Journal of Veterinary Behavior 10 (2015) 194–198

Contents lists available at ScienceDirect

Journal of Veterinary Behavior

journal homepage: www.journalvetbehavior.com

Research

Oral tyrosine changed the responses to commands in German shepherds and Labrador retrievers but not in toy poodles

Masaaki Kano [a], Hidehiko Uchiyama [b], Mitsuaki Ohta [c], Nobuyo Ohtani [c,*]

[a] Animal Life Solutions Co., Ltd., Midori-ku, Yokohama, Kanagawa, Japan
[b] Department of Human and Animal-Plant Relationships, Tokyo University of Agriculture, Atsugi, Kanagawa, Japan
[c] Department of Animal Science and Biotechnology, Azabu University School of Veterinary Science, Chuo-ku, Sagamihara, Kanagawa, Japan

ARTICLE INFO

Article history:
Received 8 April 2014
Received in revised form
3 October 2014
Accepted 31 December 2014
Available online 8 January 2015

Keywords:
training abilities
tyrosine
German shepherd
Labrador retriever
toy poodle

ABSTRACT

Dog behaviors, particularly being easily distracted and having difficulty sustaining attention, may resemble those of children with the attention deficit hyperactivity disorder, which may be correlated with catecholamine levels in central and peripheral neurons. Thus, in this study, we examined the relationship between dog behavior that involved focusing or concentrating on a human and the sympathetic nervous systems activity. The catecholamines, noradrenaline and adrenaline, which are released into the blood, remain unmetabolized in the urine. The urinary concentrations of noradrenaline and adrenaline seem to strongly reflect the activity level of the sympathetic nervous system. We used 3 dog breeds with different training abilities, German shepherd, Labrador retriever, and toy poodle. Tyrosine is the amino acid known to induce increased levels of catecholamine in the brain. The aim of this study was to examine the effect of oral tyrosine on training levels in the 3 breeds of dogs. The oral tyrosine appeared to induce a dramatic improvement in the training qualities of German shepherds and Labrador retrievers but not in some toy poodle dogs possibly because of much excitement or distractions. These results suggest that catecholamine, probably in the brain, is important for the appropriate attention level.

Introduction

Neural mechanisms involved in the stimulation of motivation and attention in human behavior have been revealed as functions of the central brain (Nieuwenhuis and Yeung, 2005; Schmidt et al., 2012). Attention deficit hyperactivity disorder (ADHD) is a developmental disorder of human behavior whose characteristics are a lack of attention and increased hyperactivity (Diagnostic and Statistical Manual of Mental Disorders, by the American Psychiatric Association, 2013). Electrophysiological studies in animals have suggested that norepinephrine enhances signals through postsynaptic α2A adrenoceptors in prefrontal cortex (PFC), whereas dopamine decreases noise through modest levels of D1 receptor stimulation. The α2A adrenoceptor stimulation strengthens the functional connectivity of PFC networks, whereas blockage of α2 receptors in the monkey PFC recreates the symptoms of ADHD, resulting in impaired working memory, increased impulsivity, and locomotor hyperactivity (reviewed by Brennan and Arnsten, 2008). The functional magnetic resonance imaging, a noninvasive and safe technique for measuring and mapping brain activity, of neural networks associated with executive attention in children with ADHD has indicated the activation of the precentral gyrus by methylphenidate (Konrad et al., 2007). From these various studies, roles for catecholamines in the brain and neural mechanisms involved in hyperactivity, attention, and concentration defects seen in ADHD have been suggested. Additionally, noradrenaline (NA) activity, which is increased by stimulation, such as stress (Reinstein et al., 1984), also affects attention and working memory (Skosnik et al., 2000). Similarly, in a study of children with ADHD, the urinary concentration of adrenaline (AD) at rest and after an intelligence test was significantly lower than in general children (Wigal et al., 2003). In addition, the peripheral sympathetic nervous system has been revealed to relate to the activity of AD in the central nervous system (Maas, 1984).

Some aspects of dog behaviors, such as being easily distracted and having difficulty sustaining attention, may somewhat resemble

* Address for reprint requests and correspondence: Nobuyo Ohtani, Department of Animal Science and Biotechnology, Azabu University School of Veterinary Science, 1-17-71 Fuchinobe, Chuo-ku, Sagamihara, Kanagawa 252-5201, Japan, Tel: +81-42-769-1778; Fax: +81-42-786-7147.
E-mail address: ohtani@azabu-u.ac.jp (N. Ohtani).

http://dx.doi.org/10.1016/j.jveb.2014.12.009
1558-7878/

Table 1
Experimental animals

Breed	Number of individuals	Age (y)	Sex	
			Male	Female
German shepherd dog	16	5.0 ± 3.0	9	7
Labrador retriever	11	4.8 ± 1.3	9	2
Toy poodle	22	2.2 ± 1.2	18	4
Total	49	3.7 ± 2.4	36	13

patients with ADHD (American Psychiatric Association, 2013). In this study, we examined the relationship between dog behavior that involved focusing or concentrating on a human and the activity of the sympathetic nervous system. Discharged NA and AD, which is released into the blood, remain unmetabolized in the urine, and their urinary concentrations seem to strongly reflect the activity of the sympathetic nervous system (Akerstedt et al., 1983; Hay et al., 2000).

