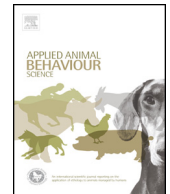




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Measuring fear in dogs by questionnaires: An exploratory study toward a standardized inventory



Andrea Temesi^{a,*}, Borbála Turcsán^a, Ádám Miklósi^{a,b}

^a Department of Ethology, Eötvös Loránd University, Budapest, Hungary

^b MTA-ELTE Comparative Ethology Research Group, Budapest, Hungary

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ABSTRACT

Several types of questionnaires are in use to measure fear-related behaviour in family dogs. Our aim was to develop a general questionnaire based on relevant previous studies in order to facilitate the standardization of measurements of fear-related behaviour in dogs (social fear, non-social fear, separation problems, anxiety/destructiveness and neuroticism). We investigated which aspects of fear do emerge as distinct factors when measuring fear in dogs with our consensus questionnaire.

We developed the questionnaire by piercing together seven discrete fear-related factors from six previous studies representing different aspects of fear. Our final questionnaire consisted of 56 items and was filled out by 833 Hungarian pet dog owners.

Principal component analysis was applied to explore the factorial structure of the questionnaire scores. The original seven factors used in developing the questionnaire did not emerge as discrete factors. Instead, we found four factors (33 questionnaire items) labeled as neuroticism (CRA = 0.87), dog-directed fear (CRA = 0.84), human-directed fear (CRA = 0.90) and separation-related behavior (CRA = 0.83).

The effects of demographic and dog keeping characteristics on these factors were also tested by generalized linear models (GLMs). For example, toy dogs had a higher risk to show neuroticism and dog-directed fear. Female owners were more frequently reporting human-directed fear in their dogs. Female dogs showed higher level of dog-directed fear. Older dogs score was higher on neuroticism and neuroticism correlated with the time of acquisition.

The standardization of specific trait measures provides an advantage to the researchers in constructing further, more specific tools and offers a greater comparability of research across dog and human populations.

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1. Introduction

Over the past 30 years, a variety of studies have been conducted in order to characterize the individual behaviour

of dogs across contexts and over time (e.g. Hsu and Serpell, 2003; Gosling et al., 2003; Jones and Gosling, 2005; Turcsán et al., 2012). Currently we are far from understanding the whole structure of dog personality traits, however some aspects of the dogs' consistent individual behaviour seems to show some generality as they come up repeatedly across studies (e.g. those related to sociability, activity or fear, Jones and Gosling, 2005). However, even studies focusing on the same trait are highly diverse in terms of methodological design and terminology which makes comparison between them difficult. The need for transparency

* Corresponding author at: Eötvös Loránd University, Department of Ethology H-1117, Pázmány P. s. 1/c, Budapest, Hungary.
Tel.: +36 1 3812179; fax: +36 1 3812180.

E-mail addresses: andrea.temesi@gmail.com (A. Temesi), turcsanbori@gmail.com (B. Turcsán), amiklosi62@gmail.com (Á. Miklósi).

and standardization in methodological design has already become a pressing issue in behavioural sciences (Diederich and Giffroy, 2006.) The overall goal of the present work is to take a step forward in this direction.

Jones and Gosling (2005) identified seven broad categories called ‘temperament dimensions’ for ordering canine personality behaviour, labelled as Reactivity, Fearfulness, Activity, Sociability, Responsiveness to training, Submissiveness, and Aggression. Trait names of the different studies can be classified in terms of the temperament dimensions (Fratkin et al., 2013). There are numerous studies analysing such traits representing a wide variety of research interest, including the focus on behaviour problems (e.g. Jagoe and Serpell, 1996), assessment of the dogs’ suitability for specific functions (e.g. guide dogs: Serpell and Hsu, 2001), estimation of heritability (e.g. Goddard and Beilharz, 1986), or determination of breed differences (e.g. Duffy et al., 2008).

We chose the fearfulness dimension as the target of our study. Fear-related behaviour emerged as an important aspect of the dogs’ personality also from applied point of view as it relates to the welfare of the animals and could have a strong influence on the owner-dog relationship (Hsu and Sun, 2010; Duffy et al., 2008; Guy et al., 2001). Therefore, developing a standard methodology to assess this dimension of behaviour could be beneficial, both practically and scientifically.

Fear is often defined as a cognitive and emotional mental state that activates defensive behaviours in response to threatening and/or painful stimuli (Cannon, 1929; Rachman, 1998; Öhman and Mineka, 2001). Fear is regarded as a biologically adaptive (evolved) mechanism that contributes to the survival of the individual by controlling its distance to the stimulus (e.g. escape/avoidance, fight/flight, immobility) (Öhman and Mineka, 2001). While fear is usually determined in relation to a particular stimulus, fearfulness is a character of an individual, and could be defined as the behavioural manifestation of fear emotion (i.e. a more fearful animal has a tendency to react stronger and more intensively to fear-evoking stimuli in general).

Jones and Gosling (2005) found traits related to the fearfulness dimension in dogs in 43 of the investigated 50 publications, thus fearfulness is considered as the most frequently emerging temperament dimension. A large number of these investigations rely on questionnaires (ratings of individual dogs) aiming to obtain information from dog owners regarding their dogs’ fear-related behaviour. In order to validate questionnaire-based fearfulness traits Gosling et al. (2003) and Jones (2008) tested how well the owners’ personality judgments of their dogs predicted the behaviour ratings obtained in a field-testing sessions or in a test battery. The authors reported strong correlations between owners’ personality judgments and the independent behaviour ratings of the field tasks.

