The development and validation of a Dog Personality Questionnaire and the investigation of associations between behaviour coding and subjective rating and the role of experience in making video assessments on the personality of the domestic dog (*Canis familiaris*) by the application of the Dog Personality Questionnaire

PhD Dissertation

Mirkó Erika

Supervisor:
Ádám Miklósi, DSc

Department of Ethology
Eötvös Loránd University
1117 Budapest, Pázmány Péter sétány 1/C

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# Table of contents

1. **Introduction** .................................................................................................................. 4  
   1.1 Human personality models .......................................................................................... 6  
   1.2 Methods of human personality research .................................................................... 8  
   1.3 Personality models of non-human animals .............................................................. 9  
      1.3.1 The function of personality .................................................................................. 10  
      1.3.2 The mechanism of personality ............................................................................ 14  
      1.3.3 The development of personality .......................................................................... 16  
      1.3.4 The evolution of personality ................................................................................ 18  
   1.4 Personality of dogs ........................................................................................................ 21  
      1.4.1 The function of personality .................................................................................. 21  
      1.4.2 The mechanism of personality ............................................................................ 25  
      1.4.3 The development of personality .......................................................................... 27  
      1.4.4 The evolution of personality ................................................................................ 29  
   1.5 Methods of personality research of dogs ................................................................... 31  
2. **Purpose of study** .............................................................................................................. 33  
   2.1 Purpose of Study I ....................................................................................................... 33  
   2.2 Purpose of Study II ...................................................................................................... 36  
3. **Study I** ............................................................................................................................. 39  
   3.1 Subjects and Methods ................................................................................................. 39  
      3.1.1 Subjects ................................................................................................................ 39  
      3.1.2 Development of the questionnaire ....................................................................... 44  
      3.1.3 Data analysis ........................................................................................................ 45  
   3.2 Results ............................................................................................................................ 46
3.2.1 Investigation of internal validity ................................................................. 46
3.2.2 Investigation of external validity ............................................................... 48
3.2.3 FCI breed group differences .................................................................... 50
3.2.4 Comparison of Hungarian Vizsla and the German Shepherd Dog .......... 53
3.3 Discussion .................................................................................................... 56
3.3.1 Internal validity ....................................................................................... 57
3.3.2 External validity ....................................................................................... 60
3.3.3 FCI breed group differences .................................................................... 63
3.3.4 Differences between Hungarian Vizslas and German Shepherd Dogs ....... 65

4. Study II ......................................................................................................... 67

4.1 Subjects and Methods ................................................................................ 67
4.1.1 Experiment 1: The comparison of the questionnaire study and behaviour coding 67
4.1.1.1 Subjects ............................................................................................... 67
4.1.1.2 Procedure .......................................................................................... 68
4.1.1.3 Hypothesised correspondences between subjective rating by the owner and behavioural coding ................................................................. 71
4.1.2 Experiment 2: The comparison of the owners’ subjective ratings and the video-based assessments using the DPQ ............................. 73
4.1.2.1 Subjects ............................................................................................... 73
4.1.2.2 Procedure .......................................................................................... 74
4.1.3 Data analysis ........................................................................................... 75
4.2 Results .......................................................................................................... 75
4.2.1 Experiment 1: The association between the owners’ subjective rating and behaviour coding ................................................................. 75
4.2.2 Experiment 2: The comparison of the owners’ ratings and the video-based
done by humans with different levels of experience with dogs ....................77

4.3 Discussion ................................................................................................................80

4.3.1 Association between owners’ subjective rating and behaviour coding ..........80

4.3.2 The comparison of the owners’ ratings and the video-based ratings
done by humans with different levels of experience with dogs .......................86

Conclusions .....................................................................................................................88

References .......................................................................................................................90

Summary ..........................................................................................................................105

Összefoglaló .....................................................................................................................106

Acknowledgements ..........................................................................................................108

Appendices ........................................................................................................................109
1. **Introduction**

Individuals of the same population often differ in the way they behave (Wilson, 1998). Individually consistent behavioural differences across contexts are referred to as ‘personality’ (e.g. Dingemanse and Reale, 2005).

However, in current animal research, there is a great confusion regarding the term *personality*. This is partly due to ethologists’ and animal psychologists’ fear of being accused of anthropomorphism. Synonyms such as behavioural syndromes (e.g. Bell, 2007), coping styles (e.g. Coppens et al., 2010), temperament (Murphy, 1998) are all present in the literature. In dog ethology mainly two terms are used, unfortunately interchangeably, *temperament* and *personality* (Jones and Gosling, 2005). The term *personality* might be preferred to *temperament*. In human literature there is a trend to use *personality* to describe adults, while *temperament* is preferred for developing humans. This distinction is also reflected by Goldsmith et al. (1987) who distinguish temperament as inherited, early-appearing tendencies that continue throughout life and serve as the foundation for personality.

In contrast, personality is the product of genetic and environmental effects, therefore it is expected to undergo marked changes from birth to the end of an individual’s life. This process involves complex patterns of genetic activation and stimulation from the environment. Both effects are expected to become less influential after maturation, but naturally it does not mean that personality is resistant to changes after the individual matures. It only means that environmental effects in particular are expected to have a greater impact before the maturity of the individual (Miklósi, 2007). Thus temperament is closely related to the genetic compound of a trait, whereas personality is the product of a long-lasting gene-time-
environment interaction. As Jones and Gosling (2005) define it, personality represents those characteristics of adult individuals that describe and account for consistent patterns of feeling, thinking and behaving.

Pavlov (1951-52) was the first to categorize dogs on the basis of their behaviour into different types. He noted very early that dogs show a specific but consistent behaviour during the training sessions in the laboratory. On the basis of his observations and influenced by the ancient Greek typology, Pavlov divided dogs into two main categories: one with a 'strong’, the other with a 'weak’ nervous system. Dogs with a weak nervous system are melancholic, that is, sensitive, nervous, inhibited and shy and they struggle when restrained. The nervous system of choleric dogs is ’strong’ but unbalanced; they are active and tend to be aggressive. Phlegmatic dogs are ’strong’ and balanced, but at the same time they are 'slow’: quiet, restrained and persistent. The nervous system of sanguine dogs is ’strong’ and balanced. They are very active, reactive to novel stimuli and do not like monotony (Teplov, 1964).

In the last century a lot of dog trainers adopted these categories worldwide. Current personality research in dogs, however, does not favour such typology and use methods applied in human personality investigations that are based on establishing personality traits (Miklósi, 2007). Still, Pavlov’s legacy is linked both to human and animal personality research, since his theory of the types of the nervous system greatly influenced the theories of modern human personality psychologists as well, like that of Eysenck or Gray (Strelau, 1997).

The main aim of my investigations was to provide contribution to the field of research on establishing specific personality dimensions for dogs (Canis familiaris). Such research is important, because animal studies can be used to address questions that are difficult or impossible to address with human studies alone. A comparative approach to personality research can also enrich the field of human personality psychology by providing unique opportunities to examine the biological, genetic, environmental bases of personality and to
study personality development, personality-health links and personality perception (Gosling, 2002).

1.1 Human personality models

Apart from Pavlov’s early work little specific research in animal personality has been conducted. Thus in order to put present day interest in animal personality into context, it is advantageous to review the main theories of human personality.

Biological theories suggest that personality roots in the behavioural and physiological processes of an individual. Eysenck (1967) was the first to link aspects of personality to biological processes. He argued, for example, that introverts had high cortical arousal, leading them to avoid stimulation while extroverts had low cortical arousal, causing them to seek out stimulating experiences.

Psychoanalytic theorists of personality emphasize the influence of the unconscious mind and childhood experiences on personality (Carver and Scheier, 2000). According to Freud (1961) there are three constituting elements of the structure of personality: the id, the ego, and the superego. The id is responsible for all needs and urges, while the superego for ideals and moral. The ego moderates between the demands of the id, the superego and reality.

The so called ‘trait approach’ to personality is one of the major theoretical areas in the study of personality (Carver and Scheier, 2000). The trait theory suggests that individual personalities are composed of broad dimensions, the broad dimensions are composed of traits. The combination and interaction of various traits form a personality that is unique to each
individual. Trait theory is focused on identifying and measuring these individual personality characteristics.

According to Allport (1961) the traits are organized in a hierarchical order. The Cardinal Traits characterize every aspect of an individual’s behaviour. Central Traits can be highlighted in specific situations. *Honest, shy or anxious*, for example, are all Central Traits. They are the ones which are used when an individual has to be characterized. Secondary Traits are even more specific. They can only be observed in a particular situation therefore they cannot be used to characterize a person. Preference for food or tendency to take drugs are both Secondary Traits.

Cattel (1965) emphasized the importance of measuring personality with the application of a questionnaire and analysing the data by carrying out factor analysis. Cattell and Kline (1977) developed a questionnaire called the Sixteen Personality Factor Questionnaire (16PF) of which sixteen factors aim to grasp the structure of human personality in a comprehensive way.

Eysenck developed a model of personality based upon three so called super-traits: introversion, extraversion and neuroticism/emotional stability (Eysenck and Eysenck, 1985). Eysenck also gained his super-traits by conducting factor analysis on the data set collected with the Eysenck Personality Questionnaire (Eysenck and Eysenck, 1975).

Norman (1963), Borgatta (1964), Smith (1967) and Goldberg (1981) also applied factor analysis to create a model for human personality. They all concluded that human personality can be modelled best and in the most practical way with five factors. McCrae and Costa (1990) showed that all the five factors have convergent and discriminant validity across instruments and observers. They also suggested that the Five Factor Model could provide a common framework for organizing research and could also serve as a guideline for educational, industrial/organizational and clinical psychologists in the comprehensive
assessment of individuals. While researchers often disagree about the labels of the five factors, often referred to as the ‘Big Five’, the following terms are the most common: Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness (McCrae and Costa, 1997).

1.2 Methods of human personality research

In human personality research information can be gained about the target individual from three sources: the target individual fills in a form of self-report; acquaintances or knowledgeable persons fill in the form; independent observers answer the questions after gaining some experience about the target person. Self-reports can be retrospective or hypothetical. Retrospective self-reports have two types, contextualized and generalized. In the case of contextualized retrospective self-reports behaviours within situational contexts are under focus. For example, Fleeson (2007) examined conscientious behaviour in different specific situational contexts. In the case of generalized self-reports questions concern generally occurring behaviours without regard to specific contexts. For instance, Zentner and Renaud (2007) assessed parental nurturing behaviour with questions like „I express affection for my child, for example, by holding and hugging my child“. In the case of hypothetical self-reports the participants describe what they would probably do in specific situations. Human personality research often relies on information provided by informants who are either independent observers or acquaintances who know the participants. With regard to the way information is gathered from the informants, two main types can be distinguished. One is
making interviews either with the participants themselves or with the independent informants. The other way is the application of questionnaires.

McCrae (1982) correlated self-reports of 281 individuals with their spouses’ ratings on a set of 18 traits from the dimensions Neuroticism, Extraversion and Openness and found strong association between the two types of data. McCrae and Costa (1987) correlated self-reports with peer ratings highlighting significant correlation between the two data sets with regard to all the five dimensions of the Five Factor Model. The peers in the study were friends, neighbours or co-workers. Gomá-i-Freixanet (1997) revealed strong correlation between self-reports and the spouses’ reports of 198 men and women with regard to the three dimensions of the Eysenck Personality Questionnaire. Evidence for convergent and discriminant validity in the entire sample as well as in both men and women was also shown in the study.

1.3 Personality models of non-human animals

Over the last few years empirical research has shown personality differences in a wide range of animals. In order to explain the phenomena, researchers started to develop conceptual frameworks and theoretical models (Dingemanse and Wolf, 2010). Modelling the personality of dogs, for example, depends to a great extent on the method used. As a result, personality models of dogs often differ, however, overlaps can be detected. It is also important to note that whichever method is applied, it is impossible to collect data from all possible situations that might happen during the lifetime of a dog or any other animal. This is particularly the case with test batteries used to estimate behavioural tendencies in specific
situations. In this way, personality models only capture a specific aspect of the complex structure of behaviour (Miklósi, 2007).

Tinbergen (1972) summarized the main goals of the biological study of animal behaviour in the framework of function, mechanism, development and evolution. The question of individual variation is often tackled from these four perspectives. For this reason, I am also going to present the personality models of non-human animals within Tinbergen’s framework.

1.3.1 The function of personality

The first question regards the function of behaviour, that is, how any behaviour pattern contributes to the survival of the species in the current environmental conditions (Tinbergen, 1972). During the last few decades individual variation received a lot of interest and many studies suggested a two dimensional model in the case of a number of species including rodents (e.g. Benus et al., 1990), birds (e.g. van Overveld and Matthysen, 2010), and pigs (Bolhuis et al., 2004). The two dimensions of this personality model (described also as ‘coping styles’) are labelled: ‘reactive’ and ‘proactive’ coping styles, though the terms ‘shyness’ and ‘boldness’ are also used (Coppens et al., 2010). Whatever label is applied, they refer to the different response patterns in reaction to challenges which are stable over time and across situations (Koolhaas et al., 1999). According to recent research, the proactive coping style is based on rigid, internally organized predictions of the environment. As opposed to that, the reactive coping style is characterized by direct stimulus-response relationship with the environment. This results in a differential degree of behavioural flexibility. This degree of flexibility has a great influence on the differential survival value of proactive and reactive
animals in nature (Coppens et al., 2010). A reactive coping animal appears to be more successful under variable and unpredictable environmental conditions, while a proactive animal may do better in stable environmental conditions. Maze experiments in house mice (*Mus musculus domesticus*), for example, have revealed that proactive individuals tend to rely on routines in finding food, while reactive individuals reacted more flexibly to changes in maze structure. (Benus et al., 1990). The difference in behaviour flexibility can also be detected when the animals’ response to a 12 hour shift in light/dark cycle is examined. Benus et al. (1988) carried out experiments with male mice and found that proactive individuals remained in their original day-night rhythm for a few days and their rhythm only shifted gradually to the new cycle. In contrast, the rhythm of the reactive coping males shifted immediately. Besides the difference in the two strategies of finding food resources or shifting to an altered light/dark cycle, animals with either copying style display further alterations in behaviour. Proactive animals tend to be more offensive towards male rivals and more often take risks than their reactive conspecifics. The difference in the level of aggressive behaviour is supposed to be in connection with proactive animals’ tendency to defend their home territory (David et al., 2004; Groothuis and Carere, 2005; Steimer and Driscoll, 2005).

In the case of nonhuman primates a battery of measures or questionnaire studies are used to assess personality with the involvement of humans knowing the animals well. Personality differences are very important in nonhuman primate societies with respect to the survival chances of the individual, since it is the personality of the animal which influences most aspects of daily life like access to resources, interactions with peers and adults and even reactions to stress (Weiss et al., 2006).

The most frequently used personality model to describe a nonhuman primate is the Five Factor Model including the dimensions Neuroticism, Extraversion, Agreeableness, Conscientiousness and Openness (e.g. Locurto, 2007). The main factors in this case are
established on the basis of ratings made by people who know the animals well. Data is collected with the application of questionnaires. There are two types of ratings, behaviour rating and adjective rating. Adjective rating is often referred to as trait rating (Uher et al., 2008). The items of behaviour rating describe actions and the observers make frequency assessments (e.g. „gets frightened by noises” can be rated from ‘rarely’ to ‘often’). The items of adjective rating only consist of adjectives, which summarize a range of behaviours (e.g. an aspect of an animal’s behavioural history is condensed on a scale ranging from ’unaggressive’ to ’aggressive’). It is important to note that not all the five factors have been found to be represented in nonhuman primates. Conscientiousness, for example, could only be revealed in the case of chimpanzees (*Pan troglodytes*). Besides that, Dominance was often found to form an additional, distinct factor being related to an individual animal’s rank in the hierarchy of the colony (King and Figueredo, 1997).

In nonhuman primate studies the dimension Extraversion is marked by traits associated with exploration, energy and activity (see e.g. Weiss et al., 2006). As far as the general exploratory and activity level of an individual animal is concerned from the perspective of its prospects for survival, there is a fundamental trade-off in activity level when it is trying to find food. Individuals which are more active than others in the absence of predators feed and grow at higher rates. However, it might be inappropriately active in the presence of predators, as a result, might be killed (Sih, et al., 2004).

The positive end of the factor Agreeableness is characterized by affability, sociability and affection, while its negative end is associated with aggression (Roeff et al., 2005). An individual animal’s aggression level can increase or decrease depending on different situations during its lifetime. However, some animals are consistently more aggressive than others in all situations. The aggression level of an individual, thus, also has a consequential impact on a given animal’s fitness, since it can, on the one hand, increase the fitness of the
animal in competitive situations like maintaining rank order but, on the other hand, carries the
danger of fatal injuries (Sih et al., 2004).

The factor Neuroticism is marked by impulsivity, fearfulness and emotional reactivity
(Gosling, 2001). Suomi (1991, 1997) carried out extensive research in rhesus macaques
(Macaca mulatta) and found that approximately 20 percent of the animals showed high
emotional reactivity to changes both in the physical and social environment. Reactive
macaques were less exploratory than their conspecifics and were more anxious and socially
more inhibited than the rest of the colony. Five to ten percent of rhesus macaques proved to
be highly impulsive and showed a tendency to take risks during play and in the case of social
aggression (Box, 1999; Capitano and Widaman, 2005; Fairbanks, 2001). They also left their
home colony earlier than their age mates and suffered more injuries as a result of falls and
fights. Not surprisingly, these animals had higher mortality rates than the rest of the group.

The majority, about 75% of the rhesus macaque colony involves emotionally stable
individuals (Box, 1999). They have more stable and supportive social networks, and as a
result, enjoy more protection in the case of predation risk. They also gain access to food
patches of better quality and develop more effective foraging strategies than their reactive
and/or impulsive conspecifics. Taken everything together, they have better chances for
survival than the reactive and impulsive members of their group.

Openness is characterized by curiosity, playfulness and preference for novelty (Gosling
and John, 1999) and it is also closely related to social learning (Pasquaretta et al., 2014).
Pasquaretta et al. (2014) studied 78 groups of 24 primate species and examined their social
networks. They found that if individuals of a primate group sensitive to social learning can
identify other knowledgeable individuals demonstrating fitness increasing traditions and build
relationships with them, the new bond can indirectly increase the individual fitness of all the
members of the group via the newly acquired innovations, extractive foraging or tool use. The
ability to create supportive social bonds inside the native community increases the fitness of an individual animal.

1.3.2 The mechanism of personality

Tinbergen’s (1972) second question concerned the mechanism of behaviour, that is, the underlying genetic or physiological processes which control or reflect a certain aspect of behaviour.

