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Research

Physiological effects of interactions between female dog owners with neuroticism and their dogs

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ABSTRACT

The aim of this study was to investigate the physiological effects of the relationship between dog owners with neuroticism and their dogs using noninvasive procedures to measure urinary cortisol and heart rate variability (HRV). Owner personalities were tested via the NEO Five-Factor Inventory and this study focused only on the dimension of neuroticism with 12-item scales. The 24 participating owners and their dogs were randomly divided into experimental and control groups. Each participant and their dog stayed in the test room for 80 minutes. The behavioral test included 2 resting times (R1 and R2, respectively), 2 command-communication times, a separation time, and a free time. In the control group, the command-communication times were changed to noncommunication times. Each participant wore a chest heart rate transmitter and a wrist watch monitor (RS800CX; Polar Electro) during the experiment. HRV is a quantitative parameter of autonomic activity. The spectral analysis of HRV is divided into 2 major oscillatory components: the high-frequency (HF) domain, which reflects parasympathetic activity and the low-frequency (LF) domain, which reflects both sympathetic and parasympathetic activities. The LF to HF ratio reflects sympathetic activity. In the experimental group, the neuroticism scores showed a positive significant correlation with a change in the HF power and a negative correlation with the ratio of the change in the LF to HF ratio. No correlations were found in the control group. Next, all participants were divided into 2 groups according to the HRV in R1 and R2. One group included participants whose HF increased in R2, and the other included participants whose HF decreased in R2. The neuroticism scores were significantly higher in the experimental subjects whose HF increased in R2 than in those whose HF decreased in R2. High neuroticism scores indicate individuals that may be sensitive to daily stresses. Our results showed that a parasympathetic activation occurred in owners with high neuroticism scores 10 minutes after a command-communication interaction with their dogs. This suggests that daily command communication–based interactions with their dogs could improve the owner's health for the better.

Introduction

The evaluation of personality traits is a method for measuring the differences among people. The personality is described by 5 dimensions: "neuroticism," "extraversion," "openness," "agreeableness," and "conscientiousness." Neuroticism refers to individual differences in emotional stability among healthy human subjects (Shimonaka et al., 1999). The persons who score high in neuroticism may be sensitive to daily stresses (Gunthert et al., 1999; Mroczek and Almeida, 2004), and the neuroticism sometimes causes serious health problems (Suls and Bunde, 2005). Kotrschal et al. (2009) demonstrated that highly neurotic dog owners were more closely attached to their dogs for social support. A dog's behavior can be affected by many factors related to its owner, including the owner's gender, attitude, and personality (Jagoe and Serpell, 1996; O'Farrell, 1997; Bennett and Rohlf, 2007; Kotrschal et al., 2009; Arhant et al., 2010; Hoffman et al., 2012; Kis et al., 2012). The owner's personality in particular influences the dogs' behavior (Aliabadi, 2010; Wedl et al., 2010), salivary cortisol concentrations (Aliabadi, 2010; Wedl et al., 2010), and stress coping ability (Schöberl et al., 2012). In 2008, we conducted a survey on 354 dog owners regarding the

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relationship between their personalities and their dog's behavioral problems. The results showed significant positive correlations between an owners' neuroticism and a dogs' aggression (owner directed and stranger directed) (Tateishi et al., 2010).

Some physiological indices have been used to evaluate the effects of the relationships between dogs and their owners (Kingwell et al., 2001; Kotrschal et al., 2009; Barker et al., 2010; Handlin et al., 2011; Handlin et al., 2012; Schöberl et al., 2012). Cortisol secretion is a common biomarker for stress. Collecting naturally voided urine for the analysis of urinary cortisol levels in animal subjects is advocated as less stressful and more humane than collecting blood samples (Beerda et al., 1996). According to the Task Force of the European Society of Cardiology (1996), heart rate variability (HRV) is a quantitative parameter of autonomic activity. HRV represents the beat-to-beat variation in heart rate (HR) generated by the interplay of sympathetic and parasympathetic nerve activity. The spectral analysis of HRV is divided into 2 major oscillatory components (Pagani et al., 1986); the high-frequency (HF) domain (0.15-0.40 Hz), which reflects parasympathetic activity, and the low-frequency (LF) domain (0.04-0.15 Hz), which reflects both the sympathetic and parasympathetic activities. The LF to HF ratio reflects sympathetic activity. Therefore, it is possible to evaluate each domain by dividing it into sympathetic and parasympathetic components using a spectral analysis (Akselrod et al., 1981). An increase in the HF domain represents a relaxed state, and an increase in the LF to HF ratio represents a high-level stress state (Roeser et al., 2012). Thus, using HRV, we assessed the participant's stressed and relaxed states in various situations. In previous studies, persons scoring high in neuroticism had higher levels of sympathetic activity than those scoring low in neuroticism (Zeverev and Mipando, 1999).