In recent years a wide range of questionnaires have been developed for measuring fearfulness in dogs, however, without any standardization in the construction of the questionnaires or the nomenclature. The studies also differ in which types (class) of fear-related behaviour they discriminate. Some studies assess fearfulness as a general personality trait with no discrimination regarding the

source of it (e.g. Guy et al., 2001; Jones, 2008). Others investigate fear-related behaviour separately to specific type (or class) of stimuli. For example, many studies discriminate between social and non-social fear (Jagoe and Serpell, 1996), a few of them even divide the social fear into separate types (e.g. human-, and dog-directed fear, Serpell and Hsu, 2001).

The method and terminology of the studies seem to mirror the above concept. Studies of the former type usually utilize adjective-based methodology or more general short statements, for example “Dog is shy”, “Gets nervous easily”. Such traits are labelled as “apprehension” (Cattell and Korth, 1973), “timidity” (Hennessy et al., 2001; Stephen and Ledger, 2007), “calmness” (Kubinyi et al., 2009) or – drawing on human psychology – “neuroticism/emotional reactivity” (Gosling and Bonnenburg, 1998; Gosling et al., 2003; Ley et al., 2009). Studies of the later type assess “fear” by posing specific questions about the reaction of the dog to these specific “threats”, e.g. a strange human, an unfamiliar situation, or a vacuum cleaner. They usually describe everyday situations and label their traits accordingly, for example as “social fear”, “non-social-fear”, or “noise phobia” (Jagoe and Serpell, 1996; Blackwell et al., 2013).

Earlier work revealed intrinsic and extrinsic variables in association with different fear-related behavioural traits in dogs. Intrinsic variables included the dog’s breed, sex, neutering status, and age (Bennett and Rohlf, 2007; Tami et al., 2008; Blackwell et al., 2013). Extrinsic (environmental) variables such as owners’ characteristics (e.g. age, gender, previous experience with dogs: Jagoe and Serpell, 1996; Kobelt et al., 2003; Bennett and Rohlf, 2007; Kubinyi et al., 2009), keeping situation (place where the dog lives, number of dogs/children/adults in the household: Tami et al., 2008; Kubinyi et al., 2009), interaction with the owner (age at acquisition, hours spent with the dog per day, training experience: Bennett and Rohlf, 2007; Tami et al., 2008; Kubinyi et al., 2009) have all been reported to correlate with one or more aspects of the dog’s fearfulness. Some variables appeared to be specific for a sample in influencing different types of fear (e.g. the owners’ previous experience with dogs, Jagoe and Serpell, 1996; Kobelt et al., 2003; Bennett and Rohlf, 2007), still others seem to be more specific for a given type of fear (e.g. the place where the dog lives—fear of loud noises, Tami et al., 2008).

In this study our aim was to develop a questionnaire from the previous studies in order to facilitate the standardization of measurements of fear in dogs. We searched for all potentially relevant questionnaire studies and reviewed questionnaire traits (“factors”) which were designed to measure (1) fearfulness or neuroticism as a personality trait, (2) behaviours related to specific types of fears, and (3) separation-related behaviours.

Separation anxiety is a common behavioural disorder in dogs (Pageat, 1995; Voith and Borchelt, 1996; Overall, 1997) characterized by signs of destructiveness, inappropriate elimination (defecation, urination), vocalization, autonomic arousal (hyper-salivation, trembling or diarrhoea) and motor restlessness (pacing, circling, digging or excessive licking) when the dog is left alone or is separated from its attachment figure, usually its owner (McCrave, 1991; Pageat, 1995; Voith and Borchelt, 1996; Overall,

1997). Separation anxiety is usually treated separately from the other fear-related traits as it emerges only as a consequence of being separated from the owner (Voith and Borchelt, 1985; McGreevy and Masters, 2008; Konok et al., 2011). Jones and Gosling (2005) also mentioned it separately from the seven temperament dimensions. In our study we investigated separation anxiety because its behavioural manifestations are similar to the signs of fear.

To achieve our goal on the basis of the fear-related measures of previous questionnaire studies we developed our questionnaire and asked an *ad hoc* population of dog owners to assess the fear of their dogs. The studies were chosen on the basis of the questions, that is, we looked for the most diverse list of questions for the present investigation.

We inquired for the following questions:

- (1) Which aspects of fear do emerge as distinct factors in our consensus questionnaire?
- (2) Are the fear-related traits from the previous studies reproducible on a new, independent sample from another country?
- (3) Which intrinsic and extrinsic (environmental) variables do associate with these fear-related traits?

2. Methods

2.1. Subjects

Hungarian pet dog owners were asked to fill out our online questionnaire which was advertised among the participants of the Family Dog Project in Budapest. In addition we used different forms of popular social networking services to recruit owners for this project. The questionnaire data were recorded from 833 participants in February and March 2013, 34 of them were incomplete and were excluded from the subsequent analysis.