As for rodents, the functioning of the prefrontal cortex was found to have a substantial impact on behavioural flexibility. The prefrontal cortex has been associated with aggressive behaviour (Blair, 2004) as well as with impulsivity (Siever, 2008).

The prefrontal cortex receives input from the neurotransmitter system serotonin which originates in the dorsal raphe nucleus. Experiments with different species have revealed that serotonin plays an important role in the regulation of aggression (Kravitz, 2000; Kravitz and Huber, 2003; Miczek et al., 2007) and is involved in the regulation of behaviour flexibility as well (Kravitz, 2000). A number of studies have pointed out difference in the serotonergic input of the prefrontal cortex in proactive and reactive coping rats and mice (e.g. Caramaschi et al., 2007; Miczek et al., 2007). Caramaschi et al. (2007) found that rats experiencing a lot of aggression had lower levels of serotonin release in the prefrontal cortex. Impulsivity was also associated with a decrease in the serotonergic function (Homberg et al., 2007).

The most widely investigated biological correlates of different personalities in nonhuman primates regard exposure to stress. The most frequently used method to induce stress in primates is social separation (Locurto, 2007). Being socially separated, reactive rhesus
macaques show more dramatic changes in sympathetic nervous system functioning and hypothalamic-pituitary-adrenal (HPA) activity than their more evenly tempered counterparts. The changes are followed by levels of adrenocorticotropic hormone (ACTH) and cortisol. ACTH increases the secretion of cortisol, cortisol, among other things, increases blood pressure and blood sugar levels. Reactive monkeys’ cardiac patterns remain altered for days after separation and sleep disorders can also be observed (Suomi, 1997). Field studies revealed that high reactive monkeys respond with fear and anxiety to stimuli non-reactive members of their troop explore with interest. Genetic evidence proved significant heritability for the behavioural and physiological differences in reactivity in rhesus macaques (Suomi, 1997). Experiments carried out with tufted capuchins (Cebus apella) found associations with high cortisol reactivity and personality traits like fearfulness, insecurity and submissiveness, whereas negative correlation was revealed with traits such as confidence, curiosity and effectiveness (Byrne and Suomi, 2002). Kalin’s (2003) work also pointed out that in reactive rhesus macaques, in response to stress, extreme asymmetric right frontal electrical activation can be observed.

Basal cortisol levels have also been found to be related to the personality dimension Dominance in primates (e.g. Ray and Sapolsky, 1992). Sapolsky and Ray (1989) and Sapolsky (1990) carried out extensive research on the social hierarchy in olive baboons (Papio anubis). Initial results suggested that all the dominant males in stable hierarchies had lower basal concentrations of cortisol than the other members of the troop. Further research shed light on the fact, however, that the findings only applied to males with a particular type of dominance but did not prove to be right in the case of a second type. Dominant males of the first type were able to distinguish between threatening and neutral interactions with male rivals and frequently initiated fights that they won. At the same time they were able to displace their aggression and avoided a direct confrontation with other high-ranking males.
The second style of dominance was characterized by poor social skill and high responsiveness to environmental challenges. Dingemanse and Reale (2005) highlighted that their cortisol levels did not correlate with the overall frequency of male to male aggression.

Besides the basal level of cortisol, social rank was found to be associated with the concentration of serotonin as well. The effect of serotonin on dominant behaviour became the focus of attention after Raleigh et al. (1991) had demonstrated that in vervet monkeys (Chlorocebus pygerythrus) males achieved dominant positions in their group following treatment with tryptophan, the amino acid precursor of serotonin. When dominant males were treated with a serotonin depleting agent called fenfluramine, they became subordinate. In the case of rhesus macaques low serotonin levels correlated with impulsivity, low levels of grooming and other social activities and fierce aggression (Dingemanse and Reale, 2005).

The level of dopamine also appears to have an influence on the personality dimension Dominance both in the case of males and females (Kaplan et al., 2002). Investigations showed that in cynomolgus monkeys (Macaca fascicularis) the levels of homovanillic acid (HVA), the principal dopamine metabolite in the primate central nervous system, showed negative association with Dominance both in the case of males and females.

1.3.3 The development of personality

The 'nature vs nurture' debate over the development of personality traits has been a long-lasting dispute (for reviews, see Balaban 2002; Plomin et al., 1988). While many scientists held that personality was subject to evolutionary pressures and therefore was coded in the genes, others believed that personality was more strongly influenced by the environment.
Today it is widely accepted that the development of personality is shaped by both nature and nurture, moreover, the genes and the environment interact (for review, see Gunzerath and Goldman, 2003). Many observations support that parental behaviour and/or the social environment of an individual animal have a substantial impact on the course of personality development.

In studying gene-environment interactions, a lot of attention is devoted to the variation within the regulatory or coding regions of those genes which contribute to behavioural responses in a stressful environment (Barr et al., 2003). Serotonin was found to be one of the key neurotransmitters implicated in behavioural disorders in those animals that were exposed to stress at a young age. During the early postnatal period, serotonin has proven to play a far-reaching role in the development of the central nervous system (CNS) (reviewed in Lauder, 1983), furthermore, serotonin neurotransmission was found to be involved in both the activation and the feedback control of the neuroendocrine stress axis (Weidenfeld et al., 2002). Higley et al. (1996b) showed that rhesus macaques reared with peers only, show CNS serotonin impairments and tend to be highly aggressive. Peer-reared animals also show less complex social behaviours, spend more time in withdrawal, achieve lower rank in the social hierarchy and consume more alcohol than their conspecifics reared with their mothers (Higley et al., 1991; Higley et al., 1996a; Higley et al., 1996b; Suomi et al., 1992). It is important to note, however, that some peer-reared animals are not as severely affected by early hurtful rearing experiences than most of their conspecifics. This suggests that a certain genetic background can reduce the negative effects of harmful experience (Barr et al., 2003).

Suomi (1979) observed that infant monkeys reared by their mother tend to engage in play with age-mates less frequently than peer-reared infants. This must be due to the fact that the mothers are far less likely to engage in playful behaviours. Among peer-reared infants, however, some animals, probably with a certain genetic background do not differ from
mother-reared infants in their frequency of play. This observation suggests that variation in genes involved in the serotonin pathway might be associated with reticence to get involved in play with age-mates.

Suomi (1997) conducted cross-fostering studies with rhesus macaques to reveal whether there is connection between an individual animal’s physiological profile and the parenting style of the adoptive mother. He found that when an adopted animal was stressed, its behavioural style was more predictable from the biological mother’s physiological profile and behavioural style than from his adoptive mother’s.

1.3.4 The evolution of personality

In natural populations phenotypic variation is maintained all through the history of a given species in mammals, birds and fish alike. As has been outlined above, the variations in behaviour and physiology has adaptive significance with regard to the survival of the population as a whole. The question thus arises whether field studies support the idea that proactive and reactive coping strategies were related to the survival of a species during the course of its history, in other words, the question arises why a given species evolved the particular forms of adaptations during the history of its evolution.

In nature, mouse populations go through phases of growth and decline. The population cycles usually cover a period from 4 to 7 years. In extreme cases the population can suddenly collapse at the end of a cycle and becomes extinct. Chitty (1967) hypothesized that the cyclic nature of rodent populations might be due to a disruptive selection for aggressive behaviour in the course of the population cycle.
Van Oortmerssen and Busser (1989) found evidence for Chitty’s hypothesis in semi-natural populations of house mice consisting of males and females alike. The analysis of the mortality revealed that there was a strong increase in females, juveniles, and pre-weanling juveniles just before the crash of the population. The idea that this increase in mortality was due to enhanced levels of male aggression was supported by the index of territoriality. In the growth phase of the population, four males on average were found together in each nest. As the crash was approaching, the males were generally found alone, suggesting that tolerance for additional males in the nest substantially decreased. During the population cycle, animals keep migrating from the population. The nonaggressive phenotype was observed to be more successful in establishing a new colony than the highly aggressive phenotype. This suggests that the two phenotypes examined in the semi-natural populations of house mice have a differential fitness depending on the phase of the population cycle.

Studies in the great tit (Parus major), show a similar differentiation of phenotypes rodent studies revealed. In the case of great tits proactive birds are labelled ‘bold’, while the reactive ones are termed ‘shy’. Bold great tits are more aggressive, superficial explorers with a greater tendency to develop behavioural routines than shy birds. In a field study, Verbeek, et al. (1994) found a bimodal distribution of aggressive behaviour of individual birds. These observations seem to support the idea that the different variations of behaviour in a natural population were evolved to increase the chances of the survival of the population as a whole when it faced the negative effects of environmental variation such as a decrease in food availability (Dingemanse et al., 2003).

Another approach to study individual differences from an evolutionary point of view is to examine puzzling behaviour (Bell, 2007). Precopulatory sexual cannibalism, for example, is hard to understand from the evolutionary perspective, because those females that eat their potential mates prior to mating with them produce unfertilized clutches. Johnson and Sih
(2005) explained this phenomenon as the spill-over of aggression. They observed the behaviour of female spiders before copulation and found differences in their tendency to behave in a cannibalistic way. Females that showed cannibalistic behaviour were more likely to be highly voracious towards food even as juveniles. Their voracity resulted in faster growth and increased fecundity. The benefits of their strong voracious tendencies during the juvenile period appear to outweigh the costs of their extensively aggressive adult behaviour.

With regard to the Five Factor Model of personality, Gosling and John (1999) reviewed 19 factor analytic studies representing 12 different species. They examined the items describing each personality factor in each study and compared them with the definitions of each of the dimensions of the Five Factor Model plus two additional dimensions: Dominance and Activity. Considering the evolutionary continuity between humans and other nonhuman species, they hypothesized that some dimensions of personality might be common across a wide range of species. Three factors of the human Big Five: Extraversion, Neuroticism and Agreeableness were found to show the most considerable generality across species while Openness related factors were found to be less frequent. Dominance emerged as a separate factor where dominance rank was relevant in the life of the species under focus. The factor Conscientiousness could only be detected in the case of chimpanzees whereas little evidence was uncovered for Activity to be retained as a separate factor. The fact that a wide range of taxa including primates, non-primate mammals and even guppies and octopuses show individual differences in the dimensions Extraversion and Neuroticism, and with the exception of guppies and octopuses in the dimension Agreeableness suggest that the traits associated with these factors appeared early in the evolutionary course of the animal world. Openness and Dominance evolved at a later stage of the long history of evolution but only in species in the case of which the appearance of the traits associated with these factors were essential with respect to the survival of the species as a whole. The traits comprising the
dimension Consciousness seem to have appeared relatively recently in the evolution of Homininae (Gosling and Jones, 1999).

1.4 Personality of dogs

1.4.1. The function of personality

During evolution humas (*Homo sapiens sapiens*) adopted a set of species-specific skills which had an essential impact on their social life, since these new skills allowed them to form large, closed individual groups (Csányi, 2001). According to Csányi (2000), three noteworthy aspects of human social behaviour changed since the *Pan-Homo* split, that is, since humans and chimpanzees (*Pan troglodytes*) diverged approximately 6 million years ago: sociality, synchronization and constructive activity. These can be regarded as broad collective groups of behaviour traits and the assembly of these traits is termed as the Human Behavioral Complex (Csányi, 2000). Taking the divergence of the dog from the wolf (*Canis lupus*) from the perspective of behavioral evolution, scientists have found evidence for the same direction of behavioral evolution in the case of dogs as well, that is, several social skills in dogs have undergone convergent evolutionary changes (Miklósi et al., 2004). We talk about convergent evolution when similarities between evolutionary unrelated characteristics of different species are attributed to their adaptation to similar environments. Based on evidence suggesting that dogs’ behaviour became to some extent functionally similar to the most marked aspects of the Human Behaviour Complex, a framework named the Dog Behaviour Complex was suggested.
to conceptualize the evolutionary changes in dogs (Topál et al., 2009) essential for their survival in the human environment. Due to evolutionary constraints like the lack of linguistic skills, dogs cannot entirely reflect the Human Behaviour Complex. Still, there is mounting evidence for a parallel between the Human and the Dog Behaviour Complex.

Marked differences have been observed between the way wolves and dogs display human-oriented social behaviour (e.g. Frank and Frank, 1982). Three main factors have been identified: social attraction, attachment and agonistic behaviour (Topál et al., 2009). Oakes et al. (1998) defined social attraction as the behavioural manifestation of group cohesiveness and intragroup attraction that holds groups together. As such, it is an inevitable component of the Dog Behaviour Complex in forming social groups with humans, since it is based on liking the other members of the group, simply because they are the members of the group. Comparative experiments have proved that dogs display a stronger attraction toward humans than wolves do (Frank and Frank, 1982; Zimen, 1987) and show a strong inclination to build an interspecific tie with a human (e.g. Miklósi, 2007).

As far as attachment is concerned, it does not equal with social attraction. Wickler (1976) defined attachment as a long-lasting attraction to a particular set of stimuli manifesting itself as particular behaviours directed toward or performed in the presence of these stimuli in addition to maintaining proximity to the relevant stimuli. Research provided evidence that dogs display separation stress in the absence of their owner, seek proximity and contact with him/her and perform greeting behaviour when he/she appears (Gácsi et al., 2001).

With regard to agonistic behaviour in the case of dogs, Gácsi et al. (2005) found that even extensively socialized wolves were more likely to growl at or bite their caretaker during an experiment than dogs did. Topál et al. (2009) suggested that these results may be due to the fact that dogs, as opposed to wolves, have the ability to control their aggressive tendencies more effectively than wolves do. From a functional point of view the ability of controlling
aggression also has a substantial contribution to the formation of close interspecific ties between humans and ‘their best friend’.

Another essential factor for the creation and maintenance of group cohesion is synchronization, a process leading to behavioural and motivational/emotional conformity (Engel and Lamprecht, 1997). Four aspects of dog behaviour have been revealed: emotional synchronization, social learning, and rule following and complementary cooperation (Topál et al., 2009). As regards emotional synchronization, Vas et al. (2005), for example, revealed that dogs showed rapid changes of emotional and behavioural response when approached by an unfamiliar person in a test situation showing signs of friendliness and threat in succession.

In the case of social learning information is obtained from conspecifics through observation. Dogs are able to use human behaviour as a cue to select functionally similar behaviour and to obtain information to solve certain problems (Kubinyi et al., 2003a; Miller et al., 2009; Topál et al., 2006). Further, Pongrácz et al. (2004) found that dogs learn more effectively from humans than from conspecifics in a detouring task when the human is talking to them while walking around a fence in a test situation.

As far as rule following is concerned, dogs are assumed to display obedient behaviour because of their social skill to comprehend and follow social rules (e.g. Bekoff and Allen, 1998). In an experiment Kubinyi et al. (2003b) tested whether dogs would adopt a novel, arbitrary, seemingly irrational behaviour spontaneously as a result of interaction with their owner. Owners were asked to take a longer route to their flat than usual with their dog off leash. After a period of 3-6 months the dogs developed a behaviour which corresponded to their owners’ new habit and half of the animals not only followed the owner but even finished the detour earlier than he/she did. From a functional point of view these observations suggest that dogs’ ability for the synchronization of group activities must have made and still makes their interactions with humans more efficient in the human society (Topál et al., 2009).
As regards complementary cooperation, it can only be achieved by cooperative interactions with the other members of the group. Findings suggest that interacting dogs and humans establish a complex behavior pattern when joint actions are being performed (Kerepesi et al., 2005; Rooney et al., 2001). Naderi et al. (2001) highlighted the existence of complex, interwoven behavioural interactions between blind persons and their guide dogs. Dog-owner dyads were examined in an obstacle course and the ratio of actions initialized by either the dog or the human were examined. Although large variation could be detected among the dyads, dogs and humans were observed to initialize the actions in equal ratio. Furthermore, at the individual level the role of the initiator kept changing, typically after each single action. Such switching of roles, in addition to the dogs’ ability to do complementing actions to achieve a common goal, largely resembles cooperative activity described in the case of humans (Reynolds, 1993).

Functionally, the ability to initialize communicative interactions with humans as well as the capability to respond to human communicative gestures enhances the success of dogs in a human environment. Visual signals such as looking and gaze alternation, which are functionally similar to those used by humans, are patterns of behaviour that can be observed in situations where dogs are exposed to problems to be solved in the presence of humans. Under such circumstances, dogs display their ability to direct the attention of the human onto themselves or the task to be done (Miklósi et al., 2000). Research also revealed that dogs can rely on a number of different human bodily gestures as communicative signals. In these experiments dogs had to find hidden food with the help of cues provided by a human (for a review, see Miklósi and Soproni, 2006).
1.4.2 The mechanism of personality

Saetre et al. (2006) investigated quantitative genetic effects on the personality traits of individual dogs using a large sample of dogs who had participated in the DMA test. Two breeds were under focus, the German shepherd dog and the Rottweiler. They revealed that the pattern of inheritance was very similar in the two breeds and a common underlying genetic factor was found, which was related to the boldness-shyness trait. The heritability of this trait was much higher than the individual behavioural traits.

Although quantitative studies can highlight underlying genetic variance (e.g. Goddard and Beilharz, 1984ab, 1985; Wilsson and Sundgren, 1998; Ruefenacht et al., 2002; van den Berg et al., 2003) and also, provide information about the approximate number of the relevant genes, they cannot pinpoint the particular genes that lie behind particular personality traits. To be able to model gene and trait associations, molecular genetic methods are necessary to be applied. There are two ways to model correspondence between genes and traits. One model assumes that personality traits are controlled by a number of genes (quantitative trait loci, QTL). Of these, one single gene only has a slight effect (e.g. Flint et al., 1995). With the help of polymorphic genetic markers of the nuclear DNA, researchers try to find associations between a certain phenotypic trait and the presence of these markers at a certain location on the chromosome.

The other genetic model hypothesizes that a phenotypic trait is determined by genes that have a major effect. These genes are called candidate genes. Their role can be predicted by the modification of certain hormones or transmitter levels which affect personality traits. It is assumed that the variability in the phenotypic trait is, to some extent, explained by allele
polymorphism in the gene (Miklósi, 2007). This approach has gained popularity in recent years.

Kubinyi et al. (2012) revealed association between repeat polymorphism in intron 4 of the tyrosine hydroxylase (TH) gene and two personality traits: activity-impulsivity and inattention in German shepherd dogs. Dogs with at least one short allele were found to be more active-impulsive compared to dogs possessing two copies of the long allele. In another study Wan et al. (2013) investigated whether dopamine receptor D4 (DRD4) exon 3 and tyrosine hydroxilase (TH) intron 4 repeat polymorphisms are linked to activity and impulsivity in Siberian Huskies. Siberian Huskies with two short alleles of the TH polymorphism received higher ratings of inattention by their owners on Dog-Attention Deficit Hyperactivity Disorder Rating Scale than those carrying the long allele. Examination of the joint effect of DRD4 and TH showed that dogs with long alleles at both sites were scored as less active-impulsive than others.

