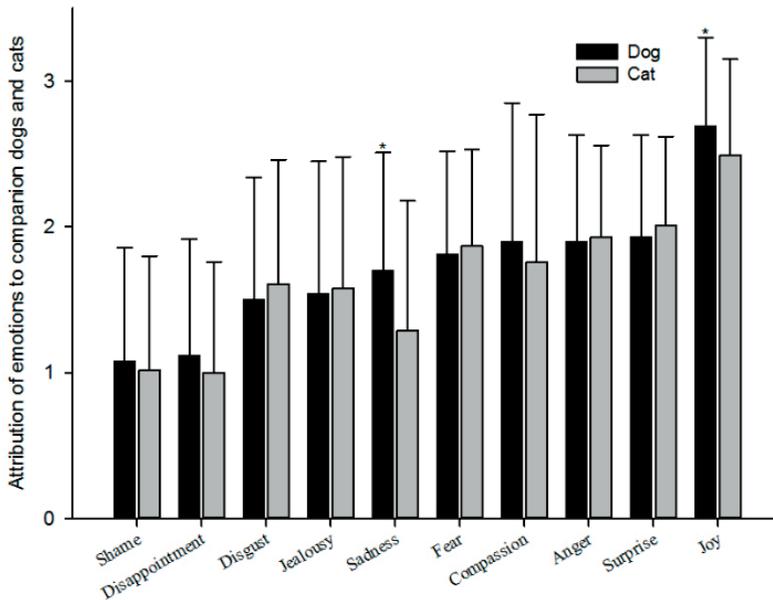


Figure 6. 1 Attribution of emotions to companion dogs and cats

Note: An asterisk indicates significance of the attribution of emotions (joy [$p < 0.001$] and sadness [$p < 0.001$]) between companion dogs and cats; $df = 544$.

6.3.3 The degree of attachment to companion animals and its predictor variables

Our results showed that the Cronbach's alpha value for the PBS in the present study was 0.958. The mean attachment (PBS) score of all the respondents was 74.63 ($SD = 14.94$) out of 100. Female owners showed a higher attachment score to their animals ($M = 79.04$, $SD = 13.37$) than did male owners ($M = 70.13$, $SD = 15.14$, $z = -7.04$, $p < 0.001$). Dog owners showed a higher attachment score to their dogs ($M = 75.64$, $SD = 14.94$) than did cat owners to their cats ($M = 72.91$, $SD = 14.82$, $z = -2.25$, $p = 0.024$).

Companion dogs

We considered all the possible demographics variables and the interaction paths between companion dogs and their owners that might associate with the PBS score. The Durbin-Watson statistic suggested no autocorrelation ($d = 2.13$). According to stepwise multiple regression analysis results, respondents who considered their relationship with their dogs to be “good” had a higher PBS score than those who felt they had a bad relationship. Female respondents had a higher PBS score than male respondents. Respondents who liked watching their dogs and who brushed their dogs frequently had a higher PBS score than those who did not. Companion animals' numbers and their living places also influenced their owners' PBS score: those respondents who owned other pets had a higher PBS score than those who only had one dog, while respondents whose dogs slept in their bedroom had a higher PBS score than those whose dogs slept in other places (e.g., kitchen, living room, garage and basement). In addition, the results also showed that those reporting that their dogs can stay at home alone scored higher on PBS than those who thought their dogs could not stay at home alone (Table 6.2).

Companion cats

We also identified several predictor variables on the PBS score from the information we collected from cat owners. The Durbin-Watson statistic suggested no autocorrelation ($d = 2.11$). The results showed that respondents who considered their relationship with their cat to be “good” and who owned their cat for themselves showed a higher PBS score than those who considered their relationship with their cat to be “bad” and those who owned their cat for work or for children. Respondents who thought their behavior resembled their pet's behavior had a higher PBS score than those who did not. Female respondents had a higher PBS score than male respondents. The PBS scores of respondents who had belonged to an organization involved in improving animal welfare were higher than the scores of those who did not. Furthermore, the interactions between owners and animals were also associated with the degree of attachment to cats: the PBS scores of respondents who liked taking care of their pets and who thought their pets communicate with them by touching were higher than the scores of those who did not. We also found that owners who had a garden had a higher PBS score than those who did not (Table 6.3).

Table 6. 2 Predictors of scores on the Pet Bonding Scale (PBS) for companion dogs

Y: PBS for dogs (<i>df</i> = 343)	Unstandardized Coefficients		Standardized Coefficients	Zero-order coefficients	<i>t</i>	<i>p</i>
	<i>B</i>	Std. Error	Beta			
(Constant)	97.72	9.66			10.11	< 0.001
X ₁ : Your relationship with your pet: bad (1) – good (2)	11.15	1.56	0.36	-0.074	7.13	< 0.001
X ₂ : Gender of owner: female (1) – male (2)	-6.20	1.42	-0.22	-0.297**	-4.36	< 0.001
X ₃ : You like watching your pet: yes (0) – no (1)	-21.89	6.97	-0.16	-0.268**	-3.14	0.002
X ₄ : You have other pets: yes (1) – no (2)	-4.92	1.66	-0.15	-0.203**	-2.97	0.003
X ₅ : The frequency of brushing dogs: once or more times each day (1) – once or more times each month (2)	-2.21	0.92	-0.12	-0.181**	-2.41	0.016
X ₆ : Your dog can stay at home alone: yes (1) – no (2)	-7.45	3.15	-0.12	-0.127*	-2.36	0.019
X ₇ : Your pet sleeps in bedroom: no (0) – yes (1)	1.84	0.88	0.10	0.172**	2.08	0.038

Note: Unstandardized and standardized coefficients refer to the partial effect of one predictor after adjusting for the others. Zero-order correlation test: ** $p < .01$, * $p < .05$.

Table 6. 3 Predictors of scores on the Pet Bonding Scale (PBS) for companion cats

Y: PBS for cats (<i>df</i> = 201)	Unstandardized Coefficients		Standardized Coefficients	Zero-order coefficients	<i>t</i>	<i>p</i>
	<i>B</i>	Std. Error	Beta			
(Constant)	67.70	9.57			7.08	< 0.001
X ₁ : Your relationship with your pet: bad (1) – good (2)	7.06	1.72	0.23	0.449**	4.10	< 0.001
X ₂ : Getting the pet for yourself: no (0) – yes (1)	6.96	1.66	0.23	0.433**	4.20	< 0.001
X ₃ : Your behavior resembles your pet's behavior: no (0) – yes (1)	5.16	1.75	0.16	0.313**	2.95	0.004
X ₄ : You like taking care of your pet: yes (1) – no (2)	-9.13	2.77	-0.19	-0.428**	-3.29	0.001
X ₅ : Gender of owner: female (1) – male (2)	-4.68	1.57	-0.16	-0.298**	-2.98	0.003
X ₆ : Animal welfare organization participation: yes (0) – no (1)	-8.33	2.77	-0.16	-0.244**	-3.01	0.003
X ₇ : Your pet communicates with you by touching you: no (0) – yes (1)	3.39	1.32	0.14	0.354**	2.56	0.011
X ₈ : You have a garden: no (0) – yes (1)	3.92	1.56	0.13	0.162**	2.52	0.013

Note: Unstandardized and standardized coefficients refer to the partial effect of one predictor after adjusting for the others. Zero-order correlation test: ** $p < .01$.

6.3.4 The correlation between the degree of attachment and the attribution of emotions to companion animals

Significant correlations were found between the degree of attachment (according to PBS score) and the attribution of primary ($r = 0.262$) and secondary emotions ($r = 0.317$, both $p < 0.001$). Specifically, there was a significant correlation between the degree of attachment and the attribution of joy, sadness, disgust, fear, surprise, shame, jealousy, disappointment and compassion to companion animals (all $p < 0.01$). Our results also showed significant correlations between the degree of attachment and female owners' attribution of joy, disgust and compassion. Regarding male owners, this correlation was significant for five of the six primary emotions (with the exception of anger) and all four secondary emotions (all $p < 0.05$). The correlation between dog owners' degree of attachment and their attribution of five of the six primary emotions (with the exception of anger) and three of the four secondary emotions (with the exception of disappointment) was found to be significant, while for cat owners, this correlation was significant for four of the six primary emotions (with the exceptions of anger and fear) and all four secondary emotions (Table 6.4). According to the results of cocor, we also found that the correlations between male respondents' degree of attachment and the attribution of sadness, jealousy and compassion to companion animals were stronger than those of female respondents (all $p < 0.05$), and the correlation between cat owners' degree of attachment and their attribution of joy was stronger than that of dog owners ($p < 0.05$).

Table 6. 4 Correlation coefficients of PBS score and the attribution of emotions to companion animals

Emotions	Overall correlation	Female owners	Male owners	Dog owners	Cat owners
Anger	0.049	0.005	0.030	0.037	0.079
Joy	0.301**	0.200**	0.298**	0.224**	0.402**
Sadness	0.193**	0.091	0.262**	0.153**	0.218**
Disgust	0.171**	0.124*	0.158**	0.173**	0.186**
Fear	0.135**	0.019	0.139*	0.144**	0.131
Surprise	0.198**	0.066	0.217**	0.204**	0.205**
Shame	0.185**	0.100	0.244**	0.137*	0.263**
Jealousy	0.231**	0.100	0.300**	0.209**	0.279**
Disappointment	0.150**	0.066	0.199**	0.087	0.248**
Compassion	0.369**	0.229**	0.431**	0.327**	0.428**

Note: Pearson correlation test: ** $p < 0.01$, * $p < 0.05$

6.4 Discussion

The aim of this study was to investigate Japanese companion animal owners' attribution of emotions to their dogs and cats, as well as how their degree of attachment relates to

the attribution of emotions to their animals. The results indicate that respondents attributed a wide range of emotions to their companion animals, with women attributing more emotions than men. Dog owners showed a higher level of attachment to their dogs than cat owners to their cats, while female owners showed a higher level of attachment to their companion animals than did their male equivalents. The degree of attachment was significantly correlated with Japanese respondents' attribution of five of six the primary emotions and all four secondary emotions to their companion animals, with the higher the level of attachment, the stronger the attribution of emotions to animals.

6.4.1 Emotions attributed and species differences

Our findings indicate that companion animal owners more commonly attributed primary emotions than secondary emotions to their animals. This finding is in line with the results of earlier studies that reported a trend in which primary emotions were more commonly attributed to companion animals than were secondary emotions (Konok, et al. 2015, Martens, et al. 2016, Morris, et al. 2008, Su & Martens in press). However, the secondary emotions of jealousy and compassion, two exceptions to this finding, were frequently attributed to companion animals in Japan. The result of jealousy parallels earlier findings in Western countries, while the result of compassion is inconsistent with findings from Western countries (Martens, et al. 2016, Morris, et al. 2008) but is in line with findings from China (Su & Martens in press). Compassion is a necessary condition for actions that are hardly ethically neutral, and it is more easily aroused among identified situations than among unidentified situations (Loewy 1995). Japanese and Chinese people are more collectivistic than Western population. Their mentality is holistic, focusing attention on the contextual situation in which animal emotions are occurred and ascribing causality by reference to the relationship between animal emotions and the contextual factors (Norenzayan & Nisbett 2000, Takano & Osaka 1999). Therefore, we suppose the relatively higher probability of animal cruelty in China and Japan, compared to that in Western countries, would promote owners' empathic abilities of compassion, which may affect their attribution of compassion to animals. Additionally, in Japanese and Chinese culture, the feeling of compassion reflects the principle of benevolence, one of the five basic elements of Confucianism (Blakeley 2003). Dogs and cats are regarded as sentient beings and as having the nature of compassion to all misfortunes (Ambros 2012, Blakeley 2003). Japanese and Chinese people therefore tend to give more anthropomorphic descriptions of animal emotions than Western population. Another reason to explain companion animal owners' similar attribution of compassion in China and Japan is their relativistic ideology. Animals in Japan and China have been respected as an essential part of human society. Nevertheless, due to the concept of special omens (e.g., a hen pheasant was seen as a good omen), they were commonly used in ceremonies, including sacrificial offerings of

How Japanese companion dog and cat owners' degree of attachment relates to the attribution of emotions to their animals

various sorts (Blakeley 2003, Kondo & Sato 1999). Therefore, Chinese and Japanese people's attitudes toward animals, including the attribution of emotions, are based on situational analysis, while Western populations' attitudes toward animals are formed by their universal principle of animal welfare (Su & Martens 2017). Notably, the attribution of emotions (particularly secondary emotions) to companion animals is complicated, and no one simple reason or theory can explain all of the psychological phenomena that are called "emotions" and "attribution of emotions". Further evidence from neuroscientific or psychological perspectives is therefore needed to confirm and clarify this point.

Previous studies have demonstrated that people's attribution of emotions to animals changes significantly depending on the different animal species, such as dog and cat (Darwin 1965, Martens, et al. 2016). Our results also reveal this difference between dogs and cats, yet this difference was only reflected in the emotions of joy and sadness, which confirms that dogs are more expressive in their body language and facial expressions than cats are, especially when they feel joy and sadness (Darwin 1965, Martens, et al. 2016). However, the lower number of emotional attributions implies that the relationship between companion animals and owners in Japan is different from that in Western countries. Many Japanese companion animal owners relate to their animals emotionally and with little knowledge about animal characteristics, such as their habit and behavior (Miura, et al. 2000, Tomizawa 1997). Therefore, it is not surprising that Japanese companion animal owners can attribute emotions to their animals, but their attribution of emotions to companion animals was not as significantly different as that of Western populations regarding animal species. Women were found to more frequently attribute anger, joy, disgust, fear, surprise, jealousy and compassion to their companion animals than men were. This finding confirms previous surveys conducted in China and Australia reporting that women, compared to men, were more willing to attribute emotions to companion animals (Su & Martens in press, Walker, et al. 2014).

6.4.2 Predictor variables of the PBS

In addition to the attribution of emotions, we were also interested in the variables that predicted companion animal owners' degree of attachment to their animals, since determining these variables is an important way to improve human-animal relationships and animal welfare. Our results reveal that there is general consent on considering the mutual interactions between animals and owners (e.g., for owners: watching and taking care of their pets; for pets: interacting with their owners by touching them) as rewarding experiences that can improve owners' degree of attachment to their animals. In opinion surveys on relationships with animals, gender is sometimes found to be a correlated factor (Martens, et al. 2016, Peek, et al. 1996, Su & Martens in press). Our results confirmed this finding by showing that women had a higher PBS score than men,

suggesting that women are more concerned with animals and are likely to have a more positive relationship with animals. Another interesting finding is that the independence of dogs can promote the good relationship between dogs and their owners. This result is in accordance with a previous finding on the relationship between livestock and owners (Campbell 2009). We interpreted this result as likely resulting from the lower degree of trouble they cause their owners.

6.4.3 Owner attachment and attribution of emotions

Our analyses demonstrate that all respondents were highly attached to their companion animals, and the attachment levels positively correlated with the willingness to attribute emotions to companion animals. This finding implies that a combination of animal experience (pet ownership) and strong attachment may promote owners' brain activations to attributing emotions to animals (Kujala, et al. 2017). The identification of this correlation could serve as an alternative to or complementary part of existing methods to assess animal emotions, as well as animal welfare. The correlation between the attribution of emotions and the degree of attachment was significant for most of the animal emotions in Japan. This finding is in accordance with earlier observations in European countries (Martens, et al. 2016) but is different from results reporting that attributions of only a few significant animal emotions exist among female and male owners, as well as dog and cat owners in China (Su & Martens in press). Therefore, it seems that the degree of attachment plays a more important role in predicting Japanese and European people's attribution of certain emotions to companion animals than that of Chinese people.

In addition, our results reveal that the correlation between male respondents' degree of attachment and their attribution of certain emotions (sadness, jealousy and compassion) to companion animals was stronger than that of female respondents. Indeed, female respondents tend to be more attached to their animals than male respondents. Nevertheless, according to our results, the attribution of these emotions generally agreed between female and male respondents (with only minor deviations for jealousy), suggesting that the degree of attachment may be more prominent when considering such correlations. These results also demonstrate that the differences in the attribution of these emotions between male and female respondents were not as strong as the difference in the degree of attachment between male and female respondents. Additionally, our results reveal that dog owners were more attached to their dogs than cat owners were to their cats, although a stronger correlation between the degree of attachment and the attribution of joy existed among cat owners. This finding confirms that the difference in the degree of attachment between dog and cat owners was not as strong as the difference in the attribution of joy between dog and cat owners in Japan.

6.4.4 Limitations of this study

Although this study is innovative, as it attempts to investigate the relationship between the degree of attachment and the attribution of emotions to companion animals from a Japanese cultural perspective, it is appropriate that we acknowledge the limitations. We used both paper-based and online questionnaire surveys to collect data, which may make the findings inconsistent. However, many previous studies reported that findings obtained by web survey are consistent with findings obtained by traditional paper-based survey (Costa, et al. 2001, Gosling, et al. 2004, Srivastava, et al. 2003). Our results also showed non-significant differences between the two surveys, except for the minor deviations of the PBS score. We think this minor difference may be due to the unbalanced distribution of participants from the two method surveys.

6.5 Conclusion

In the present study, companion animal owners are reported to attribute a wide range of emotions to their animals, with a trend toward primary emotions being more frequently attributed than secondary emotions. Most owners of dogs and cats also attribute a restricted range of secondary emotions of compassion and jealousy to their animals at levels comparable with primary emotions. Japanese people relate to their animals emotionally. They regard both companion dogs and cats as equally important, and both of them are associated with the spirit world. Therefore, their attribution of eight out of ten emotions to companion animals was not significantly different between dogs and cats. These findings are different from studies in Western countries showing that companion animal owners were more likely to attribute emotions to companion dogs than cats. We suppose the more collectivist mentality in Japan would explain these different findings between Japan and Western countries. Japanese people understand animal emotions in terms of complex interactions between dispositions of animals and contextual factors, whereas Western populations often view animal emotions primarily as the direct unfolding of animal dispositions. Additionally, our results provided evidence that the correlation between the attribution of emotions and the degree of attachment was significant for more animal emotions by Japanese and Western owners than by Chinese owners, which means that the attribution of emotions was more associated with the degree of attachment in Japan and Western countries than in China. Animal emotions have been identified as a critical marker for animal welfare, and thus, investigating methods for approaching animal emotions and exploring the correlations between the degree of attachment and the attribution of emotions to animals is essential to understand animal feelings and promote optimal animal welfare worldwide. Professionals who are expected to advise on animal welfare and human-animal relationships should take this correlation into account.

PART III

The Environmental Relationship
Between Companion Animals and
Owners

Chapter 7

A neglected predictor of environmental damage: the ecological paw print and carbon emissions of food consumption by companion dogs and cats in China

“I am in favor of animal rights as well as human rights. That is the way of a whole human being.”

Abraham Lincoln

Abstract

Food consumption has considerable impacts on the environment. Recently, increasing numbers of companion animal owners feed their animals with high nutritional food, which requires much land space and has great impacts on carbon emissions. Therefore, the environmental impacts of food consumption by companion animals can be significant, especially in a country with a large companion animal population, like China. In the present study, the ecological indicators of the ecological paw print (EPP), carbon emissions and energy consumption have been introduced for the first time to quantify the environmental impacts of food consumption by companion dogs and cats in China. Our results showed that the dietary EPP and carbon emissions of an average-sized dog relying on commercial dry food (0.82-4.20 ha per year and 0.037-0.190 ton per year) were ca. eight and three times higher than the dog relying on human leftover food (0.11-0.53 ha per year and 0.014-0.064 ton per year). There were more than 27.4 million companion dogs and 58.1 million companion cats in China in 2015. Assuming all these dogs and cats eat commercial dry food, the dietary EPP of the total dogs and cats was 43.6-151.9 million ha per year, which was equivalent to the dietary ecological footprint (EF) of 5.1% to 17.8% (70.3 to 245.0 million) of Chinese people in 2015. The annual food consumption of all these dogs and cats was responsible for up to 2.4-7.5 million tons carbon emissions, which was equivalent to the entire carbon emissions of 2.5% to 7.8% (34.3 to 107.1 million) of Chinese people in terms of food consumption in 2015. Our results also demonstrated that many companion animals (especially large dogs) consumed more energy than their actual needs to keep normal activity, which resulted in food waste and exacerbated the environmental burden. This research develops an accurate method for companion animals' dietary EPP calculation and quantifies their significant environmental impacts by investigating the dietary carbon emissions and energy consumptions. Findings from this study will motivate companion animal owners to reconsider the feeding regimens and husbandry activities, improve owners and even the whole Chinese people's awareness of sustainability, and ultimately promote the whole country's sustainable development.

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7.1 Introduction

Companion animals are an integral part of human society in the world. They provide a host of therapeutic, physiological and psychological benefits to people (Okin 2017, Su, et al. 2018), such as reducing risk of heart attacks, improving survival rates, increasing physical activity and providing emotional and social support (Friedmann & Thomas 1995, Qureshi, et al. 2009, Wood, et al. 2015). According to the data from the Vetnosis and The European Pet Food Industry Federation (FEDIAF), there were 223 million registered companion dogs and 220 million registered companion cats in the world in 2014. These animals require food and space, which might be suitable as human food and arable land to produce human food. Previous research has demonstrated that the land use for only dried cat food in the top ten cat-owning countries in the world is equal to an area about six times the size of New Zealand or Japan (Vale & Vale 2009). This number dramatically increases if we include companion dogs' food consumption. Therefore, the food consumption by companion animals is of importance to the increasing level of environmental degradation and needs further investigations.

In the present study, we questioned the environmental impacts of food consumption by companion dogs and cats. We selected China as the representative due to its large population of companion animals. Further, an examination of the data from China industry information network showed that the estimated companion dog population in China was 27.4 million and the cat population was 58.1 million in 2015. These numbers were expected to increase by 10% annually, because China has entered into an aging society and people, in particular old people like empty-nesters, are increasingly likely to own one or more companion animals (MIIT 2015, Wu, et al. 2015). Given the rapid growth of the economy, urbanization and industrialization, China's environmental problems and the ecological deficit have increased dramatically in the last decade and the increasing number of companion animals' impacts on carbon emissions would be more serious than we heretofore imagined (Gao & Tian 2016, Wang, et al. 2016). Additionally, due to the improving living standards and the increasing purchase power, most companion animal owners have started to pay much attention to their animals' nutritional requirements. Companion dog and cat's main dietary source, leftovers from human food, has begun to be replaced by the better-quality commercial pet food, which includes more animal products and contributes to more environmental impacts (Carrión & Thompson 2014). These trends may aggravate the environmental impacts of resource consumptions by companion animals and can increase the environmental burden of not only China but also the whole world. However, case studies evaluating the magnitude of these environmental impacts are rare and the development of related policies in addressing these potential impacts deserves more attention.

The ecological indicators of the dietary "Ecological Paw Print" (EPP), carbon emissions and energy consumptions were introduced to investigate the accurate

environmental impacts by companion animals. The EPP was originated from the “Ecological Footprint” (EF). The EF was first introduced by Wackernagel and Rees (1998) as a measure of sustainability. It relates to how much productive land is needed for an individual or population to maintain itself and to process the manufactured waste beside given technological development (Fiala 2008, Szigeti, et al. 2013). In *New Scientist*, David Mackay, a physicist at the University of Cambridge estimated the EPP of a cat to represent about 2% of the average British person’s EF (Ravilious 2009). More shockingly, when comparing data from a study conducted by Vale and Vale (2009), it appears the dietary EPP of some large dog breeds is as high as the EF for individuals in some undeveloped countries in the world (Schwartz 2014). In the US, dogs and cats consume about $19\% \pm 2\%$ of the amount of dietary energy that humans do, and through their diet, constitute about 25–30% of the environmental impacts from animal production in terms of the use of land, water, fossil fuel, phosphate, and biocides (Okun 2017). These studies imply that the negative environmental impacts of food production and consumption by companion animals are significant and expected to grow worldwide in the near future (Reijnders & Soret 2003).

The primary purpose of this research was to investigate the environmental impacts of food consumption by companion dogs and cats in China. Specifically, we first quantified companion animals’ food consumption, dietary EPP and carbon emissions regarding human leftover food and commercial dry food. In view of companion animals’ strong impacts on the environment, reducing their food consumption is potentially the most direct attempt to reduce their dietary EPP and carbon emissions. In order to determine feeding directions and simultaneously guarantee companion animals’ health, we additionally compared their energy requirement and energy consumption regarding both diet types. To the best of our knowledge, this is the first study to approximate and highlight the dietary EPP and carbon emissions of companion dogs and cats by utilizing market-wide knowledge of pet food and direct data on pet food consumptions. Therefore, our results will be representative of the actual relationship between companion animals’ food consumption and their environmental impacts in China, and will be more powerful and valuable compared to the results that based on stochastic data in previous studies. The accurate and accessible methods and frameworks in this research can serve as a motivational platform for other environmental studies related to the food consumption by other animal types and us humans. Findings and recommendations in this study will motivate companion animal owners to reconsider the feeding regimens and husbandry activities, encourage the government and policymakers to reconstruct their policies concerning companion animals (e.g., taxation and registration), and ultimately promote Chinese people’s awareness of sustainability and the whole country’s sustainable development.

7.2 Methods

7.2.1 The schematic overview of the methods

In Fig. 7.1, a schematic overview of the methods that we proposed in the present research is presented. This schematic overview described how we quantified the environmental indicators of the dietary EPP, carbon emissions and energy consumption in this research.

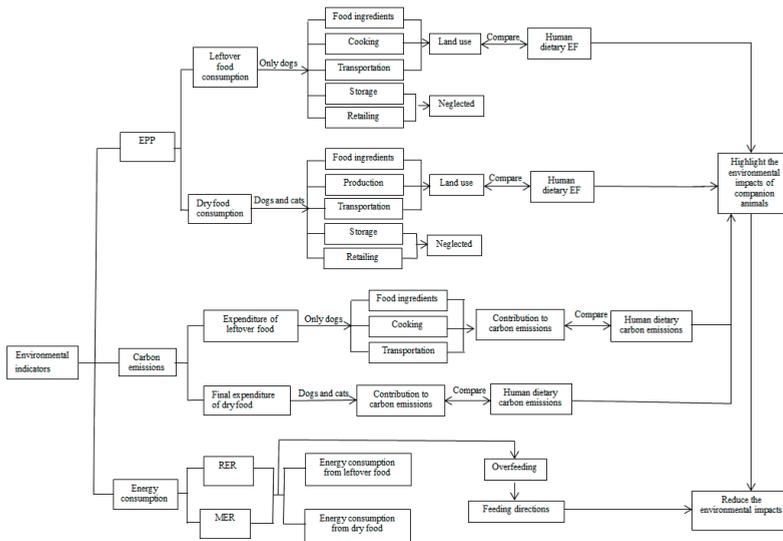


Figure 7.1 The schematic overview of the methods

7.2.2 Application of the ecological footprint (ecological paw print) analysis

The EF represents demand for ecosystem products and services in terms of land use types (Geng, et al. 2014, Wackernagel & Rees 1998). The EFA has been used widely for fundamental studies of sustainable development (Lambrechts & Van Liedekerke 2014, Liu, et al. 2017). EFA categorizes bio-productive land into six land use types: arable land, grazing land, forest land, fishing grounds, built-up land and energy land (Geng, et al. 2014, Wackernagel & Rees 1998).

Generally, in national or global EF accounts, the EF calculation is usually estimated by adding the imports and subtracting the exports to the output in the study system (Wackernagel & Rees 1998). However, at scales smaller than the world as a whole, the EF calculation assesses the resources related to the final consumption activities of that population (Geng, et al. 2014, Kitzes, et al. 2008). Considering that our

study mainly focused on dogs and cats' dietary EPP, the calculation is carried out directly through the final consumption data rather than the production and trade data.

The dietary EPP calculation is based on the per capita dog/cat consumption of food resources in various categories. The food consumption items include poultry (chicken) and cereal regarding commercial dry food while including beef, mutton, port, poultry, fish, oil, egg, milk, grain, vegetable and fruit regarding leftovers from human food (according to the categories of human food in China Statistical Yearbook). The land types of arable land, grazing land, and fishing grounds were included in the present study. Additionally, considering the resource consumption in the processes of food production (including leftover food cooking) and transportation (based on the resource consumption by train sets because rail freight is the most popular way for pet food transportation in China) (Canning 2011, Mukherjee 2008, Wakeland, et al. 2012), the energy land was also involved in the calculation of the dietary EPP. Although the pet food business has increased rapidly in China, it is still not as popular as that in the developed countries and many pet foods are sold through online retailers. Therefore, the EPP from retailing process would be very small and can be neglected. Due to the short periodicity of the food production and the limited requirements for temperature and humidity during storage, the proportion of storage EPP is also very small and can be reasonably neglected.