2.2. Development of the questionnaire

We searched for all potentially relevant questionnaire studies using the online publication database. Our aim was to develop a questionnaire which can measure as many as possible aspects of fearful behaviour, so we investigated not the complete questionnaires from the different studies, only the fear-related and separation-related traits. We excluded studies if the investigators reported to use a formerly established questionnaire by other authors, because these questionnaires contain the same items as the original ones. We found 22 relevant studies with 176 questionnaire items. After that we ignored the relevant factor of the questionnaire of King et al. (2009) because this study identified the characteristics of the modern “ideal dog” by asking the Australian public, however our goal was to measure the fearful behaviour of the owners’ own dog. Also we eliminated the relevant factor of Parthasarathy and Crowell-Davis (2006) which contains simple choice questions because we aimed to use a frequency scaling.

In our consensus questionnaire we used items on statements/situations (e.g. “The dog behaves fearfully towards other dogs”, (Jones, 2008)), because we preferred to

develop an ethologically relevant, uniform questionnaire what the owners can easily fill out. Therefore we ignored the studies used only one-word adjective-type questionnaire (Gosling and Bonnenburg, 1998; Kobelt et al., 2003; Kwan et al., 2008; Ley et al., 2008, 2009). These adjectives present in other factors as a declarative sentence.

We included complete and discrete factors from the investigated studies, we did not remove items from them. There were different factors from different studies, which contain items with very similar meaning and phrasing. To avoid duplicates, in these cases we included the factor containing the most items and the most expressing (detailed and precise situation description) items.

Accordingly, for the final version of our questionnaire we combined the items of 7 questionnaire traits (from 6 studies) that resulted in 56 items in total (see Table A1). These included the following questionnaire traits (original name of the trait, reference publication): “social fear” (Hsu and Sun, 2010); “non-social fear” (Hsu and Serpell, 2003); “negative activation” (Sheppard and Mills, 2002); “fearfulness” (Jones, 2008); “neuroticism/emotional reactivity” (Gosling et al., 2003); “separation-related behaviour” (Hsu and Serpell, 2003); “separation problem” (Blackwell et al., 2008).

In the questionnaire, these 56 items were reproduced in pseudo-randomized order; two or more questions from the same studies did not to get next to each other. Certain factors refer to concrete situation (e.g. fear from other dogs) with similar phrasing of the items. As a result of this procedure the similar items did not follow each other, our questionnaire did not consist of different sections which could have affected the answers of the owners.

For the categorization of the answers we used a 5-point frequency scale (1 = never, 2 = seldom, 3 = sometimes, 4 = usually, 5 = always) (see Table A1).

We also asked the respondents for demographic information about themselves and their dogs to determine the correspondences between the fearful behaviour and the intrinsic and extrinsic variables (the descriptive statistics are presented in Tables 1 and 2).

2.3. Data collection and analysis

The scores for all factors were calculated by averaging the relevant scores. In the “negative activation” (Sheppard and Mills, 2002), the “fearfulness” (Jones, 2008) and the “neuroticism/emotional reactivity” (Gosling et al., 2003) factors scores were reverse coded for items with negative loadings for that factor (e.g. “Dog adapts easily to new situations and environments” (Jones, 2008)). For subsequent analysis we assigned scores to each dog based on the consensus questionnaire.

The classification of breeds was based on the internationally recognized system of the American Kennel Club (AKC, www.akc.org). Six breeds which are not recognized by the AKC (Australian Kelpie, Berger Blanc Suisse, Croatian Shepherd Dog, German Jagdterrier, Moscow Watchdog, Transylvanian Hound), were assigned to whichever AKC breed group most closely matched their classification by the Fédération Cynologique Internationale (FCI, www.fci.be).

Table 1The demographic characteristics of the owners in the present study ($N = 799$).

Characteristics	Descriptives
Gender	Man: 8.64%; Woman: 91.36%
Age	<18 years old: 4.51%; 19–30 years: 41.68%; 31–60 years: 51.19%; >60 years old: 2.63%
Education	Primary school: 5.01%; Secondary school: 36.92%; High school/University: 58.07%
Previous dogs	No previous dog: 28.66%; 1 previous dog: 28.54%; More than one previous dogs: 42.80%
Hours spent with the dog per day	>3 h: 26.53%; 1–3 h: 60.58%; <1 h: 9.39%; Rather other family members spend time with the dog: 3.0%
Number of the dogs in the household	Mean \pm S.D. = 1.93 \pm 1.46
Number of the adults in the household	Mean \pm S.D. = 1.47 \pm 1.00
Number of the children in the household	Mean \pm S.D. = 0.29 \pm 0.66

Table 2The demographic characteristics of the dogs in the present study ($N = 799$).

Characteristics	Descriptives
Sex and neutering	Male: 31.79%; Female: 21.90%; Neutered male: 15.89%; Neutered female: 30.41%
Age	Mean \pm S.D. = 4.79 \pm 3.20
Breed group (based on the AKC categorization)	Sporting: 15.14%; Hound: 9.01%; Working: 9.51%; Terrier: 8.14%; Toy: 7.38%; Non-sporting: 3.00%; Herding: 11.14%; Miscellaneous: 1.00%; Foundation stock service: 3.76%; Mixed breed: 31.91%
Age at acquisition	Born at the owner: 4.01%; 5–13 weeks: 58.07%; 3–12 months: 23.03%; >1 year: 14.89%
Place where the dogs spent most of their time	In flat: 44.68%; Both in flat and in garden: 36.17%; in garden freely: 17.90%; in kennel: 1.00%; in garden on chain: 0.25%
Training experience	Trained: 56.07%; Untrained: 43.93%

For the statistical analysis the SPSS statistical program (version 21.0) was used.