Besides the impact of genes on personality traits, there is a growing interest in revealing the influence of neurobiological and neuroendocrine variables as well. Many scientists find that the investigation of parallels in human and animal models supports the hypothesis of a homologous origin of certain personality traits (Miklósi, 2007). Although there has been little systematic research in this field, single traits like aggressiveness (dominance-proneness) or fearfulness (stress-proneness) has already been targeted. Vincent and Mitchell (1996) found that dogs characterised as stress-prone by their handlers had higher levels of blood pressure and heart rate than their less sensitive conspecifics. Beerda et al. (1997) also revealed that stressful stimulation with sudden and novel stimuli increased heart rate in dogs. Several studies examined the changes in blood cortisol concentration (e.g. Dreschel et al., 2005; Tuber et al., 1996; Coppola et al., 2006). Horváth et al. (2007) investigated the relationship between human-directed aggression and cortisol changes in a population of police dogs. After being
threatened by a human, the dogs’ cortisol levels generally increased. Further analysis revealed that the dogs could be grouped into three categories. The first group, showing a tendency to counter-attack was labelled ‘bold’, those who displayed a submissive tendency were called ‘shy’, and the ones who showed passivity and displacement behaviours were termed ‘ambivalent’. The pre-test cortisol levels of the three groups did not differ. As a result of threat, however, the cortisol level of the ambivalent group increased to the greatest extent. This suggests that those dogs were the most stressed that had problems in responding to the threatening human. Those who had a tactic, either to attack or to withdraw, to resolve the situation proved to be less stressful.

1.4.3. The development of personality

In order to determine the future of a young dog regarding its prospective owners, further breeding or participation in organised training, tests aiming to receive information about a particular puppy’s temperament as well as tests monitoring their personality development have become increasingly fashionable, however, with very mixed results (Miklósi, 2007). The structure of development is heavily affected by selective breeding. Not only has the speed of maturation changed but also the duration of the developmental periods and the sequence of the emergence of behaviours. During a test designed for young dogs, different breeds show different rate of sensitivity to interact with humans (Freedman, 1958). For this reason, test batteries comprising a series of short tests testing for sociability, retrieval ability, neophobia or activity at around the age of eight weeks fail to predict a puppy’s suitability for service work (Wilsson and Sundgren, 1998). Various single tests, however, carried out at a different
age in order to monitor the development of a given animal, have a much higher predictive value. Tests on retrieval, for example, at the age of 8 and 12 weeks, or tests on startle behaviour at the age of 12 and 16 weeks were found to have a satisfactory predictive value for suitability as a police dog (Slabbert and Odendaal, 1999). Taking everything into consideration we can conclude that the predictive value of tests developed for young dogs, increases with age. The same conclusion was drawn by Goddard and Beilharz (1986) as well, who measured fear in guide dogs for the blind.

In spite of the poor predictive value of tests designed to measure certain traits in young dogs, some other investigations focused on broader behavioural manifestations. Pfaffenberger and Scott (1959) were among the first experts who highlighted the importance of early socialization for puppies. They raised guide dogs and found that puppies kept in kennels and missing early socialization were more likely to fail their training than their normally socialized conspecifics. Freedman et al. (1961) investigated that the seventh week of age was the period in which young dogs were most receptive to socialization and that the critical period for socialization to humans was found to fall between the interval of 2.5 and 9-13 weeks of age. If no socialization occurred before 14 weeks of age, withdrawal reactions from humans became so expressed that no normal relationships could be established thereafter. One of the control puppies was petted and fondled every day for the following three months but still failed to become more sociable. Stanley and Eliot (1962) also put the importance of early socialization under scrutiny and unveiled that dog puppies develop preferences toward humans after only a brief exposure and despite being punished for social contact (Fisher, 1955). These results suggest that dogs might have some predisposition to be attracted to humans but their innate tendencies must be ignited by at least a brief contact with humans.

In comparative experiments (e.g. Gácsi et al., 2005) the preference of dog puppies and young wolves for creating eye contact with humans was investigated. It was found that the
preference to look at the human develops very early in dogs in comparison to wolves, which can provide the basis for the emergence of complex communicative interactions between the two species.

1.4.4. The evolution of personality

Tinbergen’s fourth question concerns evolution. Genetic studies have proved that the wolf is the nearest living ancestor of dogs. Coppinger and Coppinger (2001) pointed out that an extinct wolf may be the actual ancestor of present day dogs. In order to share our niche, the ancient wolf had to be subject to the artificial selection made by humans. Although most researchers agree with this idea (e.g. Hare et al., 2002), there is an ongoing debate over the existence of any substantive difference between dogs and wolves regarding the skills necessary for social interaction with humans (e.g. Hare and Tomasello, 2005; Miklósi and Topál, 2005).

Svartberg (2002), by using the Dog Mentality Assessment (DMA) test, established the following personality factors for individual dogs: playfulness, curiosity/fearlessness, chase-proneness, sociability and aggressiveness. He found that shyness-boldness explains most of the phenotypic variability present in the personality traits: sociability, playfulness, curiosity and chase-proneness. Since in the DMA test a stranger (an adult human the dog does not know) is involved in the subtests measuring the above personality traits, Svartberg’s (2002) finding indicates that the bolder, that is, the more curious an individual dog is, the more sociable he/she is likely to be. In the case of many species boldness seems to be related to aggressive tendencies, however, no such relationship was found in the case of the dog (Miklósi, 2007).
According to the personality structure described by Svartberg (2002), bold dogs did not necessarily have aggressive tendencies. It means that selection may have altered the relationship between personality factors under certain environmental conditions (Miklósi, 2007).

One can raise the question in what way this selection process affected the personality structure of dogs. It is difficult to provide an answer, since no personality model has been set up for the wolf so far (Miklósi, 2007). According to a hypothesis, however, the original wolf-human environment may have had several elements in common. In consequence, selection might have affected single personality traits by selecting for a different mean value in the population. For example, there may have been selection against boldness in dogs, since humans did not favour the dogs’ tendency to disperse to novel areas (Miklósi, 2007). In line with this idea, Svartberg (2002) argued that the boldness-shyness personality trait is inherited from the wolf. Moreover, the fact that the boldness-shyness trait is independent from the trait aggressiveness in dogs suggests that selection for less bold individuals did not necessarily reduce the general level of aggression in the population. Vica versa, selection for aggressive behaviour does not seem to have had an impact on the boldness-shyness personality trait.

Besides the fact that aggressiveness and the boldness-shyness trait became independent, domestication might have resulted in the emergence of novel personality traits. This idea seems to be supported by another study of Svartberg (2005). In the case of the personality trait 'playing with humans', he found no relationship with 'playing with conspecifics'. 'Playing with humans’ therefore might relate to special aspects of the dog-human relationship including a tendency to cooperate as discussed above regarding the functional aspects of dog behaviour. Cooperativeness might be an additional trait to the personality structure, since individual dogs vary in this tendency, some are more, some are less independent (e.g. Szetei et al., 2003). The effect of the selective environment on the evolution of the personality of
individual dogs thus appears to be supported by some studies, however, further research needs to be done to get a deeper insight into the emergence of novel personality traits in dogs.

1.5 Methods of personality research of dogs

In a review article Jones and Gosling (2005) made a survey in the field of dog personality research, assessed the different methods applied in the field and made suggestions for improvements. Ten years later Rayment et al. (2015) re-surveyed the literature focusing on questionnaire studies and test batteries developed to assess the personality of dogs and called attention to the deficiencies of dog personality research.

Jones and Gosling (2005) identified four main methods by which the personality of individual dogs was assessed: Test Batteries, Ratings of Individual dogs, Expert Ratings of Breed Prototypes and Observational Tests.

The main goal of the studies applying a behavioural test battery is to document dogs’ reactions to specific stimuli. It was found to be the most common method researchers used. Behaviour coding is used to assess the dogs’ reactions to the tests. Svartberg and Forkman (2002), for example, used the Dog Mentality Assessment (DMA) test to describe stable behaviour traits which provide the raw material for personality dimensions.

The second most common method of assessment was ratings of individual dog. In these studies data are collected from an informant who provides information about an individual dog’s behaviour and history. Generally two types of questionnaires are used. The aim of situational questionnaires is to estimate the dogs’ behaviour in a specific situation. The C-BARQ developed by Hsu and Serpell (2003), for example, contains a long list of possible
situations. The respondent has to assess the intensity or the frequency of the occurrence of a particular behaviour (e.g. Dog reacts aggressively when mailman or other delivery workers approach the home.)

Adjective-based questionnaires consist of a selected list of adjectives. This type of questionnaire was used in developing the human 'Big Five Inventory' (John, 1990), widely used in human personality research. Gosling et al. (2003) rephrased some of its questions and applied it to dogs. They obtained four of the five human personality traits which were also revealed by Kubinyi et al. (2009), however, by using a Hungarian version, Turcsány et al. (2012) obtained all the five personality dimensions.

The aim of observational tests is to evaluate and describe broad traits observable in naturalistic environments. Like behavioural test batteries, observational behavioural tests have two main components: the test itself and a scoring system to assess dogs’ performance in the test. Unlike test batteries, however, observational tests are carried out in uncontrolled, though carefully selected environments where unforeseen stimuli can occur during the experiment. Goddard and Beilharz (1984a), for example, observed dogs while the animals were walking through a shopping centre. The target dogs are usually scored on a number of predetermined traits like cooperativeness based on their overall behaviour displayed during the walk (Murphy, 1998).

With regard to the reliability of the four methods Jones and Gosling (2005) noted that only few articles reported the reliability scores and suggested that future researchers should compute and report the reliability of their measures. Concerning the examination of validity, they called attention to the fact that past validity research focused on convergent validity but neglected discriminant validity. Jones and Gosling thus recommended that future research should examine both types of validity.
Rayment et al. (2015) also emphasized that although a lot of work has been dedicated to dog behaviour test development, only a few protocols have been examined with regard to their accurate and reliable predictive value of measuring the behavioural traits of dogs. Furthermore, they also called attention to the limitations of the behaviour-only scoring systems with focus on passive behaviour saying that test developers seem to have the incorrect assumption that observable active behaviours like flight or aggression reliably measure arousal in all dogs. Besides that, they also highlighted the necessity of the assessment of both temporal and contextual stability during personality testing with consideration to the effects of impulsivity and the affective state of the target animal.

2 Purpose of study

2.1 Purpose of Study I

In a review Gosling and John (1999) applied the Five Factor Model (FFM) to characterize animal personality where they compared personality structures of 12 species including dogs. Gosling (2003) further examined whether canine personality dimensions represent analogues of the human FFM factors. In order to test this, he used the Big Five Inventory. The wording of four original FFM scales was altered to make them suit dogs’ behaviour and the Consciousness scale was omitted. Their adjusted questionnaire was filled in by the owners of 78 dogs, half of which were mongrels. The scales established were Energy as the analogue of human Extraversion, Affection as the analogue of the human Agreeableness, Emotional Reactivity for the human Neuroticism and Intelligence for the
human Openness/Intellect. Kubinyi et al. (2009) established similar scales on the basis of a shorter version of the human FFM (24 questions only). On a large sample of dogs (more than 14,000 individuals) they developed four personality scales: calmness, trainability, dog sociability and boldness. Ley et al. (2008) used a 67 item questionnaire based on dog specific adjectives like ‘non-aggressive’ or ‘trainable’ to contribute to the identification of dog personality. Five personality dimensions were identified: extraversion, self-assuredness/motivation, training focus, amicability and neuroticism (Ley et al., 2008).

Despite the interest in deriving breed specific “personality-like” profiles neither of the studies above compared the breeds in terms of these specific scales. Such comparisons could be revealing because it is not clear how genetic and environmental factors contribute to behavioural variations among breeds. The behaviours under past selection are no longer regarded prominent in the breed standards today (McGreevy and Nicholas, 1999). The differences in individual dogs’ behaviour within a breed may exceed variations among breeds (Hart and Miller, 1985), therefore an individual-based analysis has become remarkably essential in order to unveil whether a given behavioural trait differentiates not only individual dogs but also a greater number of dogs belonging to a particular breed or breed group. Observing a range of dog breeds in a behavioural test battery Svartberg (2006) did not find support for breed-group differences in certain personality dimensions. The use of modified human FFM for dogs may not be advantageous because it lacks dog specific questions. For example, FFM does not distinguish between intra- and inter-specific aggression which is not an issue in humans but which is a very important aspect of a dog’s life.

(1) In this study my first aim was therefore to use a different method by collecting dog specific questionnaire items from people who lived with or trained dogs (see Methods). The questionnaire I developed is thus biased to use adjectives (with explanations). My hypothesis
is that this questionnaire has in this way the potential to grasp some of the behaviour traits of individual dogs at more global level (\textit{in sensu} McCrae and John, 1992). There is also evidence that human observers are able to judge the behaviour of animals using their own terminology, mainly referring to the behaviour in terms of adjectives (Wemelsfelder, 2000; see also Gosling, 1998).

(2) My second aim was to provide some ways of internal and external validation for the personality dimensions obtained by the questionnaire.

(3) My third aim was to investigate how the five personality dimensions are represented in the ten Fédération Cynologique Internationale (FCI) breed groups and in a group of mongrels.

(4) My fourth aim was to compare two popular breeds in Hungary. My choice fell upon the comparison of the German shepherd dog and the Hungarian vizsla because the ancestors of the former breed were originally bred for herding sheep, the latter was used as a gun dog. These different breed-typical tasks required inevitably different skills, and as a consequence, detectable differences in personality were hypothesised between the two populations. Moreover, in our modern society, where the focus of breeding has witnessed a number of changes (McGreevy and Nicholas, 1999; Svartberg, 2006), the difference between these two breeds with regard to function is still there. While the German shepherd dog has become a preferable breed for police and border guard purposes and less favoured as a pet (Miklósi, 2007), the Hungarian vizsla is a popular family dog (Gottlieb, 2002).
2.2 Purpose of Study II

As has been mentioned above, there are two main methods to record information about the behaviour of individual animals. One is behaviour coding, which is based on units of behaviour (ethograms: Martin and Bateson, 2007; Lehner, 1996), the other one is subjective rating of behavioural tendencies on ordinal scales (e.g. Wemelsfelder et al., 2001; Gosling et al., 2003; Ley et al., 2008; Kubinyi et al., 2009). In the case of behaviour coding, the occurrence of discrete, well-defined behaviour units without reference to their function are recorded on a ratio scale in a behavioural test battery to capture in a quantitative way (overall duration or frequency) what an animal does on that particular occasion. Researchers, for example, may count how many times the target animal lifts its leg etc. This method is thus considered objective, unaffected by the observers’ perceptual and interpretational biases (Gosling, 2001). Subjective ratings focus on the aggregated character of animal behaviour and observers pay little attention to small, specific behaviour units. Since both behaviour and adjective rating rely on the subjective judgement of the observers, they are sometimes considered less reliable than behaviour coding (e.g. Stevenson-Hinde and Zunz, 1978; Gosling, 2001).

However, examination of inter-observer agreement, internal consistency and test-retest reliability have proven that the reliabilities of subjective ratings can be strong (for a review see Weinstein et al., 2008) and some even argued subjective ratings are more reliable than behaviour coding (Vazire et al., 2007). Though both methods provide grounds for considering that they are valid, few studies have studied the possible correlations between subjective rating and behaviour coding (for a review see Gosling, 2001). In a recent study Konok et al.
(2011) constructed a questionnaire to collect information from owners about their dog’s separation behaviour and in parallel coded the dogs’ separation-related behaviour in a behavioral test. Their results show that owners provided a realistic picture about their dog’s reactions in a separation situation.

There have been few empirical comparisons of the two methods regarding the personality of individual dogs (e.g. Svartberg, 2005). If both behaviour coding and subjective rating as methods are reliable to the same extent, the rating and coding measures of the traits reflecting the same underlying factors must converge (Vazire et al., 2007). For instance, if the owner rates the dog as highly noise sensitive, the dog should avoid an object producing a loud noise in a behaviour test.

(1) My first aim in Study II was thus to examine the convergence between behaviour coding and subjective rating. My hypothesis was that some associations may be revealed between behaviour coding and subjective rating but strong correlations might not be found because of the quantitative nature of the former and qualitative nature of the latter method.

A number of researchers argue that during a test battery the behaviour of an animal in reaction to a particular stimulus can be under the influence of various factors like the presence of other dogs around the test scene etc. and the inner state of the target animal can also change during the course of the test situations (e.g. Jones and Gosling, 2005). The behaviour of the target animal in a test battery thus might not accurately reflect a particular aspect of a dog’s character (e.g. Jones and Gosling, 2005). If a dog, for example, does not typically bark a lot, but in a test scene keeps barking at its conspecifics, the animal’s performance in a behaviour test may substantially differ from its manners at home. In this case it might happen that no
association can be detected between owner’s report and behaviour coding not because the
former assesses behaviour in a qualitative while the latter does so in a quantitative way, but
because of the fact that behaviour assessments based on test batteries lack the aggregated
character of questionnaire studies (Vazire et al., 2007).

(2) My second aim was thus to investigate correspondence between the dogs’ behaviour in
the test battery and owners’ report with the exclusion of any potential divergences resulting
from the qualitative vs quantitative quality of the two methods. For this reason I carried out a
second experiment. Independent observers unfamiliar with each dog were asked to watch the
video clips of a test battery, then rate the dogs on the video by filling in the same
questionnaire the owner had completed. In this way the data sets I gained only differed in the
amount of knowledge the assessors had about each dog. My hypothesis was that there will be
significant variability between owner’s ratings and the assessment of the dogs done by the
three independent rater groups.

(3) Few studies have examined the influence of the assessors’ previous experience on
subjective ratings of dogs based on video recordings of test batteries (Tami and Gallagher,
2009). To investigate the potential impact of prior experience, the third aim of my second
study was to compare the assessments of three rater groups each having different levels of
hands-on experience with dogs. The three groups comprised dog trainers, independent dog
owners and people who had never kept a dog. My hypothesis was that the owners’ report will
not show strong association with the assessments of any of the rating groups, but the
assessments of all the rating groups will reveal significant correlation with each other.