The calculations of the dietary EPP are as shown below:

First, the per capita dietary EPP component of each consumption item should be calculated by the equation below (Du, et al. 2006):

$$A_i = C_i/Y_i$$

Where,

$i = 1, 2, \dots$, is the number of consumption items; A_i = per capita dietary EPP component of item i (ha); C_i = per capita consumption of item i (kg or t); Y_i = the annual average productivity in the world of item i (kg/ha or t/ha).

Then, the equation of per capita dietary EPP is as shown below (Du, et al. 2006, Liu, et al. 2017):

$$EPP_{dietary} = \sum_{i=1}^n r_i A_i$$

Where,

r_i is the equivalence factor.

To align the measurement units, all three land types should be converted using this equivalence factor. The equivalence factor is the ratio of the average productive capacity of an area and the world (Liu, et al. 2017, Wackernagel, et al. 1999).

The dietary EPP of companion dogs was calculated based on their consumption of leftover food and commercial dry food (chicken-based), which are the two most common pet food types in China. Considering that companion cats are carnivores and

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not adapted to human food, the dietary EPP of companion cats was calculated only based on their consumption of commercial dry food (chicken-based). Notably, as for the calculation of dietary EPP regarding commercial dry food, we assumed both the crude protein and fat were from chicken, and the carbohydrate was from cereals. We used the raw chicken and cereal in the calculation process, and the equations of the per capita consumption of raw chicken and cereal are as shown below:

$$Chicken_{raw} (kg) = \frac{(protein_{commercial\ food} + fat_{commercial\ food})\% \times food\ consumption (kg)}{(protein_{raw\ chicken} + fat_{raw\ chicken})\%}$$

$$Cereal_{raw}(kg) = \frac{carbohydrate_{commercial\ food}\% \times food\ consumption(kg)}{carbohydrate_{raw\ cereal}\%}$$

According to the data from USDA (United States Department of Agriculture), Food Composition Databases, the average percentages of protein and fat in raw whole chicken are 17.33% and 17.98%, respectively, while the average percentage of carbohydrate in raw cereal is 73.3%. The proprietary nature of and incredible variety in pet food recipes make an exact calculation impossible (Okin 2017). Hence, calculations in this part were made on the assumptions that 1) the weight of protein and fat in raw chicken and carbohydrate in raw cereal did not change during the process of industrial production (the conversion rate is one to one) and 2) these two raw ingredients make up nearly all of the mass of the pet food.

7.2.3 The carbon emissions

According to the Consumer Lifestyle Approach (CLA), household carbon emissions are related to individual (household) consumption behaviors (Bin & Dowlatabadi 2005, Xu, et al. 2016). Carbon emissions contain both direct (e.g., electricity, natural gas, domestic cars) and indirect carbon emissions (e.g., clothing, eating, residing). Companion animals as “stuff we have at home” also contribute to the household carbon emissions. Considering that companion animals’ direct and some indirect carbon emissions (e.g., residing) are difficult to separate out from household carbon emissions, in the present study, we only measured their indirect carbon emissions from food consumption.

The per capita carbon emission was calculated as follows (Wei, et al. 2007, Xu, et al. 2016):

$$CO_2 = CI_f \times X$$

Where,

CI_f refers to the carbon emission intensity of food consumption in China (0.23t/10⁴ CNY) (Wei, et al. 2007, Xu, et al. 2016), and X refers to the expenditure of food consumption for companion animals (CNY).

Notable, the expenditure of commercial dry food was calculated according to the final price, which includes the cost of all the ingredients and processes (e.g., fresh food, food production, and transportation). The price of food items in human leftover food was calculated according to the fresh food, but the expenditure of food transportation and cooking was also included when we calculated the carbon emissions of human leftover food (transportation 0.07t/10⁴ CNY, cooking 0.08t/10⁴ CNY) (Wei, et al. 2007, Xu, et al. 2016).

7.2.4 The energy requirement

The “Resting Energy Requirement” (RER) is the amount of calories required by an animal at rest in a thermoneutral environment and does not support any exercise, growth, or reproduction. It is a function of metabolic body weight and can be calculated using the formula (Fleeman & Owens 2007):

$$RER (Kcal/day) = 70 \times (BWt_{kg})^{0.75}$$

The “Maintenance energy requirement” (MER) is defined as the energy required to keeping an animal in a “maintenance state”, or maintaining a normal activity (Fleeman & Owens 2007, Flynn, et al. 1996, Jones & Ackerman 2016, Streeter & Wakshlag 2015).

The following is a guide to the calculation of MER for companion dogs and cats.

For companion dogs (Fleeman & Owens 2007, Linder & Freeman 2010, Thatcher, et al. 2010):

$$MER_{dog} = X(1.39) \times RER$$

For companion cats (Linder & Freeman 2010, Thatcher, et al. 2010):

$$MER_{cat} = X(1.27) \times RER$$

X refers to a coefficient. The coefficients (1.39 for companion dogs and 1.27 for companion cats) were calculated according to the results from Linder and Freeman (2010).

7.2.5 The metabolizable energy in feeding stuff

The metabolizable energy in leftovers from human food (ME_l) is calculated by the formula below:

$$ME_l = \sum_{i=1}^n C_i \times Y_i \quad (i = 1, 2, 3, 4, 5, 6, 7, 8, 9)$$

Where,

i refers to consumption items, C means the weight of food consumption, Y refers to the calorie content per weight (kg) of consumption item in human food.

The calorie content of human leftover food was calculated according to the information of Calorie Control Council. We chose ten most conventional cooking ways of each consumption item in human food (with the exception of milk and oil) and calculated the average calorie content of each item.

The calorie content of commercial dry food is dependent on the amounts of crude protein, crude fat, and carbohydrate in the product. According to the information from Association of American Feed Control Officials (AAFCO), carbohydrates are estimated by calculating the “nitrogen-free extract” (NFE) in the product. This is determined by subtracting the average of each of the other components (percent crude protein, crude fat, crude fiber, moisture and ash) from 100. The equation of the calculation is as shown below:

$$NFE = 100 - (\text{crude protein} + \text{crude fat} + \text{crude fiber} + \text{moisture} + \text{ash})$$

The metabolizable energy of commercial food (ME_c) is calculated by the following formula (Meldrum, et al. 2017):

$$ME_c = [(3.5 \times \text{crude protein}) + (8.5 \times \text{crude fat}) + (3.5 \times NFE)] \times 10$$

7.2.6 Data

In order to complete our analysis on Chinese companion animals' dietary EPP, carbon emissions and energy requirement, several approaches for data collection were introduced.

An online survey was carried out amongst a group of Chinese dog and/or cat owners from 557 people among a sampling frame of 3006 people throughout the mainland of China. In order to keep the answer consistent, respondents were asked to respond for only one dog or cat. For those owners who owned more than one companion animal, we asked them to respond according to the animal they had owned the longest. In the questionnaire, respondents were asked to supply information about their companion animals' basic characteristics (species, breed, gender, size, age,

neutered status and owners' perceptions of their animals' health condition), as well as their husbandry practices (How often do you visit the vet with your companion animals?; how often and how long do you go for a walk with your dog?; How often does your cat go outside?; How often and how much do you feed your dog or cat?; How often do you brush your dog [change your cat's litter]?; Does your cat sit frequently on your lap?; Is your dog friendly to strangers?; Can your dog/cat stay alone at home?; Where does your dog/cat sleep?; Who is taking care of your dog/cat when you are not around?). Additionally, respondents were asked if they were the main caregivers of their pets, whether they have other pets, how many years they have owned their pets, and why they have chosen to have pets.

Additionally, we reviewed the secondary sources of information from China Statistical Yearbook, China Industry Information Yearbook, China industry information network, government reports, statistical reports, published papers, international organizations and web pages. Data on the composition items, the price and calorie content of each item in human food were derived from China Statistical Yearbook, 2015 and Calorie Control Council. Data were reported as the mean score (Table 7.1). Data on the resource consumption of food production (including leftover food cooking) and transportation was calculated according to the information from China Statistical Yearbook and National Bureau of Statistics of China. The nutritional components, the metabolizable energy and the price of the commercial dry food were calculated according to the data from the seven most famous Chinese pet food brands (RoyalCanin, Purina, Pedigree, ProPlan, Bridge, Care and Myfoodie), which was evaluated by Chinese Brand Research Institute regarding brand popularity, product sales, employee numbers, asset size and operating conditions. Data were shown in Table 7.2.

Table 7. 1 The percentage, price and calorie content of each composition item in human food

Items	Percent (%)	Price (Yuan/kg)	Kg/Kcal
Beef and mutton	1.07	65.64	1913
Pork and other meat	6.85	24.84	2943
Poultry	2.57	20.04	2432
Fish	4.03	15.33	873
Oil	3.04	10.10	8840
Egg	2.88	9.83	906
Milk	4.68	13.4	630
Cereal	30.84	5.38	3790
Vegetable and fruit	43.69	6.98	470

Note: data were from China Statistical Yearbook, 2015 and Calorie Control Council.

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Table 7. 2 The ingredients, metabolizable energy and price of commercial companion animal food

	Small dog	Middle dog	Large dog	Dog (average)	Cat (average)
Protein (%)	26.60	25.19	23.91	25.21	29.15
Fat (%)	14.14	14.66	12.73	13.80	13.17
Ash (%)	9.20	8.83	9.59	9.23	8.39
Fiber (%)	3.80	3.39	3.92	3.72	4.66
Moisture (%)	10.43	10.51	10.44	10.44	8.75
Carbohydrate (%)	35.83	34.42	39.41	37.60	35.88
ME_c (kcal/kg)	3386.95	3332.45	3298.25	3371.35	3395.50
Price (CNY/kg)	39.82	32.48	30.18	34.08	51.57

Note: data were calculated according to the information from seven most popular pet food brands.

Data on global production, land use for average productivity and equivalence factors were taken from the United Nations Food and Agriculture Organization (FAO), National Bureau of Statistics and published papers (Table 7.3) (Liu, et al. 2017, Shi, et al. 2015, Wackernagel, et al. 1999, Wackernagel & Rees 1998). These factors were used to calculate the dietary EPP components of grazing land, arable land and fishing grounds.

Table 7. 3 The annual average productivity and equivalence factor of different land types

Items	Annual average productivity	Equivalence factor	Land type
Beef and mutton	33	0.5	Grazing land
pork	74	0.5	Grazing land
Poultry	33	0.5	Grazing land
Fish	29	0.2	Fishing grounds
Oil	1856	2.8	Arable land
Egg	400	0.5	Grazing land
Milk	502	0.5	Grazing land
Cereal	2744	2.8	Arable land
Vegetable and fruit	18000	2.8	Arable land
Energy*	5.2	1.1	Energy land

*Note: Carbon emission factor is 0.409, the C-CO₂ transformation factor is 3.67 (Liu, et al. 2017).

7.3 Results

7.3.1 Human demographics

In total, 503 completed surveys were received. Participants' basic information is reflected in table 7.4.

Chapter 7

Table 7. 4 The basic information of participants

	n (%)
Gender	
Male	240 (47.7)
Female	263 (52.3)
Age	
18–29years	118 (23.5)
30–39 years	164 (32.6)
40-49 years	116 (23.1)
50-59 years	80 (15.9)
60 years and older	25 (5.0)
Highest Level of Education	
Less than grade 12	6 (1.2)
High school	32 (6.4)
College or technical school	96 (19.1)
University and above	369 (73.4)
Place of Residence	
Urban areas	483 (96.0)
Rural areas	20 (4.0) ^①
Career Types	
Liberal profession	50 (9.9)
Employed	386 (76.7)
Retired	23 (4.6)
Student	28 (5.6)
Social welfare	3 (0.6)
Other	3 (0.6)
Organization Participation	
Improving the welfare of animals	259 (51.5)
Conservation of the natural environment	351 (69.8)
Improving human rights or health	252 (50.1)

Note: N means the number of responses; % means the percentage of responses in each item. ^① This research suffered from a somewhat unbalanced distribution of participants. Only 4% of the surveys originated from rural areas because of the less internet access in rural areas, people's reluctance to respond and their relatively lower level of education.

7.3.2 Animal demographics

In total, 503 completed surveys were received. Companion animals' basic information is presented in table 7.5.

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Table 7. 5 The basic information of animals

	Dog: N (%)	Cat: N (%)
Animal species	373 (74.2)	130 (25.8)
Gender		
Male	231 (91.9)	62 (47.7)
Female	142 (38.1)	68 (52.3)
Age		
< 5 years	227 (60.9)	77 (59.2)
5-10 years	128 (34.3)	44 (33.8)
> 10 years	18 (4.8)	9 (6.9)
Size		
Small(1.5-10kg) ^①	113 (30.3)	–
Middle (10-25kg)	190 (50.9)	–
Large (25-70kg) ^②	70 (13.9)	–
Food consumption		
Dog: < 10g.BW ⁻¹ .day ⁻¹ (^③); Cat: < 50g.day ⁻¹ (^④)	69 (18.5)	19 (14.6)
Dog:10-25g.BW ⁻¹ .day ⁻¹ ; Cat: 50-100g.day ⁻¹	233 (62.5)	84 (64.6)
Dog: > 25g.BW ⁻¹ .day ⁻¹ ; Cat: > 100g.day ⁻¹	48 (12.9)	18 (13.8)
No idea	23 (6.2)	9 (6.9)
Health condition		
Good	299 (80.2)	100 (76.9)
Fair	70 (18.8)	30 (23.1)
Bad	4 (1.1)	0 (0)
Sterilization conditions		
Neutered	91 (24.4)	46 (35.4)
Sexually intact	282 (75.6)	84 (64.6)
Activity		
Dog: < 1 hour; Cat: Never	157 (42.1)	45 (34.6)
Dog: 1-2 hours; Cat: Sometimes	201 (53.9)	69 (53.1)
Dog: > 2 hours; Cat: Whole day	15(4.0)	16 (12.3)
Significantly overweight ^⑤	11 (2.9)	–

Note: ①The Chihuahua is the smallest dog breed in the world (also in our study) (Knowler, et al. 2017) and The Fédération Cynologique Internationale (FCI) standard states that an adult Chihuahua in general not weight less than 1.5kg. Therefore, we set the minimum value for dog weight as 1.5kg. ②The Tibetan Mastiff is the largest dog breed in China (as well as in this study), and an adult companion Tibetan Mastiff generally not weight more than 70 kg (Guo, et al. 2015). Therefore, we set the maximum value for dog weight as 70kg. ③ According to the sample in our study, the minimum resting energy requirement for a companion dog is 24.2 kal.kgBW⁻¹.day⁻¹, which means Chinese dog owner should give their dog at least 7 g. kgBW⁻¹.day⁻¹ of dry food or 12 g. kgBW⁻¹.day⁻¹ of leftovers to keep their dog in good or fair health condition (99.0% respondents reported their dog's health condition as good or fair). Therefore, in the calculation process, we set the minimum value for dog food consumption as 7 g. BW⁻¹.day⁻¹ and 12 g. kgBW⁻¹.day⁻¹ regarding commercial dry food and leftover food. ④The body weight of cats (in general 2-6 kg) varies less than that of dogs, so the daily food consumption of cat was asked without considering their body weight. The minimum resting energy requirement for a companion cat is 117.7 kcal.day⁻¹, which means Chinese cat owners should give their cat at least 35 g.day⁻¹ of dry food to keep their cat in good or fair health condition (100% respondents reported their cat's health condition as good or fair). Therefore, in the calculation, we set the minimum value for cat food consumption as 35 g. day⁻¹regarding dry food. ⑤ Significantly overweight means that the bodyweight of companion dogs exceeds the upper limit of the standard bodyweight of the corresponding breed.

7.3.3 The ecological paw print and carbon emissions of companion animals in China

Individual companion dog

Our results showed that an average Chinese companion dog consumed 62.43 to 286.58 kg leftover food or 47.34 to 242.91 kg commercial dry food in a year. We found significant correlations between food consumption per unit body weight and companion dogs' age ($r = 0.166$, $p = 0.001$), size ($r = 0.296$, $p < 0.001$), sterilization station ($r = 0.160$, $p = 0.002$), and their activity time ($r = 0.131$, $p = 0.011$), although the relationships were not strong. In China, the natural gas consumptions for per kg dry pet food production and per kg human food cooking are 0.12249 kg and 0.03762 kg, respectively, while the electric consumption for per kg food transportation is 0.04kwh (calculated based on the data from the Chinese Statistical Yearbook). According to this information, we calculated that the EPP of commercial food production and human food cooking was 0.039 ha/ton and 0.012 ha/ton, respectively, and the EPP of food transportation was 0.021 ha/ton. Based on companion dogs' size and food consumption (including fresh food ingredients, food production and transportation), we calculated their dietary EPP and carbon emissions regarding different food types. Our results showed that a large dog's dietary EPP and carbon emissions were much higher than that of a small dog. The dietary EPP and carbon emissions of an average-sized dog relying on commercial dry food were ca. eight and three times higher than those of the dog relying on human leftover food (Table 7.6). Generally, the average lifespan of a dog is around 10 to 12 years, but there are cases where dogs have reached the age of 17 to 22 years, depending on the variety and size (Lazăr, et al. 2016, Shaw 1892). In the present study, we estimated the lifespan of an average dog is 12 years and their annual food consumption would not change over time. According to their food consumption during their whole life, we found that the dietary EPP of an average-sized dog relying on leftover food is 1.37 to 6.31 ha, which is responsible for the release of up to 0.164 to 0.769 tons of carbon dioxide. However, assuming they eat commercial dry food during their whole life, then the EPP of an average-sized dog would increase to 9.92 to 50.49 ha, which is responsible for up to 0.449 to 2.285 tons carbon emissions (Table 7.6).

Individual companion cat

An average cat could consume 20.11 to 33.63 kg per year of commercial dry food, and the dietary EPP and carbon emissions of one cat were 0.36 to 0.63 ha per year, and 0.024 to 0.040 tons per year, respectively (Table 7.6). In general, the average lifespan of a cat is around 14 years (Lazăr, et al. 2016, Shaw 1892). Therefore, the whole-life dietary EPP of a cat relying on dry food is 5.06 to 8.85 ha, which is responsible for the release of up to 0.334 to 0.558 tons of carbon dioxide (Table 7.6). Additionally, we also analyzed the correlation between food consumption and cat's gender, age, the

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sterilization stations, as well as their activity time. However, we did not find any significant correlations (data not presented in Table).

Table 7. 6 Individual pet's food consumption, ecological paw print and carbon emissions regarding leftover food and commercial dry food in China (2015)

	Leftover food			Dry food (chicken-based)		
	Food consumption (Kg/year)	EPP (ha)	CO ₂ emissions (t)	Food consumption (Kg/year)	EPP (ha)	CO ₂ emissions (t)
Dog						
Average-sized dog	62.43-286.58	0.11-0.53	0.014-0.064	47.72-242.91	0.82-4.20	0.037-0.190
Small dog	7.93-91.25	0.01-0.16	0.002-0.021	5.70-68.44	0.10-1.23	0.005-0.063
Middle-sized dog	47.12-228.13	0.09-0.42	0.010-0.051	38.67-212.66	0.68-3.75	0.029-0.159
Large dog	158.12-638.75	0.30-1.17	0.035-0.143	142.21-615.17	2.32-10.05	0.099-0.427
One dog (lifetime)	749.16-3438.96	1.37-6.31	0.164-0.769	572.64-2914.92	9.92-50.49	0.449-2.285
Cat						
Average-sized cat	-	-	-	20.11-33.63	0.36-0.63	0.024-0.040
One cat (lifetime)	-	-	-	281.54-470.82	5.06-8.85	0.334-0.558

Note: commercial food was calculated without moisture; Small dog: 1.5~10kg, Middle dog: 10-25kg, Large dog: 25-70kg, Average dog: 10-29 kg, Average cat: 2-6kg.

Total companion dogs and cats

The China industry information network estimated that there were 27.4 million companion dogs and 58.1 million companion cats in China in 2015. Our results showed that the EPP of an average-sized dog relying on leftover food was 0.11 to 0.53 ha per year. Multiplied by the estimated number of dogs in China, this leads to an estimate of 3.1 to 14.5 million ha per year of EPP, which is responsible for up to 0.4 to 1.7 million tons of carbon emissions. The dietary EPP of an average-sized dog relying on commercial dry food was 0.82 to 4.20 ha per year. This leads to an estimate of 22.6 to 115.2 million ha per year of EPP for the total dogs, which is responsible for up to 1.0 to 5.2 million tons of carbon emissions (Table 7.7). With regard to cats, the dietary EPP of an individual cat relying on the commercial dry food was 0.36 to 0.63 ha per year. Multiplied by the estimated number of cats in China, this leads to an estimate of 21.0 to 36.7 million ha per year of EPP, which is responsible for up to 1.4 to 2.3 million tons of carbon emissions (Table 7.7).

Table 7. 7 The total food consumption, dietary ecological paw print and carbon emissions of Chinese companion animals in 2015

	Leftover food			dry food (chicken-based)		
	Food (million kg/year)	EPP (million ha)	CO ₂ emissions (million tons/year)	Food (million kg/year)	EPP (million ha)	CO ₂ emissions (million tons/year)
Total dog	1711-7852	3.1-14.5	0.4-1.7	1308-6656	22.6-115.2	1.0-5.2
Total cat	–	–	–	1168-1954	21.0-36.7	1.4-2.3

Note: The estimated dog population in China was 27.4 million, and the estimated cat population in China was 58.1 million (China industry information network, 2015).

According to the data from Chinese Statistical Yearbook, 2015, the per capita food consumption by the human was 354 kg per year. As calculated, the per capita dietary EF in China was 0.62 ha per year, which yielded an estimate of 0.070 tons of carbon emissions (Table 7.8). Assuming all these dogs and cats eat commercial dry food, the total dietary EPP of Chinese dogs and cats was equal to the entire dietary EF of 5.1% to 17.8% (70.3 to 245.0 million) of Chinese people, while the total carbon emissions by food consumption of Chinese dogs and cats were equal to the entire dietary carbon emissions of 2.5% to 7.8% (34.3 to 107.1 million) of Chinese people.

Table 7. 8 The per capita food consumption, dietary ecological footprint and carbon emissions of Chinese people in 2015

Human	Food consumption (Kg/year)	EF (ha)	CO ₂ emissions (t)
Per capita	354	0.62	0.070

Note: Data for the food consumption per capita were from Chinese Statistical Yearbook, 2015.

7.3.4 The energy requirement and energy consumption of companion animals in China

The results of the analysis regarding the energy requirement are included in Fig. 7.2. According to our data, the body weight of 10-29 kg was used to represent average dog weight. We found that an average-sized dog's RER and MER were 143,678 to 319,293 kcal per year and 199,713 to 443,817 kcal per year, respectively. The energy they finally consumed regarding leftover food and commercial dry food varied from 125,999 to 578,387 kcal per year and 160,881 to 818,935 kcal per year, respectively. The calorie intake for many dogs (in particular middle-sized and large dogs) relying on commercial dry food was much higher than their actual needs (Fig. 7.2). For cats, the body weight of 2-6 kg was used to represent average cat weight, and an average cat's RER and MER were 42,970 to 97,950 kcal per year and 54,572 to 124,396 kcal per year, respectively. The energy they finally got from commercial dry food ranged from 68,284 to 114,191 kcal per year. The calorie intake from commercial dry food was sufficient to offset their actual energy requirement (Fig. 7.2).

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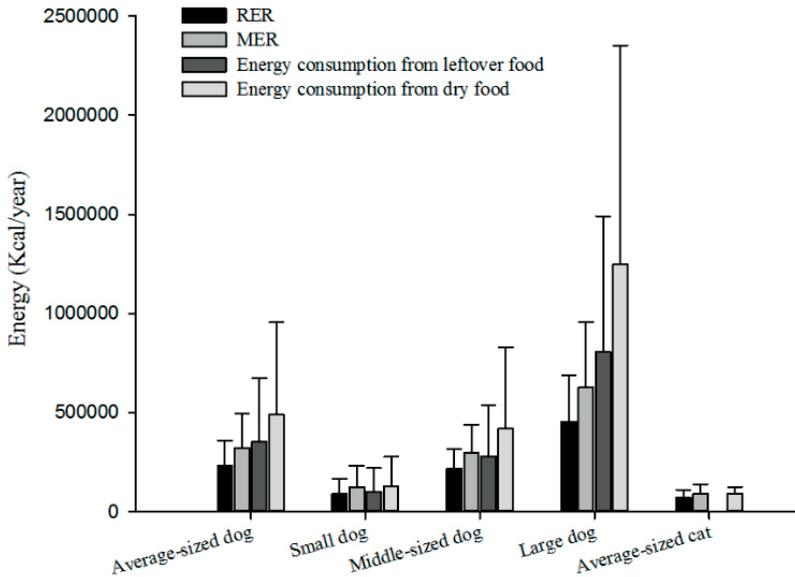


Figure 7. 2 The resting energy requirement (RER), maintenance energy requirement (MER) and the final energy consumption of individual companion animal in 2015. The error bar means standard deviation (SD).

In order to reduce overfeeding and food waste, Fig. 7.3 shows an overview of the feeding directions concerning different food types. The recommended food consumption for each diet was determined on the basis of MER.

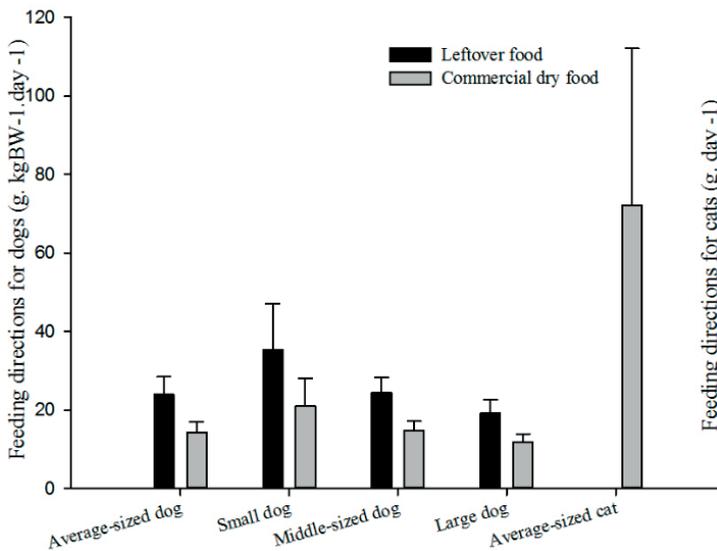


Figure 7. 3 Feeding directions regarding different food types. The error bar means standard deviation (SD).

7.4 Discussion

Growing evidence has revealed that owning one or more pets can increase owners' physical activity, decrease their loneliness and improve their sense of physical and psychological well-being (Cutt, et al. 2007, Dotson & Hyatt 2008, Qureshi, et al. 2009, Wood, et al. 2015). Nonetheless, we should not deny or neglect their negative impacts on the national and global environment. The purposes of performing Chinese companion animals' dietary EPP and carbon emissions in the present study were (1) to have a clear view of their food consumption, (2) to investigate their ecological impact and (3) to raise their owners' awareness of environmental protection and animal well-being. The results indicate that dogs and cats consumed a significant amount of food and energy, resulting in negative environmental impacts such as the huge carbon emissions. This is particularly true given increasing companion animal numbers in China and the higher nutritional content of companion animal food (Okin 2017, Swanson, et al. 2013). Measures that would considerably reduce companion animals' environmental impacts should be discussed.