Principal component analysis was applied to explore the factorial structure of the questionnaire scores with varimax rotation. Cronbach's alpha was calculated to assess the internal reliability of extracted factors and the internal reliability of the original factors.

In order to reveal the relationship between the different aspects of fear, we performed two second order principle component analyses: one on the derived factors and the other on the original seven factors from the previous studies.

GLMs with backward elimination (limited to two way interactions) were run separately for the traits obtained after the PCA as well as for each published questionnaire trait if the Cronbach's alpha value was acceptable (Cronbach's alpha > 0.60). Only significant ($p < 0.05$) explanatory variables/interactions have been retained for the final model.

3. Results

3.1. Principal component analysis (PCA)

The PCA retained 33 questionnaire items (out of total 56), and four factors have been obtained which explained together 50.1% of the total variance. Factors, interpreted as traits (see below), were labelled on the basis of items loading (see Table 3): (1) Neuroticism (Neu, Variance explained = 16%, 14 items, CRA = 0.87); (2) Dog-directed fear (DogFear, 11.4%, 7 items, CRA = 0.84); (3) Human-directed fear (HumFear, 11.4%, 5 items, CRA = 0.90) and (4) Separation-related behaviour (SRB, 11.1%, 7 items, CRA = 0.83). According to Table 3 each trait consists of items from at least 2 or 3 different questionnaires, thus we will refer to this obtained structure of items as consensus questionnaire.

The factor structure showed that separation-related behaviour was different from fear (similar to Hsu and Serpell, 2003; Hsu and Sun, 2010). Social fear was divided into dog-directed fear and human-directed fear (similar to Hsu and Serpell, 2003). Neuroticism – as excitement in strange situations or places or a fearful reaction to sudden visual or acoustic stimuli, how cautiously or nervously a dog is perceived to behave (Ley et al., 2009) – was separated from the two forms of social fear (see Table 3).

3.2. Cronbach's alpha values of the fear-related questionnaire traits

In order to see whether our Hungarian sample is comparable to earlier results measuring fear in dogs, Cronbach's alpha was calculated to assess the internal reliability of the seven original trait which were used in our study. All but one original trait had an acceptable Cronbach's alpha value ("social fear" (Hsu and Sun, 2010): CRA = 0.860; "non-social fear" (Hsu and Serpell, 2003): CRA = 0.751; "negative activation" (Sheppard and Mills, 2002): CRA = 0.779; "fearfulness" (Jones, 2008): CRA = 0.796; "neuroticism/emotional reactivity" (Gosling et al., 2003): CRA = 0.828; "separation-related behaviour" (Hsu and Serpell, 2003): CRA = 0.776; "separation problem" (Blackwell et al., 2008): CRA = 0.510).

3.3. Secondary principle component analysis

In order to reveal the relationship between the different aspects of fear, two second order principle component analyses were carried out. One on the four derived factors (neuroticism; dog-directed fear; human-directed fear and separation-related behaviour) and the other on the original seven factors from the previous studies ("social fear" (Hsu and Sun, 2010); "non-social fear" (Hsu and Serpell, 2003); "negative activation" (Sheppard and Mills, 2002); "fearfulness" (Jones, 2008); "neuroticism/emotional reactivity"

Table 3

Factor structure of the consensus questionnaire. After each item, the name of the original trait that item belonged to are shown in parenthesis. Loadings greater than 0.3 are in bold-face. Asterisk indicates reversed scored item.