My investigations in Study II follow the direction suggested by Jones and Gosling
(2005), namely that future research on the personality of individual dogs (Canis familiaris)
should focus on the comparison of different methods.
3 Study I

3.1 Subjects and Methods

3.1.1 Subjects

Dogs representing the 10 FCI groups and mongrels

The dogs and their owners were recruited on voluntary basis from dog training schools, dog-shows, from among the participants of our Family Dog Research Database and from different parts of the country reacting to our notice in the Hungarian edition of International Dog Magazine calling for dog keepers to fill in our Dog Personality Questionnaire. The owners I recruited in dog training schools and dog shows filled in the previously printed questionnaire on their own on the scene of the given event. Those who reacted to the notice in the Hungarian edition of International Dog Magazine filled in the copy I sent to them via e-mail. I asked everyone to complete the questionnaire on their own. The questionnaire data were recorded from 395 participants between January 2005 and June 2008, but 43 were incomplete and were excluded from the analysis. The ultimate sample consisted of 284 animals of the 10 FCI breed groups, balanced in number for all the groups with regard to how many breeds are registered under a particular FCI category and sixty-eight mongrels were also added to the sample (for more details see Appendix I). In order to avoid overrepresentation on the part of any of the breeds, maximum 8 dogs were included from any of the breeds. 189 of the dogs (54%) were males and 163 (46%) were females. In terms of
their age, the dogs were assigned to three classes: Young dogs (subjects of 1-3 years old; N = 190), Mature dogs (subjects of 3.5-7 years old; N = 112), Old dogs (subjects of 7.5 -17.5 years old; N = 50). The classifications were based on previous studies examining the signs of aging in dogs (e.g. Golini et al., 2009) and the effect of aging on the personality dimensions of dogs established by Kubinyi et al. (2009). One hundred and twenty dogs of the 352 (34 %) spent most of their time in a flat, 125 (35.5 %) both in the flat and in the garden while 81 dogs (23 %) were kept in the garden, 26 (7.5%) in a kennel. 141 of them (40%) were trained and 211 (60%) untrained. The dogs were also categorized into four weight groups on the basis of veterinary weight classifications. Group one involved dogs which were 10 or under 10 kgs. Sixty-five dogs (18.5%) of the whole sample belonged to this category. Group two comprised the ones weighing between 11-25 kgs with 90 dogs (25.5%) in it. Group three was formed with 107 dogs (30%) weighing between 26-44 kgs while group four contained 22 dogs 6% weighing 45 kgs or above. I had no data about the 68 mongrels (19%) of the total number of subjects. The demographic data of the owners together with some additional independent variables can be found in Table 1.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age</th>
<th>Educational background</th>
<th>Time spent with the dog</th>
<th>Opinion about dog’s human speech comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>14-18</td>
<td>Elementary School</td>
<td>Less than 1 hour</td>
<td>Intonations only</td>
</tr>
<tr>
<td>N=110 (31%)</td>
<td>N=28 (8%)</td>
<td>N=33 (9%)</td>
<td>N=62 (17.5%)</td>
<td>N=37 (10.5%)</td>
</tr>
<tr>
<td>Female</td>
<td>19-30</td>
<td>High School</td>
<td>1-3 hours</td>
<td>Words</td>
</tr>
<tr>
<td>N=242 (69%)</td>
<td>N=151 (43%)</td>
<td>N=171 (49%)</td>
<td>N=205 (58.5%)</td>
<td>N=98 (28%)</td>
</tr>
<tr>
<td></td>
<td>31-60</td>
<td>Degree</td>
<td>Over 3 hours</td>
<td>Sentences</td>
</tr>
<tr>
<td></td>
<td>N=172 (49%)</td>
<td>N=148 (42%)</td>
<td>N=85 (24%)</td>
<td>N=92 (26.2%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fluent speech</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N=124 (35.3%)</td>
</tr>
</tbody>
</table>

Table 1. The demographic data of the dog owners comprising the 10 FCI groups and mongrels
The Hungarian vizsla and the German shepherd dog

I had the collected questionnaires of thirty-six Hungarian vizslas and fifty-five German shepherd dogs. Twenty of the Hungarian vizslas (55.5%) were males and 16 (44.5%) were females. In terms of their age, the Hungarian vizslas were also assigned to three classes: Young dogs (subjects of 1-3 years old $M=1.90$, $SD=0.72$; $N = 16$), Mature dogs (subjects of 3.5-7 years old $M=5.03$, $SD=1.06$; $N = 15$), Older dogs (subjects of 7.5-17.5 years old $M=9.68$, $SD=2.20$; $N = 5$). As regards their housing conditions, 11 dogs of the 36 (31%) spent most of their time in a flat, 20 (55.5%) both in the flat and in the garden while 5 dogs (13.5%) were kept in the garden. 18 of them (50%) were trained and 18 (50%) untrained. As regards the German shepherd dogs, 24 (44%) were males and 31 (56%) were females. Their representation in the above mentioned three age groups: Young dogs (subjects of 1-3 years old; $N = 28$), Mature dogs (subjects of 3.5-7 years old; $N = 20$), Older dogs (subjects of 7.5-17.5 years old; $N = 7$). Eight dogs (14.5%) of the 55 spent most of their time in a flat, 20 (36%) both in the flat and in the garden while 17 (31%) dogs were kept in the garden and 10 (18%) in a kennel. Thirty-two of them (58%) were trained and 23 (42%) untrained. The data regarding the owners together with other independent variables are in Table 2.
<table>
<thead>
<tr>
<th></th>
<th>Sex</th>
<th>Age</th>
<th>Educational background</th>
<th>Time spent with the dog</th>
<th>Opinion about dog’s human speech comprehension</th>
<th>Opinion about dog’s human speech comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HV</td>
<td>GSD</td>
<td>HV</td>
<td>GSD</td>
<td>HV</td>
<td>GSD</td>
</tr>
<tr>
<td>male</td>
<td>N=9</td>
<td>N=20</td>
<td>14-18</td>
<td>14-18</td>
<td>&lt;1 hour</td>
<td>intonations</td>
</tr>
<tr>
<td></td>
<td>25%</td>
<td>36%</td>
<td>N=0</td>
<td>N=0</td>
<td>N=0</td>
<td>N=2</td>
</tr>
<tr>
<td>female</td>
<td>N=27</td>
<td>N=35</td>
<td>19-30</td>
<td>High School</td>
<td>1-3 hours</td>
<td>words</td>
</tr>
<tr>
<td></td>
<td>75%</td>
<td>64%</td>
<td>N=18</td>
<td>N=17</td>
<td>N=24</td>
<td>N=7</td>
</tr>
<tr>
<td></td>
<td>50%</td>
<td>47%</td>
<td>19-30</td>
<td>N=42</td>
<td>1-3 hours</td>
<td>N=12</td>
</tr>
<tr>
<td>female</td>
<td>N=18</td>
<td>N=29</td>
<td>31-60</td>
<td>Degree</td>
<td>over 3 hours</td>
<td>over 3 hours</td>
</tr>
<tr>
<td></td>
<td>53%</td>
<td>53%</td>
<td>N=19</td>
<td>N=13</td>
<td>N=12</td>
<td>N=16</td>
</tr>
<tr>
<td></td>
<td>50%</td>
<td>53%</td>
<td>31-60</td>
<td>Degree</td>
<td>over 3 hours</td>
<td>over 3 hours</td>
</tr>
<tr>
<td></td>
<td>N=18</td>
<td>N=19</td>
<td>Degree</td>
<td>N=13</td>
<td>N=12</td>
<td>N=16</td>
</tr>
<tr>
<td></td>
<td>53%</td>
<td>53%</td>
<td>over 3 hours</td>
<td>N=33</td>
<td>over 3 hours</td>
<td>sentences</td>
</tr>
<tr>
<td></td>
<td>N=18</td>
<td>N=19</td>
<td>sentences</td>
<td>N=32</td>
<td>sentences</td>
<td>sentences</td>
</tr>
<tr>
<td></td>
<td>N=12</td>
<td>N=12</td>
<td>sentences</td>
<td>33%</td>
<td>sentences</td>
<td>sentences</td>
</tr>
<tr>
<td></td>
<td>N=24</td>
<td>N=24</td>
<td>sentences</td>
<td>24%</td>
<td>sentences</td>
<td>sentences</td>
</tr>
<tr>
<td></td>
<td>N=32</td>
<td>N=32</td>
<td>sentences</td>
<td>27%</td>
<td>sentences</td>
<td>sentences</td>
</tr>
<tr>
<td></td>
<td>N=15</td>
<td>N=15</td>
<td>sentences</td>
<td>27%</td>
<td>sentences</td>
<td>sentences</td>
</tr>
<tr>
<td></td>
<td>N=16</td>
<td>N=16</td>
<td>sentences</td>
<td>44.5%</td>
<td>sentences</td>
<td>sentences</td>
</tr>
<tr>
<td></td>
<td>N=12</td>
<td>N=12</td>
<td>sentences</td>
<td>33%</td>
<td>sentences</td>
<td>sentences</td>
</tr>
<tr>
<td></td>
<td>N=6</td>
<td>N=6</td>
<td>sentences</td>
<td>11%</td>
<td>sentences</td>
<td>sentences</td>
</tr>
</tbody>
</table>

Table 2. The demographic data of the owners of Hungarian vizslas (HV) and German shepherd dogs (GSD) unbalanced for the demographic variables

When investigating further, I matched the two breeds according to demographic variables (dogs’ sex, age group, housing conditions, training background, owner’s sex, owner’s age, owner’s educational background, the amount of time the owner spends with the
dog, the owner’s opinion about the dog’s human speech comprehension) as much as I could.

For further details see Table 3 and Table 4.

<table>
<thead>
<tr>
<th></th>
<th>Sex</th>
<th>Age</th>
<th>Educational background</th>
<th>Time spent with the dog</th>
<th>Opinion about dog’s human speech comprehension</th>
<th>Opinion about dog’s human speech comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HV</td>
<td>male</td>
<td>14-18</td>
<td>Elementary School</td>
<td>&lt;1 hour</td>
<td>N=0</td>
<td>N=0</td>
</tr>
<tr>
<td>GSD</td>
<td>N=9</td>
<td>N=20</td>
<td>N=0</td>
<td>N=0</td>
<td>N=0</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>female</td>
<td>19-30</td>
<td>High School</td>
<td>1-3 hours</td>
<td>N=18</td>
<td>N=42</td>
</tr>
<tr>
<td></td>
<td>N=27</td>
<td>N=35</td>
<td>N=18</td>
<td>N=17</td>
<td>N=42</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>31-60</td>
<td>Degree</td>
<td>over 3 hours</td>
<td>N=18</td>
<td>N=13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N=18</td>
<td>N=29</td>
<td>N=19</td>
<td>N=13</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 3. The demographic data of the owners of Hungarian vizslas (HV) and German shepherd dogs (GSD) unbalanced for the demographic variables*
<table>
<thead>
<tr>
<th>Sex</th>
<th>Age group</th>
<th>Housing conditions</th>
<th>Training background</th>
<th>Weight group</th>
</tr>
</thead>
<tbody>
<tr>
<td>HV</td>
<td>GSD</td>
<td>HV</td>
<td>GSD</td>
<td>HV</td>
</tr>
<tr>
<td>male</td>
<td>male</td>
<td>1-3 years old</td>
<td>flat</td>
<td>trained</td>
</tr>
<tr>
<td>N=20</td>
<td>N=20</td>
<td>N=16</td>
<td>N=11</td>
<td>N=18</td>
</tr>
<tr>
<td>55.5%</td>
<td>55.5%</td>
<td>44.5%</td>
<td>31%</td>
<td>50%</td>
</tr>
<tr>
<td>1-3 years old</td>
<td>N=15</td>
<td>42%</td>
<td>flat</td>
<td>trained</td>
</tr>
<tr>
<td>female</td>
<td>female</td>
<td>3.5-7 years old</td>
<td>both flat and garden</td>
<td>untrained</td>
</tr>
<tr>
<td>N=16</td>
<td>N=16</td>
<td>N=15</td>
<td>N=20</td>
<td>N=18</td>
</tr>
<tr>
<td>44.5%</td>
<td>44.5%</td>
<td>42%</td>
<td>55.5%</td>
<td>50%</td>
</tr>
<tr>
<td>7.5-17.5 years old</td>
<td>N=5</td>
<td>13.5%</td>
<td>garden</td>
<td>untrained</td>
</tr>
<tr>
<td>27.5%</td>
<td>7.5-17.5 years old</td>
<td>N=5</td>
<td>13.5%</td>
<td>N=10</td>
</tr>
</tbody>
</table>

Table 4. The demographic data of Hungarian vizslas (HV) and German shepherd dogs (GSD) balanced for the variables

3.1.2 Development of the questionnaire

The item generation process had three phases. First, a dog expert with over 25 years of experience including obedience, agility and assistance dog training with a large number of breeds and with experience in breeding Tervueren dogs, two breeders breeding German and Belgian shepherd dogs (both Tervueren and Malinois) and five dog owners with at least eight years of experience with a wide range of breeds were asked to write a list of behavioural traits of dogs on their own on a blank sheet of paper which, on the basis of their observations,
contained items like ‘brave’, ‘sensitive’, ‘aggression towards stranger’ etc. In this way, eight lists of traits were written altogether, one by the dog expert, two by the two breeders and five by the five dog owners. The eight lists contained a total number of 411 items.

In the second phase the eight lists were compared and the overlapping items were grouped. From each group the one considered to be the most concise, the most telling and the easiest to understand was retained. The selection was made by me and the collaborating expert, Márta Gácsi together. In this way, 78 items were kept.

The last phase was also carried out by me and Márta Gácsi. During this phase the remaining set of features was reconsidered, the items conveying similar meanings grouped again and the ones which we considered to capture dog personality in the most telling way were retained. After this third phase the final version of the Dog Personality Questionnaire contained 38 items with concise examples for each one with a 5-point frequency Likert scale (ranging from ‘not typical at all’ (1) to ‘absolutely typical’ (5)). Data were also collected regarding the owner’s age and educational background as well as what he/she thinks about the cognitive abilities of dogs in general. With the question “To what extent do you think your dog understands human speech?” I aimed to learn about the owner’s anthropomorphic attitude toward the dog.

3.1.3 Data analysis

Principal Component Analysis was applied to explore the factorial structure of the questionnaire scores with Varimax rotation. The internal consistency of the questionnaire was estimated by the calculation of Theta (Armor, 1974), which is a more reliable method for the calculation of scale reliability than Cronbach’s alpha (see also
Spearman’s correlation coefficient was calculated for investigating the discriminant validity of the personality factors. In order to analyse external consistency (the effect of age, gender etc.) one-way ANOVA and post hoc test was done with Tukey pairwise comparison. I calculated the factor scores of the Hungarian vizslas and the German shepherd dogs by adding their data one by one to the sample containing the data of the 352 dogs and reran the Principal Component Analysis. In order to compare the effect of training background and also to reveal whether there is a statistically significant difference between the factor scores of the personality dimensions of the Hungarian vizsla and the German shepherd dog, independent-sample t-tests were also implemented. For the statistical analysis the SPSS statistical program (version 13.0) was used. The significance level of post hoc tests was set at p<0.05.

3.2. Results

3.2.1 Investigation of internal validity

Principal Component Analysis was used to examine the factorial structure of the questionnaire scores. First, however, the median of the items was examined. Seventeen of the 38 items, of which the median was above 4 or less than 2, were excluded from further analysis (for more details see Appendix II). The remaining 21 were grouped into four factors following the guidelines drawn up by Tabachnick and Fidell (2001), that is, only those variables were retained that had 0.4 or greater loading on a particular factor. The four factors (Stranger-directed Sociability, Activity, Aggressiveness, Trainability) accounted for 44.32% of the total
variance in nearly equal portions (see Table 5.). The variables discarded either did not reach the threshold or they had high loadings on other factors. The convergent validity of all the four factors was satisfactory because all Theta values were 0.90. Usually, values above 0.7 are regarded desirable (Armor, 1974).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Stranger-directed Soc</th>
<th>Activity</th>
<th>Aggressiveness</th>
<th>Trainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brave</td>
<td>0.65</td>
<td>-0.07</td>
<td>0.15</td>
<td>0.34</td>
</tr>
<tr>
<td>Afraid of noises</td>
<td>-0.55</td>
<td>-0.07</td>
<td>0.02</td>
<td>-0.01</td>
</tr>
<tr>
<td>Mistrustful</td>
<td>-0.74</td>
<td>-0.03</td>
<td>0.27</td>
<td>-0.01</td>
</tr>
<tr>
<td>Initiative</td>
<td>0.68</td>
<td>-0.01</td>
<td>-0.04</td>
<td>-0.07</td>
</tr>
<tr>
<td>Lazy</td>
<td>0.14</td>
<td>-0.57</td>
<td>0.07</td>
<td>-0.08</td>
</tr>
<tr>
<td>Likes apporting</td>
<td>0.10</td>
<td>0.72</td>
<td>-0.10</td>
<td>0.12</td>
</tr>
<tr>
<td>Likes games of fight</td>
<td>0.01</td>
<td>0.54</td>
<td>0.09</td>
<td>0.07</td>
</tr>
<tr>
<td>Overactive</td>
<td>0.14</td>
<td>0.70</td>
<td>0.21</td>
<td>-0.12</td>
</tr>
<tr>
<td>Likely to bite a human</td>
<td>-0.07</td>
<td>-0.15</td>
<td>0.64</td>
<td>0.08</td>
</tr>
<tr>
<td>Jealous of dogs</td>
<td>0.02</td>
<td>-0.01</td>
<td>0.58</td>
<td>0.07</td>
</tr>
<tr>
<td>Hysterical</td>
<td>0.08</td>
<td>-0.05</td>
<td>0.50</td>
<td>-0.38</td>
</tr>
<tr>
<td>Barks</td>
<td>-0.24</td>
<td>0.25</td>
<td>0.58</td>
<td>-0.02</td>
</tr>
<tr>
<td>Retaliative</td>
<td>-0.05</td>
<td>0.31</td>
<td>0.56</td>
<td>-0.16</td>
</tr>
<tr>
<td>Learns things easily</td>
<td>0.20</td>
<td>0.17</td>
<td>-0.01</td>
<td>0.67</td>
</tr>
<tr>
<td>Pleases the owner</td>
<td>0.04</td>
<td>0.16</td>
<td>0.07</td>
<td>0.46</td>
</tr>
<tr>
<td>Controllable</td>
<td>-0.09</td>
<td>-0.05</td>
<td>0.04</td>
<td>0.66</td>
</tr>
<tr>
<td>Disorganised</td>
<td>-0.02</td>
<td>0.10</td>
<td>0.22</td>
<td>-0.65</td>
</tr>
<tr>
<td>Eigenvalues</td>
<td>1.91</td>
<td>1.88</td>
<td>1.87</td>
<td>1.86</td>
</tr>
<tr>
<td>Explained variance</td>
<td>11.26%</td>
<td>11.09%</td>
<td>10.99%</td>
<td>10.98%</td>
</tr>
<tr>
<td>Theta</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
</tr>
</tbody>
</table>

Table 5. Factorial Structure, loadings of items, Eigenvalues of factors, explained variance, and Theta. Note that only 55% of the original items of the questionnaire could be retained for the analysis.
In order to investigate discriminant validity, that is, whether the four factors are independent from each other I correlated the factor scores of all the four factors. Spearman’s correlation coefficient was low, suggesting only weak association among the personality dimensions (Table 6.).