7.4.1 Ecological paw print

Due to the higher percentage of animal products in commercial dry food, the dietary EPP of an individual dog relying on such food was found to be much higher than that of an individual dog relying on leftover food. The estimated companion dog population in China was 27.4 million in 2015 (MIIT 2015). Assuming all these dogs eat human leftover food, then their dietary EPP was 3.1 to 14.5 million ha per year, which was equivalent to 0.4% to 1.7% (5.0 to 23.4 million) of Chinese people's dietary EF, while this number would increase to 2.6% to 13.5% (36.5 to 185.8 million) of Chinese people if assuming all these dogs eat commercial dry food. Therefore, it is clear, at least for countries with a large number of animal populations like China, that the consumption by companion animals should be considered when measuring national environmental performances (Okin 2017). A large variation of dietary EPP was also found among different sizes of dogs. Thus, care must be taken when measuring the dietary EPP of different sizes of dogs. Inconsistent with a previous study showing that the dietary EPP for a small dog relying on commercial dry food was 0.09 to 0.18 ha while for a middle-sized dog (15kg) was 0.48 ha (Vale & Vale 2009), our results demonstrated that the dietary EPP of a small dog relying on commercial dry food was 0.10 to 1.23 ha, while for a middle-sized dog was 0.68 to 3.75 ha. One possible explanation might be that our study was conducted six years later, and the EPP is a dynamic indicator because the resource consumption of companion animals and the nutritional content of animal food would change over time (Ou & Tan 2013). Notably, an important caveat for the calculations of the dietary EPP of dogs is that the source of the data and mode of calculation are dramatically different. Therefore, it is not surprising that the results may be systematically different.

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Considering that a detailed calculation was provided in the present study, with market-wide knowledge of pet food and direct data on food consumption, we think our findings are more representative of dogs' actual food consumption and environmental impacts.

With regard to companion cats, our results indicate that total companion cats' dietary EPP was equal to 2.5% to 4.3% (33.9 to 59.2 million) of Chinese people's dietary EF, or 0.1% to 0.2% (1.7 to 2.9 million) of Chinese people's whole EF according to the data from a previous study (Venetoulis & Talberth 2008). The dietary EPP of an average cat relying on commercial dry food was 0.36 to 0.63 ha, which is basically in accordance with previous findings (Vale & Vale 2009) reporting that the dietary EPP of an average cat was 0.3 ha. An explanation of the similar results is that we used the same approach (according to the fresh chicken that an individual cat consumed, rather than dry chicken) to calculate the dietary EPP of companion cats. Cats have a smaller appetite than dogs, which might be another reason to explain the fact that cat's dietary EPP would not change too much over time.

The gap between urban and rural areas is one of the most significant characteristics of contemporary China and this gap directly influences household lifestyle including companion animals' feeding regimens (Su & Martens 2017). For instance, in rural areas, plant-based leftover food and even by-products from agriculture (crop residue and straw) are often used to feed household animals, and the malnutrition problems exist among many companion animals (Li & Davey 2013). Commercial dry food and leftover food with both plant and animal-based products are more commonly used to feed companion animals in urban areas than in rural animals, and the phenomena of food waste and overfeeding in urban areas are more serious than that in rural areas. These different husbandry activities between rural and urban areas will lead to different dietary EPP of companion animals. However, in this study, only 4% of the surveys originated from rural areas probably due to limited internet access in such places, people's reluctance to respond and their relatively lower level of education (Su & Martens 2017). This would to some extent bias our results. Yet, considering that dogs and cats in rural areas are generally viewed as working animals and have roles in civilian security and pest control (Cao 2015, Headey, et al. 2008), we feel that the influences of unbalanced samples are minimal and can be reasonably neglected.

7.4.2 Carbon emissions

Companion animals' food consumption is often neglected by their owners and researchers, although it actually contributes to a significant proportion of carbon emissions. Our results demonstrate that due to the higher meat content, carbon emissions derived from animals' commercial dry food were higher than that from leftover food. As calculated, the carbon emissions from commercial dry food consumption by all companion dogs and cats in China were equal to 2.5% to 7.8% (34.3

to 107.1 million) of Chinese people's dietary carbon emissions. The increasing pet ownership in contemporary China may also serve to increase the potential carbon emissions of pet dogs and cats (Okin 2017).

Meat plays a large role in determining the environmental impact of an individual animal's diet. It could be argued that dogs and cats eat meat that humans cannot consume and which is simply a byproduct of production for human use, and therefore should not be counted when calculating their carbon emissions (Okin 2017). However, many ingredients (e.g., chicken liver) in pet food can certainly be edible after processing (Okin 2017). The trend toward premium pet food with more animal products that Chinese people would recognize as edible indicates that companion animals are eating animal products that could also be eaten by humans (Okin 2017). This reminds us that a direct competition of some ingredients exists between animal food and human food systems (Swanson, et al. 2013), and therefore companion animals' food-derived environmental impacts cannot be neglected. Inasmuch as increasing animal production is a threat to Chinese and even global environment, the non-negligible contribution of dogs and cats compounds the problem and exacerbates the threat to sustainability posted by human consumption (Okin 2017, Tilman, et al. 2011, Tilman & Clark 2014). The results from the present study suggest that additional research is needed to evaluate the animal content and human-edibility of ingredients in dog and cat food after processing. The calculations presented here indicate that companion animals comprise a significant proportion of total energy and animal product consumption in China, with a considerably great impact on carbon emissions (Tilman & Clark 2014). Additionally, since many dogs and cats in rural areas are not registered and licensed, we suppose the environmental impacts by companion animals would increase dramatically if including all companion animals in rural areas, although their owners prefer to feed them more plant-based food than animal-based food.

7.4.3 Energy requirement

In view of that RER does not consider animal gender, age, size or activities (Fleeman & Owens 2007), we provided both RER and MER in the present study. Interestingly, there might be some floor effects that made small and middle-sized dogs' minimum energy consumption lower than their minimum MER, but our results demonstrate that some companion animals, particularly middle-sized and large dogs, consumed more food than their actual needs to keep normal activity. This may directly lead to animal obesity, which is not only associated with numerous diseases, but also with resource consumption and environmental degradation. For overweight or obese companion animals, the extra weight would require more calories and the environmental impacts due to overfeeding would be more severe. This also reminds us that the environmental degradation resulted from overweight and obesity should also be quantified in the future studies, especially for those will be conducted in countries with many obese

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companion animals. It also indicates that greater calorie restriction is necessary to keep companion animals' standard body weight and simultaneously reduce their energy consumption and environmental impacts.

Fortunately, companion animal obesity in China is not as common as that in developed countries, but a trend is seen towards higher energy consumptions by companion animals. Therefore, efforts to reduce overfeeding and food waste should be considered in order to reduce their environmental impacts. However, many companion animal owners and even veterinarians rely on the recommendations in a pet food's label (Linder & Freeman 2010). However, based on consumer demand, many commercial pet goods are formulated to provide excessive nutrients, resulting in overfeeding, energy waste and animal obesity. To ensure both human society and pet ownership can be sustained in the future, the pet food industry should provide accurate information about the nutrition and portion sizes of pet food, and guarantee that the pet food should be economically affordable and culturally acceptable, and should effectively satisfy the needs for the good health of animals as pets.

It should be mentioned that diet selection and control of calories from animal diets are important, but they are not the only two components for a healthy weight control intervention (Linder & Freeman 2010). Companion animals vary greatly in their energy requirements, and it is necessary to adjust feeding recommendations for each animal (Linder & Freeman 2010). This requires companion animal owners to pay more diligent attention to their animals' activity and health condition. Pet food is a major source of calories for companion animals. Therefore, pet food companies could assist in improving pet health by developing foods with appropriate caloric density on a volume basis, and making more accurate and specific feeding directions regarding animal size, age, breed and activity (Linder & Freeman 2010, Swanson, et al. 2013). The information this study provides should be of use to Chinese pet owners, veterinarians and pet food manufacturers, in understanding the energy and nutritional requirement of companion dogs and cats.

7.4.4 Indicator analysis: use of the ecological paw print in animal welfare and sustainable development

Scientific evaluation of companion animals' dietary EPP, energy requirement, and environmental impacts can provide valuable insights to pet owners and policymakers so that the awareness of animal welfare can be improved and the sustainable development patterns can be recognized (Geng, et al. 2014). According to our study, close attention should be paid to the feeding directions of different food types, which are related to both environmental degradation and animal health. By comparing companion animals' energy requirement and consumption, owners can be reminded to consider their animals' health conditions, which is good for improving the awareness of animal welfare (Su & Martens 2017). Since animal-based products, compared to plant-

based products, have considerably greater impacts on the environment, some companion animal owners are suggested to feed their animals with more plant-based food, or human leftover food which includes less animal-based products than commercial dry food. However, due to the nutrient deficiencies and food safety issues, the plant-based food and human leftover food may lead to health risks to companion animals, such as the long-term complications varying from the poor skin to chronic diarrhea (Laflamme, et al. 2008, Weeth 2013). Therefore, when caring for companion animals' food consumption and the environmental impacts, owners and policymakers should focus on animal welfare, based on which the approaches of low dietary EPP and carbon emissions should be emphasized in feeding regimens and mitigation policies (Xu, et al. 2016).

The number of dog- and cat-owning households is increasing in China, and at the same time, there is an increasing trend in the high nutritional content of pet food. As a possible consequence, obesity will become a major problem among companion animals in China.

Therefore, the pet food industry should start to confront the issue of the sustainability of feeding pets through advances in product design and manufacturing in order to avoid overfeeding and food waste (Okin 2017). Additionally, future energy policies should be oriented toward encouraging recycling and finding alternative sources of protein (Okin 2017, Swanson, et al. 2013). We suppose such measures would reduce companion animals' environmental impacts. However, in order to drastically reduce their dietary EPP and environmental impact, other measures such as changing the food system, replacing large animals with small ones which can provide the same emotional benefits to humans and reducing companion animal numbers should be considered.

7.4.5 Limitation of this study

This research is the first to examine the dietary EPP, carbon emissions and energy requirement of companion dogs and cats in China. Hence, it inevitably involves some limitations. For example, there is quite a bit of uncertainty regarding the exact amount of food (particularly leftover food) eaten by companion animals. Many Chinese companion animal owners give their animals leftover food mixed with dry food or prepare pure meat food (or commercial canned food) when their animals are sick or when they are bored with the normal food (i.e., leftover food and dry food). It is not possible for respondents to provide the accurate percentages of different food types. This may result in the uncertainty dietary EPP of an individual companion animal. However, in the present study, we analyzed companion dog and cat's EPP regarding each food type, which has primarily addressed this problem. Additionally, asking respondents to provide the exact body weight of their companion animals is very difficult if we want to collect more samples. Therefore, we provided three possible body

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weight ranges to respondents, and consequently, the results of EPP, carbon emissions and energy requirements were also displayed as ranges. In order to cover all the possible answers and simultaneously make the calculation possible, we provided the minimum body weight and food consumption per unit body weight, as well as the maximum body weight of companion animals. This may lead to the larger ranges of the EPP, carbon emissions and energy requirement. Nevertheless, this also reminds us that research with specific values of body weight and resource consumption should be conducted in the future. Due to the manner of information collection, this research suffered from a somewhat unbalanced distribution of participants. For instance, the number of urban respondents was much higher than that of rural respondents. As we mentioned above, this might make our results of the dietary environmental impacts of companion animals are slightly more severe than the real scenario because most of the companion animal owners in rural areas prefer to feed their animals with more or even all plant-based leftover food. However, given that dogs and cats in rural areas are not generally viewed as companion animals (Headey, et al. 2008), this limitation can be reasonably neglected.

7.5 Conclusion

Animal companionship can benefit physiological, psychological as well as social aspects of human life. However, their contribution to the environmental degradation is crucial to sustainability and therefore should not be neglected. Calculating the dietary EPP and carbon emissions of companion dogs and cats in China is an important way to contextualize their different dietary choices in environmental protection. Our results showed that the dietary EPP and carbon emissions of an average-sized dog relying on commercial dry food were around eight and three times of the dog relying on human leftover food. Assuming all companion dogs and cats in China eat commercial dry food, then the dietary EPP of the total dogs and cats was equivalent to the dietary EF of 5.1% to 17.8% (70.3 to 245.0 million) of Chinese people in 2015. The annual food consumption of all these dogs and cats was responsible for up to 2.4-7.5 million tons carbon emissions, which was equivalent to the entire carbon emissions of 2.5% to 7.8% (34.3 to 107.1 million) of Chinese people in terms of food consumption in 2015. Additionally, our results demonstrated that many companion animals (especially large dogs) consumed more energy than their actual needs to keep normal activity, which will aggravate the household and even the national environmental burden.

This research developed an accurate and accessible method for companion animals' dietary EPP calculation and quantified the significant environmental impacts by investigating dietary carbon emissions. China has a large companion animal population, and the sustainable development of China will undoubtedly have a huge influence on the global development. Therefore, finding ways to reduce the entire resource consumptions by companion animals not only in China but also in other countries is

significant to the well-being of future generations. In China, animals' commercial dry food, compared to human leftover food, includes more animal products, requires more land and has greater environmental consequences in terms of carbon emissions. As pet ownership increases in China and trends continue in pet food towards higher percentages of animal products, pet ownership will definitely aggravate environmental degradation and exacerbate the threat to the sustainability. It is clear that a transition to companion animal owners that avoid overfeeding and food (especially animal product) waste would reduce the overall food consumption and the environmental damage in China. Our findings demonstrate that animal (dog) size is significantly correlated with food and energy consumption, the smaller the animals, the lower the dietary EPP and carbon emissions. Therefore, replacing large dogs with small dogs or cats that offer similar health and emotional benefits would considerably reduce their environmental impacts (Okin 2017).

Findings from this study imply that quantifying companion animals' dietary EPP and carbon emissions is an important step toward exploring their environmental impacts. This will improve owners and even all Chinese people's awareness of sustainability and ultimately promote the whole country's sustainable development. Yet, quantifying the precise relationship between companion animals' food consumption and their environmental impacts needs owners to provide the detail information of their animals' food consumption, body weight, and activity level. Research with specific values of these variables, therefore, should be conducted in the near future. Besides food consumption, companion animals also need water, living spaces, entertainment, health care and other resources and services, which would dramatically exaggerate their environmental impacts. Hence, a broader quantification of companion animals' all aspects of resource consumptions is needed to be designed and tested. Another interesting avenue for future research is using the framework of the dietary EPP to assess the relationship between the environmental impacts and the food consumption by other animal types, such as farm animals, wild animals, zoo animals, working animals and laboratory animals. Additionally, we should admit that there is no single evaluation approach can present all dimensions of sustainability (Geng, et al. 2014). It may be necessary to integrate EPP analysis with other evaluation frameworks so that more scientific sustainable approaches can be addressed for minimizing resource consumption and simultaneously maximizing the sustainability of a country as a whole. Despite the difficulties inherent in studying animals particularly companion animals' environmental impacts; we believe such research is necessary if we wish to make sense of the manner in which other species are related to the environmental world.

Chapter 8

Environmental impacts of food
consumption by companion dogs and cats in
Japan

“A man can live and be healthy without killing animals for food; therefore, if he eats meat, he participates in taking animal life merely for the sake of his appetite. And to act so is immoral.”

Leo Tolstoy, 1892

Abstract

In Japan, there are more than 20 million companion dogs and cats that consume resources. Yet, little is known about their environmental impacts and the related energy policies aiming to reduce such impacts. In this study, we quantified Japanese companion dogs and cats' environmental impacts regarding their food consumptions. More specifically, we analyzed their dietary “ecological paw print” (EPP), greenhouse gas (GHG) emissions and energy consumption. Our results showed that the dietary EPP of an average-sized dog was 0.33 to 2.19 ha per year, which was equivalent to one Japanese people's dietary “ecological footprint” (EF) in a year. The dietary EPP of an average-sized cat was lower with 0.32 to 0.56 ha per year. All companion dogs and cats in Japan could consume about 3.6% to 15.6% of the amount of food that Japanese people do and release 2.5 to 10.7 million tons of GHG through their diet in a year. Many companion animals (particularly medium-sized and large dogs) consumed more energy than they actually needed to sustain their normal activity. By providing direct data on food consumption, this study gained an insight into the future of possible energy policies to reduce Japanese companion animals' environmental impacts.

This chapter was written in collaboration with Pim Martens, and has been resubmitted to the Journal of Ecological Indicators.

8.1 Introduction

Achieving sustainability has become an issue of global concern for policy and decision makers as a result of the realization of the impacts the activities of humans have on the environment (Alshuwaikhat and Abubakar 2008). Sustainability can be described as providing sufficient energy and resources required to maintain good health in a population without compromising the ability of future generations to meet their resource needs (Mani et al. 2016, Ahmadi et al. 2017). Over the last few decades, Japan has witnessed a substantial growth in its economic development, which, in turn, has increased the national demand for energy. Therefore, Japan has also witnessed a large environmental degradation problem (Rafindadi 2016). While the nexus of the relationship between environmental degradation and energy consumption has been thoroughly studied by Japanese researchers (Galli et al. 2014, Iguchi and Koga 2015, Lilja et al. 2015, Rafindadi 2016), very few studies have been conducted documenting animals especially companion animals' environmental impacts and their correlation with sustainable development.

Dogs and cats are the two most common household companion animals and they are an integral part of the human society in Japan (Su et al. 2018). They play an important role due to their positive impact on both the psychological and physical health of people with whom they have contact (Swanson et al. 2013, Su and Martens 2017). Psychological benefits include reducing stress levels, increasing self-esteem in children and adolescents and decreasing depression associated with spousal loss. Physical benefits include increasing physical activity, reducing blood pressure and risk of heart disease and decreasing medical expenses (Allen et al. 1991, Serpell 1991, Headey 1999, Headey et al. 2002). For companion animal owners, feeding is a significant way of demonstrating a caring and loving relationship with their animals (Fleeman and Owens 2007). Many companion animal owners prefer to give their animals nutrients in excess of minimum recommendations, or use ingredients that compete directly with the human food system, which presents challenges in optimizing the sustainability of the pet food system and pet ownership (Swanson et al. 2013). Therefore, it is imperative to quantify companion animals' environmental impacts and evaluate how the pet food system can sustainably support the nutrition of the growing population of companion animals not only in Japan but also in other countries.

The "Ecological Footprint" (EF) is a mature aggregated indicator of environmental sustainability (Rees 1992, Wackernagel 1994, Wackernagel and Rees 1998). It is often used for the analysis of human demand on natural resources and it capsulizes a wide range of environmental data into a single indicator (Ulucak and Lin 2017). According to its definition, the EF is the amount of land that would be required to provide the resources and absorb the emissions of humanity (Wackernagel and Rees 1998, González-Vallejo et al. 2015). The dietary "Ecological Paw Print" (EPP) was

originated from the EF, and it indicates the amount of land that would be required to provide the food resources for animals.

In Japan, there are more than 20.3 million companion dogs and cats that consume, as a significant portion of their diet, animal products and thus potentially constitute a considerable dietary EPP, greenhouse gas (GHG) emission and energy consumption (Keyzer et al. 2005, Swanson et al. 2013, Mullis et al. 2015, Okin 2017). Animal production, compared to plant crops, requires greater land to produce equivalent protein energy and contributes to more GHG emissions and soil erosion (Wirsenius et al. 2010, Tilman et al. 2011, Okin 2017). Given the significant environmental impact of meat production, prior studies have reported the enormous energy requirement of dogs and cats (Bermingham et al. 2010, Swanson et al. 2013, Bermingham et al. 2014, Mullis et al. 2015, Okin 2017). Results showed that the resource consumption by dogs and cats could result in significant environmental impacts, such as GHG emission and feces production. The energy consumption of dogs and cats in the United States is equivalent to one-fifth of the US population's energy consumption (Okin 2017). Further studies show that the EPP of a cat is equal to 2% of the average British person's EF (Ravilious 2009), while the dietary EPP of some large dog breeds is as high as the EF for individuals in some undeveloped countries in the world (Vale and Vale 2009, Schwartz 2014). Additionally, due to the overfeeding, animal obesity has become a common health problem of dogs and cats, with the consequence of food waste and environmental degradation (Fleeman and Owens 2007, Linder and Freeman 2010, Swanson et al. 2013, Okin 2017). Nevertheless, very few studies aim to investigate the dietary EPP and GHG emissions of companion animals from energy policy perspectives, particularly in Asian countries, such as Japan.

This study was designed to quantify the dietary EPP, GHG emissions, and energy requirement for companion dogs and cats in Japan. The goal of this study was to evaluate the scale of these animals' dietary resource consumption and to gain an insight into the future of possible energy policies in order to reduce their environmental impacts. The number of companion dogs and cats is increasing in Japan, and simultaneously a trend toward increasing meat quantity and quality in pet foods has occurred. As a possible consequence, the potential environmental impacts of companion dogs and cats might increase, which will eventually influence Japanese sustainable development in a negative way. Through this study, we aim to improve companion animal owners and even the whole Japanese people's awareness of environmental protection, to provide policy recommendations, and to balance companion animals' mission in emotional value creation and influence on environmental degradation.

8.2 Methods

8.2.1 *The dietary ecological footprint (paw print) of companion dogs and cats*

The method used to calculate the dietary EPP of companion animals in Japan was the componential method based on the calculation of the EF (Wackernagel and Rees 1998). The EF is an indicator for quantifying man-land relations from the perspective of human consumption and is therefore a demand-side calculation method (Feng 2014). Calculating the EF from the perspective of population consumption demand is one of the most important components of the “Ecological Footprint Analysis” (EFA) approach (Feng 2014, Miao et al. 2016). The EFA has been used widely for fundamental studies of sustainable development (Lambrechts and Van Liedekerke 2014, Liu et al. 2017) and it categorizes bio-productive land into six types: arable land, grazing land, forest land, fishing grounds, built-up land and energy land (Wackernagel and Rees 1998, Geng et al. 2014). Companion animals’ dietary EPP calculation is based on per capita (dog/cat) commercial dry food consumption. Considering that chicken is commonly used as the main source of protein and fat, while cereal (maize, wheat and rice) is the main source of carbohydrate in animal food in Japan, we only considered arable land and grazing land when calculating the EPP in the present study.

To simplify the calculation process, we assumed that the crude protein and fat were from chicken, and the carbohydrate was from cereals. We used the raw chicken and cereal in the calculation process, and the equation of the raw chicken and cereal is as shown below:

$$R_i = \frac{I_c \times F}{I_r} (i = 1, 2)$$

Where,

i = the number of consumption items; R_i = raw ingredients of item i (kg); I_c = percentage of ingredients in commercial food; F = total food consumption (kg); I_r = percentage of ingredients in raw food.

According to the data from the Food Composition Databases, The United States Department of Agriculture (USDA), the average percentages of protein and fat in raw whole chicken are 17.33% and 17.98%, while the average percentage of carbohydrate in raw cereal is 73.3%. The proprietary nature and incredible variety of pet food recipes make an exact calculation impossible (Okin 2017). Hence, calculations in this part were made on the assumptions that 1) the weight of protein and fat in raw chicken and carbohydrate in raw cereal did not change during the process of industrial production (the conversion rate is one to one) and 2) these raw ingredients make up nearly all of the mass of the pet food.

The main steps of the EPP calculation method are as follows:

First, the per capita EPP component of each consumption item should be calculated by the equation below (Du et al. 2006):

$$A_i = C_i/Y_i \quad (i = 1, 2)$$

Where,

i = the number of consumption items; A_i = per capita EPP component of item i ; C_i = per capita consumption of item i (kg); Y_i = a yield factor for the i th type of land, it represents the annual average productivity in the world of item i (kg/ha).

Then, the equation of the per capita EPP is as shown below (Du et al. 2006, Liu et al. 2017):

$$EPP = \sum_{i=1}^n r_i A_i$$

Where,

r_i is the equivalence factor.

To align the measurement units, the two land types should be converted using an equivalence factor. The equivalence factor is the ratio of the average productive capacity of an area and the world (Wackernagel et al. 1999, Liu et al. 2017).

8.2.2 The greenhouse gas (GHG) emission

The GHG emission is related to global warming and climate change (Francke & Castro 2013), and it is often used to assess the impact of human activities on the environment (Qu & Li 2013). Companion animals also contribute to GHG emissions through their energy-related behaviors, such as eating and residing. In the present study, we mainly focused on their GHG emissions from food consumption.

The per capita GHG emission of companion animals is calculated as follows (Xu & Lan 2017):

$$GHG = \sum I_i \times EI_i$$

Where,

i is the items of the food inputs, I_i is the food inputs of item i (kg), EI_i is the GHG emission intensity for the food commodities (kg CO₂/kg) (Table 8.1).

Table 8. 1 Greenhouse gas (GHG) emissions for the food commodities (Gerber, et al. 2013, Nemecek, et al. 2012)

Food category	GHG emission intensity (kgCO ₂ eq/kg)
Poultry Meat	5.40
Cereal	1.15
Maize	0.49
Wheat	0.58
Rice	2.38

Note: the GHG emission of cereal was the average score of maize, wheat and rice.

8.2.3 The energy requirement

The Resting Energy Requirement (RER) and the Maintenance Energy Requirement (MER) are calculated by the equations we mentioned in chapter 7.

The following is a guide to the calculation of MER for companion dogs and cats.

For companion dogs (Fleeman & Owens 2007, Linder & Freeman 2010, Thatcher, et al. 2010):

$$MER_{dog} = 1.39 \times RER$$

For companion cats (Flynn, et al. 1996, Jones & Ackerman 2016, Linder & Freeman 2010, Thatcher, et al. 2010):

$$MER_{cat} = 1.27 \times RER$$

The coefficients of MER (1.39 for dogs and 1.27 for cats) were calculated according to the results from Linder and Freeman (2010).

8.2.4 Data collection

The paper-based and online questionnaires were distributed throughout Japan in 2015. The paper questionnaires (n = 146) were conducted using the authors' networks by means of snowball sampling (Goodman 1961), while the online questionnaire (n = 400) was conducted via Cross Marketing, one of the pioneer research companies in Japan, by means of simple random sampling (Tillé 2006). A total of 546 dog and cat owners were obtained throughout all the 47 prefectures of Japan. In the questionnaire, respondents were asked to supply information about their companion animals' basic characteristics (species, breed, gender, size, age, neutered status and health conditions), as well as their husbandry practices (How often and how long do you go for a walk with your dog?; How often does your cat go outside?; How often and how much do you feed your dog or cat?). Respondents were also asked whether they have other pets, and how many years they have owned their pets.

Additionally, we reviewed the secondary sources of information from the Japan Statistical Yearbook, government reports, statistical reports, published papers, international organizations and web pages. The nutritional components and calorie content of commercial animal food (see Table 8.2) were calculated according to the data from Purp Corporation and ten reputed animal food brands (Iams, Science diet, Jiwi Peak, Schupremo, Super gold, Natural choice, Pinnacle, Pro Plan, Eukanuba and Royal Canaan) in Japan.

Chapter 8

Table 8. 2 The percentage of ingredients and the calorie content in commercial animal food (chicken-based)

	Dog food	Cat food
Protein (%)	25.67	26.00
Fat (%)	14.67	7.50
Ash (%)	8.00	8.00
Fiber (%)	3.83	6.25
Moisture (%)	10.00	10.00
Carbohydrate (%)	37.83	42.25
Calorie (kcal/kg)	3533.3	3445.0

Note: data were calculated according to the information from ten reputed animal food brands in Japan.

Data on land use for average productivity and equivalence factors were taken from the United Nations Food and Agriculture Organization (FAO), National Bureau of Statistics and published papers (Table 8.3) (Liu, et al. 2017, Shi, et al. 2015, Wackernagel, et al. 1999, Wackernagel & Rees 1998). These factors were used to calculate EPP components of grazing land and arable land.

Table 8. 3 The annual average productivity and equivalence factor of different land types

Items	Annual productivity	average	Equivalence factor	Land type
Poultry	33		0.5	Grazing land
Cereal	2744		2.8	Arable land

8.3 Results

8.3.1 Animal demographics

In total, 546 completed surveys were received (63.0% from dog owners and 37.0% from cat owners). The information that we collected from companion dog and cat owners includes their animals' species, gender, age, size, food consumption, health condition, sterilization condition and activity time (Table 8.4).