Questionnaire items	Neuroticism	Dog-directed fear	Human-directed fear	Separation-related behaviour
Dog is emotionally stable, not easily upset* (neuroticism/emotional reactivity)	0.689	0.046	0.299	0.132
Dog remains calm in tense situations* (neuroticism/emotional reactivity)	0.668	0.091	0.334	0.076
Dog gets nervous easily (neuroticism/emotional reactivity)	0.655	0.132	0.129	0.109
Dog can be tense (neuroticism/emotional reactivity)	0.647	0.074	0.229	0.109
Dog is relaxed, handles stress well* (neuroticism/emotional reactivity)	0.616	0.010	0.149	0.080
Your dog usually appears relaxed* (negative activation)	0.619	0.061	0.278	0.056
Your dog appears nervous and/or jumpy for several minutes after it has been startled (negative activation)	0.599	0.201	-0.143	0.068
Your dog appears calm in unfamiliar environments* (negative activation)	0.599	0.052	0.260	0.060
Your dog appears calm in noisy, crowded places* (negative activation)	0.579	0.086	0.013	0.189
Dog is anxious (fearfulness)	0.581	0.070	0.244	-0.001
Dog adapts easily to new situations and environments*(fearfulness)	0.523	0.060	0.326	0.042
Dog acts anxious or fearful in response to sudden or loud noises (non-social fear)	0.501	0.279	0.217	0.047
Dog acts anxious or fearful during thunderstorms (non-social fear)	0.494	0.191	-0.244	-0.008
Your dog has a specific fear or phobia (negative activation)	0.446	0.158	0.013	-0.050
Dog acts anxiously or fearfully when approached directly by an unfamiliar dog of the same or larger size (social fear)	0.222	0.783	0.217	0.073
Dog behaves fearfully towards other dogs (fearfulness)	0.199	0.777	0.229	0.062
Dog acts anxiously or fearfully when barked, growled or lunged at by an unfamiliar dog (social fear)	0.153	0.727	0.232	0.019
Dog acts anxiously or fearfully when approached directly by an unfamiliar dog of smaller size (social fear)	0.063	0.683	0.152	0.113
Dog acts anxiously or fearfully when unfamiliar dogs visit your home (social fear)	0.192	0.608	0.220	0.037
Dog avoids other dogs (fearfulness)	0.113	0.608	0.042	-0.013
Dog behaves submissively (e.g., rolls over, avoids eye contact, licks lips) when greeting other dogs (fearfulness)	0.019	0.510	0.024	0.038
Dog acts anxiously or fearfully when an unfamiliar person tries to touch or pet the dog (social fear)	0.223	0.224	0.814	0.012
Dog acts anxiously or fearfully when approached directly by an unfamiliar adult while away from home (social fear)	0.239	0.252	0.801	0.041
Dog behaves fearfully towards unfamiliar people (fearfulness)	0.256	0.210	0.779	-0.003
Dog acts anxiously or fearfully when unfamiliar persons visit your home (social fear)	0.242	0.246	0.695	0.100
Dog acts anxiously or fearfully when approached directly by an unfamiliar child while away from home (social fear)	0.237	0.265	0.626	0.070
Bark or howl when owner out of the house only (separation problem)	0.078	-0.042	-0.013	0.822
Dog displays howling when left or about to be left on its own (separation-related behaviour)	0.055	0.054	-0.009	0.770
Dog displays whining when left or about to be left on its own (separation-related behaviour)	0.108	0.087	0.010	0.740
Dog displays barking when left or about to be left on its own (separation-related behaviour)	0.126	0.022	0.049	0.725
Dog displays restlessness, agitation, or pacing when left or about to be left on its own (separation-related behaviour)	0.230	0.057	0.029	0.682
Dog displays chewing or scratching at doors, floor, windows, and curtains when left or about to be left on its own (separation-related behaviour)	-0.014	0.170	0.036	0.630
Chew or destroy items when owner out of the house only (separation problem)	-0.011	-0.037	0.081	0.534

(Gosling et al., 2003); “separation-related behaviour” (Hsu and Serpell, 2003); “separation problem” (Blackwell et al., 2008)). In the case of our four factors the analysis revealed two factors: the neuroticism, the dog-directed fear and the human-directed fear loaded on the first factor, the separation-related behaviour separated as the second factor (Table 4a). The results were similar in the case of the original factors: five factors (social fear, non-social fear, negative activation, fearfulness,

neuroticism/emotional reactivity) loaded on the first factor, and the two separation-related variables (separation-related behaviour, separation problem) comprised the second factor (Table 4b).

3.4. GLM analysis of the consensus questionnaire

We investigated which intrinsic and extrinsic (environmental) variables associated with our four traits.

Table 4

The outcome of the secondary higher-order PCA using the (a) traits of the consensus questionnaire and (b) the original seven traits. Loadings greater than 0.3 are in bold-face.

(a) Name of the trait	Component 1 fear-related behaviour	Component 2 separation-related behaviour
Human-directed fear	0.853	0.022
Dog-directed fear	0.782	0.029
Neuroticism	0.764	0.239
Separation-related behaviour	0.095	0.987
(b) Name of the trait (reference publication)	Component 1 fear-related behaviour	Component 2 separation-related behaviour
Fearfulness (Jones, 2008)	0.902	0.133
Negative activation (Sheppard and Mills, 2002)	0.886	0.157
Non-social fear (Hsu and Serpell, 2003)	0.836	0.014
Neuroticism/emotional reactivity (Gosling et al., 2003)	0.819	0.203
Social fear (Hsu and Sun, 2010)	0.817	0.058
Separation problem (Blackwell et al., 2008)	0.011	0.916
Separation-related behaviour (Hsu and Serpell, 2003)	0.226	0.872

The dog breed group showed a significant effect in the case of neuroticism (Neu), and in the case of fear from other dogs (DogFear) because toy dogs were characterized as being more fearful. In the case of human fear (HumFear) the effect of breed group depended on the age of acquisition (in mongrels and toy dogs early acquisition has a smaller protecting effect against the development of human fear), and female owners were more frequently reporting fear from humans in their dogs. Breed group played no role in emergence of separation-related behaviour (SRB).

Female dogs showed more fearful behaviours toward other dogs (DogFear).

Neuroticism (Neu) in younger dogs associated with the time of acquisition: dogs joined the family at younger age had lower score on neuroticism than dogs joined the family later. Older dogs score was higher on neuroticism independently of the time of acquisition.

In addition, untrained dogs of young owners showed more fear toward humans (HumFear) than trained dogs.

We found that living in the flat or in the flat and in the garden positively correlated with the separation-related behaviours (SRB) in case of younger owners.

3.5. GLM analysis on the fear-related questionnaire traits

We performed separate backward GLMs on the questionnaire traits from the original investigations where the Cronbach's alpha was over 0.65 to examine the correspondence between the dogs' scores and their demographic characteristics (Table 5). In case of the dog these included sex, age, breed category, training experience, housing conditions, age at acquisition and neutering while for the owner we investigated the effect of gender and age.