<table>
<thead>
<tr>
<th></th>
<th>Activity</th>
<th>Aggressiveness</th>
<th>Trainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stranger-directed Sociability</td>
<td>-0.011</td>
<td>0.019</td>
<td>-0.026</td>
</tr>
<tr>
<td>Activity</td>
<td>-</td>
<td>-0.043</td>
<td>0.005</td>
</tr>
<tr>
<td>Aggressiveness</td>
<td>-</td>
<td>-</td>
<td>0.006</td>
</tr>
</tbody>
</table>

*Table 6. Correlations between the four personality factors (Spearman’s rho). In the present analysis the factor variables did not correlate.*

### 3.2.2 Investigation of external validity

In order to test the external validity of the questionnaire, group comparisons were planned to analyze the effect of the dogs’ age, sex, weight and training background on the scores of the four factors. The effect of the owners’ sex, age, educational background and attitude towards their dog was also examined as well as the variables regarding the dog-owner interaction. Only 7.5% of the dogs were kept in a kennel, thus this category was excluded from this analysis. For the same reason, dogs weighing over 45 kgs, owners between the age of 14 and 18 and owners finishing only Elementary School were excluded from the investigation of external validity.

In the case of Stranger-directed Sociability, I found significant association with the length of time pet and owner spent together F(3,349)=2.89 p=0.036. The more daily interaction they had, the higher the dogs were scored on this personality factor.
In the case of the *Activity*, I revealed statistically significant variation in the dogs’ activity scores \( F(2,320)=5.38 \ (p=0.005) \). The highest values appeared in young dogs (1-3 years old) somewhat decreased in mature dogs (3.5-7 years old) and were the lowest in older dogs (7.5-17.5 years old). A significant difference was also discovered between dogs belonging to different weight groups \( F(2,318)=2.89 \ (p=0.001) \). Dogs weighing under 10 kgs were reported the most active. Housing condition was found to affect activity level, that is, dogs living in flats were reported to be the most active, while those living in a yard scored lowest \( F(2, 301)=11.89 \ (p=0.001) \).

I found that dogs taking part in organized training were characterised as being more aggressive than untrained ones \( t(349)=3.90 \, \text{p}=0.001 \). Furthermore, dogs considered to understand intonations of human utterances only were rated more aggressive than the ones which were believed to understand words or sentences whereas owners considering that their dog understands quite well what people are talking about rated their dog the least aggressive \( F(3,334)=2.82 \ (p=0.022) \). Besides the effect of the training background, a statistically significant relationship was revealed between weight and aggression. Those weighing between 26-44 kgs received the highest scores on *Aggressiveness* while those between 11-25 kgs were assessed the lowest \( F(2,346)=4.48 \ (p=0.001) \).

Dogs having taken part in organised trainings also got higher scores on *Trainability* than their non-trained conspecifics \( t(349)=3.954 \, \text{p}=0.001 \), and dogs that were reported to understand human speech quite well were rated high on the factor *Trainability* \( F(3,294)=3.66 \ (p=0.003) \).
3.2.3 FCI breed group differences

The breed groups showed significant variation in *Stranger-directed Sociability* (F(10,342)=2.17 p<0.05). Surprisingly, Tukey *post hoc* analysis found terriers more sociable than mongrels (p=0.019) (Fig.1.).

*Figure 1. The means and SE of factorscores in the ten FCI breed groups and mongrels for Stranger-directed Sociability. (1) Sheep- and Cattle Dogs (2) Molossoids (3) Terriers (4) Dachshunds (5) Spitz and Primitive Types (6) Scenthounds (7) Pointing Dogs (8) Flushing- and Water Dogs (9) Companion and Toy Dogs (10) Sighthounds (11) Mongrels. Groups marked with ’b’ differ significantly from groups marked with ’a’ (p<0.05). The population means is zero.*
Regarding the Aggressiveness no statistically significant difference could be detected among the eleven groups of pet dogs (Fig. 2.).

Figure 2. The means and SE of factorscores in the ten FCI breedgroups and mongrels for Aggressiveness. (1) Sheep- and Cattle Dogs (2) Molossoids (3) Terriers (4) Dachshunds (5) Spitz and Primitive Types (6) Scenthounds (7) Pointing Dogs (8) Flushing- and Water Dogs (9) Companion and Toy Dogs (10) Sighthounds (11) Mongrels. There are no statistical differences between the breedgroups. The population means is zero.

Significant variations were found in Activity (F(10, 342)=2.41 p<0.05). Tukey post hoc test found Sheep- and Cattle dogs and Terriers more active than Sighthounds p=0.009 (Fig.3.).
Figure 3. The means and SE of factorscores in the ten FCI breedgroups and mongrels for Activity. (1) Sheep- and Cattle Dogs (2) Molossoids (3) Terriers (4) Dachshunds (5) Spitz and Primitive Types (6) Scenthounds (7) Pointing Dogs (8) Flushing- and Water Dogs (9) Companion and Toy Dogs (10) Sighthounds (11) Mongrels. Groups marked with 'b' differ significantly from groups marked with 'a' (p<0.05). The population means is zero.

Trainability showed significant variation among the breed groups (F(10,341)=2.19 p<0.05). Tukey post hoc test found Retrievers – Flushing dogs – Water dogs less trainable than mongrels p=0.018 (Fig.4.).
3.2.4 Comparison of the Hungarian vizsla and the German shepherd dog

In the case of Stranger-directed Sociability and Activity the means of factor scores in both breeds were around the population means. However, in the case of Aggressiveness, the Hungarian vizsla was found to have significantly lower scores than the German shepherd dog ($t(89)=-0.24$, $p=0.04$). I had the same finding with Trainability as well ($t(89)=-5.97$, $p=0.001$) (Fig. 5a).
Since I wanted to find out whether the difference between the two breeds in the personality dimensions *Aggressiveness* and *Trainability* was due to the different functions these two breeds were originally bred for, or the result is due to the variations in the demographic variables, I matched the data for the two breeds for as many demographic variables as possible and reran the analysis. In this case I had thirty-six dogs both in the Hungarian vizsla and the German shepherd dog sample and did not find any significant differences between the personality dimensions of the two breeds (Fig. 5b).
Figure 5. (a). The means and SE of factorscores of personality traits in Hungarian vizsla and German shepherd dog. (1) Stranger-directed Sociability, (2) Activity, (3) Aggressiveness, (4) Trainability. (b) The means and SE of factorscores in the personality traits of Hungarian vizsla and German shepherd dog based on matched groups. * indicates significant difference (p<0.05). Note the scaling difference.
In order to unveil the underlying factors causing the difference in the first analysis, I examined the potential influences of the independent variables on the factor scores of the German shepherd dog group. I found that in this breed housing condition had a statistically significant effect both on the factor *Aggressiveness* \((F(3,98)=3.73, \ p=0.02)\) and *Trainability* \((F(3,52)=3.30 \ p=0.03)\). Post hoc test revealed that dogs living in flats were rated the least aggressive while the ones living in a garden the most aggressive. Also, dogs spending most of their time both in the flat and in the garden were significantly more aggressive than those spending most of their time in the garden only. No interaction was found between any of the independent variables. In the case of *Trainability* post hoc test revealed that dogs living in flats were rated the least trainable while those which lived both in the flat and in the garden were the most trainable. No interaction was found between any of the independent variables.

### 3.3 Discussion

In this study I applied an adjective-based dog personality questionnaire developed to measure the personality factors of pet dogs. The dogs were evaluated by their owners and the primary aim of the study was to determine validity of this questionnaire. Many years of research have proven that data gathered by means of questionnaires can be accurate and consistent in evaluating individual dogs for various behavioural traits (e.g. Gosling et al., 2003; Gosling et al., 2005).
3.3.1 Internal validity

I have investigated construct validity using both internal and external validation. The PCA extracted four factors (Stranger-directed Sociability, Activity, Aggressiveness and Trainability) and subsequent analysis showed good internal consistency suggesting that each item is a relevant and important part of its scale. A correlation analysis confirmed that the factors can be regarded as unrelated dimensions of dog personality. Despite the fact that both individually only approximately 10% and in total the extracted factors explain only about 40% of the variance, all of them appear consistent with previous research on dog personality (see Gosling et al., 2003; Hsu and Serpell, 2003; Kubinyi et al., 2009; Svartberg and Forkman, 2002; Ley et al., 2008; Jones and Gosling, 2005). It is important to stress that the naming of the personality dimensions is often arbitrary, and thus any comparison on the basis of the dimension labels could be misleading. So any comparative analysis should refer also to the behaviour items which constitute those factors. Indeed, such an analysis in the present case results in surprising analogies at the level of factor labels.

Gosling et al. (2003) suggested that a four-dimensional model based on the human Big Five Inventory captures most the personality factors in dogs. ‘Energy’ is comparable to human ‘Extraversion’ comprising behaviour traits like ‘active’, ‘likes excitement’, ‘not reserved’, ‘not shy’ (Costa and McCrae, 1992) thus analogous to our Activity. ‘Affection’ the analogue of human ‘Agreeableness’, covering behaviour traits similar to the ones loading on my Trainability like ‘tender-minded’ and ‘cooperative’(Costa and McCrae, 1992), ‘Emotional Reactivity’, analogous to human ‘Neuroticism’ of which behaviour traits are ‘anxiety’, ‘angry hostility’, ‘vulnerability to stress’, ‘negative feelings’ like fear, sadness, anger and disgust (Costa and McCrae, 1992), thus very similar to our Aggressiveness and finally ‘Intelligence’, the analogue of human ‘Openness/Intellect’ of which behaviour traits correspond to my
Stranger-directed Sociability, since it includes traits like ‘curious’ ‘open to experiences’ ‘does
not mind the unfamiliar’ (Costa and McCrae, 1992). Kubinyi et al. (2009) also employed a 24-
item human personality inventory as a tool for establishing a model for dog personality
factors and, similarly to Gosling et al. (2003), extracted four factors labelled ‘Calmness’
alogous to my Activity, ‘Trainability’ similar to my Trainability, ‘Dog sociability’
corresponding to my Stranger-directed Sociability and ‘Boldness’ which again, including the
variables ‘reserved’, ‘aloof’ and ‘fearful’ parallels to my ‘brave’, ‘initiative’ and ‘mistrustful’
loading high (the last one negatively) on my Stranger-directed Sociability. Kubinyi et al.
(2009) did not distinguish a separate factor for dog aggression, which is due to the fact that
the human Big Five Inventory does not differentiate between intra- and interspecific
aggression.

Hsu and Serpell (2003) used a 152 item questionnaire which aimed to collect
information about how dogs responded to certain events and situations in their natural
environment. In this way they established 11 factors which constitute segments of broader
terms like aggression or sociability. The analysis of the factor loadings revealed that the
variables loading strongly on Hsu and Serpell’s ‘Stranger-directed fear’, ‘Nonsocial fear’ and
‘Pain sensitivity’ are analogous to the ones having high loadings on my ‘Stranger-directed
Sociability’, since their variables loading strongly on their factors describe the dogs’ anxious
and fearful behaviour when being in interaction with humans or being exposed to different
noises. Similarly, the items loading high on their ‘Stranger-directed aggression’, ‘Owner-
directed aggression’, ‘Dog-directed fear or aggression’, ‘Separation-related behaviour’ and
‘Excitability’ correspond to the ones loading high on my Aggressiveness. Finally, their
‘Attachment or attention-seeking behaviour’ and ‘Trainability’ together capture what I call
Trainability. However, Hsu and Serpell (2003) did not extract any factors describing the
activity level of dogs simply because no variables were included measuring this factor.
Svartberg and Forkman (2002) revealed five personality factors on the basis of their behavioural test battery. It seems that their ‘Playfulness’ and ‘Chase-proneness’ correspond to my *Activity*, and ‘Curiosity/Fearlessness’ and ‘Sociability’ is similar to my *Stranger-directed Sociability*. Finally, ‘Aggressiveness’ is analogous to my *Aggressiveness*. However, no factor was extracted which corresponds to my ‘Trainability’ trait probably because they did not include a sub-test which may have provided a context for measuring trainability.

Ley et al. (2008) used a 67 item questionnaire containing dog specific adjectives and established five personality factors. Their ‘Extraversion’ corresponds to my *Activity*, which analogue could be detected in the study of Gosling (2003) as well. ‘Self-assuredness/Motivation’ and ‘Training Focus’ is analogous to my *Trainability*. The variables loading strongly on their ‘Amicability’ capture a similar construct as my *Aggressiveness*, however, with adjectives expressing the opposite of those my *Aggressiveness* comprises. Their ‘Neuroticism’ including the items ‘nervous’, ‘fearful’, ‘timid’, ‘cautious’, ‘submissive’ and ‘sensitive’ is the converse of my *Stranger-directed Sociability* including terms ‘brave’ and ‘initiative’ with positive while ‘afraid of noises’ and ‘mistrustful’ with negative loadings.

Jones and Gosling (2005) conducted a meta-analysis on a great number of empirical studies on the basis of which seven personality dimensions were extrapolated: ‘reactivity’, ‘fearfulness’, ‘activity’, ‘sociability’, ‘responsiveness to training’, ‘submissiveness’ and ‘aggression’. My four dimensions fit well into their framework and even the labels of their factors ‘activity’, ‘sociability’, ‘responsiveness to training’ and ‘aggression’ are almost the same as mine. Although I did not identify ‘reactivity’, ‘fearfulness’ and ‘submissiveness’ as a distinct dimension, some items in my *Aggressiveness* like ‘jealous of dogs’ or ‘hysterical’ are reactivity-related, ‘brave’ and ‘afraid of noises’ on my *Stranger-directed Sociability* are fearlessness-related, and the question whether activity and submission should be considered a separate personality factor or not has not yet been answered (Gosling and John, 1999; Jones
and Gosling, 2005). The reason why ‘reactivity’, ‘fearfulness’ and ‘submissiveness’ were established as independent dimensions by these authors may lie in the fact that their review merged the results of test batteries, questionnaire studies, expert ratings of breeds and observational tests but not by doing statistical analysis based on correlations but by item classification made by a panel of expert judges (Jones and Gosling, 2005). As the authors noted themselves, their results may have been influenced by the idiosyncrasy of the collaborating judges (Jones and Gosling, 2005).

In summary, I can say that previous personality studies regardless of methodology, although limited by their structure in identifying certain personality dimensions, established factors analogous to my personality factors. It suggests that my study is most likely to be a valid representation of personality factors in dogs, that is, the questionnaire items loading high on my factors were properly chosen to capture the personality traits of dogs, and hint that the established factors must be evolutionary stable facets of dog personality. Nevertheless, the large number of papers published on dog personality recently relying on diverse methodology (even if using questionnaires) call for a more standardised application before more specific hypotheses could be formulated.

3.3.2 External validity

When analysing the potential associations between the demographic variables and the factor scores the dogs had on each personality dimension I found that the more daily interaction dog and owner had, the higher the dogs were scored on my factor Stranger-directed Sociability. In previous experiments significant association was revealed between dogs’ friendliness with strangers and the time ratio a dog spent with its owner a day in active
interaction. For example, Kubinyi et al. (2009) found that more frequent playing with the dog was related to higher scores on the “sociability” scale. Kobelt et al. (2003) found that excitability correlated negatively with dog-owner interaction. Since the Stranger-directed Sociability in this study is characterised by items which are the opposite of excitability, there is a reliable agreement between my results and those highlighted by Kobelt et al. (2003).

In my study the level of activity decreased with age. In former studies, the decline of activity with age was found using questionnaires (Bain et al., 2001; Vas et al., 2007) and behavioural observations (Head et al., 1997; Siwak et al., 2001). In addition, Kubinyi et al. (2009) found that dogs less than 2.5-year-old were the least calm and the calmest dogs were over 6.9 years of age. Ley (2009) also examined the changes in activity level in dogs belonging to different age groups and came to the same conclusion.

Housing condition was found to affect activity level, that is, dogs living in flats were reported to be the most active, while those living in a yard scored lowest on this factor. Although, to my knowledge, no study unveiled the effect of housing condition on the activity level of dogs, it is common assumption that smaller dogs, kept more typically in flats, may appear to be more active.

I found that dogs taking part in organized training were characterized more aggressive than untrained ones. In line with my result Roll and Unshelm (1997) concluded, that the dog’s training background as well as the owner’s attitude towards obedience training has, among other factors, a notable impact on the dog’s aggressive behaviour. Besides that, owners lacking strong attachment to the dog may attribute more aggression to their pet. Owners believing that organized training is essential to avoid losing control over the dog had more aggressive dogs than those who thought that training should either be fun or is not relevant at all. It must be noted, however, that in spite of the fact that my findings are in harmony with that of Roll and Unshelm (1997), I suggest that one should be careful with interpreting the
results solely from this angle because this does not necessarily reflect a causal relationship. It is also possible that dogs behaving aggressively are taken to dog training schools in order to get their behaviour corrected or changed. Furthermore, robust dogs kept for the purpose of guarding are represented in great numbers in dog training schools while small ones are not typically taken there. Moreover, aggressive acts like an attempt to bite a human are usually not taken seriously in the case of small dogs (Duffy, 2008). For these reasons, in further research, a question like “Why have you taken your dog to a dog training school?” should be included in questionnaires.

Podberscek and Serpell (1997) as well as Hsu and Sun (2010) found that those dogs that spent a lot of time with their owners were rated less aggressive compared to those which spent little time with them. Although I did not include a question like “To what extent are you attached to your dog?” to our view, the question, “To what extent do you think your dog understands human speech?” may provide some reflection on the nature of the relationship between owner and pet. Dogs considered understanding words only were rated more aggressive than the ones which were believed to understand sentences. Owners considering that their dog understands quite well what people are talking about rated their dog the least aggressive. However, the latter case could also be explained by the attitude of these people towards their pet, that is, the stronger anthropomorphic attitude they reflect, the less aggressive they perceive their dog’s behaviour.

Not surprisingly, dogs having taken part in organised training got higher scores for Trainability than their non-trained conspecifics. Furthermore, the greater extent the dog was reported to be able to understand human speech the higher it was scored on the factor Trainability. In line with my results Kubinyi et al. (2009) found that previous training experience with dogs as well as frequent playing with the owner correlated with higher trainability. These factors should be taken into account when dog-breeds are compared in
relation to trainability by means of questionnaires. It is also possible that more anthropomorphic humans perceive their pet differently from those who lack this kind of attitude. For these reasons I suggest that further studies should pay attention to the underlying factors having a potential impact on humans’ perceptions concerning their pet.