Environmental impacts of food consumption by companion dogs and cats in Japan

Table 8. 4 Companion dogs and cats' basic information of gender, age, size, food consumption, health condition, sterilization condition and activity time

	Dog: N (%)	Cat: N (%)
Animal species	344 (63.0)	202 (37.0)
Gender		
Male	198 (58.4)	90 (44.6)
Female	141 (41.6)	111 (55.0)
Age		
< 5 years	73 (21.2)	64 (31.7)
5-10 years	151 (43.9)	66 (32.7)
> 10 years	120 (34.9)	72 (35.6)
Size		
Small (1.5-10kg) ^①	226 (41.4)	–
Medium-sized (10-25kg)	96 (17.6)	–
Large (25-59kg) ^②	22 (6.4)	–
Food consumption		
Dog: < 10g.BW ⁻¹ .day ⁻¹ ^③ ; Cat: < 50g.day ⁻¹ ^④	115 (35.4)	40 (20.7)
Dog: 10-25g.BW ⁻¹ .day ⁻¹ Cat: 50-100g.day ⁻¹	126 (38.8)	89 (46.1)
Dog: > 25g.BW ⁻¹ .day ⁻¹ Cat: > 100g.day ⁻¹	13 (4.0)	10 (5.2)
No idea	71 (21.8)	54 (28.0)
Health condition		
Good	195 (56.7)	110 (54.5)
Fair	133 (38.7)	86 (42.6)
Bad	16 (4.7)	6 (3.0)
Sterilization conditions		
Neutered	180 (53.4)	177 (87.6)
Sexually intact	157 (46.6)	25 (12.4)
Activity		
Dog: < 1 hour, Cat: Never	267 (80.7)	152 (75.2)
Dog: 1-2 hours, Cat: Sometimes	57 (17.2)	23 (11.9)
Dog: > 2 hours, Cat: Whole day	7 (2.1)	26 (12.9)

Note: ^①The Chihuahua is the smallest dog breed in the world (as well as in this study) (Knowler, et al. 2017) and The Fédération Cynologique Internationale (FCI) standard state that an adult Chihuahua in general not weight less than 1.5kg. Therefore, we set the minimum value for dog weight as 1.5kg. ^②The Akita is the largest dog breed in our study, and an adult Akita generally not weight more than 59 kg (American Kennel Club). Therefore, we set the maximum value for dog weight as 59kg. ^③The minimum resting energy requirement for a companion dog is 25.3 kcal.kgBW⁻¹.day⁻¹, which means Japanese dog owner should give their dog at least 7 g. kg BW⁻¹.day⁻¹ of chicken-based dry food to keep their dog in good or fair health condition (95.3 % respondents reported their dog's health condition as good or fair). Therefore, we set the minimum value for dog food consumption as 7 g. BW⁻¹.day⁻¹. ^④The minimum resting energy requirement for a companion cat is 117.7 kcal.day⁻¹, which means Japanese cat owner should give their cat at least 34 g.day⁻¹ of dry food to keep their cat in good or fair health condition (97% respondents reported their cat's health condition as good or fair). Therefore, we set the minimum value for cat food consumption as 34 g. day⁻¹.

8.3.2 The individual dietary ecological paw print and greenhouse gas emissions of companion dog and cat in Japan

Our results showed a range of dietary EPP and GHG emissions of companion dogs and cats regarding their commercial dry food (Table 8.5). On the whole, dogs (particularly medium-sized and large dogs) have a larger impact than cats, both in terms of dietary EPP and GHG emissions. Dog's size has an important impact on food consumption, as well as the dietary EPP and GHG emissions, the larger the dogs, the more the food consumption and the stronger the environmental impacts. Assuming the average lifespan of a dog is 12 years and a cat is 14 years, then the dietary EPP of an average-sized dog and cat in their lifetime is 4.01 to 26.28 ha and 4.46 to 7.80 ha, which is responsible for the release of up to 1.52 to 9.97 and 1.69 to 2.96 tons CO₂e GHG, respectively (Table 8.6).

Table 8. 5 Individual pet's annual food consumption, ecological paw print (EPP) and greenhouse gas (GHG) emissions regarding commercial dry food in Japan (2015)

	Food consumption (Kg/year)	EPP (ha/year)	GHG emissions (ton CO ₂ e/year)
Dog			
Average-sized dog	18.75-122.80	0.33-2.19	0.13-0.83
Small dog	5.04-60.83	0.09-1.09	0.03-0.41
Medium-sized dog	35.19-191.35	0.63-3.41	0.24-1.29
Large dog	96.38-498.00	1.72-8.88	0.65-3.37
Cat			
Average-sized cat	17.88-31.25	0.32-0.56	0.12-0.21

Note: Commercial food was calculated without moisture; Small dog: 1.5~10kg, Medium-sized dog: 10-25kg, Large dog: 25-59kg, Average dog: 10.9-29.5 kg, Average cat: 2-6kg.

Table 8. 6 Individual pet's lifetime food consumption, ecological paw print (EPP) and greenhouse gas (GHG) emissions regarding commercial dry food in Japan (2015)

	Food consumption (Kg)	EPP (ha)	GHG emissions (ton CO ₂ e)
One dog (lifetime 12 years)	225.00-1473.60	4.01-26.28	1.52-9.97
One cat (lifetime 14 years)	250.32-437.50	4.46-7.80	1.69-2.96

8.3.3 The total dietary ecological paw print and greenhouse gas emissions of Japanese companion dogs and cats

According to the latest survey data from Japan Pet Food Association, there were 10.35 million companion dogs and 9.96 million companion cats in Japan in 2014. The estimated dietary EPP of all companion dogs and cats in 2014 in Japan was 6.6 to 28.3 million ha, which was responsible for up to 2.52 to 10.70 million tons of GHG emissions

(Table 8.7). The Japan Statistical Yearbook and the latest version of EUREAPA showed that the per capita dietary EF of Japanese people was 1.43 ha and the per capita GHG emissions regarding food consumption by Japanese people were 2.16 tons in 2004. Therefore, the total dietary EPP of dogs and cats was equal to the entire dietary EF of 4.62 of to 19.79 million Japanese people, while the GHG emissions of total dogs and cats were equal to 1.17 to 4.95 million Japanese people's GHG emissions regarding their food consumption.

Table 8. 7 The total food consumption, ecological paw print (EPP) and greenhouse gas (GHG) emission of Japanese companion animals

	Food consumption (million kg/year)	EPP (million ha/year)	GHG emissions (million ton CO2e/year)
Total dog	194.1-1271.0	3.4-22.7	1.31-8.60
Total cat	178.1-311.3	3.2-5.6	1.20-2.10

Note: The estimated dog and cat population in Japan was 10.35 and 9.96 million in 2014 (Japan Pet Food Association)

8.3.4 Companion animals' energy requirement

The results of the analysis regarding energy requirement and energy consumption by companion dogs and cats were presented in Table 8. Our findings showed that large dogs' energy consumption to a great extent exceeded their resting energy requirement. Most companion dogs, particularly medium-sized and large dogs, consumed more energy than they actually needed to sustain their normal activity, although there were some floor effects that made the minimum energy consumption lower than the minimum MER. The energy consumption by companion cats was sufficient to sustain their MER (Table 8.8).

Table 8. 8 The resting energy requirement (RER), maintenance energy requirement (MER) and energy consumption of companion dogs and cats in Japan in 2015

	RER/year (Kcal)	MER /year (Kcal)	Energy consumption/year (Kcal)
Average-sized dog	153271-323413	213047-449544	66249-433889
Small dog	34631-143678	48136-199713	17808-214931
Medium-sized dog	143678-285658	199713-397064	124337-676097
Large dog	285658-543914	397064-756040	340539-1759583
Average-sized cat	42970-97950	54572-124396	61597-107656

Note: Small dog: 1.5~10kg, Medium-sized dog: 10-25kg, Large dog: 25-59kg, Average dog: 10.9-29.5 kg, Average cat: 2-6kg.

8.4 Discussion

The Japanese national EF accounts show that household resource consumption is in a state of overshoot, demanding more capacity than the biosphere can supply each year. Companion animals provide important therapeutic, physiological and psychological benefits to humans and nowadays they are often regarded as family members by their owners (Okin 2017). Their various activities taking place within families exaggerate household resource consumption and have some serious direct and indirect impacts on the environment. The aims of the present study are to measure companion animals' environmental impacts caused by their food consumption by quantifying their dietary EPP, GHG emissions and energy requirement and simultaneously provide some suggestions on the possible energy policies to reduce such environmental impacts. Our results indicate that the huge number of companion dogs and cats in Japan contributes to a significant food consumption and environmental degradation. Reducing their resource consumption and environmental impacts requires complex strategies and decisions on how the total dietary EPP and GHG emissions need to shrink. Using quantitative approaches such as the dietary EPP, GHG emissions and energy requirement, targets can be set and progress measured towards reducing demand for land capacity (Kitzes, et al. 2008). Policy regulations such as impose tax burdens on owners, control companion animal numbers and encourage technological innovations on alternative energy sources would be considered as key driving forces for reducing companion animals' environmental impacts.

8.4.1 Dietary ecological paw print

An important way to assess the relationship between companion animals' food consumption and environmental degradation is through the concept of the dietary EPP. Our results demonstrate that one medium-sized dog's dietary EPP was even larger than one Japanese people's dietary EF and two medium-sized dogs or one large dog's dietary EPP was equivalent to one Japanese people's whole EF (5.25ha). This finding reveals that companion animals could consume a large amount of food resources, which are important components of household resource consumption and should be included when calculating the household EF and the national EF in Japan. Large dogs' food consumption is undoubtedly higher than small dogs and cats. Our results indicate that a large dog's dietary EPP is equivalent to around nine small dogs or 12 cats' dietary EPP. Both small and large animals have been demonstrated to be related to important benefits, such as companionship, friendship and opportunities to learn responsibility (Blue 1986, Kidd and Kidd 1998). Therefore, reducing the rate of large dog ownership and in favor of small dogs and cats that can offer similar benefits would be an efficient way to reduce the overall dietary EPP of companion dogs and cats in Japan.

According to our calculation, the dietary EPP of all companion dogs and cats was equivalent to 4.62 to 19.79 million Japanese people's dietary EF. In addition to the huge number of companion dogs and cats, the high percentage of animal products in pet food is another important reason for the high dietary EPP of companion animals in Japan. Animal production requires more land compared to plant crops to produce the same protein energy (Reijnders and Soret 2003). However, meat consumption, already high in human food, is still increasing in pet food. Previous studies indicate that meat alternatives (e.g., artificial meat, vitro meat) have the advantages of requiring less arable land and minimalizing the negative environmental impacts (Hopkins and Dacey 2008, Hocquette et al. 2015). Therefore, replacing animal products with alternatives might be a choice for pet food industry in the near future. The potential of the technological development and the need for investment in artificial meat and other meat alternatives should be emphasized in order to reduce animal products' negative impacts on the environment (Vinnari 2008). Additionally, according to our findings about the large range of the dietary EPP, we suppose overfeeding would exist among companion animal owners in Japan. To ensure feeding of appropriate amounts in order to avoid food waste and reduce the dietary EPP, we suggest owners using accurate methods to determine portion sizes such as with electronic scales (Bermingham et al. 2014).

In view of companion animals' significant impact on resource consumption and land use, we consider that scientific evaluation of companion animals' dietary EPP may provide valuable insights to policymakers so that sustainable development patterns can be recognized (Geng et al. 2014). The dietary EPP accounts as a detailed resource accounting tool can be used to analyze aggregate companion animals' pressure on ecosystems. Therefore, appropriate policies, such as changing animal food systems and finding alternative sources of protein, should be raised by considering companion animals' dietary EPP, nutritional requirement and environmental impacts.

8.4.2 Dietary GHG emissions

We examined the GHG emissions associated with companion animals' daily diets and the results demonstrate that all companion dogs and cats in Japan release 2.5 to 10.7 million tons of GHG through their diet in a year, which is equivalent to 1% to 4% (one to five million) Japanese people's environmental impacts according to their annual diet. These issues of companion animals' environmental pressure are easily neglected by researchers and decision makers. Yet, without any doubt, their continuously increasing ecological pressures will make management of demand on and supply of ecological capacity one of the central concerns in Japan and even the whole world (Kitzes, et al. 2008).

In order to guide further initiatives within companion dog and cat household operations, a set of scenarios should be developed in order to lower the GHG emissions.

Companion animal obesity can be defined as a condition of excessive energy storage, and it is quite a prevalent phenomenon in many developed countries including Japan (Courcier, et al. 2010). Actually, many companion animal owners' fairly restricted knowledge about the feeding directions results in their activity of overfeeding. Therefore, the scenarios pointed out that priority should be given toward overfeeding and food waste. Veterinarians play a critical role in optimal pet body weight by educating owners on the selection of appropriate pet food. They can provide specific knowledge on assessing animals' body and health conditions, according to which give recommendations about the amount to feed. Additionally, previous studies demonstrated that an animal consuming animal-based diets causes more GHG emissions than the GHG emissions associated with consuming the same number of calories, but from plant sources (Eshel & Martin 2006). Therefore, the environmental degradation caused by companion animals in form of food consumption could be considerably reduced by effective choices of reducing the percentage of animal products in animal food and replacing meat with plant-based or low-paw print animal products. Japanese government, social scientists and economists are encouraged to estimate how much of their ecological resource base will be required to shift Japanese people and animals' current trajectory onto a sustainable path within the ecological capacity of the country (Kitzes, et al. 2008).

8.4.3 Dietary energy requirement

The current literature that investigates the energy requirement of companion animals quantifies the relationship between overfeeding and obesity. Obesity is one of the most common health problems of companion animals (Linder and Freeman 2010). Recently, the prevalence of companion animal obesity has been increasing (German 2006, Linder and Freeman 2010), with studies showing that 22% to 40% of companion dogs are overweight (McGreevy et al. 2005). Our results reveal that most of the medium-sized and large dogs consumed more energy than they actually needed for their normal activity. Therefore, owners should give their animals food according to animals' size, activity and health condition because all these factors can influence animals' energy requirement (Bermingham et al. 2010, Bermingham et al. 2014). However, without specific calorie information on labels or guidance from veterinaries, it is difficult for owners to appropriately assess their animal's calorie intake or to feed their animals to achieve and maintain optimal body weight (Linder and Freeman 2010). Hence, we suggest pet food industries and veterinaries provide more accurate and specific feeding directions regarding animal size, activity, weight and health conditions.

Notably, some owners may feed their animal additional food, such as leftover food. Yet, owners should be aware of the danger of feeding additional food to their animals, and the portion of such additional food should be taken into account when determining animals' energy requirement in order to avoid overfeeding (Bermingham et

al. 2014). However, due to the growing number of companion animal population in Japan as well as in other countries of the world, the energy consumption by these animals would increase dramatically, even if companion animal owners pay more attention to their feeding activities to their animals. The challenge of satisfying the energy requirements of growing animal population, while at the same time shrinking their total dietary EPP in Japan, is daunting. It is the duty of not only the government but also the pet food industries and the companion animal owners to make the pet ownership sustainable. How to reduce companion animals' dietary EPP, therefore, is significantly important for the promotion of global sustainability for the benefit of all.

8.4.4 Options for policies to stimulate companion animals' sustainable resource use

The EPP directly affects the level of the environmental development. Decision makers concerned about the environmental impacts of companion animals should focus on how to reduce their EPP. Therefore, more government involvement and regulations seem necessary to accomplish this task because knowing whether policy implications permanently affect companion animals' environmental impacts is an important consideration in policy discussions (Ulucak and Lin 2017). The first premise of reducing companion animals' environmental impacts is to let owners know their animals' huge resource consumption. Therefore, the government and media should carry on a massive and extensive campaign to improve owners' awareness on issues about their animals' environmental impacts. The research aims to quantify animals' environmental impacts and improve sustainable development deserves to be the priority when making educational policy decisions. Taxation is an important basis of the energy policy (Vringer et al. 2016). In order to improve companion animal management and, to some extent, reduce their numbers, companion animal registration and tax should be included in the government tax system; the larger and the more number the companion animals, the more the tax. Such a tax differentiation could be part of a broad tax reform that the Japanese government is currently preparing. "Adopt Instead of Buying a Pet" should be a slogan of any individual who wants to own a pet and the government, as well as the media, should encourage this approach by proper policies (De Lavigne 2015). Veterinary as a professional practitioner should play a more comprehensive role in avoiding overfeeding and reducing companion animals' environmental impacts by providing specific information about animals' energy requirement. Hence, providing preferential policies (e.g., tax privileges) to improve veterinaries' enthusiasm would be a good choice for the government to reduce companion animals' energy consumption. Additionally, facilitating greater investment to encourage technological innovation in not only pet food industry, but also in agriculture production including finding alternative sources of meat and protein, is essentially important to reduce environmental impacts.

8.4.5 Limitations

Our study is the first to quantify the dietary EPP and GHG emissions of companion dogs and cats in Japan. Therefore, the calculations presented in this research are, without any doubt, characterized by some limitations. For instance, asking respondents to provide the exact body weight and food consumption of their companion animals is impossible if we want to achieve a large sample size. Therefore, we provided the minimum and maximum body weight, as well as the minimum food consumption per unit body weight, which resulted in the large range of dietary EPP, GHG emissions and energy requirement. However, these data are the best available source for the present EPP studies in Japan. Additionally, our calculations were based on companion animals' commercial dry food, while there were some owners may prepare pure meat food or other specific food for their animals. Hence, the accuracy of the assessment would profit from more detailed information, while this limitation has also revealed the need to deploy more precise quantitative methods in our follow-up research.

8.5 Conclusions and policy implications

This study quantified the environmental impacts of companion dogs and cats in Japan, with a focus on the dietary EPP, GHG emissions and energy consumption. Our results demonstrate that companion dogs and cats in Japan consumed a significant amount of food resources, resulting in negative environmental impacts such as the huge GHG emissions. Overfeeding and food waste might be a common phenomenon in dog- and cat-owning households in Japan, which inevitably aggravate the burden of environmentally sustainable development. Companion animals' negative impacts on the environment would be more evident with the increase of animal population and the decrease of the environmental capacity. It is recommended that reducing companion animal numbers, replacing large dogs with small dogs or cats and avoiding food waste and overfeeding would considerably reduce companion animals' environmental impacts.

To the best of our knowledge, this is the first study to approximate and quantify the dietary EPP and energy requirement of Japanese companion dogs and cats and evaluate their environmental impacts by analyzing GHG emissions. By utilizing market-wide knowledge of pet food and direct data on pet food consumption, we think our results are more powerful compared to the stochastic data in previous studies. This research contributes to the field of empirical research dealing with the relationship between companion animals and environmental issues and therefore can serve as a baseline for further sustainable development studies. Companion dogs and cats are important to humans because of their benefits on human physical and psychological health (Su and Martens 2018). Acknowledging their negative impacts on the environment does not mean neglecting their emotional bond with humans. Similarly,

the positive relationship between companion animals and owners may not be an acceptable reason for ignoring their negative environmental impacts (Rastogi 2010). Therefore, the government should re-construct their companion animal keeping policies, pet food industries should re-formulate their feeding directions and companion animal owners should re-think their husbandry activities in order to contribute to sustainable development at national and even global levels.

Chapter 9

Using ecological paw print analysis in food consumption of companion dogs and cats in the Netherlands

“Now I can look at you in peace; I don't eat you anymore.”

— Franz Kafka

“It is my view that the vegetarian manner of living, by its purely physical effect on the human temperament, would most beneficially influence the lot of mankind.”

Albert Einstein, 1930

Abstract

Quantitative environmental evaluation of food consumptions by companion animals suggests that the environmental impacts by companion dogs and cats are usually underestimated by researchers without market-wide knowledge of pet food and direct data on food consumption. The present study quantified companion dogs and cats' dietary “ecological paw print” (EPP, originated from “ecological footprint”, EF), greenhouse gas (GHG) emissions and energy requirement by analyzing the direct data from 1023 companion dog/cat owners in the Netherlands. Our results showed that the dietary EPP and GHG emissions of an average-sized dog were 0.90-3.66 ha per year and 0.349-1.424 ton per year, while the dietary EPP and GHG emissions of an average-sized cat were 0.40-0.67 ha per year and 0.150-0.251 ton per year. Owning a large dog could increase the household's annual EF and GHG emissions by 58% and 11.3%, respectively. Through food consumption, all companion dogs and cats in the Netherlands could consume about 2.94% to 8.89% of the amount of resource and release 0.6% to 1.7% of the amount of GHG emissions that Dutch people do in a year. Many medium-sized and large companion dogs in the Netherlands, China and Japan consumed more energy than they actually needed to sustain their normal activity, suggesting that overfeeding and food waste are common phenomena in dog-owning households (especially in the former two countries). The food consumption by companion cats was sufficient to offset their energy requirement among three countries. This study demonstrates that the food consumption by companion dogs and cats, although is different from country to country, contributes to a big portion of household environmental impacts. Further studies about the resource consumptions by companion animals from global levels are needed to confirm and clarify this point.

9.1 Introduction

Households are high consumers of resources and significant contributors to the environmental degradation through their direct energy consumption and broader indirect consumption in and outside of the home (Fielding, et al. 2016). A promising way to reduce household resource consumption and greenhouse gas (GHG) emissions is through the encouragement of more sustainable household patterns (Peters & Hertwich 2006). Reducing the current level of consumption is an important approach for controlling household environmental burden (Farber 2012). Specific strategies include reducing direct (e.g., household heating, cooling and nonbusiness transportation) and indirect (e.g., the purchase of products) individual energy consumption, making daily decisions about energy use (e.g., using cold water to wash clothes) and changing the ways in which family members use products (e.g., owning small companion animals instead of large ones). Companion animals are an integral part of the household and owning a companion animal has been regarded as a new lifestyle for populations (Amiot, et al. 2016). Yet, very few studies have been conducted documenting the contribution of companion animals when calculating household energy consumptions and environmental impacts.

According to the data from the Vetnosis and The European Pet Food Industry Federation (FEDIAF), there were 223 million registered companion dogs and 220 million registered companion cats in the world in 2014. In the Netherlands, there were 1.8 million companion dogs and 3.3 million companion cats that competing resources with 17.02 million Dutch people within around 42 thousand square kilometers of territory. Companion dogs and cats are carnivorous by nature, yet, they also play an important role in household and society (Rushforth & Moreau 2013). They provide a host of benefits to people including companionship, improved mental and physical health, as well as benefits for teenagers' development (Beverland, et al. 2008, Cutt, et al. 2007, Okin 2017, Wood, et al. 2005). Therefore, many companion animal owners regard their animals as family members and give their animals nutrients in excess of the minimum recommendations to show their caring and loving relationship (Fleeman & Owens 2007, Swanson, et al. 2013). This will undoubtedly increase companion animals and even the whole household's resource consumption and, to some extent, result in environmental degradation (Okin 2017). In light of this, it is critical to understand the resource consumption and the potential environmental impacts of companion animals.

The "Ecological Footprint" (EF) has been widely used as a tool to measure the "ecological assets that a given population requires to produce the natural resources it consumes and to absorb its waste" since it was first introduced by Wackernagel and Rees (1998). Households have proven to be at the origin of numerous pollutant activities on earth and remain the primary drivers of climate change (Larry Schwartz 2014). In order to sustain the daily energy requirement and normal activity, companion animals, as an important part of family, require a significant amount of resources and

simultaneously contribute to GHG emissions. Their contribution to the EF and GHG emissions of their owners thus cannot be ignored (Okin 2017, Rushforth & Moreau 2013). The “Ecological Paw Print”(EPP) and GHG emissions could therefore be good indicators in order to assess companion animals’ environmental impacts and more specifically to assess the portion of the environment necessary to produce the goods and services supporting companion animals’ basic life (Beynen 2015, Hammerly & DuMont 2012). The energy consumption of dogs and cats in the United States was demonstrated to be equivalent to one-fifth of the US population’s energy consumption (Okin 2017). Therefore, the individual and cumulative environmental impacts of pet food and the industry behind its manufacturing are significant, especially when considering the sheer volumes of pet ownership.

Considering that the EPP of companion animals is an important contributor to the EF of their household, more thorough studies should be carried out in order to further the understanding of the environmental impacts of pet ownership (Ravillious 2009, Rushforth & Moreau 2013). The food consumption (particularly animal products consumption) is the most significant part of companion dogs and cats’ EPP; it is therefore wise to develop in some details the impacts of pet food on the environment. In this research, we aimed to quantify Dutch companion dogs and cats’ environmental impacts by analyzing their dietary EPP, GHG emissions and energy requirement. Additionally, we also aimed to compare the similarities and differences of the environmental impacts by companion animals among countries of the Netherlands, China and Japan. As with the EF, quantifying the EPP could raise people’s awareness of resource consumption, clarify the correlation between companion animals’ food consumption and the environmental degradation and simultaneously advance sustainable development at a household and even national level. The usage of the EPP framework in the present study is an innovative and creative approach to quantify the environmental impacts of companion animals in the Netherlands and even the world.

9.2 Methods

The method used to calculate the dietary EPP of companion dogs and cats was originated from the EF, which is often used to measure humanity’s overall impacts on the nature, by analyzing six main categories of ecologically productive areas including arable land, grazing land, forest land, fishing land, built-up land and energy land (Fu, et al. 2015, Wackernagel & Rees 1998). Each of these land types has its own annual productivity and equivalence factor. In order to estimate and quantify the dietary EPP of companion animals regarding their commercial dry and canned food, two materials of consumption (chicken and cereal) were defined and, therefore, the arable land and grazing land were considered in the present study.

In this research, we mainly focused on companion dogs and cats’ food consumption. Data about animals’ basic information and owners’ husbandry activities

were collected from an online survey (in Dutch) by utilizing the networks of the authors. By means of snowball sampling (Goodman 1961) amongst cat and/or dog-owners, 1023 questionnaires were completed and returned. Data about the commercial food information were collected from the three most common supermarkets (Albert Heijn, Jumbo and ALDI) in the Netherlands. Data on global production, land use for average productivity and equivalence factors, which are used to calculate the dietary EPP components of arable land and grazing land, were taken from the United Nations Food and Agriculture Organization (FAO) and published papers (Liu, et al. 2017, Shi, et al. 2015, Wackernagel, et al. 1999, Wackernagel & Rees 1998). Individual and total companion dogs and cats' dietary EPP, GHG emissions and energy consumption in the Netherlands, together with the comparison with such findings from China and Japan, were included in the present study.

9.3 Results

9.3.1 The dietary EPP of individual companion dog and cat in the Netherlands

The dietary EPP of companion dogs and cats regarding their commercial dry food and minimum canned food consumption is presented in Table 9.1. The size of companion dogs is undoubtedly an important factor that could influence their food consumption and dietary EPP, the larger the dog, the more the food consumption and the higher the dietary EPP. Companion dogs (particularly medium-sized and large dogs) generally consumed more food and therefore had a higher dietary EPP than companion cats. The minimum dietary EPP of companion animals depending on commercial canned food was higher than the minimum dietary EPP of those depending on commercial dry food (Table 9.1).

Table 9. 1 The food consumption and dietary ecological paw print (EPP) of companion dogs and cats regarding their commercial dry food and minimum canned food consumption in the Netherlands (2014)

	Commercial dry food		Commercial canned food _{min}	
	Food consumption (Kg/year)	EPP (ha/year)	Food consumption (Kg/year)	EPP (ha/year)
Small dog	7.46-72.73	0.11-1.08	14.24-94.90	0.09-0.59
Medium-sized dog	55.47-206.23	0.82-3.05	94.90-237.25	0.59-1.46
Large dog	178.24-808.23	2.64-11.96	237.25-863.59	1.46-5.33
Cat	19.92-33.27	0.40-0.67	> 51.10	> 0.33

Note: commercial food was calculated without moisture; Small dog: 1.5-10kg, Medium-sized dog: 10-25kg, Large dog: 25-91kg, Average dog: 10-30 kg, Average cat: 2-6kg.

9.3.2 The GHG emissions of food consumption by individual companion dog and cat in the Netherlands

According to companion dogs and cats' food consumption, we calculated their GHG emissions. Our results showed that the GHG emissions of a large dog relying on commercial dry food was around 12 and 14 times of the GHG emissions of a small dog and a cat, respectively. Similar with the findings of the dietary EPP, the minimum GHG emissions of companion animals depending on commercial canned food was slightly higher than the minimum GHG emissions of those depending on commercial dry food (Table 9.2).

Table 9. 2 The greenhouse gas (GHG) emission (ton/year) of companion dogs and cats regarding their commercial dry food and minimum canned food consumption in the Netherlands.

	Commercial dry food	Commercial canned food _{min}
Small dog	0.043-0.419	0.032-0.212
Medium-sized dog	0.319-1.187	0.212-0.529
Large dog	1.026-4.652	0.529-1.925
Cat	0.150-0.251	> 0.117

9.3.3 The energy requirement and energy consumption of individual companion dog and cat in the Netherlands

According to companion animals' body weight, we calculated their resting energy requirement (RER) and maintenance energy requirement (MER). Our results showed that most of the companion animals depending on commercial dry food consumed more energy than their RER and all large dogs' energy consumption even exceeded their MER. The energy consumption by companion cats was sufficient to sustain their MER (Table 9.3).

Table 9. 3 The resting energy requirement (RER), maintenance energy requirement (MER) and energy consumption (kcal) of companion dogs and cats regarding their commercial dry food and minimum canned food consumption in the Netherlands.