The breed category had a significant effect in all traits but the "separation-related behaviour" (Hsu and Serpell, 2003). In all cases mongrels and toy dogs were reported being more fearful than dogs in the other breed categories.

Female dogs tended to show more "social fear" (Hsu and Sun, 2010) and higher "neuroticism" (Gosling et al., 2003) than males but in case of "non-social fear" (Hsu and Serpell,

2003), "fearfulness" (Jones, 2008) and "negative activation" (Sheppard and Mills, 2002) only the interaction term was significant: females were more fearful if living only in the flat. Older females' "negative activation" (Sheppard and Mills, 2002) was also higher. No effect of gender was found in the separation-related trait ("separation-related behaviour", Hsu and Serpell, 2003).

Older dogs, which were acquired at late age, showed higher "negative activation" (Sheppard and Mills, 2002). Older dogs living in flats tended to show more "separation-related behaviour" (Hsu and Serpell, 2003).

Dogs acquired as puppies tended to show less "social fear" (Hsu and Sun, 2010), and especially females, which were acquired relatively late, seemed to display fear toward non-social stimuli ("non-social fear", Hsu and Serpell, 2003). According to reports of male owners, later acquisition of their dog seemed to decrease "neuroticism" (Gosling et al., 2003) whereas no such correlation was presented for female owners.

Living with younger owners intact dogs seem to show more frequently "separation-related behaviour" (Hsu and Serpell, 2003), older owner's dogs acquired as a puppy are also more prone to "neuroticism" (Gosling et al., 2003). Owner's age seem to increase the risk of neuroticism in dogs acquired as puppy or as adult, but no such trend was found in dogs that joined the family between 3 and 12 months of age. Younger owners of untrained dogs report more "social fear" (Hsu and Sun, 2010). In the case of "non-social fear" (Hsu and Serpell, 2003) dogs living with younger females are reported to be more fearful, in contrast a reverse trend was indicated for older people.

4. General discussion

In this study we developed a questionnaire from the relevant previous studies in order to facilitate the standardization of measurements of fear in dogs. The aim of the present exploratory analysis was to see which aspects of fear do emerge as distinct factors when measuring fear in dogs with our consensus questionnaire.

Table 5
Results of the GLM analysis on the original fear-related traits.

Name of the trait	Fixed factors	Statistics
Fearfulness (Jones, 2008)	<ul style="list-style-type: none"> • Dog gender × living place of the dog • Breed category 	$F_{(2,579)} = 3.641, p = 0.027$ $F_{(6,579)} = 8.538, p < 0.001$
Negative activation (Sheppard and Mills, 2002)	<ul style="list-style-type: none"> • Dog gender × living place of the dog • Dog gender × dog age • Dog age × age at acquisition • Breed category 	$F_{(2,579)} = 3.844, p = 0.022$ $F_{(1,579)} = 6.615, p < 0.01$ $F_{(1,579)} = 5.225, p = 0.006$ $F_{(6,579)} = 8.206, p < 0.001$
Neuroticism/emotional reactivity (Gosling et al., 2003)	<ul style="list-style-type: none"> • Dog gender • Owner gender × age at acquisition • Owner age × age at acquisition • Breed category 	$F_{(1,579)} = 4.732, p < 0.01$ $F_{(2,579)} = 3.442, p = 0.033$ $F_{(6,579)} = 2.944, p = 0.006$ $F_{(6,579)} = 6.795, p < 0.001$
Non-social fear (Hsu and Serpell, 2003)	<ul style="list-style-type: none"> • Dog gender × living place of the dog • Dog gender × age at acquisition • Owner age × owner gender • Breed category 	$F_{(2,579)} = 4.023, p = 0.018$ $F_{(4,579)} = 5.065, p = 0.001$ $F_{(3,579)} = 3.691, p = 0.012$ $F_{(6,579)} = 8.219, p < 0.001$
Social fear (Hsu and Sun, 2010)	<ul style="list-style-type: none"> • Dog gender • Age at acquisition • Owner age × training experience • Breed category 	$F_{(1,579)} = 3.537, p < 0.001$ $F_{(2,579)} = 4.145, p = 0.016$ $F_{(3,579)} = 3.230, p = 0.022$ $F_{(6,579)} = 7.636, p < 0.001$
Separation-related behaviour (Hsu and Serpell, 2003)	<ul style="list-style-type: none"> • Dog age × living place of the dog • Owner age × neutering • Training experience 	$F_{(6,579)} = 5.245, p = 0.006$ $F_{(3,579)} = 2.862, p < 0.036$ $F_{(1,579)} = 4.555, p = 0.033$

Our results showed that the seven fear-related traits (factors) of the previous studies were not reproducible on our new, independent sample in Hungary, however according to Cronbach's alpha they were reliable. The joined measure of these questionnaire traits, however, offered the possibility to search for a consensus questionnaire which relies on the most informative items. Our efforts led to a four trait solution which provides measures for important aspects of fear-related behaviour. Neuroticism, fear from dogs, humans and separation-related behaviour have been identified as most significant in evoking fear in dogs.