3.3.3 FCI breed group differences

Very few studies have explored the differences in the behavioural tendencies observed in different breed groups (e.g. Jones and Gosling, 2005; Svartberg, 2006; Ley, 2009) which are considered to be remnants from past selection determined by the original purpose of breeding (e.g. Hart and Miller, 1985; Scott and Fuller, 1965). The FCI classification I applied is based partly on similarities among breeds regarding their original function.

The fact that Terriers were found to score highest on Stranger-directed Sociability of all the breed groups may come as a surprise. The reason for this may root in the way the owners in this study perceived these dogs. Two third of them declared that their dog understands fluent human speech or whole sentences while only one third claimed that their dog can grasp words or intonations only. Terriers are becoming more and more popular as family dogs, and this tendency in Hungary may account for the results obtained. Since in my sample only 29 dogs represented the Terrier breed group, a bigger sample size may have provided a more balanced picture.

There were also significant differences between Terriers, mongrels and Sheep- and Cattle Dogs in Activity. Sheep- and Cattle Dogs were found to be the most active while Terriers scored somewhat lower than Sheep- and Cattle Dogs and Sighthounds got the lowest scores. In the case of Trainability Retrievers – Flushing Dogs – Water Dogs were scored
lower than mongrels. This result may not be in harmony with the general view that Golden and Labrador retrievers are among the most trainable breeds (e.g. Serpell and Hsu, 2005). If I consider, however, that spaniels are also part of this breed-group and, for example, the English Cocker Spaniel (which comprise nearly one-third of our sample) is prone to show problem behaviours (e.g. Amat et al., 2010) my result may not come as a surprise. In parallel more and more attention (and increased empathy) is being paid to mixed-breed dogs. Until the early 1980s mongrels were typically excluded from obedience competitions. By now, a number of opportunities have opened up for them and they have proved to excel even at dog sports like agility, flyball and frisbee. Moreover, 77% of Labrador and Golden retrievers in the present sample were not trained at all which, as has been discussed above, may have affected the way the owners scored their pet. As far as Aggressiveness is concerned, no significant variation could be observed between breeds.

Considering that with the addition of a separate mixed breed category eleven groups were compared, the number of the statistically different groups is low. The lack of the detectable differences, however, is in harmony with the findings of Svartberg (2006). He found also that there was little correspondence between the breed groups and their historical origin and function (Svartberg, 2006). The reason for this phenomenon may root in the overwhelming cultural changes modern Western countries went through in the past few decades. During this period dogs’ practical functions have started to diminish because in most households dogs have been kept as companion animals. The changes in recent selection may have altered breed-specific behaviour as well (Svartberg, 2006). The other possible explanation for the similar outcomes of the two investigations, however, is that the effect of the demographic variables in both samples overshadowed the otherwise existing differences. Moreover, the owners who provided information in the investigations on voluntary basis must have been interested in issues regarding dogs. For this reason, the samples in the two studies
might not represent the general dog population. Whatever factors lie behind the results of the two studies, the correspondence between them is undeniable and should serve as a basis for triggering further investigations.

3.3.4 Differences between Hungarian vizslas and German shepherd dogs

In the first comparative analysis the Hungarian vizslas and the German shepherd dogs showed that in the case of Stranger-directed Sociability and Activity the mean scores for both breeds were around the population means, but in the case of Aggressiveness the Hungarian vizsla obtained significantly lower scores than the German shepherd dog. The same applied to Trainability.

However, further analysis of the matched samples showed that this was the result of environmental differences. The underlying factor found to cause the difference in the first sample of the German shepherd dog was housing condition, influencing both Aggressiveness and Trainability. Dogs living in a flat were found to be the least trainable, the ones living in the garden slightly more trainable while the ones which spent most of their lives both in the house and in the garden the most trainable. Similarly, dogs living in flats were scored the least aggressive and the ones living in a garden were assessed the most aggressive. These findings are in harmony with previous results, that is, the more time a dog spent together with the owner the less aggressive it was reported to be (Hsu and Sun, 2010). However, the result must be interpreted with caution. It is quite evident that dogs spending most of their lives in a flat have the greatest amount of daily interaction with their owner and this might be the reason why they are rated the lowest on Aggressiveness, while those which spent most of their time in the garden guarding the house and reacting to the passing people with barking the most
aggressive. The other possible explanation is that the group of dogs living in flats may serve as companion animals, as a result, their owner do not find them aggressive. In parallel, there may be fewer stimuli in a flat which could provoke signs of aggression like barking and threatening behaviour towards strangers walking in the street. Further research is necessary to find out how housing condition affects dogs’ aggression and/or the owners’ perception of their dog’s aggression.

German shepherd dogs living in flats may not be able to do as much physical exercise as they need, which may bring about some restless behaviour and other unwanted actions. In the present research Trainability is characterised by learning things easily, pleasing the owner, being controllable and not disorganised. It is common assumption that dogs which are confined in a relatively small place perform extra activities, such as tearing different things apart like slippers etc., in consequence, are not considered controllable and organised, and do not make the impression that they learn things easily, that is, follow the instructions of the owners. Owners may not feel that their pet does what they want them to do, thus also rate on the variable ‘pleases the owner’ lower. In addition, owners living in flats only bought their dog to have a companion animal and even if these owners try to teach their pet some exercises to perform, they might not know how to handle a dog in a proper way. Probably this is the reason why these dogs score low on this factor. Further research is necessary to unveil the correlation, if there is any, between the owner’s competence in handling dogs and the ratings given to their dog on the variables constituting the factor Trainability.

Dogs living in the garden only may be kept solely for the purpose of guarding the house, which task does not require special training background. The fact that they are not allowed into the house may reflect the lack of strong emotional bonds between human and pet. This may be a reason why, they are not rated high on the items constituting Trainability. In contrast the fact that owners let their relatively big dog go into the house suggests a strong
emotional bond between owner and pet. Being allowed into the house also implies non-destructive, controllable behaviour which may explain the high scores on the variables ‘learning things easily’, ‘pleasing the owner’, ‘being controllable’ and ‘not disorganised’.

These results also warn against the uncritical use of breed comparisons based on experts’ opinion. Breed differences, even if they show cross-nation similarities may rather reflect a combination of genetic and environmental factors than breed-specific (genetic) effects per se (see also Bradshaw et al., 1996; Notari and Goodwin, 2007).

4. Study II

4.1 Subjects and Methods

4.1.1 Experient 1: The comparison of the questionnaire study and behaviour coding

4.1.1.1 Subjects

I collected the video recording of the FIDO Personality test (Brúder et al., manuscript) of 100 dogs and asked the owners to fill in the Dog Personality Questionnaire (Mirkó et al., 2012). In this way I obtained both the video recordings of the test battery and the completed questionnaires of the 100 dogs. The protocol of the FIDO Personality test is described in Appendix III. The dogs and their owners were recruited on voluntary basis to participate in the Family Dog Research Programme of the Department of Ethology, Eötvös Loránd
University. The sample comprised 27 breeds registered in the FCI (Fédération Cynologique Internationale) breed groups and six mongrels, for further details see Appendix IV. The sample consisted of 42 males, 48 females, 4 neutered males and 6 neutered females. The mean age was 3 years (SD=2.00) Thirty-seven dogs took part in organized obedience trained, sixty-three did not.

4.1.1.2 Procedure

The behavioural tests were carried out in Budapest, in the park next to the building of Eötvös Loránd University, at a holiday camp for dogs and their owners in Dombrád, Hungary, at a festival organized for owners of beagles in Tatabánya, Hungary and in Debrecen, Hungary. The behavioural tests were conducted by three female students, including me, and a researcher working for the Department of Ethology at Eötvös Loránd University. Prior to conducting the test batteries, pilot tests were carried out by which all the experimenters were trained on over 20 dogs how to carry out the FIDO test until the analysis of the video recordings showed that all of them conducted it meticulously according to the protocol. The 20 dogs the experimenters practised on were not included in the present study. The subjects were tested individually with no other dogs nearby. Three participants, the dog, the owner and the experimenter took part in the tests. The behaviour of the dogs was recorded from the side by a camerawoman from a distance of about 8 metres.
Collecting ratings by means of the questionnaire

Before the behaviour test, each owner was asked to fill in the Dog Personality Questionnaire (DPQ) described in Study I (Mirkó et al., 2012). On the basis of the questionnaire, I established four personality factors which included the following adjectives: 

**Stranger-directed Sociability**: brave, not afraid of noises, not mistrustful, initiative; 

**Activity**: not lazy, likes fetching balls, likes games of fight, overactive; 

**Aggressiveness**: likely to bite a human, jealous of dogs, hysterical, shows a tendency to bark, retaliative; 

**Trainability**: learns things easily, likes pleasing the owner, controllable, not disorganised.

Statistical analysis showed good internal and external consistency of these factors and correlation analysis confirmed that they were unrelated dimensions of dog personality (Mirkó et al., 2012).

Behaviour coding via video recordings

The videotapes of the test batteries were coded with Solomon Coder beta 30 June 2011 (Copy right András Péter http://solomoncoder.com). The behaviour coding was done by me. Twenty per cent of the videos (N=20) were also coded by a second observer. Inter-observer reliability was determined by computing Cohen’s Kappa coefficients between the two observers. The reliability can be considered very good as Cohen’s Kappa ranged from 0.78-1.0. Table 7. shows the coded behaviour variables hypothesized to measure the same constructs as the adjective items (see above) loading high on the personality dimensions identified by my DPQ.
### Personality Factors and loading questionnaire items

#### Stranger-directed Sociability
- Brave (+)
- Afraid of noises (-)
- Mistrustful (-)
- Initiative (+)

#### Activity
- Lazy (-)
- Likes fetching balls (+)
- Likes games of fight (+)
- Overactive (+)

#### Aggressiveness
- Likely to bite a human (+)
- Hysterical (+)
- Shows a tendency to bark (+)

#### Trainability
- Learns things easily (+)
- Pleases the owner (+)
- Controllable (+)
- Disorganised (-)

#### The tests and the scoring of the coded variables

<table>
<thead>
<tr>
<th>Test 2. Greeting</th>
<th>Latency of approaching the experimenter</th>
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<tbody>
<tr>
<td>0: not approaching; 1: approaches when being called; 2: approaches in 3 seconds after the experimenter stood in front of the dog; 3: approaches immediately</td>
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<tr>
<th>Test 6. Playing with the experimenter</th>
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<tr>
<td>The duration of playing with the experimenter (s)</td>
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<tr>
<th>Test 13. Sudden appearance</th>
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<tr>
<td>0: no reaction; 1: moves the head backwards; 2: steps back; 3: runs away</td>
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<tr>
<th>Test 1. Spontaneous activity</th>
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<tr>
<td>The duration of moving the legs (s)</td>
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<th>Test 8. Playing with the owner</th>
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<tr>
<td>The duration of playing with the owner (s)</td>
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<tr>
<th>Test 9. Ball-playing with the owner</th>
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<tbody>
<tr>
<td>The duration of running after the ball (s)</td>
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<tr>
<td>The duration of keeping the ball in the mouth (s)</td>
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<tr>
<th>Test 3. Getting DNA sample</th>
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<tr>
<td>Latency of getting the DNA sample</td>
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<tr>
<td>0: sample cannot be taken; 1: 10-60s; 2: &lt;10s; 3: immediately</td>
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<tr>
<th>Test 11. Bone take-away test</th>
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<tr>
<td>0: no aggressive reaction; 1: growling; 2: biting the artificial hand; 3: trying to attack the experimenter</td>
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<th>Test 12. Threatening approach</th>
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<tr>
<td>0: interrupting eye contact and/or moving away; 1: growling; 2: barking; 3: straining the leash in order to attack</td>
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<th>Test 4. Attention test</th>
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<tr>
<td>The duration of orienting the swinging sausage (s)</td>
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<th>Test 10. Problem-solving test</th>
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<tr>
<td>Latency of obtaining the piece of meat</td>
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<tr>
<td>0: meat is not obtained; 1: 10-60s; 2: &lt;10s; 3: immediately</td>
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<th>Test 14. Laying down to the side</th>
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<tr>
<td>Latency of making the dog lie down</td>
</tr>
<tr>
<td>0: dog does not lie down; 1: 10-60s; 2: &lt;10s; 3: immediately</td>
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</table>
Table 7. The table shows the personality factors obtained by Mirkó et al. (2012) and respective items (left column) and the corresponding subtests of the FIDO Personality test with the coded behaviour variables. (-) and (+) indicates that the specific item has a negative/positive loading on the factor. For the statistical analysis duration data were re-calculated as % of time.

4.1.1.3 Hypothesised correspondences between subjective rating by the owner and behavioural coding

As has been mentioned above, in Experiment 1 I wanted to establish association between subjective rating and behavioural coding. Based on preliminary experience and literature survey (see for example, Svartberg, 2005), I made some specific predictions with regard to these associations.

*Stranger-directed Sociability* consists of the questionnaire items: ‘brave’, ‘not afraid of noises’, ‘not mistrustful with unfamiliar humans’ and ‘initiative’. I assumed correlation between the dog’s reaction (moves the head backwards; steps back; runs away) to the suddenly unfolding umbrella opened by the experimenter and the owner’s report regarding the traits ‘brave’ and ‘not afraid of noises’, because the sudden appearance of the umbrella (Sudden appearance test) was hypothesised to provide a strong visual stimulus supposed to frighten a dog and its opening was also accompanied by a noise (Svartberg, 2005). The traits ‘initiative’ and ‘not mistrustful with unfamiliar humans’ were assumed to show association with the latency of approaching the experimenter (‘stranger’) in the Greeting test and the duration of playing with the experimenter. Both of these traits and test battery variables were supposed to be related to dogs’ contact seeking behaviour towards unfamiliar humans (see „social impulsivity” in Héjjas et al., 2009).
The personality factor *Activity* consists of the following questionnaire items: not lazy, likes fetching balls, likes games of fight, overactive. On the basis of previous findings (e.g. Vas et al., 2007) my hypothesis was that the trait 'overactive' and 'not lazy' will correlate with the activity level of the dog observed in the Spontaneous activity test. I also supposed positive association between the trait 'likes fetching balls' and the duration of 'following the ball' and 'keeping the ball in the mouth' (Ball-playing with the owner).

The personality factor *Aggressiveness* consists of ‘likely to bite a human’, ‘jealous of dogs’, ‘hysterical’, ‘shows a tendency to bark’ and ‘retaliative’. The questionnaire items ‘jealous of dogs’ and ‘retaliative’ were excluded from the analysis, since the FIDO test did not involve any tests on the basis of which these traits could be rated.

The questionnaire items ‘likely to bite a human’ was assumed to correlate with the responses of the dogs in all the three tests in which I examined the animals’ potential aggressive behaviour in the following three subtests: Getting DNA sample, Bone take-away test and Threatening approach. When getting the DNA sample, the experimenter puts her hand into the mouth of the dog and buccal cell tissue is scraped from the gum and cheek surfaces. This process may trigger ambiguity and/or fear in dogs. Since a number of authors reported convergence between fear and aggression (e.g. Guy et al., 2001abc; Overall, 2001; O'Sullivan et al., 2008) I also expected positive association between the owners’ report and the dogs’ reactions.

Food guarding behaviour can also manifest in aggressive tendencies in a dog when the experimenter is trying to get the bone in the Bone take-away test (Coppinger and Coppinger, 2001). Finally, based on the results of Vas et al. (2008), the Threatening approach test was also thought to evoke aggressive behaviour in the subjects.

I presumed convergence between the trait ‘hysterical’ and the dogs’ behaviour during getting the DNA sample. I assumed that in the case of those dogs that were scored high on
this trait the process of getting the sample will last longer, because moving the wiper in the animals’ mouth may cause them distress. Finally, on the basis of the study by Pongrácz (2010), the trait ‘shows a tendency to bark’ was expected to correlate with the dogs’ behaviour in all the three subtests: Bone take-away test, Threatening approach and Getting DNA sample.

Trainability was characterised by the phrases ‘learns things easily’, ‘pleases the owner’, ‘controllable’ and ‘not disorganised’. I presumed that if a dog is scored high by the owner on the trait ‘learns things easily’, it may have a short latency of obtaining the piece of meat in the Problem-solving test. I also supposed positive association between the trait ‘pleases the owner’ and the duration of playing interaction in the Ball-playing with the owner test, since in the test situation it was the owner’s task to initiate play with the dog. Thus those dogs that were scored high on this trait were expected to play with the owner for a long period of time. Previous results suggest that the owner’s success in laying down a dog on the side is related to the ability of the owner to enforce his or her will on the dog. (Netto and Planta, 1997; Rooney and Bradshaw, 2002, 2003). For this reason, the trait ‘controllable’ was hypothesised to correlate (negatively) with the latency of the owner’s success to make the dog lie down (Lying down on the side test). Finally, as regards the questionnaire item ‘not disorganised’ positive association was assumed with the duration of watching the swinging sausage in the Attention test.

4.1.2. Experiment 2: The comparison of the owners’ subjective ratings and the video-based assessments using the DPQ

4.1.2.1 Subjects
As has been described above, I had both the video recordings of the FIDO Personality test and the DPQ completed by the owners of 100 dogs. Of these, I used the data of 33 beagles to compare the owners’ subjective ratings and the video-based subjective ratings of naïve observers. I chose to use this breed, because it represented the biggest pure-breed subgroup in my sample and it was considered important that raters should assess dogs belonging to the same breed-group so that any bias regarding breed typical stereotypes could be prevented. The sample comprised 18 males, 13 females and 2 neutered females. The mean age was 3.8 years (SD=2.28). Eight dogs took part in organized obedience training, twenty-five did not.

4.1.2.2 Procedure

The recorded personality tests of the thirty-three beagles were shown to three groups of observers with three different levels of hands-on experience with dogs. The first group of raters comprised 33 dog trainers whom I called ‘trainers of non-included dogs’ the second one 33 owners of family dogs, whom I called ‘owners of non-included dogs’, while in group three there were 33 observers who had never kept a dog before, they were termed ‘non-owners’. Working with as many observers as possible reduces measurement error because the errors due to the systematic idiosyncracies of an observer can be eliminated (Block, 1961) and the effect of pseudoreplication can be avoided (Kroodsma et al., 2001). For this reason, all the raters saw only one dog’s FIDO Personality test and on the basis of that filled in the Dog Personality Questionnaire. Each dog was assigned randomly to each rater. None of the raters knew any of the dogs and any of the owners and they did not know each other either so that no information could be exchanged about any of the target dogs or the behaviour test itself.
Each rater saw the video clip of the behaviour test in a room alone and only once, and then filled in the questionnaire right after seeing the recording. In this way, together with the owners’ reports, 4 different assessments of each dog were made.