	RER (Kcal)	MER (Kcal)	Commercial dry food consumption (Kcal)	Commercial canned food consumption _{min} (Kcal)
Small dog	34630-143678	48136-199713	23468-228794	12293-81922
Medium-sized dog	143678-285658	199713-397064	174498-648758	81922-204807
Large dog	285658-752787	397064-1046374	560707-2542530	204807-745494
Cat	42970-97950	54572-124397	67509-112752	> 42886

9.3.4 The different environmental impacts of companion dogs and cats in the Netherlands, Japan and China

In order to interpret the results of Dutch companion dogs and cats' environmental impacts, Table 9.4 and Table 9.5 showed an overview of per capita, per capita of the lifetime and total dietary EPP, GHG emissions and energy consumption of companion dogs and cats in three countries (i.e., the Netherlands, Japan and China). Our results showed that the dietary EPP of one companion dog relying on commercial dry food in the Netherlands and China was around two times of the dog relying on commercial dry food in Japan. Consequently, their GHG emissions/carbon emissions and energy consumption were also higher than those in Japan. China has the largest number of companion dogs among the three countries and the Netherlands has the least. Therefore, the dietary EPP, carbon emissions and energy consumption of all companion dogs in China were the biggest while such variables in the Netherlands were the smallest (Table 9.4).

With regard to cats, our results showed the dietary EPP, GHG emissions and energy consumption of per capita companion cat are similar in three countries. However, although the per capita environmental impacts were similar, their total environmental impacts were quite different. The total companion cats in China, due to their bigger numbers, consumed more resources and, to a large extent, contributed to a bigger environmental degradation than the companion cats in the Netherlands and Japan (Table 9.5).

Additionally, we also found that many companion dogs in the Netherlands and China consumed more energy than their actual needs, while the calorie intake of companion cats was sufficient to offset their energy requirement in all three countries.

Table 9. 4 The ecological paw print (EPP), greenhouse gas (GHG) emissions and energy consumption of companion dogs in the Netherlands, Japan and China.

		EPP (ha)	GHG emission (ton)	energy consumption (kcal)
Per capita average-sized dog	The Netherlands	0.90-3.66	0.349-1.424	190730-778114
	Japan	0.33-2.19	0.127-0.831	66249-433889
	China	0.82-4.20	0.313-1.592	160881-818935
Lifetime of one dog	The Netherlands	10.77-43.93	4.188-17.087	-
	Japan	4.01-26.28	1.522-2.959	-
	China	9.92-50.49	3.756-19.104	-
		(million ha)	(million ton)	(million kcal)
Total dogs	The Netherlands	1.62-6.59	0.608-2.480	-
	Japan	3.40-22.70	1.312-8.596	-
	China	22.6-115.2	8.576-43.621	-

Note: An average-sized dog weights 10-20kg; the RER for an average-sized dog is 143678-327516 Kcal, the MER for an average-sized dog is 199713-455247 Kcal; the estimated lifespan of a dog is 12 years; the estimated dog population is 1.8 million in the Netherlands, 27.4 million in China and 10.35 million in Japan in 2014.

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Table 9. 5 The ecological paw print (EPP), greenhouse gas (GHG) emissions and energy consumption of companion cats in the Netherlands, Japan and China.

		EPP (ha)	GHG emission (ton)	energy consumption (kcal)
Individual average-sized cat	The Netherlands	0.40-0.67	0.150-0.251	67509-112752
	Japan	0.32-0.56	0.121-0.211	61597-107656
	China	0.36-0.63	0.141-0.237	68384-114191
Lifetime of one cat	The Netherlands	5.62-9.39	2.102-3.511	-
	Japan	4.46-7.80	1.693-2.959	-
	China	5.04-8.82	1.974-3.318	-
		(million ha)	(million ton)	(million kcal)
Total cats	The Netherlands	1.28-2.14	0.480-0.803	-
	Japan	3.20-5.60	1.204-2.105	-
	China	20.90-36.60	8.192-13.770	-

Note: An-average-sized cat weights 2-6kg; the RER for an average-sized dog is 42970-97950 Kcal, the MER for an average-sized dog is 54572-124397 Kcal; the estimated lifespan of a cat is 14 years; the estimated cat population is 3.2 million in the Netherlands, 58.1 million in China and 9.96 million in Japan in 2014.

9.4 Discussion

Many studies in the literature which aim to analyze animals' environmental impacts and make policy recommendations regard animals' (particularly farm animals and livestock) energy consumption as a key indicator (Bermingham, et al. 2014, Bermingham, et al. 2010, Fleeman & Owens 2007, Fowler, et al. 2013, Linder & Freeman 2010, Nutrition 1971, Okin 2017). These studies confirm the correlation between energy consumption and health condition and the correlation between animals' resource consumption and the national resource consumption, implying that animals do consume a host of energy and therefore more attention should be paid to animals' food consumption to reduce their environmental impacts and simultaneously guarantee their health and nutritional well-being (Collier, et al. 1982, Mullis, et al. 2015). However, very few studies have been conducted to quantify companion animals' dietary EPP, GHG emissions, energy requirement and energy consumption in a systematic way. The present study was undertaken to verify these variables by utilizing direct data on companion dogs and cats' food consumption in the Netherlands and to compare the results with previous findings in Japan and China. Through this research, we attempted to clarify the specific resource consumption of companion animals in different countries and gain some insights into the strategies to reduce companion animals' environmental impacts in a national and international level.

9.4.1 The environmental impacts of companion dogs and cats in the Netherlands

The negative environmental impacts of food consumption by companion animals are expected to grow in the Netherlands and worldwide in the near future (Okin 2017). However, companion animals as a seeming insignificant source of energy consumption are often neglected by researchers. Therefore, the knowledge is limited when it comes to the assessment of the environmental impacts of companion animals. Previous studies demonstrated that the environmental impacts of companion animals are significantly underestimated if the emissions embodied in food consumptions are not accurately evaluated. Our findings show that one Dutch people' EF (5.8 ha, CBS) was equivalent to ten small dogs' or 11 cats' dietary EPP, but it was still lower than the dietary EPP of one large dog that depending on the commercial dry food. This finding implies that large dogs do consume a host of food resource in the Netherlands. According to the data from the CBS (Statistics Netherlands), the average household size in the Netherlands was 2.17 in 2015 and 2016, which means that owning a large dog could increase the household's whole EF by 58% while owning a cat could increase the household's whole EF by 4.2% in a year. Considering that many Dutch respondents (38.6%) prefer to own large dogs, we thought, when we calculating the household environmental impacts, the ratio of companion animals' environmental impacts was larger than the ratio of environmental impacts by companion animals in other countries where people prefer to own small dogs (e.g., Japan). Our results also reveal that small dogs and cats, compared to large dogs, consumed fewer food resources and released less GHG, suggesting that replacing large dogs with small dogs and cats would be a good way to reduce household's environmental impacts, and it would definitely promote the national sustainable development from a long-term perspective (Okin 2017). All companion dogs and cats in the Netherlands could consume about 2.94% to 8.89% of the amount of resource that Dutch people do. Specifically, the dietary EPP of all companion dogs and cats that depending on commercial dry food in the Netherlands was equivalent to the EF of 0.50 to 1.51 million Dutch people. The Dutch Taskforce on Biodiversity and Natural Resources advised to halve the EF of Dutch consumption by 2030 and fit the footprint to the earth's biocapacity by 2050. Therefore, we suppose this task would be easier to accomplish with the large-scale reduction in companion animals' (especially large dogs) number (Okin 2017).

With regard to GHG emissions, our results demonstrate that the one large dog's annual GHG emissions were equal to 12 small dogs' or 14 cats' GHG emissions in a year (based on their commercial dry food). According to the CBS (2016), the per capita GHG emission of the Netherlands was 11.57 tons in a year, and the whole Dutch people's annual GHG emission was around 197 million tons. Therefore, according to our results, owning a large dog could increase the household's whole GHG emissions by 11.3%, while owning a cat could increase the household's whole EF by 1.6% in a year. The annual GHG emissions by all companion dogs and cats that depending on

commercial dry food in the Netherlands was equivalent to 94 to 284 thousand of Dutch people' GHG emissions in a year. The animal products in companion animals' food play a large role in determining their environmental impacts. Therefore, finding alternatives with lower GHG emissions is essentially important to promote the sustainable environment. The mix of meat and plant-based products is an important choice in the formulation of companion animal food (Swanson, et al. 2013). Previous research has demonstrated that the protein content in animal-based products is around 11 times higher than that in plant-based products, which means that pet food manufacturers can achieve the protein requirements easier with more animal products (Swanson, et al. 2013). However, proteins in meat and its by-products are more expensive and have a higher environmental impact than proteins in plants and cereals (Swanson, et al. 2013). Therefore, consuming fewer animal proteins or replacing animal proteins with plant-based proteins would lower the GHG emissions from companion animals' food consumption (Westhoek, et al. 2011). This requires pet food industries take their responsibility of producing more sustainable pet food through product design or manufacturing process (e.g., production facilities running on renewable energy, green supply chains) (Beynen 2015, Rushforth & Moreau 2013, Swanson, et al. 2013).

Compared to the minimum consumption of commercial dry food, the minimum consumption of commercial canned food was generally related to larger dietary EPP and GHG emissions. This finding confirmed that meat production has more negative environmental impacts than plant production because the percentage of animal products in canned food is higher than that in dry food. Despite the variety of home-made food and commercial dry food, increasing number of Dutch companion animal owners started to choose canned food due to its convenience and the assurance of sufficient and balanced nutrition it offers (Knight & Leitsberger 2016). Additionally, commercial diet is, if not the only, at least the best way to feed companion dogs and cats for their optimal health Berschneider (2002). Yet, besides commercial food, there are also many other diets (e.g., home-made diet) that can provide enough nutrition to companion animals without too much energy waste, and will result in a reduction of companion animals' dietary EPP in the end (Berschneider 2002).

Most of the large and medium-sized companion dogs in the Netherlands actually consume more energy than their actual needs to keep normal activity, suggesting that overfeeding and food waste exist among dog-owning houses. Dutch people are increasingly aware of the sustainability aspects that are connected to food (Schösler, et al. 2013). Pet food industry and retailers try to meet this growing awareness by providing informative labeling. In the pet food market, the need for a better overview of and uniformity in labels, as well as insight into the meaning of certain indications on labels is strongly emphasized and would definitely improve owners' knowledge about how to feed their animals (PBL 2013). Additionally, companion animal obesity is becoming a common phenomenon in the Netherlands, maintaining ideal body weight and avoiding overfeeding proteins and nutrients could

therefore diminish food waste and prevent additional dietary EPP and GHG emissions (Schwartz 2014, Swanson, et al. 2013).

9.4.2 The environmental impacts of companion dogs and cats in different countries

Companion dogs (in particular medium-sized and large dogs) in the Netherlands and China consume more food resource than their actual needs and therefore result in a high dietary EPP and huge GHG emissions. Compared to the Dutch and Chinese owners, Japanese companion dog owners generally give their dog nutritionally appropriate amounts of food, suggesting that overfeeding and food waste are more common phenomena in the Netherlands and China than in Japan. Dog's size could, to some extent, influence owners' judgment about the feeding portions for their animals, the larger the dog, the harder the decision about how much to feed. Considering that many Dutch people prefer to own large dogs and show strong attachment to their dogs, it is therefore plausible that overfeeding exists in the Netherlands. Different with Dutch companion animals' main diets of commercial dry and canned food, the leftover food and commercial dry food are the two main diet categories among Chinese companion animals. Many owners directly give their animal leftover food, which is hard to measure the energy and protein content. Some other owners may, besides providing enough commercial dry food or other food, give human leftover food to their animals in case of food waste. This would undoubtedly result in overfeeding, although it is different to judge whether this is a good way to avoid food waste. The dietary EPP, GHG emissions and energy consumption of companion cats were similar in three countries, and most owners seem to give their cat appropriate amount of food. One possible reason is that companion cat's weight difference was not as big as that of companion dog's and most of the cats' weight between two to six kilograms, therefore, it is relatively easy for owners to provide the appropriate amount of food according to the labels on pet food package.

The per capita dietary EPP, GHG emissions and energy requirement of individual dog/cat in the Netherlands are higher than those in Japan. However, due to the bigger numbers of Japanese companion dogs and cats, their total dietary EPP, GHG emissions and energy requirement were much higher than those of the companion dogs and cats in the Netherlands. This finding reveals that the large-scale reduction of companion animal numbers is definitely one of the best ways to reduce their environmental impacts. Additionally, changing companion animals' food system and reducing individual animal's resource consumption would also be useful for the household and national sustainable development.

Through our results, we found that the dietary EPP, GHG emissions and energy requirement of companion dogs in Japan were lower than those in the Netherlands and China, implying that Japan would have a more sustainable companion animal husbandry way than the Netherlands and China. One possible explanation is that Japanese people

prefer to own small dogs. As we mentioned above, the smaller the dog, the easier the decision about how much to feed could be made. We suppose the food portions that Japanese owners give to their animals would be more appropriate than Dutch and Chinese owners. Besides the husbandry activities, pet food is another important variable that can influence animals' environmental impacts. Actually, the sustainability of pet food highly depends on the nutrients formulation and the choice of the ingredients of the pet food recipes (Swanson, et al. 2013). The ingredient selection is a key consideration in terms of cost and consumer demand in order to formulate products matching the basic nutritional requirements (Swanson, et al. 2013). An established nutrient target can be achieved through different possible combinations of ingredients (Zicker 2008). The recipe developers not only have to use sophisticated programs to combine the cheapest possible ingredients and transform them into palatable foods for pets, but also have to develop a good marketing product that companion animal owners will be willing to purchase (Nestle & Nesheim 2010, Rushforth & Moreau 2013). Moreover, pet food manufacturers and nutritionists may reduce the food waste by increasing the bioavailability and digestibility of pet foods (Swanson, et al. 2013). The choice of more sustainable suppliers for ingredients composition and selection may also increase pet foods sustainability by preferring foods from crops using less or no fertilizers (Beynen 2015, Swanson, et al. 2013).

9.4.3 Options for policies to stimulate companion animals' sustainable resource use

The Dutch government committed to an economy-wide target of reducing its GHG emissions by 26% below its 2005 level in 2025 and to make best efforts to reduce its emissions by 28%. The low EF and EPP can directly affect the level of the environmental development. Decision makers concerned about the overuse of resources by humans and companion animals should therefore focus on the EF and EPP, given its strong correlation with the environment. To quantify the EF and EPP has important implications for country policies toward the environmental degradation. The increasing number of companion dogs and cats and the higher nutritional content in pet food make companion animals a new environmental threat. Therefore, it is crucial to understand the effect of policies that will be implemented in the forthcoming years to address the environmental impacts by companion animals in the Netherlands (Ulucak & Lin 2017). Previous research revealed that households in the Netherlands could annually save 325 euros if they would not throw away any food (Backus et al., 2011). Hence, required actions and policies should urgently be taken against the environmental degradations due to the household food waste, including pet food waste. The leftovers from human food are suggested to be consumed by companion animals in order to reduce their consumption of commercial food.

The Dutch Ministry of Infrastructure and the Environment (IenM 2011) has declared some essential strategies to reduce the environmental degradation. Some of

them might be used in reducing the environmental impacts by companion animals. For instance, efficient use of raw materials, sustainable management of agriculture and animal food in international cooperation, food security and sustainable food systems, as well as transparency in companion animals' food chain (Mekonnen & Hoekstra 2012). The Dutch Government, in its economic policy, should advocate that Dutch businesses, including pet food industries, reveal companion animals' EPP and reduce it in areas with resource scarcity.

The policies that aim to reduce the national environmental degradation could also be zoomed out to the reduction of companion animals' environmental impacts. The dimension of sustainability in partner countries should be assessed and the European countries should develop tools to monitor the progress on resource efficiency in pet food production and consumption. The need for high-quality knowledge and innovation that may enhance the competitiveness of companion animals' food and other necessities should be encouraged and increased by the government. Pet food companies should provide accurate information about the way the food is produced so that companion animal owners can make informed decisions. The Dutch government should address households to stimulate sustainable consumption and increase the knowledge base within society (IenM 2011). Other strategies such as increasing companion animal tax, encouraging the communication between veterinarians and companion animal owners and facilitating greater investment to encourage technological innovations in pet food production should be included in the policy system with regard to reducing companion animals' environmental impacts (Aiking 2014, Damron & Damron 2013, Egilmez, et al. 2014, Westhoek, et al. 2014). It might also be helpful if pet food companies printed the footprint of their products on the packet to aid companion animal owners' choice (Vale & Vale 2009).

9.4.4 Limitation

The available literature investigating issues in terms of the environmental impacts by animals mainly focused on farm animals or livestock's energy consumption. Therefore, the present study extends the literature on the relationship between the environmental degradation and companion animals' resource consumptions. Our study however has several limits. First, we have not tested the canned food consumptions by companion animals in the Netherlands because canned food is not as popular as commercial dry food. Instead, we provided the rough information of the minimum canned food consumption of companion dogs and cats by measuring their energy requirement, body weight and health conditions. Second, there might be some floor effects that made the minimum energy consumption lower than the minimum MER. Yet, through this way, our results include most of the possible amount of food consumptions. Third, several other resource consumptions, such as companion animals' water use, medical cost and

entertainment needs, are excluded from the present study and will become part of the future studies to render the present analysis more robust.

9.5 Conclusion

The present study presents a novel way to calculate companion dogs and cats' environmental impacts by quantifying their dietary EPP, GHG emissions and energy consumption. It also provides the similarities and differences of the environmental impacts of companion animals among different countries (i.e., the Netherlands, China and Japan). This study goes beyond past studies that have examined the correlation between companion animals' energy consumption and obesity and the protein intake from animal-based and plant-based products. The numbers of companion dogs and cats in the Netherlands and many other countries are rapidly growing driven by the increasing wealth worldwide. The negative environmental impacts of pet food production and consumption therefore are expected to grow worldwide in the near future. Understanding the correlations between companion animals' dietary preference and their environmental impacts is of critical importance if future food security is to be ensured and long-term sustainability in the environment is achieved (Reijnders & Soret 2003).

Our results reveal that the dietary EPP of one large dog that depending on commercial dry food was even larger than one Dutch people's EF. In the Netherlands, owning a large dog could increase the household's annual EF and GHG emissions by 58% and 11.3%, respectively. Through food consumption, all companion dogs and cats in the Netherlands could consume about 2.94% to 8.89% of the amount of resource and release 0.6% to 1.7% of the amount of GHGs that Dutch people do. Medium-sized and large dogs in the Netherlands and China consumed more energy than their actual needs, suggesting that overfeeding or food waste would be very common in these two countries. These findings highlight the importance of multiple indicators of data quantification and the importance of quantifying the environmental impacts of companion dogs and cats in not only the Netherlands, but also China and Japan, as well as other countries. In light of the significant environmental impacts by companion animals, they also highlight the need for companion animal owners, pet food companies, policymakers and national government to find ways to decrease the negative environmental impacts and improve the household and national sustainable development.

Given the high impacts associated with food resources found in this study, it is imperative that reducing companion animal numbers, consuming more plant-based instead of animal-based food and encouraging companion animal owners feed their animals more efficiently might be good measures to reduce companion animals' environmental impacts and increase sustainability (Reijnders & Soret 2003). Land requirement and GHG emissions embodied in food consumption are significantly

Using ecological paw print analysis in food consumption of companion dogs and cats in the Netherlands

important; thus it would make sense for policy initiatives to pay due attention to agriculture production and food consumption. This study can provide a scientific basis for the development of the EPP and GHG emission mitigation measures.

Chapter **10**

Discussion and Conclusion

10.1 Introduction

Animals are beings with which we may have social relations (Gilhus 2006, Morris 2000). We communicate with them, feel sympathy and affection for them, and also exploit them for our own benefits. They are persons, friends and food (Gilhus 2006). People's attitudes toward animals directly influence how animals are treated. However, people's thinking about animals is not simple, and their relationships with animals are complex and multifaceted. Many factors including social conditions, cultures, ethical ideologies, awareness of animal welfare and human demographics might be related to human-animal relationships and, therefore, should be considered if we want to investigate such relationships in a more comprehensive way. This research has been conducted in China, the Netherlands and Japan because we aimed to explore public attitudes toward animals and how the factors we mentioned above were related to the relationships between humans and animals from a cross-cultural perspective.

Since the human-animal relationship is a broad issue and many factors may influence it, we divided this dissertation into three key parts. The three main questions that were addressed in this thesis are:

What are the people's attitudes toward animals in general and how does this relate to people's ethical ideologies in China, the Netherlands and Japan?

Which emotions can owners attribute to their companion dogs and cats, and what are the correlations between the attribution of emotion and owners' degree of attachment to their dogs and cats?

What are the environmental impacts of food consumption by companion dogs and cats?

This conclusion was organized based on the three parts of this dissertation and the connected research questions. It aimed at answering the three main research questions that were indicated in the introductory section of this dissertation. It also offered a research reflection on the future research. In this section, the key findings were summarized, the implications of these findings were discussed, and the considerations for future research were suggested.

10.2 Part I People's attitudes toward animals (in general) and their ideological background

The first main question focused on people's attitudes toward animals (in general) and how these attitudes were correlated with ethical ideologies and human demographics

in China, the Netherlands and Japan. Public attitudes toward animals were measured by two 5-point Likert-type scales: the Animal Issue Scale (AIS, a 43-item scale) (Meng 2009) and the Animal Attitudes Scale (AAS, a 20-item scale) (Herzog Jr, et al. 1991). People's ethical ideologies were measured by a 9-point scale of the Ethical Position Questionnaire (EPQ, a 20-item scale), which was divided into two sub-scales: ethical idealism scale and ethical relativism scale (Forsyth 1980).

Public attitudes toward animals and the predictor variables are of central concern within the fields of animal welfare and Anthrozoology. The more positive attitudes toward animals generally lead to a stronger concern for animals and a better human-animal relationship. Specifically, the positive attitudes toward animals usually contribute to a healthy dietary and living environment for animals (Blazina, et al. 2011). However, due to the different cultures, religions, geographic regions and the purposes of animal usage, people's attitudes toward animals might be varying from country to country and from time to time. For instance, European students show more concern for animals than Asian students, killing animals for medical research is more acceptable than killing animals for cosmetic test, animal welfare standards in China are lower than those of their Western counterparts, while public attitudes toward animals in contemporary China are more positive than those in several decades ago (Davey 2006, Phillips, et al. 2012, Su & Martens 2017). Therefore, it is clear that investigating people's attitudes toward animals and finding their predictor variables across countries would be beneficial to the improvement of animal welfare.

10.2.1 Key findings

It can be said, based on the aggregated results, that Dutch people showed greater concern for animals than Chinese and Japanese people.

In chapter 2 Chinese people's attitudes toward animals were examined and their correlation with ethical ideologies and human demographics were presented. Results demonstrated that people's attitudes toward animals were positively correlated with idealism and negatively correlated with relativism. Young people showed a greater concern for animals than middle-aged and old people, while women and men did not show any significant differences regarding their attitudes toward animals.

In chapter 3, we found that Dutch people's attitudes toward animals were found to be significantly related to idealism; this confirms our findings in China. While no significant correlation between relativism and attitudes toward animals was found among Dutch respondents, which is inconsistent with our findings in China. Female Dutch people showed a greater concern for animals than their male equivalents and middle-aged respondents showed a greater concern for animals than young and old respondents.

In chapter 4, the correlation between ideologies and attitudes toward animals in Japan was similar with that in China: idealism was positively correlated and relativism

was negatively correlated with public attitudes toward animals. Female Japanese people showed a greater concern for animals than male respondents, while age was not significantly correlated with people's attitudes toward animals.

10.2.2 Discussion

Comparing the results across three countries leads to an interesting discussion. Our findings reveal that the same mechanisms underlying the correlation between ethical idealism and attitudes toward animals might work in different countries. However, the manner in which ethical relativism influences attitudes toward animals may differ between countries with different cultures. Ethical ideology is a factor proposed to explain differences in ethical judgment (Barnett, et al. 1994). It may also offer guidance to individuals as they make judgments about ethical issues (Forsyth & Nye 1990). The human-animal relationship is a topic which is strongly associated with ethical issues, especially when measuring people's attitudes toward laboratory animals or the conflicts between animal welfare and the sustainable development. Therefore, involving ethical ideologies in studies of human-animal relationships is suggested and would encourage us to use them as symbols to make sense of our world (Gilhus 2006). There is increasing support for the idea that human attitudes toward animals may be indicative of the imagination of our own being (Gilhus 2006, Taylor & Signal 2005). For instance, people who are concerned about others' welfare and believe in the absolute value of moral standards based on their unselfish concern for others may show great concern for not only other humans but also non-human animals (Forsyth 1980). Others who do not base on universal ethical rules when they make judgments are generally more collectivist, and their attitudes toward animals might be varied from person to person and from one situation to another. The conclusions on the question what are the public's attitudes toward animals indicate that thinking about the influence of ethical ideology as well as culture is of vital importance to help us understand human-animal relationships.

The human-animal relationship is a relationship between one species and a tremendous variety of others. Nevertheless, sometimes the gap between our species and all others is unbridgeable and this gap will make the relationship between humans and animals extremely complex (Gilhus 2006). There is a fundamental difficulty in the measurement of animal welfare and human-animal relationships because animals are unable to vocalize their experiences in the same way as humans (Martens, et al. 2016). Additionally, people from different countries with different cultures may use different criteria in judging how animals ought to be treated and what constitutes a good life for animals (Fraser, et al. 1997). The results in part I actually provide evidence about the influence of culture on human-animal relationships. For example, the collectivistic Eastern population may understand behavior in terms of complex interactions between dispositions of the object and contextual factors. Consequently, their attitudes toward animals might be influenced by situational analysis (e.g., using animals in medical

experiments in order to improve human health). However, the individualistic Western population often neglect the situational constraints and view behavior primarily as the direct unfolding of dispositions (Norenzayan & Nisbett 2000). Therefore, their attitudes toward animals are likely to have been formed by concern for animal well-being, rather than being based on the cost-benefit analysis (Norenzayan & Nisbett 2000, Wuensch, et al. 2002). The cultural difference can explain not only its influence on people's attitudes toward social issues like animal welfare, but also our main findings in this part: the collectivistic values (highlight situational background) might play a bigger role in predicting public attitudes toward animals in the Eastern countries (e.g., China and Japan) than in the Western countries (e.g. the Netherlands and the United States).

Besides the individualistic and collectivistic characteristics, our results also demonstrated that other cultural and social differences should also be considered when we investigating public attitudes toward animals, as well as other scientific topics, from a global level. For example, the traditional culture of Confucianism and Buddhism advocate that humans should respect animals, but sacrificing animals in religious rituals to pray for a good harvest is also accepted (Bockover 2003, Kondo & Sato 1999). Therefore, Chinese and Japanese people show more tolerant attitudes toward animal use than people from the Western countries. These findings and analyzations imply that public attitudes toward animals, as well as any other social phenomena, should be considered under a number of circumstances and a combination of variables may be more suggestive than one single factor on its own. Culture as an integrated whole consisting of ideas and values should not be neglected when we investigate people's social values. However, we should note that different nations have different cultures, social conditions and values due to their different histories, geographies, environment, politics, economic systems and behavior patterns. We should take all of these possible factors into account when we explain the influence of culture on the correlation between ethical ideologies and attitudes toward animals. Other variables like people's knowledge about animals and awareness of animal welfare should also be highlighted when discussing attitudes toward animals in order to improve people's awareness of animal welfare in different countries.

10.2.3 Further considerations

Our Dutch case study demonstrated that people's attitudes toward animals were not significantly correlated with relativism, which confirms previous studies in the United States. Yet, we have to say that the samples of the available studies in the United States were university students, which could not fully represent the general American people. Therefore, further studies with general respondents in the United States or other Western countries are needed to consider.

We explained why the correlation between ethical relativism and attitudes toward animals is different between the Eastern countries and the Western countries

from a cultural perspective. Further studies conducted in African and Latin American countries are encouraged if we want to explore this relationship under the diversity of cultural backgrounds.

Our research mainly focused on the correlation between ethical ideology and attitudes toward animals (in general). However, there are six types of animals (companion animals, working animals, wild animals, zoo animals, laboratory animals and farm animals), and further research concentrated on this correlation regarding specific animal types should be considered, designed and refined.