The aim of this study was to reveal the effects of the dog owners' neuroticism on their relationship with their dogs using noninvasive procedures, such as urinary cortisol and HRV.

Materials and methods

The experimental procedures were approved by the Animal Experiment Ethics Committee of Azabu University (approval number: 120806) and the Human Research Ethics Committee of Azabu University (approval number: 0636). Research was based on voluntary participation and written informed consent.

Participants

Participants were recruited using advertisements at Azabu University and pet shops and parks in Sagamihara, Kanagawa, Japan. We recruited adult participants, because it is known that personality is fairly stable across adulthood (Shimonaka et al., 1999). In Japan, women aged ≥30 years are the dog owners who spend the most time with their dogs. Since gender is a factor that may influence HRV (Antelmi et al., 2004; Saleem et al., 2012; Voss et al., 2013), we selected 24 women aged ≥30 years (mean age ± standard deviation: 48.7 ± 10.0 years) and their dogs (mean age ± standard deviation: 62.5 ± 36.5 months; 10 neutered and 2 intact males; 9 spayed and 3 intact females; Table 1).

Questionnaires

Basic information about the dogs, including age, sex, breed, and spay or neuter status, was gathered before the behavioral test (Table 1). The owner's personality was also examined, before the dog's behavioral test, via the Japanese version (Shimonaka et al., 1999) of the NEO Five-Factor Inventory (Costa and McCrae, 1992) modification of the NEO-PI-R (Costa and McCrae, 1989). This includes 60 questions that measure normal adult personality in 5 dimensions: neuroticism, extroversion, openness, agreeableness, and conscientiousness. The personality questionnaire is empirical and relevant to human personality dimensions. This study focused only on the dimension of neuroticism with 12-item scales. The neuroticism scale depicts individual differences in emotional lability or stability among healthy human subjects. Persons who score high on a neuroticism scale frequently experience negative emotions. In contrast, persons with low scores in neuroticism are calm and balanced even in stressful situations (Shimonaka et al., 1999).

Table 1
Canine subjects in all experiments

Breed	Sex	Sexual state	Age (months)	Group
American cocker spaniel	Male	Neutered	85	Experimental
Bernese mountain dog	Female	Neutered	16	Control
Border collie	Male	Neutered	96	Control
Boston terrier	Male	Neutered	35	Experimental
Chihuahua	Male	Neutered	19	Experimental
Chihuahua	Male	Intact	21	Control
Flat-coated retriever	Male	Neutered	68	Experimental
French bulldog	Female	Intact	40	Experimental
French bulldog	Female	Neutered	124	Experimental
Golden retriever	Female	Neutered	112	Experimental
Golden retriever	Female	Neutered	57	Control
Italian greyhound	Female	Neutered	104	Experimental
Jack Russell terrier	Male	Neutered	76	Experimental
Miniature dachshund	Male	Neutered	65	Experimental
Miniature dachshund	Female	Neutered	104	Control
Miniature schnauzer	Male	Neutered	60	Experimental
Mix	Female	Neutered	32	Control
Pomeranian	Male	Neutered	31	Control
Shiba	Female	Neutered	72	Experimental
Shih tzu	Male	Intact	12	Control
Toy poodle	Female	Intact	42	Experimental
Toy poodle	Female	Intact	94	Experimental
Toy poodle	Female	Neutered	122	Experimental
Yorkshire terrier	Male	Neutered	13	Control

Experimental procedure

The behavioral test was conducted by 2 experimenters at Azabu University. Each participant and her dog stayed in the test room for 80 minutes. The test room was 5 m × 7 m and the details are shown in Figure 1. It is known that the cortisol secretion in dogs (Beerda et al., 1999; Kolevská et al., 2003) and HRV in humans (Fauchier et al., 1998) have a circadian nature. To exclude these influences, all behavioral tests began at 11 AM. All participants abstained from caffeinated beverages in the morning of the examination day (McCraty et al., 1995; Kingwell et al., 2001), and they were also instructed not to eat or drink anything for 2 hours before the behavioral test (McCraty et al., 1995; Kingwell et al., 2001). The participants were asked to empty their dogs' bladder as much as possible at 9 AM. Afterward, the owners were asked to keep their dogs calm.

The participants and their dogs were randomly divided into experimental (N = 15) and control (N = 9) groups. The test included 2 resting times (R1 and R2) and 4 experimental times (E1-1, E2, E3, and E1-2; Figure 2). The first resting time (R1) was 20 minutes in length, and the last resting time (R2) was 35 minutes. Each participant wore a chest HR transmitter (Polar Electro, Kempele, Finland) and a wrist watch monitor (RS800CX; Polar Electro) during the experiment. During the resting time periods, participants were asked to sit on a chair, to measure the HR, and thus, the dogs spent resting time in another room.