4.1.3 Data analysis

I used SPSS 13.00 for the statistical analyses.

Experiment 1. The distribution of the questionnaire items and that of the behaviour coding was examined with the Shapiro-Wilk test. Since some of the items of the behaviour variables were not normally distributed, Spearman correlation was applied to investigate the associations between the corresponding variables of the personality dimensions and the behaviour coding (see above).

Experiment 2. The questionnaire variables ‘jealous of dogs’ and ‘realtiative’ on the factor Aggressiveness were excluded from the analysis, because the FIDO test did not involve any tests on the basis of which these traits could be rated. To compare owners’ reports and the assessments of each rater group with regard to each factor, the data was analysed with one-way ANOVA and post hoc test was done with Dunnett’s pairwise comparison. Spearman correlation was used to investigate the associations between the four sets of assessments given by owners, trainers of non-included dogs, owners of non-included dogs and non-owners.

4.2 Results

4.2.1 Experiment 1: The association between the owners’ subjective rating and behaviour coding
The four factors established in Study I (Mirkó et al., 2012) were examined one by one according to the predicted associations described above.

In the case of *Stranger-directed Sociability* the owners’ rating on the item ’not afraid of noises’ did not correlate with any of the variables describing the dogs’ reactions to the suddenly opening umbrella.

Correlation was found between the questionnaire item ’initiative’ and ’latency of approaching the experimenter’ (r = -0.25, p < 0.01) and the ’duration of playing with the experimenter’ (r = 0.24, p < 0.01). The questionnaire item ’not mistrustful with unfamiliar humans’ correlated negatively with the personality test variable ’latency of approaching the experimenter’ (r = -0.27, p < 0.01).

In the case of the factor *Activity* no correlation was found between the owner’s report and the behaviour of dogs displayed in the Spontaneous activity phase of the test battery. Relatively strong correlation was revealed between the questionnaire item ’likes fetching balls’ and the ’duration of following the ball’ (r = 0.47, p < 0.001). The personality test variable ’duration of keeping the ball in the mouth’ correlated with the questionnaire items ’likes tug of war’ (r = 0.25, p < 0.01) as well as with ’likes fetching balls’ (r = 0.39, p < 0.001). The personality test variable ’duration of playing with the owner’ correlated with the questionnaire items ’likes tug of war’ (r = 0.27, p < 0.01) and with ’likes fetching balls’ (r = 0.43, p < 0.001).

As regards the factor *Aggressiveness*, the questionnaire item ’shows a tendency to bark’ correlated with the dogs’ aggressive reactions (growl, bite, attack) in the bone take-away subtest (r = 0.25, p < 0.01) and with the ’latency of getting the DNA sample’ (r = 0.30, p < 0.001). No further correlations could be highlighted. With the factor *Trainability*, no correlation could be detected between any of the questionnaire items and the hypothetically corresponding test battery variables. For the correlation matrix see Table 8.
Table 8. Summary table for Spearman’s correlations (N=100) of the FIDO test variables and the questionnaire (DPQ) items loading on the factors Stranger-directed Sociability, Activity, Aggressiveness and Trainability (for details see Results). We tested only for the predicted associations and all the other cells in the table were left blank intentionally. Significant correlations are shown in bold. (-) indicates that the item scores were reversed for analysis.

4.2.2 Experiment 2: The comparison of the owners’ ratings and the video-based ratings done by humans with different levels of experience with dogs.
First, in the case of each factor, I compared the degrees of ratings done by the owners and by the three rater groups with different levels of hands-on experience with dogs. I found no difference in the case of Stranger-directed Sociability, Activity and Trainability (F(3,128)=1.17, p=0.17; F(3,128)=0.99, p=0.4; F(3,128)=1.6, p=0.18 respectively). However, there was a significant variability in judging Aggressiveness (F(3,128)=2.86, p=0.04). Dunnett’s post hoc comparisons showed that all the three video-based rater groups characterised the dogs to have more aggressive tendencies (p<0.05) than the dogs’ owners (Figure 6).

Figure 6. The means of the questionnaire scores (+SE) of the personality factors (Stranger-directed Sociability; Activity; Aggressiveness; Trainability) given by different types of raters (Owner, Trainers of non-included dogs, Owners of non-included dogs, Non-owners) watching a single dog out of N=33 (post hoc test, p < 0.05). * denotes that the group of owners differs significantly from all the other groups in the case of Aggressiveness
In the case of *Stranger-directed Sociability, Activity* and *Aggressiveness* the owner’s report correlated with the assessments of all the three rater groups and the assessments of the rater groups correlated with each other as well. As regards *Trainability*, the owners’ report did not correlate with the assessments of any of the rater groups, but the assessments of all the rater groups correlated with each other. For the correlation matrix see Table 9.

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<tr>
<th></th>
<th>Stranger-directed Sociability</th>
<th>Activity</th>
<th>Aggressiveness</th>
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<tbody>
<tr>
<td></td>
<td>Owner</td>
<td>Owners of non-included dogs</td>
<td>Non-owners</td>
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<tr>
<td>Trainers of non-included dogs</td>
<td>0.66 (p&lt;0.01)</td>
<td>0.59 (p&lt;0.001)</td>
<td>0.57 (p&lt;0.001)</td>
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<tr>
<td>Owners of non-included dogs</td>
<td>0.72 (p&lt;0.01)</td>
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<td>0.79 (p&lt;0.001)</td>
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<tr>
<td>Non-owners</td>
<td>0.50 (p&lt;0.01)</td>
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<th></th>
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<th>Activity</th>
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<tr>
<td></td>
<td>Owner</td>
<td>Owners of non-included dogs</td>
<td>Non-owners</td>
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<tr>
<td>Trainers of non-included dogs</td>
<td>0.83 (p&lt;0.001)</td>
<td>0.58 (p&lt;0.001)</td>
<td>0.59 (p&lt;0.001)</td>
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<tr>
<td>Owners of non-included dogs</td>
<td>0.60 (p&lt;0.001)</td>
<td>-</td>
<td>0.97 (p&lt;0.001)</td>
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<tr>
<td>Non-owners</td>
<td>0.57 (p&lt;0.001)</td>
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<th>Stranger-directed Sociability</th>
<th>Activity</th>
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<tr>
<td></td>
<td>Owner</td>
<td>Owners of non-included dogs</td>
<td>Non-owners</td>
</tr>
<tr>
<td>Trainers of non-included dogs</td>
<td>0.60 (p&lt;0.001)</td>
<td>0.85 (p&lt;0.001)</td>
<td>0.79 (p&lt;0.001)</td>
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<tr>
<td>Owners of non-included dogs</td>
<td>0.48 (p&lt;0.01)</td>
<td>-</td>
<td>0.95 (p&lt;0.001)</td>
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<tr>
<td>Non-owners</td>
<td>0.41 (p=0.02)</td>
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<th>Stranger-directed Sociability</th>
<th>Activity</th>
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<tr>
<td></td>
<td>Owner</td>
<td>Owners of non-included dogs</td>
<td>Non-owners</td>
</tr>
<tr>
<td>Trainers of non-included dogs</td>
<td>0.18 (p=0.31)</td>
<td>0.38 (p=0.03)</td>
<td>0.51 (p&lt;0.001)</td>
</tr>
<tr>
<td>Owners of non-included dogs</td>
<td>0.15 (p=0.40)</td>
<td>-</td>
<td>0.86 (p&lt;0.001)</td>
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<tr>
<td>Non-owners</td>
<td>0.25 (p=0.16)</td>
<td>-</td>
<td>-</td>
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</table>
Table 9. Spearman’s correlations between different raters (Trainers of non-included dogs, Owners of non-included dogs, Non-owners) and owners’ scores (p<0.05). Raters provided their scores for the personality traits Stranger-directed Sociability, Activity, Aggressiveness, and Trainability after watching a short video record of the FIDO test (see text and Appendix III). Within a group of raters each person viewed a different dog on video. Significant correlations are shown in bold.

4.3 Discussion

4.3.1 Association between owners’ subjective rating and behaviour coding

The first aim of Study II was to compare subjective rating and behaviour coding focusing on the personality dimensions of individual dogs.

In the personality factor *Stranger-directed Sociability*, the trait ‘initiative’ was defined as „Initiates contact with unfamiliar humans, when he fails to make the owner tender him/her, he/she tries to do the same with a nearby unfamiliar human.” The dogs’ behaviour in the FIDO test regarding contact seeking with the unfamiliar experimenter is in line with the owners’ report, since the higher a dog was rated on the questionnaire item ‘initiative’, the shorter the latency of approaching the experimenter was in the Greeting test. In a similar vein, those dogs who were scored high on ‘initiative’ also played more with the experimenter. These findings, in line with the investigations of Svartberg and Forkman (2002) suggest that the latency of approaching an unfamiliar human and the time ratio a dog spends playing with an unfamiliar experimenter in a test situation can provide reliable information about a dog’s
behavioural profile concerning its attitude towards unacquainted humans in a non-threatening situation.

Despite my hypothesis, the dogs’ reaction to the suddenly opening umbrella was not found to be associated with the questionnaire items ‘not afraid of noises’ and ‘brave’. The lack of association could be due to the fact that the visual stimulus the umbrella provided was far more dominant than the loudness of the noise the opening umbrella made. In the Dog Personality Questionnaire (Mirkó et al., 2012) ‘brave’ was defined as ‘He/She does not get frightened easily by different objects, animals or humans, is confident even in new environments.’ This may explain why there was a lack of association. The opening of the umbrella was a quick and unexpected event even confident animals might get frightened by. In other words, as Vazire et al. (2007) put it, behaviour codings are very sensitive to the situational variation in an animal’s behaviour, while a human observer, for example, an owner is able to discount the situational influences on a dog’s behaviour when rating the animal.

The factor Activity consists of the items ‘overactive’ (He/She is quite lively, moving about in all circumstances, not preferring sitting or lying for long), ‘not lazy’ (Often lies down), ‘likes games of fight’ and ‘likes fetching balls’. Despite my hypothesis (based on Vas et al., 2007) and more recent positive findings by the means of the FIDO test (Kubinyi et al., 2012) I did not find activity-related correlation between the Dog Personality Questionnaire and behaviour scoring. The lack of association could be due to the fact that in the Spontaneous activity phase the dogs were held on their leash for 60 seconds at an unfamiliar test scene. Diverio et al. (2008) pointed out that in novel places dogs are more cautious and less self-confident than in their own territory. Besides that, during the test, the animals were only observed for a relatively short time and not ‘for long’, as can be read in the definition of the questionnaire item.
As regards the questionnaire item 'likes fetching balls' defined as „Likes ball games very much”, moderate correlation was found with both test battery variables 'the duration of running after the ball' and 'the duration of keeping the ball in the mouth'. Thus dogs’ preference for ball games can be predicted on the basis of their performance during a ball game in a test situation. The same seems to be applied to playing tug of war. In the definition of the questionnaire item 'likes games of fight' playing tug of war was given as an example. The fact that it correlated with the duration of playing tug of war with the owner indicates that dogs’ propensity for this type of game can be measured reliably by a test battery. Moreover, in contrast to the findings of Tóth et al. (2008), the association highlighted between the trait 'likes fetching balls' and the 'duration of play with the owner' as well as between 'likes games of fight' and 'ball in mouth' hints that a dog’s tendency to play ball games and its inclination to play tug of war might also be related. This suggests the presence of a „playfulness” factor (see Svartberg and Forkman, 2002) in the personality of the dog.

In the case of Aggressiveness, ‘hysterical’ and ‘likely to bite a human’ did not correlate with any of the predicted behavioural variables, while ‘shows a tendency to bark’ was found to be associated positively with the dogs’ reactions to the experimenter’s attempt to take the bone away and also with the long latency of getting the DNA sample. The former finding is in line with other studies suggesting that barking is often related to aggressive inner state (Netto and Planta, 1997; Horváth et al., 2007; Tami and Gallagher, 2009; van den Berg et al., 2010). When taking the DNA sample, the experimenter puts her hand into the mouth of the dog and buccal cell tissue is scraped from the gum and cheek surfaces. The dogs try to divert their heads from the experimenter’s hand. This process may evoke ambiguity and fear in dogs (who may be fearful in other social contexts too). Thus the positive correlation between the latency of getting the DNA sample and the dogs’ tendency to bark appears to be
in accordance with previous studies finding that despair and fear related behaviours are also accompanied by barking (Molnár et al., 2006; Pongrácz et al., 2010).

It is important to note, however, that an observed behaviour (e.g. growling or biting) can only be regarded a characteristic trait if it is consistent and shows reliable stability over time (Vas et al., 2005). Owing to uncontrolled changes in the social environment, aggression related actions are not consistent (Goddard and Beilharz, 1985; Svartberg et al., 2005). Aggressiveness measured in a test battery shows low association with owner’s report (Svarberg, 2005), and only shows relatively high correspondence with the biting history of dogs in specific test series of aggression (Netto and Planta, 1997; Planta and De Meester, 2007). In addition, territorial and intra-specific aggression might not be reliably measured by testing (Christensen et al., 2007).

The factor Trainability consists of the questionnaire items ‘not disorganised’, ‘learns things easily’, ‘fond of pleasing the owner’ and ‘controllable’. Neither of our hypotheses was confirmed (see above). In the case of the trait ‘disorganised’ and the dog’s persistence to concentrate on the swinging sausage the lack of correlation might be due to the fact that this test might not be apt for detecting whether a dog is disorganised or not. At the beginning of this test the dogs attempt to catch the swinging sausage, but the experimenter lifts it up to prevent it from being eaten. After the unsuccessful attempts the animals appear to lose interest in the sausage and start looking at the owner and/or the experimenter or at any other stimulus coming from the nearby environment. The short duration of the dogs’ concentration on the food thus does not seem to reflect that the animals are disorganised but rather that they lost interest. Further, Topál et al. (1997) found that dogs’ poor problem-solving performance was less dependent on their cognitive abilities than on their dependent relationship with the owner. We could assume that the dogs’ relationship with the owner masked any association between the questionnaire items of Trainability and their performance in the test.
The lack of positive association between the duration of playing with the owner and the dogs’ scores on the questionnaire item ‘fond of pleasing the owner’ might also root in the fact that the test battery and the questionnaire item measure two different things. The definition of ‘fond of pleasing the owner’ was: “Repeats an activity the owner is very pleased about several times and expects praise for that.” However, playing tug of war game with the dog may not be among the everyday activities the owner is pleased about and praises the dog for. Moreover, Tóth et al. (2008) found that the behaviour of family dogs in a playing situation is more influenced by their motivation to play than by the identity of the play partner and their tendencies for cooperative behaviour.

Previous studies suggest that the owner’s success in laying down a dog on the side is related to the owner’s assertiveness over the dog (Netto and Planta, 1997; Rooney and Bradshaw, 2002, 2003). The definition of my questionnaire item ‘controllable’ was „Returns right away when being called”. This item content thus implied that those owners whose dogs were scored high on this trait were supposed to be more assertive over their pet, thus the latency of rolling the pet over on the side would be short in the FIDO test. The lack of associations suggests that following the owner’s commands regarding learned activities is not associated with a dog’s willingness to take up a body posture in which he/she will be in a defenceless position.

Though the correlations found are statistically significant, they seem to be relatively low (for comparable level of correlations see also Gosling et al., 2003). A possible explanation for that can be that subjective ratings focus on the aggregated character of animal behaviour. In contrast, in the case of behaviour coding, the occurrence of discrete, well-defined behaviour units without reference to their function are recorded. The low r-values thus might reflect the qualitative vs quantitative character of the two methods.
Another possible explanation for the apparently low correlations may be that behaviour can vary due to, for instance, pre-test condition, daily fluctuations, or seasonal effects. For a researcher aiming to assess the personality traits of an individual dog, this variance represents noise. Questionnaire studies reduce this variability, since an owner can discount situational influences on behaviour when making his/her ratings. As opposed to that, an observer making behaviour codings does not take the potential situational factors (e.g. unfamiliar test scene) into account (Vazire et al., 2007). Data collected via questionnaires are thus aggregated across all the times, while behaviour codings lack the aggregated character of observation. That results in a greater sensitivity to the situational variation in a dog’s behaviour over time (Vazire et al., 2007). The situational variance can obscure the cross-situational component of behaviour which may result in low r-values when trying to find associations between trait ratings and behaviour codings. Svartberg (2005) also investigated association between owner’s report using the CBARQ (Canine Behavioral Assessment and Research Questionnaire) and the DMA (Dog Mentality Assessment) behaviour test. Similarly to my findings, in Svartberg’s study, the values of the significant correlations were also low, and the average value of the significant correlations was even lower than in the present study.

Since both questionnaire studies and behaviour codings have their advantages, the personality of an individual dog might be best investigated by the co-application of both of them. As has been mentioned above, Svartberg (2005) aimed to establish association between owner’s report using the CBARQ (Hsu and Serpell, 2003) and the DMA behaviour test. As opposed to his expectations, chase-proneness was found to be related to play interest and non-social fear in everyday life, and not, as expected, to predatory behaviour (Svartberg, 2005). The present analysis highlighted in the case of which trait the data collected by the FIDO Personality test and the Dog Personality Questionnaire converge. The lack of the correlations between the hypothesised variables provide cause for concern for future researchers to be
wary of using one or the other method of personality assessment uncritically and make them work on making both methods more reliable.

4.3.3 The comparison of the owners’ ratings and the video-based ratings done by humans with different levels of experience with dogs

The second aim of Study II was to investigate correspondence between owners’ ratings and independent observers’ ratings on the dogs’ behaviour based on the FIDO Personality test (Brúder et al., manuscript).

My findings are in harmony with previously published results. Studies carried out on cats (Feaver et al., 1986) and pigs (Wemelsfelder et al., 2001) revealed a high level of correspondence in describing animals’ modes of behaviour by human observers. In relation to dogs, Simpson (1997) found that humans were able to interpret the meaning of a number of communicative signals given by dogs. Bahlig-Pieren and Turner (1999) reported humans’ ability to recognize facial expression of fear and curiosity in dogs with an agreement of over 80%. It is important to note, however, that hands-on experience with a particular species can improve the interpretation and prediction of an animal’s behaviour (Serpell, 1986; Bahlig-Pieren and Turner, 1999; Irvine, 2001). Using Free Choice Profiling (FCP) methodology for the qualitative behaviour assessment of emotional expression in dogs Walker et al. (2010) also found good consensus between the observers despite of one group of judges who had more extensive experience with dogs.