10.3 Part II The emotional attribution and the degree of attachment to companion animals

The second main question focused on the attribution of emotions to companion animals, as well as the correlation between owners' degree of attachment and the attribution of emotions to their animals. People's degree of attachment was measured by the Pet Bonding Scale (PBS, a 25-item scale) (Anderson 2007). The assessment of the attribution of emotions was based on six primary (anger, joy, sadness, disgust, fear and surprise) and four secondary (shame, jealousy, disappointment and compassion) emotions.

In this section, we mainly focused on companion animals because the number of companion animals is increasing dramatically worldwide due to the recently decreasing birth rate and increasingly greater age of the human population (Miyazaki, et al. 2018). Additionally, compared to the lay public, companion animal owners are a better choice when approaching animal emotions as their direct experience in interacting with animals may allow them to better comprehend animals' behaviors associated with emotions (Kujala, et al. 2017, Morris, et al. 2008). Animals' emotional states comprise physical, behavioral, subjective and cognitive components and the attribution of emotions to animals is therefore a good way to improve people's understanding of animals' emotional world and animal welfare (Horváth, et al. 2016).

10.3.1 Key findings

The survey results from the Chinese and Japanese respondents indicated a trend that respondents were more frequently to attribute primary emotions than secondary emotions to companion animals (chapter 5 and chapter 6). This finding confirms our previous study, which was conducted in the Netherlands by our team, showing that primary emotions were more commonly attributed by companion animal owners than secondary emotions (Martens, et al. 2016). Our Chinese and Japanese case studies also demonstrated that the attribution of compassion was reported at a high level. This finding was unique because it was not revealed in previous studies conducted in the United Kingdom and the Netherlands (Martens, et al. 2016, Morris, et al. 2008). Female

owners were more commonly to attribute some emotions to companion animals than male owners and younger owners were more commonly to attribute some emotions to companion animals than older owners in all three countries (i.e., China, Japan and the Netherlands).

The mutual interaction between animals and owners (e.g., for animals: interacting with their owners by touching or sniffing them; for owners: watching and taking care of their animals) is one of the most important predictor variables of the degree of attachment to companion animals in all three countries. Based on our case studies, we concluded that the correlation between the degree of attachment and the attribution of emotions was significant for most of the animal emotions in Japan and the Netherlands, while this finding is different from observations in China showing that only a few significant animal emotions exist in this relationship.

10.3.2 Discussion

The question of whether animals have emotions has long been argued, but many current studies provide compelling evidence that at least some animals (especially primates) likely feel a full range of emotions, including anger, joy, fear, sadness, disgust, jealousy, shame and compassion (Bekoff 2000a, Bekoff 2000b). An important ethical issue in animal welfare arises through the widely held opinion that most animals have emotional experiences. If animals experience disappointment and fear due to an inability to perform their natural behavior patterns or, more directly, due to animal cruelty, then this has moral importance and, in turn, may have a major influence on animal welfare (Dawkins 2000, Kujala, et al. 2017). Therefore, Animal emotions can be identified as a critical marker for animal welfare. Investigating methods for approaching animal emotions and exploring the predictor variables that highly correlated with people's understanding of animal emotions is essential to promote optimal animal welfare worldwide.

People's attribution of companion animal emotions is commonly used in an attempt to improve animal welfare (Finlayson, et al. 2016, Hemsworth, et al. 2015, Mendl & Paul 2004). Emotions are primarily brain states and bodily responses (Špinka 2012). Many emotions seem to be fundamentally an unconditional "gift of nature" rather than an acquired skill (Panksepp 2005). Our research conducted in three countries confirmed that companion dog and cat owners are more commonly to attribute primary emotions than secondary emotions to their animals (Konok, et al. 2015, Martens, et al. 2016, Morris, et al. 2008). Companion animal owners' direct interactions with animals and their observations about animal behaviors give them enough reasons to believe that animals do have feelings and emotions. Thus, we think owners' reports should be taken as a source of evidence about animal emotions, rather than a source of error (Morris, et al. 2008). Additionally, the secondary emotion of compassion was commonly attributed by Chinese and Japanese owners. This finding is

surprising because compassion is defined as secondary emotion and companion animal owners in Western countries rarely attribute this emotion to their animals (Martens, et al. 2016, Morris, et al. 2008). We introduced the cross-cultural comparisons when we explain this interesting finding (*the feeling of compassion reflects the principle of benevolence, one of the five basic elements of Confucianism*), because we think the cultural differences between the Eastern and the Western countries would be essential if we want to have a complete picture of what variables might underlie owners' different attribution of emotions to their animals.

Owners' degree of attachment to their animals has been found highly correlated with the attribution of emotions to animals. This relationship raises important questions about the accurate assessment of human-animal attachment (Zasloff 1996). It also shows that the role of attachment in understanding animal emotions is well understood. Our findings in this part imply that a combination of animal experience (pet ownership) and strong attachment may promote owners' brain activations to attributing emotions to animals (Kujala, et al. 2017). They also indicate that a better understanding of animal emotions could promote a higher attachment to companion animals and a better human-animal relationship. The greatest obstacle to study animal emotions is the common objection that we cannot know what they feel, but previous affective neuroscience strategies and our findings from the observation of companion animal owners provide evidence that animals do have feelings and emotions. The predictor variables that highly related to animal emotions inform us scientifically about the nature of our own feelings (De Waal 2011, Panksepp 2011). With Darwin's principle of evolutionary continuity of mind among animals, we think that understanding animal emotions could scientifically illuminate our own emotional lives (Panksepp 2011). The cross-species (humans and non-human animals) studies also provide knowledge about how animals should be treated in our society in order to improve their welfare and their sustainable relationships with us humans.

10.3.3 Further considerations

The attribution of emotions to companion animals is complicated, and no one simple reason or theory can explain all of the psychological phenomena that are called emotions and attribution of emotions. Further evidence from neuroscientific or psychological perspectives is therefore needed to confirm and clarify this point.

The distinction between primary and secondary emotions is significant for our understanding of the mechanisms of animal emotions. Yet, further research should also pay some attention to the distinction of positive and negative emotions because humans' understanding of animals' negative emotions would help them to consider animal welfare issues in a relatively direct way.

Although Chinese booming economy and the rising societal awareness of human rights in recent years have begun to stimulate people's awareness of animal

welfare, studies about animal emotions, animal welfare and human-animal relationship in China are still not as common as those in the Western countries. Therefore, further studies aim to promote optimal animal welfare measurement systems in China, as well as in other developing countries, are urgently required.

10.4 Part III The environmental impacts of food consumption by companion animals

The third main question focused on the environmental impacts of food consumption by companion animals. Dietary choices have important environmental impacts. For instance, a meat-based diet requires more land and has greater environmental impacts than a plant-based diet. Companion animals are often regarded as family members and increasing number of companion animal owners, with the improving living standards, prefer to give their animals nutrients in excess of the minimum recommendations or feed them animal products which compete directly with the human food system. This will increase the household and national environmental burden and result in the environmental degradation. However, companion animals as a seeming insignificant source of resource consumption and global warming are often neglected by researchers in the fields of environmental degradation and sustainable development. In this section, we mainly focused on the environmental impacts of food consumption by companion dogs and cats by quantifying their dietary EPP, GHG/carbon emission, energy requirement and energy consumption according to the first-hand data we collected from pet food market and companion animal owners. By comparing the food resource consumption between humans and companion dogs and cats, we wanted to quantify to what extent the companion animals can influence the environment.

10.4.1 Key findings

In chapter 7, we quantified Chinese companion dogs and cats' dietary EPP, carbon emissions and energy consumption according to their consumption of leftover food and commercial dry food. The dietary EPP and carbon emissions of an average-sized dog relying on commercial dry food were ca. eight and three times higher than those of the dog relying on human leftover food because the percentages of animal products in commercial dry food are much higher than the percentages of animal products in human food in China. If we assume all Chinese companion dogs and cats eat commercial dry food in China, their dietary EPP was equivalent to the dietary EF of 70.3 to 245.0 million Chinese people in a year, while their carbon emissions from food consumption were equivalent to 34.3 to 107.1 million Chinese people's carbon emissions regarding food consumption.

Human leftover food was not often used to feed companion animals in the Netherlands and Japan. Therefore, we only considered commercial food in these two countries. In chapter 8, we found that the dietary EPP of all companion dogs and cats in

Japan was equivalent to the dietary EF of 4.62 to 19.79 million Japanese people. Their GHG emissions from food consumption were equivalent to 1.17 to 4.95 million Japanese peoples' GHG emissions regarding food consumption. In chapter 9, our results showed that owning a large dog could increase the household's annual EF and GHG emissions by 58% and 11.3%, respectively. The dietary EPP of all companion dogs and cats in the Netherlands was equivalent to the whole EF of 0.50 to 1.51 million Dutch people. Their GHG emissions from food consumption were equivalent to 94 to 284 thousand of Dutch peoples' GHG emissions regarding total resource consumption.

Besides the dietary EPP and GHG/carbon emissions, we also quantified companion animals' energy requirement and consumption. Our results showed that many companion animals (especially large dogs) consumed more energy than their actual needs in all three case studies, suggesting that overfeeding and food waste are two common phenomena among companion dog and cat households.

10.4.2 Discussion

The global world has been experiencing extraordinary economic growth during last several decades. However, behind the remarkable economic statistics, how to balance sustainable development and the environmental degradation has become a hot issue especially in the field of sustainability science (Day 2016). An increasing number of researchers have participated actively in the sustainable development and environmental protection studies based on approaches to quantify the ecological footprint and ecological capacity (Brizga 2010, Kharrazi, et al. 2014, Wackernagel & Rees 1998, Wackernagel & Yount 1998). Some researchers also paid attention to the environmental impacts of animals in particular farm animals (Gerber, et al. 2013, Monteny, et al. 2006, Nijdam, et al. 2012). Nevertheless, there is a clear lack of knowledge when it comes to the assessment of the environmental impacts of companion animals. Given the large number of companion animals in the world and the high percentage of animal products in pet food, we hypothesized that the environmental impacts of food consumption by companion animals would be significant. Based on the direct data on companion dogs and cats' food consumption, our result demonstrates that companion animals (especially those eating commercial pet food) contribute to a big portion of national resource consumption. This finding confirms a previous study conducted in the US showing that dogs and cats consume about $19\% \pm 2\%$ of the amount of dietary energy that humans do, and through their diet, constitute about 25–30% of the environmental impacts from animal production in terms of the use of land, water, fossil fuel, phosphate, and biocides (Okin 2017). More shockingly, the data from the Global Network Footprint shows that the ecological paw print of some large dog breeds is as high as the ecological footprint for individuals in some developing countries. These findings together with our results demonstrate an environmental issue that is often neglected by researchers: companion dogs and cats'

food consumptions have considerable impacts on environmental sustainability and the national sustainable development (Ravilious 2009).

Companion animals are an integral part of the household. Their various activities taking place within families exacerbate household resource consumption and have some serious direct and indirect impacts on the environment. Besides food consumption, companion animals also need water, entertainment, healthcare and living spaces. These resource consumptions are difficult to quantify and will undoubtedly expand their impacts on the environment and lead to the national and even global environmental degradation (Mekonnen & Hoekstra 2012, Okin 2017, Vale & Vale 2009). The information mentioned above should be included if we want to quantify companion animals' overall environmental impacts, but the proprietary nature of and the incredible variety in these consumptions make a detailed calculation impossible. However, regardless of these difficulties, we succeeded to develop a method we refer to as the dietary "Ecological Paw Print". It offers an analytic framework to quantify the environmental impacts of food consumption by companion animals.

The main contribution of this research is to improve companion animal owners' awareness of the resource consumption and environmental impacts of their animals, and then change their husbandry activities to avoid overfeeding and at the same time maintain animals' healthy body weight. Animal obesity, which is associated with numerous diseases, is one of the most common health problems of companion dogs and cats (Linder & Freeman 2010). Our recommendations about the feeding directions concerning different food types, therefore, are most applicable to companion animal owners. The negative environmental impacts of food production and consumption by companion animals, as well as other animal types, are expected to grow worldwide in the near future (Reijnders & Soret 2003). However, as we mentioned above, acknowledging their negative impacts on the environment does not mean neglecting their emotional bond with humans. Therefore, recommendations on the balance of the physical and psychological benefits and the negative environmental impacts of companion animals are significantly important. Findings from our research confirm that reducing companion animal's environmental impacts is definitely not an easy task without large-scale of reduction in their numbers and changes to the food system that drastically reduces their animal products consumption (Okin 2017). Therefore, strategies such as advocating owning one animal one household (for those who own more than one animals), replacing large animals with small ones that can provide the same physical and psychological benefits, reducing overfeeding and food waste, using plant-based instead of animal-based food, and improving agriculture productions would be helpful to reduce companion animals' environmental impacts and promote the household and national sustainable development.

10.4.3 Further consideration

As we mentioned above, besides food consumption, companion animals also need water, entertainment, healthcare, living spaces and many other resources and services, which would dramatically improve their environmental impacts. Therefore, a broader quantification including all companion animals' resource consumptions should be considered in the future. Inspired by this, other animal types, like farm animals, wild animals, zoo animals, working animals and laboratory animals' environmental impacts would also be interesting areas that need to be explored.

Asking respondents to provide the exact body weight and food consumption of their animals is impossible if we want to collect more samples. Hence, in this research, we provided several options of the ranges of animals' possible body weight and food consumption. This leads to the large range of the dietary EPP, GHG emissions and energy requirement in our results. Therefore, research with specific values of body weight and food or energy consumption should be conducted in the future.

We all know that animal products have more environmental impacts than plant-based products and some researcher even quantified the different carbon/GHG emissions of meat and cereal. Inspired by our research, we suppose quantifying the different environmental impacts of animal products and plant-based products consumption by companion animals in different countries should be considered as well.

10.5 General conclusion about human-animal relationships

10.5.1 The implication of this research

The sustainable human-animal relationship is a contentious societal issue of today, so it is important to be clear what is understood by the term. The term of "sustainable human-animal relationships" has many definitions and different people from different research fields may have their own understanding. In this study, the "sustainable human-animal relationships" was explained as the environmentally sound, psychologically, physically and socially beneficial, ethically acceptable and economically viable practices between humans and animals. Experiencing and interacting with animals is always done in certain cultural contexts, which may be mental or physical. The point is that animals are never transparent objects and accordingly can never be grasped in isolation (Gilhus 2006). They are always involved in human life and the global environment. Therefore, a sustainable human-animal relationship is an integrated issue which is associated with a variety of disciplines and factors. It can improve not only animal welfare but also the sustainable development of the whole society.

Animal welfare means "how an animal is coping with the conditions in which it lives" (OIE 2015). Previous evidence suggests that public attitudes toward animals are increasing around the world. Increased public attitudes are indicated, for example, by

the public desire for the ethical consideration about animal well-being. Many people relate to animals more closely than to the artificial products of human civilizations or even other humans (Phillips 2008). The significance of public attitudes toward animals in the context of promoting sustainable human-animal relationships from cultural perspectives has been often emphasized in this dissertation. Our conclusions provide a clear view of people's different attitudes toward animals in different countries, as well as their correlation with the cultural and social conditions like ethical ideologies and people's awareness of animal welfare. People, the world over, agree when judging the morality of actions especially the egregious and commendable actions (Forsyth, et al. 2008). In most societies, people would suffer moral condemnation if they harmed or killed innocent or rare animals. Conversely, most societies consider persons to be due moral acclaim if they protect animals from danger and adversity (Abratt, et al. 1992). However, this cross-cultural consensus is lost when the discussion turns to less clear-cut issues. For example, some people morally condemn activities of using animals in the medical experiments because of the suffering animals encounter in practice, some people support animal experiments because they recognize that using animals in experiments is essential to the medical endeavor, while others do not care about animal experiments but they appreciate animals' sacrifice in the process of promoting medical development and improving healthcare quality. Contradictions are always situated phenomena and we should understand public attitudes toward animals, as well as any other social issues, in the context of the given cultures and situations.

Although I explained and emphasized the importance of public attitudes toward animals and the sustainable human-animal relationships from cultural and social perspectives, the explanation of the specific relationships between humans and animals, as well as between animals and the environment is helpful: it provides an insight into both positive and negative relationships between humans and animals, which may play a crucial role in helping us understanding humans, animals and the environment in a more comprehensive way. It is widely believed that people have emotional needs to connect with animals, which manifests itself in caring for the environment and owning companion animals. Similarly, animals would also have emotional needs to connect with humans in order to fulfill their welfare requests. Investigating whether humans can attribute emotions to animals is a good approach to study animal emotions because animals are always woven into specific contexts with humans and society (Gilhus 2006). Companion animal owners' observation and interaction with their animals demonstrate that animal emotions do exist. This finding is interesting because we finally know that we are not alone at this point (de Vere & Kuczaj 2016). Many people may feel strongly one way or another and so have no problem deciding when they are facing questions like whether animals have emotions. However, people may hesitate and specify which emotions animals have and which they lack. Our findings explain how people attribute ten different (primary and secondary) emotions to companion dogs and cats in a clear way. Owners' strong attachment to their animals and the interactions between

companion animals and owners are main drivers for understanding animals' emotional world. From a sustainability perspective, these findings rise to what extent that people's knowledge about animal emotions can be improved and how it affects the well-being of humans and animals, as well as their sustainable relationships, on the longer term. We recognize that studies about the attribution of emotions to companion animals and the relationship between the attribution of emotions and the degree of attachment to companion animals are inevitable because animal emotions often share many similarities with those of humans and the frequent interactions between companion animals and owners would improve people's understanding of animal emotions (de Vere & Kuczaj 2016, Mendl, et al. 2009). Discovering the ways in which the emotional experiences of humans and companion animals are different, as well as the ways in which they are similar, is essential for the advancement of the future studies of companion animal emotions.

Besides the emotional relationship between companion animals and owners, how animals relate to the household and the environment is another important issue among the systems of human-animal relationships. An increasing number of publications and popular media are very recently paying attention to the issue of sustainable development and it seems a dialogue on the role of companion animals for household resource consumption is starting up. The ecological footprint, which is widely used in evaluating sustainable development and environmental degradation, has the potential to be developed towards becoming an indicator to help assess and quantify companion animals' environmental impacts. Nevertheless, many researchers and companion animal owners never notice the link between the sustainable development of the environment and companion animals' resource consumption. Companion animals are an integral part of the household and owning a companion animal has been regarded as a new lifestyle for populations (Amiot, et al. 2016). The sheer number of companion animals in the world would significantly influence the environment. In order to reduce companion animals' environmental impacts, some researchers claim that without a large-scale reduction in companion animals' number, the environmental and energetic impacts of these animals will remain significant (Okin 2017, Vale & Vale 2009). However, considering the benefits that companion animals bring to humans, more attention should be paid to the balance of companion animals' benefits and their environmental impacts. The ecological paw print approach acknowledges that humans and animals are facing difficult challenges. These challenges are apparent and would direct actions toward sustainable living. Admittedly, acknowledging the darker side of the animal conditions is sometimes painful (Wackernagel & Rees 1998). An important step toward a more sustainable human-animal relationship is to accept ecological reality and the socioeconomic challenges it implies. Based on this, to develop a way of living that is fulfilling and sustainable within nature. This requires us to rethink our relationships with animals and nature, and our findings in this dissertation stimulate such thinking.

10.5.2 The contribution of this research

In this dissertation, we explained human-animal relationship in a relatively comprehensive way. We introduced cross-cultural comparisons and trans-disciplinary analyses and included contributions from social, political and ecological sciences. The goals of this dissertation are theoretical, empirical, and practical ones. Based on the dissertation results, it can be said that our understanding of the sustainable human-animal relationships is clearer than before.

Research into the human-animal relationship and animal welfare is more mature in the Western countries (the Netherlands) than some Eastern countries (e.g., China and Japan). However, the comparison studies of the emotional and environmental human-animal relationships between the Western countries and the Eastern countries are very few. This dissertation, therefore, can be regarded as a starting point to analyze issues of humans, animals and the environment from a global perspective. The role of the cultural differences can be emphasized as a reason for the different understanding of animals' emotional and environmental relationship with humans. This dissertation additionally highlights that acknowledging animals' negative impacts on the environment does not mean neglecting their emotional bond with humans, while the positive relationship between animals and humans may not be an acceptable reason for ignoring their negative environmental impacts. The sustainable human-animal relationships require us to pay more attention to the well-being of both humans and animals, as well as the sustainable development of both the environment and the whole society.

Our findings of public attitudes toward animals provide an insight into why we need to improve our awareness of animal welfare and how we should improve it. Investigating the correlation between the attribution of emotions and the degree of attachment in different countries has the potential to be developed towards becoming a baseline to help assess and discuss animals' emotional world. As we explained above, any emotional state is relevant for the welfare of animal experiencing it. Therefore, the mechanism and the possible predictor variables that were found in this part are of importance for the welfare of animals. Additionally, the research on the social dimension of animal emotions is still in its beginnings, while the cultural background and society conditions are involved in our analyzation, which represents a positive step toward advancing the research on social dimensions of animal emotions (Špinko 2012). We therefore suppose that paying more attention to the social dimension of animal emotions would be a creative way to positively affect animal welfare and human-animal relationships in the near future. It can also inspire researchers to study animal emotions from a cross-cultural perspective where much subjective knowledge can be gained.

To the best of our knowledge, this dissertation is the first study to quantify the environmental impacts of food consumption by companion animals. With market-wide knowledge of pet food and direct data on food consumption, we provide evidence that

companion animals contribute to significant environmental impacts. The recommendations we mentioned in this dissertation will then, to some extent, reduce animals' environmental impacts and promote the sustainable human-animal relationship. The conclusions in this research also indicate that the environmental degradation is not an independent problem within the household, and cannot be properly addressed by the existing solution approaches without the government efforts and the cooperation across countries. Therefore, our research also gains an insight into the future of possible energy strategies to reduce national and even global environmental impacts. The local and national governments and international organizations within the environmental protection framework are a strong manifestation of a successful partnership that will ensure the future of the sustainable relationships between the environment and the society. Findings from this study will motivate companion animal owners to reconsider the feeding regimens and husbandry activities, improve owners' awareness of sustainability, and ultimately promote the global sustainable development.

We should remember that it is not only individual animals which are of concern to us. We have a duty of care toward the environment and nature, without which no human and animal life would be possible (Scruton 2006). The relationship between humans and animals depends on the sustainable environment. How humans and non-human animals relate to each other is a moral, material and cultural issue. Such relationship is sometimes similar to the way humans relate to the environment and nature. The cultural value of animals is strongly influenced by their usefulness to man, which promotes humans to start considering how to improve animal welfare in a better way. Through this dissertation, we hope concerns raised by the understanding of companion animal-owner relationships will pave the way for more ethical treatment of all the other animal types worldwide.

10.5.3 The limitations and the future research

Although the present study did achieve a degree of success by measuring the relationship between humans and animals from a cross-cultural comparison perspective, it is appropriate that we acknowledge the limitations. For instance, due to the manner of information collection, this research suffered from a somewhat unbalanced distribution of participants (e.g., the number of urban respondents in China was much higher than that of rural respondents, the proportion of Dutch women that filled in the questionnaire was several magnitudes higher than that of Dutch men). These limitations remind us that finding a good way to reduce sampling errors is significantly important in our follow-up research. We used both paper-based and online questionnaire surveys to collect data from Japan, which may make the findings inconsistent. However, our results showed non-significant differences between the two surveys, so the influence of the two survey methods would be very small. Additionally,

in our studies of the environmental impacts of food consumption by companion animals, we did not ask respondents to provide the exact body weight and food consumption of their animals because it is not possible for owners to remember clearly about these numbers. Instead, we provided three possible body weight ranges to respondents, and this leads to the larger ranges of the EPP, carbon emissions and energy requirement. This reminds us that research with specific values of body weight and resource consumption should be conducted in the future.

The sustainable human-animal relationship is complicated and studies focused on emotional and environmental perspectives cannot fully explain what human-animal relationship is. Therefore, other related research perspectives and disciplines, including animals' health conditions, behavior activities and conscious situations should also be involved in order to completely understand the human-animal relationship. We conclude by expanding on some of our earlier recommendations as well as adding some additional proposals for future human-animal relationship studies. First, we advocate greater use of cross-cultural comparisons to explain human-animal relationships in different countries and regions. There is already some evidence that the differences between the Eastern culture and the Western culture may be associated with people's attitudes toward animals. Including other cultures like African culture and Latin American culture into the analyzation of human-animal relationship would be more challenging and would yield more-pleasing results. Research into how people relate to other nonhuman animal types, not only companion animals, is also important. Our relationships with companion animals will be used to improve our understanding of companion animals and their welfare conditions, so that other animal types will also benefit from our understanding of them.

Related to this dissertation, we would like to emphasize that the use of multiple measurement methods and frameworks is likely to yield the most comprehensive results with regard to understanding human-animal relationships (de Vere & Kuczaj 2016). Some people may think that using one measurement would provide an accurate way to assess the relationship, or assess one aspect of the relationship in detail. However, people's understanding of one aspect of human-animal relationship would be limited if other factors are not measured. For instance, the emotional relationship between humans and animals is not only related to people's attribution of emotions to animals but also related to some cultural, psychological, environmental and even behavioral dimensions. Besides the multiple measurement methods, we would like to stress the importance of the timeline analysis, especially when we investigate animals' different feeding regimens and people's different husbandry activities over time. We provided a review of the literature on the relationship between companion animals and owners in this dissertation, but it is clear that there remains a huge bias toward the study of the relationship between humans and other animal types, such as farm animals, zoo animals and laboratory animals. There is no doubt that they are also sentient and emotional beings. Improving our

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understanding of companion animal emotions and sharing our emotions with them are important for how they interact and bond with us. It should therefore remain a goal for researchers to include other animal types (e.g., wild animals, zoo animals, laboratory animals, working animals, farm animals) in their studies of human-animal relationships in order to improve people's awareness of animal welfare worldwide.

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Appendix 1: The first questionnaire of The Emotions of Pets

Scientists more or less agree that emotions in humans act as a “mental guide” and affect our behavior. Emotions like fear, sadness and joy tell us which situations are good for us and which are bad. As a result of an emotion people react to a certain situation and may adapt their behavior. Emotions are therefore important for our functioning. Research has identified six basic emotions: anger, happiness, sadness, disgust, fear and surprise.

From an evolutionary point of view there seem to be no reason to assume that this would work differently in animals. However, it is difficult to determine whether they experience emotions in the same way as humans. It is not always clear what an animal feels, and you can easily be wrong in judging the nature and strength of their feelings. Yet in everyday life emotions are regularly assigned to animals. We might therefore assume that animals ‘use’ their emotions to adjust their behavior to a certain situation. Emotions are important for their functioning.

Through this survey we want to gain insights into how pet owners assign specific emotions to their pets based on facial expression, body posture, and sounds (barking, meowing, growling, etc.). We also want to know how the emotions of the owner and pet synchronize, in other words, looking at whether your pet tunes his/her emotions to those of you (or vice versa, for example, being sad/happy or angry simultaneously).

We would like to ask you (preferably the main carer - i.e. the person that devotes most time to the pet (walking the dog, feeding the cat, etc.)) to complete this questionnaire regarding the behaviour of your cat and/or dog and their emotions, and if possible, to send us a picture of your pet expressing one of the emotions mentioned above. This should take no longer than about 10 minutes of your time. By participating, we hope you receive personal satisfaction that you were part of a study to improve the lives of animals, and you may understand your own pet a little more afterwards. Of course, all information you provide will be kept completely confidential. Personal information will not be released to or viewed by anyone other than the researchers involved in this project. Results of this study will not include your name or any other identifying characteristics - unless you give permission for that.

If you have any questions, during or after filling in the questionnaire, please contact: Prof. dr. Pim Martens (p.martens@maastrichtuniversity.nl) or Bingtao Su (Bingtao.Su@maastrichtuniversity.nl). Please see also the webpage: www.animalwise.info

To stay informed about this research and other Animal related items, visit our Facebook page: <https://www.facebook.com/AnimalWise>

1. Personal details:

Please give us some of information about you, your house and your family. This information is kept strictly confidential.