The first experiment in this study was to clarify the relationship between the training levels and the sympathetic nervous activity in dogs. We used 3 dog breeds with different training abilities (Hart and Hart, 1998; Serpell and Duffy, 2014), German shepherd, Labrador retriever, and toy poodle. The second experiment was to examine the effect of oral tyrosine on training levels in the 3 dog breeds. Tyrosine is the amino acid known to induce an increase in catecholamine in brain (Gibson and Wurtman, 1978; Wurtman et al., 1981; Growdon et al., 1982; Oishi and Wurtman, 1982; Fernstrom and Fernstrom, 2007; Journel et al., 2012). In this study, we discovered the importance of central catecholamines to maintain a high attention level.

Methods

Ethics

All the procedures were approved by the Animal Experiments Ethics Committee of Azabu University in accordance with the World Medical Association Declaration of Helsinki.

Experimental animals

The toy poodles (n = 22) were kenneled at the Center Animal School in Tokyo, Japan, whereas the Labrador retrievers (n = 11) and German shepherds (n = 16) were kenneled at the Murase Training Center for police dogs in Kanagawa, Japan (Mitsui et al., 2011). All the dogs were sexually intact and trained regularly. The food for the Labrador retrievers and German shepherds was IAMS adult food (P&G Pet Care, Kobe, Japan), whereas the toy poodles were fed IAMS adult food for small dogs. They were given the necessary calories per kilogram body weight, and the dietary contents were slightly different, whereas the essential amino acid contents were almost the same. Although they were given obedience commands, such as "sit," "down," and "stay," their responses to the commands were divergent (see the results). They were housed individually and walked daily with their trainers and volunteers. A detailed description of the experimental animals is shown in Table 1.

Experimental procedures

Experiment I

In a 5-minute session, the dog was given the command "sit" at an interval of once every 5 seconds without calling his or her name (Okamoto et al., 2009). The total number of potential responses was 60 per session. Three sessions were conducted, and the same trainer was used for each dog in all the experiments (Figure 1). When the dog showed an appropriate response to the command, he or she received food as a positive reinforcement.

Experiment II

The tyrosine, 100 mg/kg body weight, was given daily for 3 days to all dogs used in experiment I. The same training sessions were performed as in experiment I. The dogs were stable in the command response before the tyrosine supplement.

Behavioral evaluation

Using a video camera (GZ-MG77-S, JVC KENWOOD Corporation, Yokohama, Japan), the number of successful reactions to commands was counted, and the orienting response time to the commands was recorded. In addition, the number of reactions to unknown stimuli was counted as inattentive behavior, and the reaction time to unknown stimuli was also recorded.

Urine sampling and the analysis

Urine samples were collected before experimental sessions (pre) and 2 hours after the sessions (post) to measure the urinary catecholamine concentrations (Figure 1) based on previous methods with slight modifications (Mitsui et al., 2011; Kato et al., 2012). Samples were centrifuged at 3000 rev/min for 30 minutes at 4°C immediately after collection and dispensed into tubes. They were stored at −80°C until analysis.

The concentrations of the urinary catecholamines, NA and AD, were measured by high-performance liquid chromatography (Ohtani et al., 1999).

Statistics

The relationship between the number of successful reactions to the commands and the number of reactions to unknown stimuli as well as that between the number of successful reactions to the commands and the reaction time to unknown stimuli were evaluated using Spearman rank correlation coefficient test. The other comparisons were performed using 3 analyses, Student *t* test, the Wilcoxon signed rank test, and Mann−Whitney *U* test, which are described in the next section.

Results

Dogs used in this study

The relationship between the number of successful reactions to the commands and the reaction time to unknown stimuli as well as that between the number of successful reactions to the commands

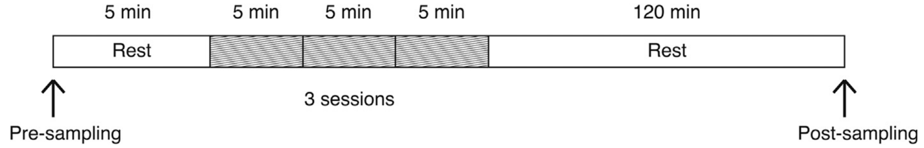

Figure 1. Experimental schedule. Three experimental sessions were conducted after presampling (pre), and the postsampling of urine (post) was conducted after 120 minutes of rest.