In the second experiment the correlation coefficients were substantially higher than in the first one. This suggests that the three independent observer groups’ subjective assessment
of the target dogs’ character may reflect the owners’ experience more than behaviour coding in the case of Stranger-directed Sociability, Activity and Aggressiveness.

The reason for this, as discussed in the case of the first experiment as well, might lie in the fact that measuring behaviour in a qualitative vs quantitative way may affect the strength of the correlations. The fact that none of the independent observers were familiar with any of the target dogs in the video clips, consequently, could only do their ratings on the basis of the test battery, suggests that trait ratings are heavily affected by the applied research tool. My findings in the second experiment thus seem to support what I discussed in the case of Experiment 1: trait rating and behaviour coding represent two different approaches to behaviour research and their co-application may offer a deeper insight into the subject under focus.

As regards Trainability, the owners’ report did not correlate with the assessments of any of the rating groups, but the assessments of all the rating groups correlated with each other. This might indicate that on the basis of the FIDO Personality test the traits comprising the personality dimension Trainability cannot be measured reliably.

Besides the above, I also compared the degrees of ratings done by the owners and by the three rater groups with different levels of hands-on experience with dogs with regard to all the four factors. This was done in order to detect possible population-level biases in the evaluations.

Regarding Stranger-directed Sociability, Activity and Trainability I found no difference in the degrees of ratings provided by the owners and by the three rater groups with different levels of hands-on experience with dogs. In the case of Aggressiveness the trainers of non-included dogs, the owners of non-included dogs and the group of non-owners characterised the target animals more aggressive than their owners did.
In the case of Aggressiveness a possible explanation why the owners reported a lower degree of their dog’s aggressive tendencies than the video-based rater groups could root in the nature of the test situation where the video-taped animals were exposed to aggression-eliciting stimuli which are much less frequently present in everyday life (Svartberg, 2005). Furthermore, as Svartberg (2005) also suggests, Aggressiveness is more difficult for owners to assess than any other aspects of dog behaviour.

Conclusions

There have been few investigations aiming to reveal differences in the personality dimensions of individual dogs belonging to pure breeds and/or breed groups. In Study I I implemented a novel type of questionnaire that relies on simple adjectives to characterize the behaviour of individual dogs. The scales obtained show good correspondence with those published by others (e.g. Gosling et al., 2003; Hsu and Serpell, 2003; Kubinyi et al., 2009; Svartberg and Forkman, 2002; Ley, 2008; Jones and Gosling, 2005).

The comparison of breed-groups and breeds revealed little differences which also parallels with earlier findings. My observations suggest that these environmental factors could mask or even enhance breed differences. Breed groups may contain dog breeds which are actually kept in very different ways. If breeds with such different environmental history are combined in one breed group then it is less surprising that the relatively large variation masks any potential breed-group specific effects. Dogs living with the owners in flats may also be more similar irrespectively of the breed because owners try to choose those individuals within a breed which can conform to such living conditions. For example, owners may perceive German shepherd dogs living in the garden or in the flat in a different way. For this reason,
further research should pay attention to balancing the demographic variables in the samples, otherwise, the environmental factors will in all probability put shadow on the genetically determined differences or similarities they intend to unveil between the target breeds and/or breed groups.

My findings in Study II suggest that there is a need and room for testing whether behaviour traits measured by the means of questionnaires and behaviour tests converge.

The fact that the assessments of all the three rater groups correlated with owners’ report in the case of Stranger-directed Sociability, Activity and Aggressiveness hints that the FIDO Personality test might be suitable to measure these aspects of the dogs’ behaviour, since the amount of information the test situations provided could serve as a basis for judging these factors with strong correspondence with the owners’ experience. The lack of associations between the hypothetically corresponding questionnaire items or factors suggest that there is further need for collaboration between researchers developing behaviour tests and questionnaire studies. Ideally, this research should be done in parallel
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Brúder, I., Kubinyi, E., De Meester, R, Pluijmakers, J., Miklósi, Á. Manuscript. Introducing a simple behaviour test battery for family dogs (FIDO) and a case study for cross-laboratory comparison.


Summary

In the first half of my dissertation I presented a novel adjective-based dog personality questionnaire, which was successfully implemented to characterize the behaviour of individual dogs. The scales obtained by Principal Component Analysis: Stranger-directed Sociability, Activity, Aggressiveness and Trainability correspond well with the results of other studies published earlier. The obtained personality scales were also used to compare breed-groups registered in Fédération Cynologique Internationale (FCI) and a distinct group of mongrels was also included in the total sample (N= 352 dogs). Results suggested that in the case of pet dogs there were only slight detectable differences in personality dimensions between breed-groups and breeds. Furthermore, my investigation also included the comparison of two breeds, the Hungarian vizsla and the German shepherd dog. After matching for demographic differences, I could not reveal differences in personality traits between the two breeds kept as pets. These observations caution against making hasty claims about the presence or absence of breed differences because environmental factors can mask, or even enhance potentially existing genetically potentiated breed differences.

The other major aim of my dissertation was to investigate association between behaviour coding based on a test battery called the FIDO Personality test for dogs (Canis familiaris) and a subjective rating given by dog owners. With regard to Trainability no correlation could be detected between any of the questionnaire items and the hypothetically corresponding test battery variables. In the case of Stranger-directed Sociability, I revealed correlation between owners’ reports and the dogs’ behaviour during the test situation. Those dogs which were reported ‘initiative’ and ‘not mistrustful with unfamiliar humans’ approached the experimenter with shorter latency and played more with her than those who were scored lower on these questionnaire items. For the factor Activity, no correlation was found between the owners’ report and the behaviour of dogs displayed in the Spontaneous activity phase of the test battery. Association was revealed between the owners’ report regarding the dogs’ preference for ball games and playing and their behaviour in the corresponding subtest. Those dogs which were reported to like ball games and like playing with the owner played with the ball as well as with a tug more in the test situation than those which were scored lower on the questionnaire item ‘likes fetching balls’. As regards the factor Aggressiveness, the questionnaire item ‘shows a tendency to bark’ correlated with the dogs’ aggressive reactions (growl, bite, attack) in the Bone take-away subtest and with the ‘latency of getting the DNA sample’ in the Getting DNA sample subtest. The results show that despite of the investigated associations there is a need for more effort to refine both questionnaire-based and behaviour-based assessment of dog personality.

The other major aim of my experiments was to reveal whether owner ratings on the above personality factors converged with the ratings of independent groups of observers based on the video recordings of the FIDO Personality test. In the case of Stranger-directed Sociability, Activity and Aggressiveness the owner’s report correlated with the assessments of all the three rater groups and the assessments of the rater groups correlated with each other as well. As regards Trainability, the owners’ report did not correlate with the assessments of any of the rating groups, but the assessments of all the rating groups correlated with each other.

My investigations provide a contribution to the field of research on comparing behaviour coding based on test batteries and subjective rating based on questionnaire studies as methods for establishing the personality factors of individual animals.
Összefoglaló

Disszertáció első részében egy új, melléknevek alkalmazásán alapuló kutya személyiség kérdőívet mutattam be, melyet sikerről alkalmaztam a vizsgálatban részt vevő egyedek viselkedésének jellemzésére. A Főkomponens Analízis által nyert skálák: Idegen ember felé irányított szociabilitás, Aktivitás, Agresszió valamint Kiképezhetőség szoros összhangban van más szerzők által korábban publikált eredményekkel.

A kapott személyiség skálákat arra is fóhasználtam, hogy a Fédération Cynologique Internationale (FCI) által regisztrált fajtacsoportokat, továbbá egy keverék kutyákból álló mintát egymással összehasonlítok. A teljes mintaszám 352 kutyából állt. Azt eredmények azt mutatják, hogy a házikedvencként tartott kutyák esetén alig volt kimutatható különbség a különböző fajtacsoportokba illetve fajtába tartozó egyedek személyiségdimenziói között. Vizsgálataim között szerepelt két fajta, a magyar vizsla továbbá a német juhászkutya összehasonlítása is. A mintaszám demográfiai paramétereinek kiegysorolása után nem volt kimutatható különbség a családi kutyáként tartott egyedek személyiségjegyei között. Megfigyeléseim arra intenek, hogy tartózkodni kell a különböző fajtához tartozó egyedek fajta jellege alapján történő megítélésétől, ugyanis különböző környezeti hatások elkendirhetik, de fokozhatják is a génként kódolt potenciális fajták közötti különbségeket.

Disszertáció másik fő célja volt, hogy összefüggéseket tájoljon fel a FIDO személyiségteszt alapján történő viselkedéskódolás valamint a gazdák kérdőíven alapuló szubjektív értékelése között. A Kiképezhetőség vonatkozásában nem volt kimutatható különbség egyik kérdőívben szereplő kérdések valamint a feltételezések szerint azoknak megfeleltethető személyiség teszt változók között. Az Idegen ember felé irányult s sociabilitás esetében korrelációt mutattak ki a gazdák értékelése valamint a kutyák személyiség teszt során mutatott viselkedése között. Azok a kutyák, melyeket gazdák a ‘kezdeményező’ valamint a ‘nem bizalmatlank idegen embereknél’ tulajdonságok esetén magas pontszámmal illettek, kisebb latenciával közelítették meg a személyiség teszben részt vevő idegent, illetve többet játszottak vele mint az e tulajdonságokra alacsony pontszámot kapott egyedek. Az Aktivitás faktor esetén nem volt kimutatható összefüggés a gazdák jellemzése és a kutyákának a személyiség teszt Spontán aktivitás részében mutatott viselkedése között. Összefüggés mutatkozott azonban a gazdák jellemzése valamint a teszt során megfigyelhető viselkedés között a labdával való játékot illetően. Azok a kutyák, melyekről gazdák úgy nyilatkoztak, hogy szeretik labdázni, valamint az idők során a labdával a kutyák és a kutyák gyakran a tulajdonos és a rendelkezésre álló kutyák között a gazdák aktívaként is szerepeltek.

Az Agresszivitás faktor esetén az ‘Ugató’ kategóriájú kutyák által kifejlesztett viselkedés kori korrelációt mutattak az adott kutya Csontelvétel és a DNS minta vizsgálatával. Az eredmények alapján azt mondtuk, hogy a feltárt összefüggések ellenére szükség mutatkozik a kutya személyiségének az eddigi és későbbi vizsgálatok mind pedig a viselkedéstervezetek alkalmazáslainak esetén.

Vizsgálataim másik fő célja annak feltárása volt, hogy a gazdák értékeléseit a fenti személyiségfaktorokra vonatkozóan milyen mértékben egyeznek a FIDO személyiségtesztet video felvételek megfigyelése, majd a kérdőíves értékelést az adott kutya Csontelvétel és DNS mintavétel alapján. Az eredmények alapján azt mondhatjuk, hogy a feltárt összefüggések ellenére szükség mutatkozik a kutya személyiségének az eddigi és későbbi vizsgálatok mind pedig a viselkedéstervezetek alkalmazáslainak esetén.
Vizsgálataim eredményei hozzájárulnak ahhoz a szélesebb körű kutatáshoz, mely a személyiségtesztek alapján történő viselkedéskódolás valamint a kérdőíves vizsgálatok módszertani összehasonlításával foglalkozik a kutyák személyiségdimenzióinak pontos meghatározása érdekében.
Acknowledgements

First, and most of all, I am remarkably thankful to my supervisor, Ádám Miklósi, DSc for his patient guidance and support all the way long.

I also owe honor to Enikő Kubinyi, PhD; József Topál DSc; Márta Gácsi, PhD and Péter Pongrácz, PhD who all provided supportive contribution during the course of my studies.

And finally I would like to express my deep gratitude to all who granted me the chance to start this PhD Program.
APPENDICES

APPENDIX I.

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**Sighthounds (N=14)**

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**Mongrels (N=68)**

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APPENDIX II.

Dog Personality Questionnaire

Variables excluded from further analysis on the basis of their median are bold

1.) Alert: If kept in a flat, he/she takes notice of even little noises coming from the outside; if kept on a yard, he/she discerns what is going on in the street and if necessary, reacts to that by barking.

2.) Shows dominance aggression towards non-owner: Behaves in a threatening way when being commanded, guards his/her food, ball, toy and is not keen on giving anyone his/her favourite cloth.

3.) Disorganised: While doing an exercise, he/she is evidently unable to concentrate.

4.) Tends to get over-involved in a task: Often gets involved in a task to the extent that he/she even snaps the owner.

5.) Aggressive with unfamiliar dogs: Cannot be involved in games with dogs he/she does not know, because he/she tends to attack them.

6.) Overactive: He is quite lively, moving about in all circumstances, not preferring sitting or lying for long.

7.) Tolerates physical contact with adult humans: Tolerates being patted without fear and/or aggression.

8.) Brave: He/She does not get frightened easily by different objects, animals or humans, is confident even in new environments.

9.) Needs physical contact with the owner: Often initiates physical contact with the owner eg. by putting his/her head on the owner’s leg.

10.) Afraid of noises: Gets frightened or restless of loud sounds like thunderstorm, gunshot etc.

11.) Hysterical: Does not tolerate things unpleasant for him/her.

12.) Sensitive: After being told off, he/she looks upset.

13.) Jealous of dogs: When the owner is patting another dog, he/she becomes restless and/or aggressive with the other dog. He wants to be patted himself.
14.) Easy to motivate: He/She can easily be made to do an exercise by being inspired with food, favourite toy or ball.

15.) Wants to own other dogs’ belongings: He/She usually takes other dogs’ balls and other toys.

16.) Likes games of fight: For example tug of war etc..

17.) Does not mind being left alone: Seems to feel good in a flat or in a kennel on his own. (If he/she does not, in extreme cases he/she even damages the flat.)

18.) Jealous of humans: When the owner is in an active interaction with another human, he/she becomes restless and/or aggressive with the person.

19.) Tolerates physical contact with children: Tolerates being patted without fear and aggression.

20.) Learns things (tasks, rules etc.) easily.

21.) Likes apporting: Likes ball games very much.

22.) Tends to shepherd other animals or humans: Aims to shepherd animals on a yard or other groups of people like family members or friends when not forming a dense group while walking.

23.) Controls other dogs: Eg. makes another dog go back to the pavement from the road when it walks off or does not let the other one eat the prohibited food.

24.) Likely to get involved in lynching: Being alone he/she is not aggressive but when in a group, he/she snaps and chases other dogs and/or takes his/her part in beating the other one.

25.) Fond of pleasing the owner: Repeats an activity the owner is very pleased about several times and expects praise for that.

26.) Affectionate: He/She follows his/her owner wherever he/she can. The owner is the security base for him/her.

27.) Initiates contact with unfamiliar humans: When he fails to make the owner tend him/her, he/she tries to do the same with a nearby unfamiliar human.

28.) Shows a tendency to bark: When seeing the postman or other people in the street, he/she starts barking. Besides that he/she often communicates by barking.

29.) Guards the house/flat.

30.) Tense: Oversensible and/or unbalanced.

31.) Impulsive: Starts behaving in a totally unexpected way, usually in moments of time.
32.) Lazy: Often lies down.

33.) Investigative: When in a new environment he/she investigates novel objects and goes up to unfamiliar people.

34.) Likely to bite a human: He/She is likely to snap or bite without any previous sign of that.

35.) Controllable: Returns right away when being called.

36.) Retaliative: Tends to retaliate offences on other dogs.

37.) Communicative with people: He/She often calls people’s attention to himself/herself.

38.) Mistrustful with unfamiliar people: Remains out of touch and is evidently tenseful when an unfamiliar human is approaching.
APPENDIX III.

The FIDO Personality test procedure

Test 1. Spontaneous activity
For 60 seconds the owner stands motionless next to the dog and holds the leash while the dog is free to move on the leash.

Test 2. Greeting
The owner stands motionless next to the dog and holds the leash. A young woman, the experimenter, who is unfamiliar to the dog, approaches them in a friendly manner. She smiles and says hello to both the dog and the owner. She stops out of reach of the leash and waits for three seconds to see whether the dog goes up to her or not. If the dog stays next to the owner, she calls the dog. If the animal does not behave in an aggressive way, she steps to it and pets it on the head and the back.

Test 3. Getting DNA sample
If the experimenter can caress the dog, she scraps buccal cell tissue from the gum and cheek surfaces with a plastic stick with cotton bundle at one end. If she fails to do so, the owner is asked to do that.

Test 4. Attention test
The experimenter ties a piece of sausage on the end of a thin rope. She stands in front of the dog and swings it about 50 cms out of the dog’s mouth for 30 seconds. In the meantime she prevents the dog from catching the piece of sausage.

Test 5. Separation I
The experimenter leaves the dog alone on the leash and gets out of sight for 30 seconds.

Test 6. Playing with the experimenter

The experimenter greets the dog like in Test 2, and then tries to play with the animal using a tug within the range of the leash for 30 seconds.

Test 7. Separation II

The experimenter leaves the dog alone on the leash and gets out of sight for 30 seconds.

Test 8. Playing with the owner

The owner greets the dog then tries to play with the animal using a tug for 30 seconds.

Test 9. Ball-playing with the owner

The owner is asked to play with the dog with a ball.

Test 10. Problem-solving test

A piece of meat is attached to one end of the rope and is put into a cage out of reach of the dog. However, a 6-7-cm long part of the rope hangs out of the cage. The meat can be obtained by pulling out the rope. The owner stands in front of the cage in the distance of about one meter and holds the leash of the dog. The dog has 60 seconds to pull out the rope and get the food. The trial ends when the dog either manages to obtain the food or the 60 seconds’ time is over.

Test 11. Bone take-away test

The owner gives the dog a large cooked bone. A piece of thin rope is attached to one end of the bone. If the animal starts chewing it, the experimenter approaches the animal wearing an artificial hand made of plaster. First, she pets the back of the dog with the artificial hand, then
asks the animal for the bone. If the dog chews it on, the experimenter puts the artificial hand on the bone then starts pulling it away with the help of the thin rope.

**Test 12. Threatening approach**

The experimenter stands motionless 5 metres from the dog. As soon as the animal looks into her eyes, she starts to approach it moving slowly with the upper body bent slightly. She looks steadily into the eyes of the dog all through the approach without any verbal communication.

**Test 13. Sudden appearance**

The owner stands motionless next to the dog and holds the leash. The experimenter stands in the distance of about 2 metres from the dog and suddenly opens the umbrella in front of the dog.

**Test 14. Laying down on the side**

The owner is asked to make the dog lie down on its side and also to keep it on the ground in the same position for 30 seconds.
APPENDIX IV. The breeds and number of dogs comprising the sample in the comparison of the questionnaire study and behaviour coding

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