1. What is your birth-year? (e.g. 1968)
2. What is your sex? Female/Male
3. What is the highest level of schooling you have completed?
 - a. No education
 - b. Less than grade 12
 - c. High school
 - d. College or technical school
 - e. University
 - f. No answer
 - g. Other
4. Do you belong or donate to an organization or charity involved in or concerned with:
 - a. Improving the welfare of animals Yes/No
 - b. Conservation of the natural environment Yes/No
 - c. Improving human rights or health Yes/No
5. Are you vegetarian/vegan? Yes/No
6. How does your household look like?
 - a. Single without children
 - b. Single with children
 - c. Married/living with partner without children
 - d. Married/living with partner with children
 - e. Other
7. In what sort of house do you live?
 - a. Apartment/flat
 - b. Semi-detached house
 - c. Detached house
8. Do you have a garden? Yes/No
9. What is your occupation?
 - a. Liberal profession
 - b. Employed
 - c. Retired
 - d. Student-scholarship
 - e. Social welfare
 - f. No answer

- g. Other
- 10. Is religion/spirituality important in your life? Yes/No /No answer
- 11. If your answer is yes, then what is your main source of inspiration (Multiple answers possible)?
 - a. Christianity
 - b. Judaism
 - c. Islam
 - d. Buddhism
 - e. Taoism
 - f. Other
- 12. What is your gross household income per month?
 - a. Below the minimum wage in your country
 - b. The minimum wage in your country
 - c. The average income in your country
 - d. About twice the average income in your country
 - e. More than twice the average income in your country
 - f. No answer
- 13. Where is your current residence place?
 - a. Urban areas (a geographical area constituting a city or town)
 - b. Rural areas (an area outside of cities and towns)

2. Your pet and its emotions

- 14. Do you own a dog or cat?
If you have more than one dog/cat, please fill in the questions for the pet you have longest first.

Mark only one oval.

- a. Dog Skip to question 15.
- b. Cat Skip to question 31.

Dog

Answer these questions if you own a dog.

- 15. What is the breed of your dog? (leave blank if unknown)

- 16. What is the sex of your dog? Male/Female
- 17. Is your dog neutered (fixed)? This applies for both male and female dogs Yes/No
- 18. How big is your dog?
 - a. Small (less than 10kg)
 - b. Medium (10-25kg)

- c. Large (more than 25kg)
19. How old is your dog?
- a. Less than 5 years
- b. 5 to 10 years
- c. 10 years or over
20. How would you rate the health of your dog? Good/Fair/Bad
21. How often have you visited the vet on average per year with your dog?
- a. Never
- b. Once or twice per year
- c. More than twice per year
22. On average, how often do you go for a walk with your dog each day?
- a. Twice or less
- b. Between two and four times
- c. Over four times
23. About how many minutes per day do you go for a walk with your dog?
- a. Less than 1 hour
- b. Between 1-2 hours
- c. More than 2 hours
24. How often do you feed your dog each day?
- a. Once
- b. Twice
- c. More than twice
25. On average, how many grams of food per kg body weight do you give your dog each day?
(e.g., if your dog weights about 10kg, and you give him 100grams, the answer is 10 grams)
- a. Less than 10 gram per kg bodyweight
- b. Between 10 and 25 gram per kg bodyweight
- c. More than 25 gram per kg bodyweight
- d. No idea
26. On average, how often do you brush your dog?
- a. Once or more times each day
- b. Once or more times each week
- c. Once or more times each month
27. Is your dog friendly to strangers?
- a. Yes
- b. No
- c. Sometimes yes/sometimes no
28. Can your dog stay alone at home? Yes/No
29. Where does your dog sleep?

(Multiple answers possible)

Check all that apply

- a. Kitchen
- b. Living room
- c. Bedroom
- d. Garage/basement/barn
- e. Hall
- f. Other

30. Who is taking care of your dog when you are (temporarily) not around?

(Multiple answers possible)

Check all that apply

- a. Shelter or kennel
- b. Neighbors, friends or family
- c. Other

Cat

Answer these questions if you own a cat.

31. What is the breed of your cat? (leave blank if unknown)

32. What is the sex of your cat? Male/Female

33. Is your cat neutered (fixed)? This applies for both male and female cats
Yes/No

34. How old is your cat?

- a. Less than 5 years
- b. Between 5 and 10 years
- c. 10 years or over

35. How would you rate the health of your cat? Good/Fair/Bad

36. How often have you visited the vet on average per year with your cat?

- a. Never
- b. Once or twice per year
- c. More than twice per year

37. How often does your cat go outside?

- a. Never
- b. Can go outside whole day
- c. Can go outside during daytime
- d. Can go outside during night time
- e. Only goes outside when someone is at home

38. How often do you feed your cat each day?

- a. Once
- b. Twice

- c. More than twice
39. On average, how many grams of food do you give your cat each day?
- a. Less than 50 gram
 - b. Between 50 and 100 gram
 - c. More than 100 gram
 - d. No idea
40. How often is the litter changed?
- a. Multiple times per day
 - b. Every day
 - c. Multiple times per week
 - d. Once per week
 - e. I do not have a litter
41. Does your cat sit frequently on your lap?
- a. Never
 - b. Every day
 - c. Several times per week
42. Where does your cat sleep?
(Multiple answers possible)
Check all that apply
- a. Kitchen
 - b. Living room
 - c. Bedroom
 - d. Garage/basement/barn
 - e. Other
43. Who is taking care of your cat when you are (temporarily) not around?
(Multiple answers possible)
Check all that apply
- a. Shelter or kennel
 - b. Neighbors, friend or family
 - c. Other

You and your pet

44. Are you the main carer of the pet? Yes/No
The main carer is the person that devotes most time to the pet (walking the dog, feeding the cat, etc.)
45. Do you have other pets? Yes/No
46. How many years do you own your pet?
- a. Less than 1 year
 - b. 1 to 5 years
 - c. 5 to 10 years

Appendix 1: The first questionnaire of The Emotions of Pets

d. More than 10 years

47. Why did you get your pet?

(Multiple answers possible)

Check all that apply

- a. For myself
- b. For the kids
- c. For my job
- d. Other

Interactions between you and your pet

48. How do you and your pet go along?

Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
My pet can make me laugh					
I have lot of fun with my pet					
My pet makes me feel important					
I have warm feelings when I think about my pet					
I like to spend a lot of time with my pet					
My pet loves me					
My pet misses me when I am gone					
I like to talk to my pet about things that are important to me					
I like to talk to my pet					
My pet understands my feelings					
I can tell secrets to my pet					
Sometimes my only friend is my pet					
My pet loves me no matter what					

49. How do you and your pet go along?

Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
One of my favorite things to do is to spend time with my pet					
My pet is an important part of my family					

My pet understands what I say					
I would be very upset if something happened to my pet					
I try to protect my pet					
I keep pictures of my pet					
My pet stays close to me when I am upset					
My pet has feelings					
I think about my pet when we are not together					
I miss my pet when I am not around					
My pet is important to me					
I am proud of my pet					

50. Does your pet communicate with you?

Mark only one oval per row.

	Never	Sometimes	Often
By meowing or barking			
By means of body language (posture)			
By touching you (with head/legs)			
By scratching (against a door, for example)			
By looking at you			
By sniffing/recognizing your smell			

51. Do you like watching your pet? Yes/No

52. Do you like touching your pet? Yes/No

53. I consider my relationship with my pet to be:

Bad/Normal/Good

54. Can you tell your pet is ill by its smell? Yes/No/Don't know

55. Do you sometimes attribute human characteristics to your pet?
Yes/No

56. Do you think you look like your pet?

(Multiple answers possible)

Check all that apply.

- a. In behaviour
- b. In appearance
- c. Other
- d. No

57. Do you like taking care of your pet? Yes/No

Your pet and its emotions

58. Did you ever see these emotions expressed by your pet?
Mark only one oval per row.

	Never	Sometimes	Often	No idea
Anger				
Joy				
Sadness				
Disgust				
Fear				
Surprise				
Shame				
Jealousy				
Disappointment				
Compassion				

59. Do you think that these emotions are caused by the behavior of yourself (or your housemates), in other words, do you directly affect the behavior of your pet?
Mark only one oval per row.

	Never	Sometimes	Often	No idea
Anger				
Joy				
Sadness				
Disgust				
Fear				
Surprise				
Shame				
Jealousy				
Disappointment				
Compassion				

60. Can you describe in a few words/phases your pet's character?

Recognizing your pet's emotions

We do understand that the following request may be somewhat more difficult to carry out and takes some more time. Nevertheless, as this is an essential part of the research, we would appreciate your cooperation. You will help us to understand the emotions of our pets better and thus improve their welfare.

We would like to ask you to take a picture / multiple photos of your pet (or take a picture/movie from the past) if you recognize any of the emotions from the previous questions by your pet:

- a. Anger
- b. Joy
- c. Sadness
- d. Disgust
- e. Fear
- f. Surprise
- g. Shame
- h. Jealousy
- i. Disappointment
- j. Compassion

We would appreciate if you could email the picture(s) to us:

AnimalWise2@gmail.com

Could you also briefly explain why you think your pet feels this emotion (certain body language, facial expression)?

Can you briefly describe in the e-mail why you think this situation occurred?

61. If you have submitted a photo, may we use it in possible publications and/or post it on the Internet (e.g. Facebook)?

(Of course, your privacy is guaranteed)

Mark only one oval.

- a. Yes
- b. No
- c. 'Yes' in publications/ 'No' on the Internet
- d. 'Yes' on Internet / 'No' in publications
- e. I did not submit a picture

Appendix 2: The second questionnaire of Humans-Animal Interactions

Through this international survey – led by ICIS, Maastricht University, The Netherlands (in cooperation with AnimalWise) - we want to gain insight in the way people treat and interact with animals in their direct environment. We would like to ask you to complete this questionnaire regarding your observations of attitudes towards and interactions with the animals around you. We will ask questions about your views about animals in captivity, animals in the wild, farm- and companion animals, as well as questions about your food preferences and some other personal details.

All the information you provide will be kept completely confidential. Your personal information will not be released to or viewed by anyone other than the researchers involved in this project. Results of this study will not include your name or any other identifying characteristics - unless you give permission for that.

Please do inform us by sending an email to the address below if we can speak to you (on phone) to ask additional questions (this will be strictly confidential as well).

If you have any questions, during or after filling in the questionnaire, please contact: Prof. dr. Pim Martens (p.martens@maastrichtuniversity.nl) or Bingtao Su (Bingtao.Su@maastrichtuniversity.nl). Please see also the webpage: www.animalwise.info

To stay informed about this research and other Animal related items, visit our Facebook page: <https://www.facebook.com/AnimalWise>

Thank you very much for your cooperation!

1. Personal details

1. What is your birth-year? (e.g. 1968)
2. What is your sex? Female/Male
3. In what country do you live?
4. What is the highest level of schooling you have completed?
 - a. No education
 - b. Less than grade 12
 - c. High school
 - d. College or technical school
 - e. University
 - f. No answer
 - g. Other
5. Do you belong or donate to an organization or charity involved in or concerned with:
 - a. Improving the welfare of animals Yes/No
 - b. Conservation of the natural environment Yes/No
 - c. Improving human rights or health Yes/No
6. How does your household look like?

- a. Single without children
 - b. Single with children
 - c. Married/living with partner without children
 - d. Married/living with partner with children
 - e. Other
7. Where is your current residence place?
- a. Urban areas (a geographical area constituting a city or town)
 - b. Rural areas (an area outside of cities and towns)
8. In what sort of house do you live?
- a. Apartment/flat
 - b. Semi-detached house
 - c. Detached house
9. Do you have a garden? Yes/No
10. What is your occupation?
- a. Liberal profession
 - b. Employed
 - c. Retired
 - d. Student-scholarship
 - e. Social welfare
 - f. No answer
 - g. Other
11. Is religion/spirituality important in your life? Yes/No
12. If your answer is yes, then what is your main source of inspiration (Multiple answers possible)?
- a. Buddhism
 - b. Judaism
 - c. Islam
 - d. Christianity
 - e. Taoism
 - f. Other
13. What is your gross household income per month?
- a. Below the minimum wage in your country
 - b. The minimum wage in your country
 - c. The average income in your country
 - d. About twice the average income in your country
 - e. More than twice the average income in your country
 - f. No answer
14. Do you own a pet? Yes/No
15. If yes, what pet do you have (Multiple answers possible)?
- a. Cat(s)
 - b. Dog(s)
 - c. Fish
 - d. Birds
 - e. Reptiles

Appendix 2: the second questionnaire of Humans-Animal Interactions

- f. Rodents
 - g. Chickens, pigeon, geese (or other poultry)
 - h. Ponies, horses
 - i. Other: ...
 - j. No, I do not have a pet
16. How often do you eat meat (including fish) every week?
- a. I do not eat meat, I am a vegetarian/vegan
 - b. Once a week
 - c. 2-3 days a week
 - d. 4-6 days a week
 - e. Every day
17. How often do you visit a zoo or aquarium?
- a. Once a month
 - b. Once every six month
 - c. Once every year
 - d. Once two years or more than two years
 - e. Never

2. The Ethics Position Questionnaire

Please indicate if you agree or disagree with the following items. Each represents a commonly held opinion and there are no right or wrong answers. We are interested in your reaction to such matters of opinion. Rate your reaction to each statement by:

- 1 = Completely disagree
- 2 = Largely disagree
- 3 = Moderately disagree
- 4 = Slightly disagree
- 5 = Neither agree nor disagree
- 6 = Slightly agree
- 7 = Moderately agree
- 8 = Largely agree
- 9 = Completely agree

1. People should make certain that their actions never intentionally harm another even to a small degree.

2. Risks to another should never be tolerated, irrespective of how small the risks might be.

3. The existence of potential harm to others is always wrong, irrespective of the benefits to be gained.

4. One should never psychologically or physically harm another person.
5. One should not perform an action which might in any way threaten the dignity and welfare of another individual.
6. If an action could harm an innocent other, then it should not be done.
7. Deciding whether or not to perform an act by balancing the positive consequences of the act against the negative consequences of the act is immoral.
8. The dignity and welfare of the people should be the most important concern in any society.
9. It is never necessary to sacrifice the welfare of others.
10. Moral behaviors are actions that closely match ideals of the most "perfect" action.
11. There are no ethical principles that are so important that they should be a part of any code of ethics.
12. What is ethical varies from one situation and society to another.
13. Moral standards should be seen as being individualistic; what one person considers to be moral may be judged to be immoral by another person.
14. Different types of morality cannot be compared as to "rightness."
15. Questions of what is ethical for everyone can never be resolved since what is moral or immoral is up to the individual.
16. Moral standards are simply personal rules that indicate how a person should behave, and are not to be applied in making judgments of others.
17. Ethical considerations in interpersonal relations are so complex that individuals should be allowed to formulate their own individual codes.
18. Rigidly codifying an ethical position that prevents certain types of actions could stand in the way of better human relations and adjustment.
19. No rule concerning lying can be formulated; whether a lie is permissible or not permissible totally depends upon the situation.
20. Whether a lie is judged to be moral or immoral depends upon the circumstances surrounding the action.

Appendix 2: the second questionnaire of Humans-Animal Interactions

3. Animal issue (AI) questions

Please rate the questions below on the following scale:

1. Extremely unacceptable; 2. Unacceptable; 3. Normal; 4. Acceptable; 5. Extremely acceptable

3.1: Use of animals

- 1 Keeping animals for the production of food or clothing
- 2 Keeping animals as pets
- 3 Keeping animals for the education of the public in zoos, wildlife parks, etc
- 4 Using animals for work
- 5 Using animals for entertainment or sports

3.2: Animal integrity

- 6 Operations on animals to improve their health
- 7 Decoration of animals, such as dyeing or cutting their hair for aesthetic reasons
- 8 De-sexing by hormone implants
- 9 Removal of a body part, such as tail docking or de-clawing
- 10 Marking animals by branding or ear notching
- 11 Removal of dead tissue, such as hair/wool removal or foot trimming

3.3: Killing animals

- 12 Killing young animals that are dependent on their parents
- 13 Allowing animals to experience pain during slaughter
- 14 Using animals for products after their natural death
- 15 Killing animals when they are seriously injured or ill
- 16 Euthanising healthy and unwanted pets because of overpopulation

3.4: Animal welfare

- 17 Depriving animals of their needs for food and water
- 18 Depriving animals of an appropriate environment to rest, including shelter
- 19 Inflicting pain, injury or disease on animals
- 20 Not providing sufficient space, proper facilities and company needed for animals
- 21 Subjecting animals to conditions and treatment which cause mental suffering

3.5: Experimentation on animals

- 22 Observing animal behaviour in an experiment
- 23 Experiments to improve animal welfare or health
- 24 Medical experiments using animals to improve human health
- 25 Testing cosmetics or household products on animals
- 26 Operating on living animals for the benefits of human medicine research

3.6: Changes in animals' genotypes

- 27 Increasing animals' reproductive or productive capabilities by genetic changes, eg cows producing more milk
- 28 Increasing animals' health or disease resistance by genetic changes

- 29 Creating farm animals that are more profitable because they feel happy with little stimulation and have little desire to be active
- 30 Genetic selection of pet animals, such as dogs and cats, to increase their rarity, potential for showing or pedigree value
- 31 Genetic modification of crops grown for animal foods

3.7: Animals and the environment

- 32 Killing animals because they are not native to the area where they live
- 33 Killing wild animals to stop the spread of diseases that could affect humans
- 34 Controlling wildlife populations by killing
- 35 Controlling animal populations by sterilisation
- 36 Destroying the habitat of endangered animal species
- 37 Destroying the habitat of non-endangered animal species to develop and promote urbanisation or crops to feed humans

3.8: Societal attitudes towards animals

- 38 Sacrifice of animals in religious rites
- 39 Considering some animal species as sacred or good luck symbols or totems
- 40 Considering some animal species as evil or bad luck
- 41 Parents displaying cruel treatment of animals in front of their children
- 42 Inflicting pain or injury on animals as part of cultural traditions
- 43 Cloning animals for human benefit

4. Animal Attitude Scale

Please judge the propositions below.

Animal Attitude Scale	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1. It is morally wrong to hunt wild animals just for sport.					
2. I do not think that there is anything wrong with using animal in medical research.					
3. There should be extremely stiff penalties including jail sentences for people who participate in cock-fighting.					
4. Wild animals, such as mink and raccoons, should not be trapped and their skins made into fur coats.					

Appendix 2: the second questionnaire of Humans-Animal Interactions

5. There is nothing morally wrong with hunting wild animals for food or a better living for poor people.					
6. I think people who object to raising animals for meat are too sentimental.					
7. Much of the scientific research done with animals is unnecessary and cruel.					
8. I think it is perfectly acceptable for cattle and dogs to be raised for human consumption.					
9. Basically, humans have the right to use animals as we see fit.					
10. The slaughter of whales and dolphins should be immediately stopped even if it means some people will be put out of work.					
11. I sometimes get upset when I see wild animals in cages at zoos.					
12. In general, I think that human economic gain is more important than setting aside more land for wildlife.					
13. Too much fuss is made over the welfare of animals these days when there are many human problems that need to be solved.					
14. Breeding animals for their skins is a legitimate use of animals.					
15. Some aspects of biology can only be learned through dissecting preserved animals, such as cats.					

16. Continued research with animals will be necessary if we are to ever conquer diseases such as cancer, heart disease and AIDS.					
17. It is unethical to breed purebred dogs for pets when millions of dogs are killed in animal shelters each year.					
18. The production of inexpensive meat, eggs, and dairy products justifies maintaining animals under crowded conditions.					
19. The use of animals, such as rabbits, for testing the safety of cosmetics and household products is unnecessary and should be stopped.					
20. The use of animals in rodeos and circuses is cruel.					

Summary

Sustainable development has been used in various contexts by theoreticians and practitioners from a number of disciplines. According to the definition of sustainable development, we think sustainable human-animal relationship means the environmental sound, psychologically, physically and socially beneficial, ethically acceptable and economically viable practices between humans and animals. Previous studies showed that many factors, including culture, geographic places, psychological feelings, sustenance, awareness of animal welfare, economy and human demographics, that could influence the sustainable human-animal relationships. However, how to investigate human-animal relationships in a more comprehensive way deserves further consideration. The emotional and environmental relationships are two of the most important aspects of sustainable human-animal relationships. Additionally, comparing to the lay public, collecting data from companion animal owners would be a better choice when measuring animal emotions and resource consumptions because owners' direct experience in interacting with animals may allow them to better comprehend animals' daily conditions. Therefore, the central aim of this dissertation is to investigate public attitudes toward animals in general and the emotional and environmental relationships between companion animals and their caretakers. To make the structure clearer and the content easier to understand, we divided this dissertation into three key parts according to the three main questions as shown below:

What are the people's attitudes toward animals in general and how does this relate to people's ethical ideologies in China, the Netherlands and Japan?

Which emotions can owners attribute to their companion dogs and cats, and what are the correlations between the attribution of emotion and owners' degree of attachment to their dogs and cats?

What are the environmental impacts of food consumption by companion dogs and cats?

These questions were answered in chapter 2 to chapter 9 by using the data from China, Japan and the Netherlands. We thought the culture, ethical ideologies, economy and people's awareness of animal welfare might be different in these three countries, and this would make it possible to execute the influence of these factors on the issue of sustainable human-animal relationships. Data for this dissertation has been collected by two questionnaires between 2015 and 2016 in those three countries.

The first main question has been addressed in chapters 2, 3 and 4, which investigated people's attitudes toward animals in general and how ethical ideologies and their interaction with human demographics were related to such attitudes toward

animals in China, the Netherlands and Japan. The second main question has been addressed in chapters 5 and 6, which explored companion animal owners' attribution of emotions to their animals and how the attribution of emotions was correlated with the degree of attachment to companion animals in China and Japan. The comparison analyses across these two countries and the Netherlands were also discussed in each chapter. The third main question has been addressed in chapters 7, 8 and 9. We quantified the food consumption by companion dogs and cats in China, Japan and the Netherlands in these three chapters. According to the food consumption, companion animals' dietary EPP, GHG/carbon emissions and energy consumption were calculated and compared with humans' dietary "Ecological Footprint" (EF) and GHG/carbon emissions.

Chapter 2 aimed to find out how Chinese people' attitudes toward animals (measured by Animal Attitude Scale, AAS, and Animal Issue Scale, AIS) as well as how ethical ideologies (measured by Ethical Position Questionnaire, EPQ) associated with Chinese people's attitudes toward animals. Since previous research has demonstrated that Chinese people's awareness of animal welfare is lower than that of the Western population, in this chapter, we questioned whether the links between ethical ideologies and attitudes toward animals could be low in a country where the awareness of animal welfare is poor. We found that Chinese people's attitudes toward animals were positively correlated with idealism and negatively correlated with relativism. According to our findings and previous studies in the United States, we concluded that the same mechanisms underlying the effect of ethical idealism on attitudes toward animals might work in different countries to increase awareness on animal welfare, while the manner in which ethical relativism influences attitudes toward animals may differ between developed (e.g. the US) and developing countries.

In order to confirm our findings in chapter 2, we conducted the study of chapter 3. **Chapter 3** analysed Dutch people's attitudes toward animals as well as how ethical ideologies related to Dutch people's attitudes toward animals. Since Dutch people have a greater awareness of animal welfare, we examined whether the correlation between ethical ideologies and attitudes toward animals differ between Dutch and Chinese people. Our results showed that Dutch people had a higher awareness of animal welfare than Chinese people. Dutch people's attitudes toward animals were significantly related to idealism; this confirmed our findings in China, while no significant correlation between relativism and attitudes toward animals was found among Dutch respondents, which was inconsistent with our findings in China. Overall, chapter 3 further clarified our point in chapter 2: the correlation between idealism and attitudes toward animals is the same in different countries, while the correlation between relativism and attitudes toward animals differs between different countries, in particular, between developed and developing countries. These findings also reveal that the different level of development and awareness of animal welfare may influence the correlation between ethical ideologies and attitudes toward animals.

However, besides the different level of development and awareness of animal welfare, we suppose other factors such as culture, society condition and geographical location may influence people's attitudes toward animals. Therefore, we conducted **chapter 4**, which used Japan as a representative because Japan's development

conditions are similar to those of the Western countries, while its culture is similar to those in other Eastern countries such as China, although their social values are also influenced by the Western culture. Chapter 4 revealed that Japanese people's awareness of animal welfare was similar to Chinese people but lower than Dutch people. In Japan, people's attitudes toward animals were positively associated with idealism and negatively associated with relativism. These findings are similar to those from China, but partly contrast with those from the Netherlands, where relativism was unrelated to attitudes toward animals. Considering that idealistic individuals are concerned about others' welfare and believe in the absolute value of moral standards based on their unselfish concern for others. Hence, greater concern for animal welfare has always gone together with a higher level of idealism. With regard to relativism, Chinese and Japanese people are considered to be more collectivistic, focusing attention on the contextual factors when explaining their attitudes toward animals. Therefore, relativism is significantly associated with their attitudes toward animals. Dutch people are more individualistic and they might regard animals as more valuable than the benefits that they bring. Hence, the relativism would be ignored when investigating the predictor variables of Dutch people's attitudes toward animals.

The emotional and environmental relationships are two of the most significant aspects of the relationship between companion animals and their owners. Therefore, we wanted to investigate sustainable human-animal relationships by measuring their emotional and environmental relationships between companion animals and their owners, respectively. Chapters 5 and 6 focused on the emotional relationship while chapters 7, 8 and 9 focused on the environmental relationship. Our research team (Pim Martens and Marie-Jose Enders) have demonstrated that Dutch companion dog and cat owners could attribute all primary (anger, joy, fear, surprise, disgust and sadness) and secondary (shame, jealousy, disappointment and compassion) emotions to their animals, with a trend toward basic emotions being more commonly attributed than secondary emotions (with the exception of jealousy). All companion animal owners showed strong attachment to their animals, and their degree of attachment was found to be significantly correlated to the attribution of seven (three primary emotions and four secondary emotions) out of ten emotions to animals. In order to find out whether these findings are also suitable in China, we conducted chapter 5. **Chapter 5** showed that Chinese companion dog and cat owners had a high attachment to their animals, which was similar to the Dutch companion owners. They frequently attributed primary emotions to their animals rather than secondary emotions (with the exception of compassion). Additionally, the degree of attachment was significantly associated with the attribution of five (two primary emotions and three secondary emotions) out of ten emotions to their animals. Our findings provided evidence that the correlation between the degree of attachment and the attribution of emotions was significant for more animal emotions by Dutch owners than by Chinese owners, which means that the attribution of emotions was more associated with the degree of attachment in the Netherlands than in China. Since animal emotions have been identified as a critical marker for animal welfare, other factors such culture may also influence the correlation between the degree of attachment and the attribution of emotions to animals. Therefore, we conducted the study of chapter 6.

Chapter 6 was conducted in Japan and similar to our findings in the Netherlands and China, it showed that Japanese owners have a strong attachment (but lower than that of Dutch and Chinese owners) to their animals. Companion animals' primary emotions, compared to secondary emotions, were more commonly attributed by their owners, with the exceptions of two secondary emotions of compassion and jealousy. The degree of attachment was significantly correlated with the attribution of nine (five primary emotions and four secondary emotions) out of ten emotions. Findings from this chapter imply that the relationship between degree of attachment and the attribution of emotions was significant for more animal emotions by Japanese and Dutch owners than by Chinese owners. In addition, based on our findings in chapter 5 and our previous Dutch research, we concluded that Chinese and Japanese animal owners were more commonly to attribute compassion to their animals than Dutch owners. This finding indicated that culture could, to some extent, influence people's attribution of emotions to animals. In Chinese and Japanese culture, the feeling of compassion reflects the principle of benevolence, one of the five basic elements of Confucianism. Dogs and cats are regarded as sentient beings and as having the nature of compassion to all misfortunes. Therefore, Chinese and Japanese people tend to give more anthropomorphic descriptions of compassion than Dutch population.

While Chapter 5 and 6 focused on the emotional relationship between companion animals and their owners, the following three chapters mainly analyzed the environmental relationship. **Chapter 7** examined the environmental impacts of food consumption by companion dogs and cats in China, by utilizing variables of dietary Ecological Paw Print (EPP), carbon emissions and energy consumption. We concluded that the dietary EPP of an average-sized dog was 0.82 to 4.20 ha. year⁻¹, while for a cat was 0.36 to 0.63 ha. year⁻¹ (regarding commercial dry food). All companion dogs and cats' dietary EPP (27.4 million companion dogs and 58.1 million companion cats, assuming they eat commercial dry food) was 43.6 to 151.9 million ha. year⁻¹, which was equivalent to the dietary EF of 70.3 to 245.0 million Chinese people in a year. Their carbon emissions from their food consumption were 2.4 to 7.5 million tons per year, which was equivalent to 34.3 to 107.1 million Chinese people's carbon emissions regarding their food consumption.

