

**Project N2019-0005**

Report by a PhD student Salla Mikkola, PhD Milla Salonen and Prof. Hannes Lohi

**Breed differences and risk factors of feline personality and behavior**

A grant (500 000 SEK) was awarded by the Agria Foundation in 2019 to Prof. Hannes Lohi and his research group to study feline personality and behavior, and to identify risk factors of problematic behaviors, such as fearfulness and aggression. For this purpose, the research group had developed a novel comprehensive personality and behavior survey. Due to the ongoing pandemic, the grant period was extended till the end of 2021.

The proposed project had four key aims as follows: 1) Collect large epidemiological data using our user-friendly online survey, 2) Examine the test-retest and inter-rater reliability and validate the survey with multiple approaches, 3) Study personality differences between breeds, 4) Identify the environmental risk factors that affect personality and problematic behavior.

The results of the aims 1-3 have been completed and published in a peer-reviewed article. Two additional manuscripts are under preparation and will cover the goals in the aim 4. The working title of the first manuscript is “Risk factors of fearfulness, aggression toward humans and excessive grooming in Finnish pet cats” and the second manuscript will examine risk factors associated with litterbox issues. We expect to submit both studies to peer review in the next 3-5 months. More details on the progress and dissemination in each aim can be found below.

**Aims 1-3) Data collection, survey validation, personality structure and breed differences**

The article was published in scientific journal *Animals*: Mikkola S, Salonen M, Hakanen E, Sulkama S, Lohi H. Reliability and Validity of Seven Feline Behavior and Personality Traits. *Animals*. 2021; 11(7):1991. <https://doi.org/10.3390/ani11071991>. The related press release can be found here: <https://www.helsinki.fi/en/news/animals/seven-personality-and-behaviour-traits-identified-cats>

In addition, several cat breed organizations requested breed specific summaries of the results and published them in their magazines. This study also raised the interest of the media and yielded media interviews and more than forty local and national lay public magazines, for example:

<https://www.hs.fi/kotimaa/art-2000008250931.html>;

<https://www.helsinginuutiset.fi/paikalliset/4285015>;

<https://dweb.news/sv/2021/09/09/science-researchers-identify-seven-personality-and-behavior-traits-in-cats/>;

<https://www.iflscience.com/plants-and-animals/cats-have-seven-personality-traits-impawtant-study-finds/>;

<https://veterinarian.news/seven-personality-and-behaviour-traits-identified-in-cats/>;

<https://www.natureworldnews.com/articles/47393/20210909/cats-7-personality-traits.htm>.

#### **Aim 4) Identify the risk factors of problematic behavior**

##### *Summary*

This aim includes two manuscripts. The first (man. 1) is being prepared under the working title “Risk factors of fearfulness, aggression toward humans and excessive grooming in Finnish pet cats”. The second manuscript (man. 2) focuses on the risk factors of litterbox issues. The results and conclusions of this aim have not been completed yet due to ongoing analyses. The study material has been collected and prepared for analyses. We expect to complete analyses and submit the two manuscripts in the next 3-5 months.

##### *Introduction and objectives*

Cats are popular pets, but further studies of their behavior are needed to avoid common welfare issues. Problematic behaviors, such as aggressiveness, excessive grooming, and inappropriate elimination<sup>1</sup>, are common reasons for cat relinquishment to an animal shelter<sup>2,3</sup> and can be considered to be remarkable welfare issues in pet cats. Previous literature has identified several factors affecting cat’s probability to develop problematic behavior. For example, genetics can affect personality<sup>4</sup> and thus some cat breeds are more vulnerable to develop certain problematic behaviors<sup>1,5-10</sup>. Other possible factors influencing occurrence of one or more problematic behaviors are age<sup>4,5,9,11</sup>, sex<sup>4,9,10,12,13</sup>, neutering status<sup>14</sup>, quality of early social exposure to people<sup>15</sup>, stress<sup>5</sup>, time spent alone<sup>14</sup>, obtaining age<sup>14</sup>, number of other cats<sup>13,14,16</sup>, obtaining place<sup>5</sup>, playing<sup>17</sup> and opportunity to go outdoors<sup>5,9,11,13,17</sup>.