The first trait (neuroticism) aims to measure fear as an individual tendency. This trait based on items from 4 different questionnaires which correlate with the cautious or nervous behaviour in strange situations/places or to sudden visual/acoustic stimuli and includes also specific items used to describe noise phobia (Sheppard and Mills, 2002; Gosling et al., 2003; Hsu and Serpell, 2003; Jones, 2008).

The second and third trait (dog-directed and human-directed fear) reveal the dogs' tendency to behave in a certain way in these specific social contexts (Jones, 2008; Hsu and Sun, 2010). Both traits are closely similar to that reported by Serpell and Hsu (2001), Hsu and Serpell (2003), Serpell and Hsu (2005), Hsu and Sun (2010); so our results support their findings.

Similarly, our fourth trait (separation-related behaviour) closely resembles that of Hsu and Serpell (2003) and Blackwell et al. (2008).

However, the secondary PCA showed, that separation related behaviour problem may be a separate trait from other, fear-related behaviours. Three of our traits (neuroticism, dog- and human-directed fear) comprised one factor, while separation-related behaviour comprised another. This finding was also supported by a secondary PCA on the seven original traits from the previous studies. Five of those traits ("social fear" (Hsu and Sun, 2010); "non-social fear" (Hsu and Serpell, 2003); "negative activation" (Sheppard and Mills, 2002); "fearfulness" (Jones,

2008); "neuroticism/emotional reactivity" (Gosling et al., 2003)) comprised one factor, while "separation-related behaviour" (Hsu and Serpell, 2003) and "separation problem" (Blackwell et al., 2008) comprised another. This suggests that separation anxiety may emerge without necessity to have a general fearful attitude in other contexts and that the tendency to react with fear to a specific situation can be captured both from a more general perspective, and also looking at specific fear-eliciting contexts. Jones and Gosling found traits related to the fearfulness (frequently overlapped with reactivity) dimension in 43 of the investigated 50 publications. Thus a tendency to react (or not to react) fearfully (see Section 1) seems to be a valid personality trait in dogs, however, it does not predict proneness to show separation related behaviour.

We investigated which intrinsic and extrinsic (environmental) variables did associate with our four traits. Neuroticism showed association with the dog breed group and the time of acquisition. The dogs of female owners and untrained dogs of young owners showed higher level of human-related fear. Female dogs showed more fearful behaviours toward other dogs. We found that living in the flat or in the flat and in the garden positively associated with the separation-related behaviours in case of younger owners. This association could be due to the fact that younger people might leave their dogs alone more frequently than older people.

We performed separate backward GLMs also on each questionnaire trait from the original investigations to examine the correspondence between the dogs' scores and their demographic characteristics. The GLMs on the original seven traits mirrored the variation found in the literature. Mixed breed and toy dogs were reported to show higher levels of fear in most cases than dogs belonging to other breed groups. Similar findings were revealed in previous studies: more nervousness, higher risk of separation-related problems and fear reaction to noises were showed in mixed breed compared to purebred (McCrave, 1991;

Bennett and Rohlf, 2007; Takeuchi et al., 2001; Blackwell et al., 2013). Furthermore it should be noted that breed or breed group and size is not independent, so our results may also reflect difference in size, that is, toy dogs may have reported to show more fear because of their small size, as previously researchers found smaller dogs (<20 kg) to be more anxious, neurotic and fearful (Ley et al., 2009; Arhant et al., 2010). In contrast, breed categories did not affect the emergence of separation related behaviour problems. Thus it seems that in our case dogs belonging to any breed group and mixed breed are equally likely to develop this condition.

Female dogs obtained higher scores in “neuroticism” (Gosling et al., 2003) and “fearfulness” (Jones, 2008) but in the case of the latter the effect was limited to flat-living dogs only. Previous research did not implicate the role of keeping condition in the development of such tendencies.

Dogs that joined as puppies to the household showed lower levels of “neuroticism” (Gosling et al., 2003). A relatively similar pattern was found in the case of “social fear” (Hsu and Sun, 2010) and “non-social fear” (Hsu and Serpell, 2003), partly reproduced in the present investigation. Social fear could be also reduced by early adoption, reflecting the well-known fact that early learning experience is very important in learning both about the non-social and social environment (Mirkó et al. 2012; Overall et al. 2001; Pongrácz et al. 2012; Reynaud et al. 2012; Takeuchi et al., 2000; Serpell and Jagoe, 1995).

In the case of the “separation-related behaviour” trait (Hsu and Serpell, 2003) we found that older dogs living in flats tended to show more separation-related behaviours in contrast to Blackwell et al. (2008) which study found negative association between the age of the dog and the separation-related problems. We could not find correlation between the gender and the separation-related problems. Previously male dogs were found more likely to show separation-related distress (Voith and Borchelt, 1985; Takeuchi et al., 2000; Takeuchi et al., 2001; McGreevy and Masters, 2008; Konok et al., 2011) than females.

The divergence in the association between the different fear-related traits and the intrinsic and extrinsic (environmental) variables may be caused by several factors.

First, some differences relate to the different approach presented by these measures. As indicated above some traits like fearfulness or neuroticism target a general underlying mental mechanism that works independently from the actual context and is individual specific. In contrast, other traits are more situation and target specific, such as fearful behaviour shown toward humans or dogs or other non-social situations (e.g. from objects, noise, etc). From the behavioural point of view it should be noted that for a family dog the social relationship with humans and dogs can be very different. Although one may expect a general sociable (non-fearful) attitude toward both humans and dogs at the individual level, there is a chance that this tendency is distorted during development,

because the intra-specific and inter-specific interaction take place under different conditions with usually different functions. For example, dogs may be more often competing against each other than humans, and specific deprivation in early socialization with either dogs (puppies have no contact with other dogs) or humans (puppies do not experience human contact) could also affect fearfulness differently.