Chapter 8 examined the environmental impacts of food consumption by companion dogs and cats in Japan, by utilizing variables of dietary EPP, greenhouse gas (GHG) emissions and energy consumption. The dietary EPP of an average-sized dog in Japan was 0.33 to 2.19 ha. year⁻¹, while for a cat was 0.32 to 0.56 ha. year⁻¹. The dietary EPP of all companion dogs and cats (10.35 million companion dogs and 9.96 million companion cats) in Japan was 6.6 to 28.3 million ha. year⁻¹, which was equivalent to the dietary EF of 4.62 to 19.79 million Japanese people. Their GHG emissions from food consumption were 2.52 to 10.70 million tons, which were equivalent to 1.17 to 4.95 million Japanese people's GHG emissions regarding their food consumption.

In **chapter 9**, our results showed that the dietary EPP of an average-sized dog was 0.90 to 3.66 ha. year⁻¹, while for a cat was 0.40 to 0.67 ha. year⁻¹. Owning a large dog could increase the household's annual EF and GHG emissions by 58% and 11.3%, respectively. The dietary EPP of all companion dogs and cats (1.8 million companion dogs and 3.2 million companion cats) in the Netherlands was 2.9 to 8.7 million ha. year⁻¹.

¹, which was equivalent to the whole EF of 0.50 to 1.51 million Dutch people. Their GHG emissions from their food consumption were 1.09 to 3.28 million tons, which were equivalent to 94 to 284 thousand of Dutch people's GHG emissions regarding their total resource consumption.

Additionally, results from chapter 7, 8 and 9 also showed that many companion animals (especially medium-sized and large dogs) consumed more energy than their actual needs in all three case studies, suggesting that overfeeding and food waste were two common phenomena among companion dog and cat households.

Chapter 10 ends with a summary of the main findings, discussions and further considerations according to the empirical chapters. In this chapter, we explained the sustainable human-animal relationships and highlighted the approaches to improve the emotional and environmental relationship between companion animals and owners. We concluded that a sustainable emotional relationship between humans and animals requires human to improve their concern for animals and understanding for animal emotions, while a sustainable environmental relationship between companion animals and owners requires a large scale reduction of companion animal numbers, replacing large animals with small animals that could supply the same emotional and physical support, and avoid overfeeding and food waste.

Through this dissertation, we hope people's awareness of animal welfare will increase and humans and animals could live on the earth in a more sustainable way. We acknowledge that this dissertation did achieve a degree of success by measuring the human-animal relationships in a relatively comprehensive way, yet we should admit that there is no one simply method can explain the complex relationships between humans and animals and the predictor variables that involved in such relationships, further studies from different perspectives and disciplines therefore need to confirm the main points in this dissertation.

总结

可持续发展近年来被广泛应用于不同的学科研究中，并得到了来自不同领域理论家与实践家的认可。根据可持续发展的定义，我们认为可持续的人与动物关系指的是发生在人和动物之间的一些可持续性的行为，包括环境的可接纳性，心理、生理和社会的可受益性，道德的可接受性以及经济的可行性。先前的研究结果表明包括经济，文化，地理位置，心理感受，生计，动物福利意识和人类统计学资料等在内的很多因素都可能影响可持续的人与动物关系。但是，如何从一个更加全面的角度去分析和理解可持续的人与动物关系值得我们深思。情感与生计是人与动物关系中十分重要的两个方面。由于伴侣动物的主人跟其有频繁且亲密的互动，因此在评估动物的情绪与资源消耗的过程中，伴侣动物的主人似乎比普通大众更能提供较为准确和全面的关于动物的生活状况的信息。因此本研究的核心目标确定为研究大众对动物的态度以及伴侣动物与其主人之间的情感与资源环境的关系。为了让论文的结构更加清晰，内容更容易被理解，我们根据论文的三个主要研究问题将本论文分成了三个主要部分。

本论文的三个主要研究问题如下：

中国人、荷兰人和日本人对动物的态度如何，以及他们的伦理意识形态在何种程度上影响他们对动物的态度？

伴侣动物（猫和狗）的哪些情绪可以被他们的主人进行归因，以及主人对伴侣动物的依恋性程度与他们对动物的情感归因的关系如何？

伴侣性动物（猫和狗）的食物消耗会产生怎样的环境影响？

本研究的数据通过 2015 到 2016 年在中国，日和和荷兰三个国家分别发放的两份问卷获得。通过对来自这三个国家的数据进行分析，本研究的这三个主要研究问题得以在第二章到第九章内容中进行解答。由于这三个国家的文化与社会发展状况均有较大差异，因此我们可以从不同的文化，伦理意识形态，经济发展及动物福利意识等角度对可持续的人与动物的关系进行分析。

第一个主要研究问题在第二章，第三章及第四章中进行了解答。这三章主要分析了中国人，荷兰人及日本人对动物的一般性态度以及人们的伦理意识形态及其与人口统计学资料的交互作用是如何影响人们对动物的态度的。第二个主要研究问题在第五章和第六章中进行了解答。这两章主要探究了中国和日本伴侣动物的主人如何对动物的情绪进行归因，以及主人对伴侣动物的依恋程度是如何与其对动物情绪的归因联系起来的。另外关于这两个国家与荷兰的状况对比也在这两章内容中进行了归纳。第三个主要研究问题在第七章，第八章与第九章中进行了分析与解答。这三个章节主要对中国，日本和荷兰的伴侣猫与伴侣狗的食物消耗进行了量化。根据伴侣动物的食物消耗，我们分别对他们的饮食性“生态爪

痕”，温室气体或者碳排放以及能源消耗这三个指标进行了计算。同时我们还将伴侣动物的这三个指标与人类相对应的指标进行了对比分析。

第二章主要对中国大众关于动物的态度（用动物态度量表和动物相关问题两个量表进行评估）以及人们伦理意识形态（用伦理状况问卷进行评估）如何影响其对动物的态度这两个问题进行了分析。由于之前的研究已经证明中国人对动物福利的意识相对西方人来讲要稍微弱一些，因此，在这一章中我们主要围绕着一个问题进行分析与讨论，这一问题即伦理意识形态与对动物的态度之间的相关性会不会由于人们较低动物福利意识而变的相对较弱。我们发现中国人对动物的态度与其理想主义的价值观念呈显著的正相关关系，与其相对主义的价值观念呈显著的负相关关系。根据我们的发现以及之前在美国的一些研究结果，我们得出结论认为理想主义价值观念与人们对动物的态度之间相关性的内在机制在不同的国家应该是一致的，但是相对主义价值观念与人们对动物的态度之间相关性的内在机制在不同国家尤其是发达国家和发展中国家是不一致的。

为了证明我们第二章的主要论点和结论，我们进一步对第三章中关于荷兰人对动物的态度以及伦理价值观念与其对动物态度的相关性进行了分析。相对中国人来讲，荷兰人对动物福利的意识普遍要高一些，因此我们想证明人们的伦理意识形态与其对动物的态度的相关性是否在两个国家呈现出一定的不同。我们的研究结果证明荷兰人的动物福利意识显著的高于中国人。另外，同在中国发现的结果一样，荷兰人的理想主义价值观念与其对动物的态度也呈现出显著的正相关关系，但是我们发现荷兰人的相对主义价值观念与其对动物的态度之间并没有任何的显著性关系，这一结果与我们在中国的研究结果是背道而驰的。因此，第三章的研究结论又进一步深化的我们在第二章中得出的结论，即理想主义价值观念与人们对动物的态度之间相关性在不同的国家应该是一致的，但是相对主义价值观念与人们对动物的态度之间相关性在不同国家尤其是发达国家和发展中国家是不同的。同时这些研究结果还表明不同的社会发展阶段以及人们不同的动物福利意识都有可能影响到人们伦理意识形态与其对动物态度之间的关系。

但是，除了不同的社会发展阶段以及人们不同的动物福利意识，我们认为包括文化，社会发展状况以及地理位置等在内的其他一些因素也能影响人们对动物的态度。因此我们开展并完成了第四章的内容。第四章我们主要以日本为代表，因为日本的社会发展状况与很多西方国家都很相似，都属于发达国家，同时日本的文化与包括中国在内的很多东方国家的文化又很相似，尽管西方的价值观念也在一定程度上影响了日本的文化。在第四章中我们发现，日本人对动物福利的意识比荷兰人要低，但跟中国人的动物福利意识水平持平。在日本，人们对动物的态度与其理想主义的价值观念呈显著的正相关关系，与其相对主义的价值观念呈显著的负相关关系。这一结果与中国的结果完全相同，然而关于相对主义价值观念与人们对动物的态度的相关性部分的研究结果与荷兰的研究结果不同。考虑到理想主义者一般比较关系他人的福利，同时他们相信绝对的道德标准主要基于他们对别人的无私的关心，因此，对动物福利的较强的关注总是与较高的理想主义道德标准同时出现。另外，关于相对主义的价值观念，中国人和日本人更加偏向于集体主义。他们对动物的态度更多的会受到当时当地所处的处境的影响。因此在中国和日本，相对主义价值观念与人们对动物的态度呈现显著的相关关系。相对中国人和日本人来讲，荷兰人受西方文化的熏陶，更加偏向于个人主义。他

们认为相对于动物所带来的一些好处来讲，他们更加关注动物存在本身这一单独时间。因此在分析荷兰人对动物的态度的过程中，其相对主义价值观念似乎可以被忽略掉。

情感和生计关系是伴侣动物与其主人之间复杂关系中的非常重要的两个方面。因此我们在分析与讨论可持续的人与动物的关系的过程中，主要评估了情感与生计这两项关系。第五章和第六章集中分析了人与动物的情感关系，而第七章，第八章及第九章主要分析了人与动物之间的生计关系。本研究的小组成员（Pim Martens 和 Marie-Jose Enders）之前的研究已经证明荷兰的伴侣动物主人可以对动物所有的初级情绪（生气，开心，恐慌，吃惊，反感和难过）和复杂情绪（羞愧，嫉妒，失望和同情）进行归因，而且相对复杂情绪（不包括嫉妒）来讲，主人可能更容易对动物的初级情绪进行归因。所有的伴侣动物主人都对他们的伴侣动物表现出很强的依恋性，同时他们对动物的依恋性程度与他们对七种情绪（三种初级情绪和四种复杂情绪）的归因都呈现出显著的相关性。为了进一步分析在荷兰的这些发现是否也同样在中国存在，我们进行了第五章内容的研究。第五章研究内容显示中国的伴侣动物主人对他们的动物表现了很强的依恋性，而且这一依恋程度与荷兰人对其伴侣动物的依恋程度相似，即没有显著性差别。相对于动物的复杂情绪（不包括同情），中国的伴侣动物主人更容易对动物的初级情绪进行归因。另外，中国伴侣动物主人对动物的依恋性与其对动物的五种情绪（两种初期情绪和三种复杂情绪）的归因呈现出显著的相关性。这一研究结果表明伴侣动物主人对其动物的依恋程度与其对动物情绪的归因的显著相关性在中国仅仅存在于动物的少量情绪中，而在荷兰这一情绪的数量相对要多一些。这一结论证明伴侣动物主人对其动物的依恋程度与其对动物的情感归因的相关性在荷兰似乎表现的更加明显。由于动物情绪被认为是测量动物福利的一项重要指标，因此分析包括文化在内的其他一些因素对主人对动物的依恋程度与其对动物情绪的归因这一关系的影响似乎显得十分必要。

因此，第六章以日本为例，从文化的角度分析了伴侣动物主人对动物的依恋程度以及其对动物情绪的归因的影响。关于对动物情绪归因的研究结果大部分与中国和荷兰的研究结果相似。日本的伴侣动物主人也对其动物表现了较强的依恋性（但比中国和荷兰伴侣动物主人对动物的依恋性要低）。相对于复杂情绪（不包括嫉妒和同情）来讲，伴侣动物的初级情绪似乎更容易被他们的主人进行归因。伴侣动物主人对动物的依恋程度与其对动物九种情绪（五种初级情绪和四种复杂情绪）的归因呈现出显著的相关关系。这一结果说明在这一相关关系中，日本和荷兰的显著性的动物情绪的数量要比中国多一些。同时，根据我们第五章的研究内容以及之前的一些相关研究结论，我们认为中国和日本的伴侣动物主人相对荷兰伴侣动物主人来讲，更加容易对动物的同情这一情绪进行归因。这一研究结论说明，在某种程度上，文化应该可以影响伴侣动物主人对动物情绪的归因。在中国和日本的文化中，同情反应了“仁”的基本思想，而仁是儒家五常中非常重要的一常。猫和狗一般被认为是具有灵性的，因此可以对一些不幸的事情表现出来一种本能的同情和怜悯。因此相对荷兰人来讲，中国人和日本人应该更容易对猫和狗赋予同情这一情绪。

第五章和第六章主要分析了伴侣动物与主人之间的情感关系，在接下来的三章内容中，我们主要分析了伴侣动物与主人之间的生计关系。在第七章中，

我们通过对饮食性“生态爪痕”，碳排放和能源消耗这三个变量进行分析，探讨了中国伴侣动物（猫和狗）的日常饮食对环境带来的影响。研究发现如果假设这些动物日常吃买来的商业性干粮，那么一只平均大小的狗的饮食性生态爪痕是 0.82 到 4.20 ha 每年，而一只平均大小的猫的饮食性生态爪痕是 0.36 到 0.63 ha 每年。中国目前有 2740 万伴侣狗和 5810 万伴侣猫，如果假设这些猫和狗全年都吃商业性干粮，那么他们每年的饮食性生态爪痕是 4360 到 15190 万 ha，相当于 0.703 到 2.450 亿中国人的饮食性生态足迹。通过食物消耗，这些动物的碳排放是 240 到 750 万吨每年，相当于 0.343 到 1.071 亿中国人通过饮食产成的碳排放。

第八章主要通过对饮食性生态爪痕，温室气体排放和能量消耗进行分析来量化日本的伴侣狗与伴侣猫的食物消耗对环境产生的影响。研究结果得出一只平均大小的狗的饮食性生态爪痕是 0.33 到 2.19 ha 每年，而一只平均大小的猫的饮食性生态爪痕是 0.32 到 0.56 ha 每年。日本目前有 1035 万伴侣狗和 996 万伴侣猫，这些伴侣猫和狗每年的饮食性生态爪痕是 660 到 2830 万 ha，相当于 462 到 1979 万日本人的饮食性生态足迹。通过食物消耗，这些动物的温室气体排放是 252 到 1070 万吨每年，相当于 117 到 495 万日本人通过饮食产生的温室气体排放。

第九章主要对荷兰伴侣猫和狗的饮食性环境影响进行了分析。分析结果显示，一只伴侣狗的平均年生态爪痕为 0.90 到 3.66ha，一只猫平均每年的生态爪痕为 0.40 到 0.67ha。如果一个家庭养一只大型宠物狗，那么这个家庭每年的生态足迹与温室气体排放量会分别增加 50%和 11.3%。目前荷兰有大约 180 百万只伴侣狗和 320 万只伴侣猫。这些猫和狗的年生态爪痕为 290 到 870 万 ha，相当于 50 到 151 万荷兰人的全部生态足迹。另外这些猫和狗通过食物消耗产生的年温室气体排放量为 109 到 328 万吨，相当于 9.4 到 28.4 万荷兰人全年所有活动的温室气体排放量。

另外，通过第七章，第八章和第九章内容的分析，我们还得出结论认为很多伴侣动物（尤其是中型和大型伴侣狗）通常消耗的能量（即消耗的总食物的量）要多于其自身维持正常生长与活动所需要的能量。这说明过度喂食和食物浪费是有伴侣狗家庭中存在的一个普遍现象。

第十章主要总结了这篇博士论文的主要结果与发现，对主要结果进行了讨论与分析，同时根据主要内容提出了未来相关研究的可能方向。在第十章中，我们解释了可持续的人与动物的关系，同时强调了有效提高人与动物之间情感与生计关系的一些可能途径。我们认为人与动物之间可持续的情感关系要求人们必须要提高对动物的关心程度以及对动物情感的理解程度，而可持续的人与动物的生计关系则需要大幅度的降低伴侣动物的数量，用小型动物替代大型动物以及避免过度喂食与食物浪费等情况，以此来降低伴侣动物对家庭能源消耗及环境可持续发展带来的影响。

通过这篇博士论文，我们希望人们的动物福利意识得以提高，人与动物可以以更加可持续的方式生存在地球上。我们认为这篇博士论文通过对人与动物的关系进行较为全面的评估，取得了一定的成果。但同时我们也需要承认一个事实：即没有任何一种单一的简单方法可以解释人与动物这一复杂关系以及这一关系背后的一些预测变量。因此未来或在不久的将来从不同角度和学科出发来进一步分析可持续的人与动物的关系是十分必要的。

Valorization

This dissertation contributes to the body of knowledge about the sustainable human-animal relationships in Europe (the Netherlands) and Asia (China and Japan). It analyzed public attitudes toward animals in general and the emotional and environmental relationship between companion animals and owners from cultural and economic perspectives. It aims to improve people's awareness of animal welfare and reduce the environmental impacts of food consumption by companion animals.

Relevance to the public domain

This dissertation offers an analysis of the relationship between animals and humans and the possible predictor variables involved in this relationship. It is motivated by a strong request for a higher level of animal welfare and a greater concern for animal well-being and environmental protection. Animals, as an important and valuable component of society and the biosphere, are significant for physical survival and critical to the soul. Therefore, studies about animal issues including people's attitudes toward animals and the possible predictor variables, animals' emotional world, as well as the environmental impacts of animals are of vital importance. In this context, the dissertation more specifically discusses the issues of people's understanding of animal emotions and the environmental impacts of companion animals.

This dissertation predicts that the degree of attachment can significantly improve people's attribution of emotions to animals, which means that improving the human-animal bond is a good way to further understanding animals' emotional world and then improve animal welfare. These parts (chapter 5 and 6) represent a positive step towards advancing the topic of animal welfare, as a higher attachment to companion animals may lead to a better understanding of animal protection and a higher awareness of animal welfare. These findings suggest that identifying the emotional relationships between companion animals and their caretakers, and eventually promoting the development of an optimal animal welfare measurement system, are the main goals for future studies. Our findings also added to a growing recognition of how individual philosophy relates to public attitudes toward animals in different countries, in particular, Asian countries. Understanding of individual opinions that moral behaviors always lead to good results and activities should be based on universal principles, from cultural and social perspectives, has been predicted to be vital to improving people's awareness of animal welfare in different countries. Additionally, increasing animal populations and resource consumptions are threatening the natural world. Hence, finding ways to reduce companion animals' environmental impacts is of critical importance if future food security is to be ensured and long-term sustainability in the environment of achieved. Through chapter 7, 8 and 9, we clarify the specific resource consumption of companion animals in different countries and gain some insights into the strategies to reduce companion animals' environmental impacts in a national and international level.

Considering that China has a large animal population, while the awareness of animal welfare among Chinese people is relatively lower than that of the Western population. We think it is important to know how Chinese people perceive animals and how to improve their awareness of animal welfare. In this dissertation, we provide some strategies and predictor variables to improve the sustainable human-animal relationships. For instance, try to perceive and attribute animal emotions, communicate with animals by watching, talking and feeding, take care of animals and notify their important values. We think Chinese people's (especially Chinese companion animal owners) awareness of animal welfare will improve through the dissemination of the ideas in this dissertation. We additionally think the awareness of animal welfare of all the respondents involved in this research will improve.

This dissertation also provides information to the public (e.g., citizens, government, NGOs), researchers and private individuals (companion animal owners) who are relevant to improve standards of animal welfare and who are willing to contribute to a more sustainable livelihood of animals, especially companion animals.

Target groups

The answers to my research questions are relevant for both the academic community and specific groups related to humans, animals and sustainable development. For that, the following groups shall be discussed: science community, animals, companion animal owners, public, pet food industry, government and policymakers.

Science community

Some chapters in this dissertation are the first studies to look into human-animal relationships, especially in Asian countries. For example, chapter 2 is the first study to look into the correlation between ethical ideologies and attitudes toward animals in China; chapter 6 is the first study to look into how Japanese companion animal owners attribute emotions to their animals by analyzing the correlations between attachment and emotional attribution; chapter 7, 8 and 9 are the first studies to evaluate companion animals' environmental impacts by measuring their dietary ecological paw print (EPP), greenhouse gas (GHG) emissions and energy requirement and comparing their resource consumption with human's resource consumption. Therefore, this dissertation actually provides some basic and new ideas about the relationships between animals and the environmental, as well as the emotional words between animals and humans. Additionally, it also narrows the gap of research into human-animal relationships between Western countries and Eastern countries. Chapter 7, 8 and 9 contribute to the field of empirical research dealing with the relationship between companion animals and environmental issues and therefore can serve as a baseline for further sustainable development studies. These parts are also very important if we wish to make sense of the manner in which other species are related to the environmental world. Additionally, the results about the huge environmental

impacts of food consumption by companion animals may inspire some technology innovation, for example, findings alternatives to meat products.

Animals

Animals are the main stakeholders in this dissertation. Animal emotions have been identified as a critical marker for animal welfare, and thus, investigating methods for approaching animal emotions and exploring the correlations between the degree of attachment and the attribution of emotions to animals is essential to understand animal feelings and promote optimal animal welfare worldwide. Very concretely, the dissertation includes five accepted papers in peer reviewed journals. Three additional papers are under review at the time of writing. These papers may attract some researchers' attention on the fields of animal welfare and human-animal relationships. Therefore, professionals who are expected to advice on such topics should take our findings into account.

Furthermore, this dissertation provides insights into the cultural perspectives that are related to human-animal relationships in different countries. By analyzing the different culture, it helps people to understand why people in different countries show different views about animal welfare and attribute different emotions to animals. This dissertation also provides recommendations for a sustainable human-animal relationship. By asking respondents to answer questions in our questionnaire, we think at least these respondents would show more concern for animals in the future.

Chapters on the emotional relationship between companion animals and owners are helpful for humans to know their animals' emotions and the reasons behind these emotions. Understanding when, why and how the general public attributes emotional states to animals is very important since the recognition of emotions in animals will be of great help in improving animal welfare. Furthering our understanding of the capacity for emotions and the range of emotions that animals experience is invaluable if environments are to be created in which animals and their emotions are acknowledged and respected, and so optimal animal welfare can be attained.

Companion animal owners

Measuring companion animals' energy requirement and environmental impacts is one of the best ways to improve companion animal owners' awareness of animal well-being and environmental protection. By quantifying companion animals' resource consumption and comparing them with humans' resource consumption, our research successfully demonstrates that companion animals do play a significant role in influencing the sustainable environment and overfeeding and food waste do exist among most of the companion animal households. Therefore, the results used in this dissertation can be valuable to companion animal owners concerned with resource conservation. The chapters on the relationship between the degree of attachment and the attribution of emotions are also relevant to companion animal owners. They provide novel tools to facilitate a high awareness of animal welfare. The attribution of emotions, for example, can contribute to a high attachment to companion animals. By

highlighting the importance of the attribution of emotions to animals, companion animal owners are also inspired to pay more attention to understanding animals' emotional world. Our results can also promote the cooperation of companion animal owners and veterinarians in order to reduce overfeeding and keep the normal body weight of companion animals.

Public

The studies about the correlation between ethical ideologies and public attitudes toward animals can be helpful in providing new perspectives to improve people's concerns for animals. Our findings suggest that the opinions that one considers that ethical behavior will lead only to positive results and that one prefers to base on universal ethical rules are helpful to improve people's positive attitudes toward animals. These results provide recommendations toward improving public attitudes toward animals from ethical ideological and cultural perspectives. Additionally, considering that many people from Eastern countries have a lower level of awareness of animal welfare than the Western people. Therefore, this dissertation can serve as a motivational platform on studies of how to increase Eastern people's awareness of animal welfare.

Findings from this study imply that quantifying companion animals' dietary EPP and carbon emissions is an important step toward exploring their environmental impacts, which will ultimately improve people's awareness of sustainability and promote the whole country's sustainable development.

Pet food industry

The chapters on the environmental impacts of food consumption by companion animals can be interesting to pet food industries. They may start to think about how to reduce companion animals' environmental impacts and simultaneously guarantee their basic energy needs. Pet food industry is the link between companion animals and the environment and between companion animals and their owners. Food plays a critical role in quantifying the environmental impacts of companion animals because animal products have been demonstrated as requiring more land and contributing more environmental impacts than plant-based products to produce equivalent protein energy. These results can be helpful with providing new ideas for pet food industries to redesign animal food, and in chapter 7, we also suggest that the pet food industry should start to confront the issue of the sustainability of feeding pets through advances in product design and manufacturing in order to reduce overfeeding and food waste. The cooperation between pet food industry and technology institution would also deserve more attention in the future in order to supply pet food with good qualities and few percentages of animal products.

Government and policymakers

The purposes of performing the dietary EPP and GHG/carbon emissions in the chapters on the environmental impacts of food consumption by companion animals were 1) to

have a clear view of their food consumption, 2) to investigate their ecological impact and 3) to raise their owners' awareness of environmental protection and animal well-being. These chapters may also be relevant to policymakers and the government because government involvement and regulations are necessary to improve people's awareness of animal well-being and the environmental protection. Whether policy implication can permanently affect animals' environmental impacts is an important consideration in policy discussions. By providing the land use, GHG/carbon emission and energy consumption of food consumption by companion animals, this dissertation provides novel approaches to facilitate a more sustainable relationship between companion animals and owners, and the relationship between companion animals and the environment. These findings would play a significant role when policymakers developing companion animal keeping policies. They also provide a scientific basis for the development of the EPP and GHG emission mitigation measures and therefore would make sense for policy initiatives to pay due attention to agriculture production and food consumption. Additionally, since we quantified to what extent companion animals could influence the environment, the government can then include companion animals in the policy system of reducing environmental degradation. Findings in this dissertation can also facilitate governments' greater investment to encourage technological innovation in not only pet food industry but also agricultural production including finding alternative sources of meat and protein. Yet, we should admit that there is no single evaluation approach can present all dimensions of sustainability. In this dissertation, we also explained that it may be necessary to integrate EPP analysis with other evaluation frameworks so that more scientific sustainable approaches can be addressed for minimizing resource consumption and simultaneously maximizing the sustainability of a country as a whole.

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Bingtao Su
Maastricht, January 2018

List of Abbreviations

PBS	The Pet Bonding Scale
AAS	The Animal Attitude Scale
AIS	The Animal Issue Scale
EPQ	The Ethical Position Questionnaire
EPP	The Ecological Paw Print
EF	The Ecological Footprint
GHG	Greenhouse Gas
MER	The Maintenance Energy Requirement
RER	The Resting Energy Requirement
EFA	Ecological Footprint Analysis
ME	The Metabolizable Energy
AAFCO	Association of American Feed Control Officials
NFE	Nitrogen-Free Extract
CLA	Consumer Lifestyle Approach

About the Author

Bingtao Su was born on May 20, 1987 in Baoding, China. She obtained a bachelor degree in sociology with honors from Northwest A&F University, China in 2011. On the strength of her outstanding academic record, in the same year, she was chosen by the Faculty of Humanities and Science to enter into the post-graduate program of Northwest A&F University without entrance examination. In 2013, she gained the national scholarship from the Chinese government. In June 2014, she obtained her master degree in sociology. In her master thesis, Bingtao studied the sustainable livelihoods of Eco-poor during the transitional period of China.

From September 2014 until August 2018, Bingtao was enrolled as a PhD researcher at the International Centre for Integrated Assessment and Sustainable Development (ICIS) with the Chinese scholarship program, sponsored by the Chinese Scholarship Council (CSC). Under the supervision of Prof. dr. Pim Martens and Prof. dr. Marie-Jose Enders, she executed the research for this dissertation. She used online questionnaire approach to collect data from China, the Netherlands and Japan. In her dissertation, Bingtao focused on the topic of sustainable human-animal relationships, which includes people's attitudes toward animals in general, the emotional and environmental relationship between companion animals and owners. Besides, in the Master program at ICIS, Bingtao supervised Master these in the years 2015-2017.

List of publications

1. Su, B., & Martens, P. (2017). Public attitudes toward animals and the influential factors in contemporary China. *Animal Welfare*, 26(2), 239-247.
2. Su B., Koda N, Martens P. (2018) How Japanese companion dog and cat owners' degree of attachment relates to the attribution of emotions to their animals. *PLoS One*, 13(1): e0190781.
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