In this aim, we focus on four problematic behaviors: fearfulness, aggression toward humans, excessive grooming, and litterbox issues, using generalized linear models. The convenience sample of over 3200 Finnish cats was collected using validated feline behavior and personality survey<sup>6</sup>. We inspect the associations of the problematic behaviors and 21 different environmental and demographic factors. In addition, we inspect their association with seven personality and behavior traits.

##### *Methodology*

In this aim, we used the seven personality and behavior traits founded in our previous study<sup>6</sup>. Based on the cat owners’ answers, each cat received a score in fearfulness, activity/playfulness, aggression

toward humans, sociability toward humans, sociability toward cats, litterbox issues, and excessive grooming.

The data set included over 31 questions related to the cat's background and current environment. From these questions, we formed 17 new variables; hormonal status, number of siblings, socialization to humans, socialization to animals, obtaining place, main reason to take the cat, food type, feeding style, number of large scratching trees, number of small scratching trees, how often the owner plays with the cat, outdoor access type, average number of days the cat is left alone during a week, hobbies, number of other cats and owner's previous cat experience/ownership. In addition, we asked about the possible diseases and other health problems the cat could have. For this study, the health information was simplified to yes, no and unknown categories. In addition, we asked "when was the last time your cat was taken to a veterinarian?" and formed groups: less than 6 months ago, 6 - 12 months ago, 1 - 2 years ago, and over 2 years ago, never or unknown.

We used generalized linear models to examine behavioral, demographic and environmental factors associated with fearfulness, aggression toward humans and excessive grooming (man. 1). We constructed three separate models, one for each trait. We first divided the data using 5-fold cross and chose the best models using the package *airGLMs*<sup>18</sup> with the forward stepwise Akaike Information Criterion (AIC) selection approach. As a result, we obtained five different models for each trait. From these models, we selected the variables occurring in every model of the specific trait. For example, feeding style occurred only in two fearfulness models out of five and it was not part of the final fearfulness model. In addition, we calculated relative influences for all variables. For the final models, we only selected the variables occurring in trait's every model and which relative influences was notable. We will use the same analytical approach for examining the risk factors of litterbox issues (man. 2).

### *Results*

The final generalized linear model for fearfulness included explanatory variables age, sex, breed, main reason taking the cat, outdoor access, socialization to humans, other cats, obtaining place, excessive grooming, litterbox issues, sociability toward humans, and aggression toward humans.

The final generalized linear model for aggression toward humans included explanatory variables age, sex, breed, obtaining place, time since the last veterinarian visit, fearfulness, sociability toward cats, excessive grooming, activity/playfulness, litterbox issues, other cats, and sociability toward humans.

The final generalized linear model for excessive grooming included explanatory variables age, sex, breed, health problems, outdoor access, aggression toward humans, litterbox issues, sociability toward humans, and fearfulness.

We have not yet completed the analyses of the risk factors associated with litterbox issues (man. 2).

### *Discussion*

The first manuscript of this aim indicates that fearfulness, aggression toward humans and excessive grooming are affected by other personality and behavior traits, and environmental variables as well as demographic factors. In general, individual effects of environmental variables were smaller than effects of personality, behavior or cat's breed. This may suggest that personality and behavior is strongly genetic.

Fearful cats had both more aggression toward humans and excessive self-grooming, possibly indicating that fearfulness is an important personality trait which affects other personality dimensions as well. As good socialization to humans was associated with lower fearfulness, we may expect that good socialization is beneficial for the two correlated traits as well. Results suggest that yearly health checks are recommended to avoid aggression related to pain.

We hypothesize that similar risk factors also associate with litterbox issues. We expect to discover that breed differences persist despite the inclusion of other demographic, environmental, and behavioral variables. We also expect to discover behavioral correlates and anticipate that their effects are larger than the effects on environmental factors.

In future, long-term experiments are needed to reveal real causality of founded variables. Furthermore, these associations could be examined in a different cat population to validate our discoveries.

### *Literature*

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