Second, cross-country or cross-nation differences in the socioeconomics of dog keeping can also have an impact on the perceived differences and risk factors (e.g. Wan et al., 2009). Neutering practices, socialization methods, and the prevalence of dog training can influence whether specific risk factors emerge in a specific study. For example, the present study attracted only a relatively small number of male dog owners as well as young dog owners, thus gender and age effects found for humans have to be treated with caution.

5. Conclusions

We have developed a consensus questionnaire from relevant previous studies to measure fear-related traits. Our efforts led to a four trait solution (neuroticism, dog-related fear, human-related fear, separation-related behaviour) which provides measures for important aspects of fear-related behaviour. Our results showed that separation related behaviour is a separate trait from the other aspects of fear behaviour.

We could not recover the original factors from the previous studies; however, we could validate them. Different intrinsic and extrinsic (environmental) variables associated with the aspects of fear.

Observing recent development in the field we would urge behavioural researchers to move toward stronger consensus in measuring specific personality traits (or other complex aspects of behaviour), instead of developing global behavioural inventories based on questionnaires. The standardization of specific trait measures could still leave space for constructing further more specific tools but would also offer a greater comparability of research across dog and human populations. Our consensus questionnaire, which is based on a relatively small number of questions, provides this advantage to the researchers.

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Appendix 1

Table A1

Table A1

The items of the consensus questionnaire (reference publication, original name of the trait, items).

Blackwell et al. (2008)	Separation problem	Chew or destroy items when owner out of the house only Bark or howl when owner out of the house only House-soil when owner out of the house only
Gosling et al. (2003)	Neuroticism/emotional reactivity	Dog is down, depressed, blue Dog is relaxed, handles stress well* Dog can be tense Dog gets nervous easily Dog is emotionally stable, not easily upset* Dog can be moody Dog remains calm in tense situations* Dog worries a lot
Hsu and Serpell (2003) C-BARQ (and modified versions: Marshall-Pescini et al., 2008; Serpell and Hsu, 2005; Duffy et al., 2008)	Nonsocial fear Separation-related behavior	Dog acts anxious or fearful in response to sudden or loud noises Dog acts anxious or fearful in heavy traffic Dog acts anxious or fearful in response to strange or unfamiliar objects on or near the sidewalk Dog acts anxious or fearful during thunderstorms Dog acts anxious or fearful when first exposed to unfamiliar situations Dog acts anxious or fearful in response to wind or wind-blown objects Dog displays shaking, shivering, or trembling when left or about to be left on its own Dog displays excessive salivation when left or about to be left on its own Dog displays restlessness, agitation, or pacing when left or about to be left on its own Dog displays whining when left or about to be left on its own Dog displays barking when left or about to be left on its own Dog displays howling when left or about to be left on its own Dog displays chewing or scratching at doors, floor, windows, and curtains when left or about to be left on its own Dog displays loss of appetite when left or about to be left on its own
Hsu and Sun (2010) modified C-Barq	Social fear	Dog acts anxiously or fearfully when approached directly by an unfamiliar adult while away from home Dog acts anxiously or fearfully when approached directly by an unfamiliar child while away from home Dog acts anxiously or fearfully when unfamiliar persons visit your home Dog acts anxiously or fearfully when an unfamiliar person tries to touch or pet the dog Dog acts anxiously or fearfully when approached directly by an unfamiliar dog of the same or larger size Dog acts anxiously or fearfully when approached directly by an unfamiliar dog of smaller size Dog acts anxiously or fearfully when unfamiliar dogs visit your home Dog acts anxiously or fearfully when barked, growled or lunged at by an unfamiliar dog
Jones (2008) dissertation (short and long version)	Fearfulness	Dog is relaxed when greeting people* Dog is shy Dog behaves fearfully towards unfamiliar people Dog is anxious Dog is confident* Dog adapts easily to new situations and environments* Dog avoids other dogs Dog behaves submissively (e.g., rolls over, avoids eye contact, licks lips) when greeting other dogs Dog behaves fearfully towards other dogs Dog behaves fearfully during visits to the veterinarian Dog exhibits fearful behaviors when restrained Dog behaves fearfully when groomed (e.g., nails trimmed, brushed, bathed, ears cleaned)
Sheppard and Mills (2002)	Negative activation	Your dog is rarely frightened* Your dog is easily startled by noises and/or movements Your dog appears nervous and/or jumpy for several minutes after it has been startled Your dog has a specific fear or phobia Your dog appears calm in noisy, crowded places* Your dog is frightened by noises from the television or radio Your dog usually appears relaxed* Your dog adapts quickly to changes in its environment (e.g. being cared for by different people, moving house or a family member leaving home)* Your dog appears afraid of the vacuum cleaner or any other familiar household appliance Your dog appears calm in unfamiliar environments* Your dog appears unsettled by changes to its routine (e.g. if it is not fed at the usual time, if it is left alone for longer than usual)

* Reversed scored items.

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