Three statistical methods to analyze breed differences in the behavioral response to a challenging situation in kittens

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Introduction

In a previous study [1], the behavior of Oriental, Siamese and Abyssinian kittens (OSA-k) was compared with that of Norvegian Forest kittens (NFO-k). Interesting breed differences emerged. In the present study, further statistical analsyses were carried out at different levels of complexity to supply a broad set of results. Outcomes were matched toghether in order to satisfactorily explain behavioral differences observed in the kittens during the response to a challenging situation.

Materials and methods

Pure breed kittens were supplied by ANFI (Associazione Nazionale Felina Italiana) and SCC (Serenissima Cat Club) cat breeders. 43 OSA-k and 39 NFO-k were exposed weekly to a 12 minute Open Field Test (OFT) from the 4th to the 10th week of age. The OFT arena was a white rounded box (1,80 m diameter); on the floor there was a cylindrical container as novel object (NO). In each session a randomly chosen kitten was introduced in the arena. After six minutes (First Part of the test - FP), a potentially aversive stimulus (AS) was produced by the sudden opening of the NO and the abrupt exit of a metal spring. The test lasted 6 more minutes (Second part of the test - SP) and the kitten was then removed from the arena.

Data collection procedures

Animal identification: schedule, pedigree name, mother, sex and coat colour were noted for each animal.

Behavioral data: all OFT were recorded with a video camera (Sony HandyCam®) placed outside the arena. Videos were downloaded on a PC using Microsoft® Windows® MovieMaker 5.1. Two trained operators registered the duration of behaviors over a total of 720 seconds (360 seconds - FP; 360 seconds - SP), according to predefined categories by focal animal sampling [2].

Data analysis

All data were analyzed using SAS 9.1 (SAS 2003, USA). The following statistical analyses were carried out:

Principal Components Analysis (PCA): data were introduced as mean values across animals to explore association between behaviors, breed, week and FP/SP.

Analysis of Variance with repeated measurements (ANOVA); to compare mean durations of each behavior among breeds, FP/SP and weeks (considered as a factor) and their interactions;

Generalized Random Effect Model, with two different specifications for the error term:

- Gamma distribution, with durations as dependent variable, in order to evaluate behavioural trends along weeks, defined as a covariate; quadratic term was included to assess the existence of non-linear trends;

- Binomial distribution, where the dependent variable was a dummy variable describing the presence or absence of a single behavior; the model assessed changes in the probability of performing a certain behavoiur in breeds, FP/SP and their interactions.

Results and discussion

The PCA showed two components explaining over 90% of the variability in behavioral patterns. The first principal component could describe "anxiety", with "anxious" behaviors like crouched and escape attempts on one extreme and "relaxed" behaviors, like walking and exploring floor on the other; anxious behaviors appeared to be associated with SP in both breeds, suggesting that AS was actually frightening; NFO-k were associated with escape attempts, OSA-k with the crouched posture. The second principal component seemed to be linked to "interest in exploration" or "curiosity", as there was a regular increase of explorative behaviors through the axis. Behaviors indicative of curiosity were on the same side of the plot of NFO-k during FP and SP.

The hypothesis was that OSA-k would passively face a challenging situation. In NFO-k, both novelty and fear would induce an active strategy. Our suggestions were validated by the further statistical analysis as described above.

ANOVA showed that, during FP, NFO-k explored more than OSA-k ($p<0.001$), but exploration decreased only in NFO-k after AV ($p<0.0001$); during first contact with NO, NFO-k spent more time exploring it ($p=0.021$) than OSA-k; but they increased the latency to enter in contact with it after AS ($p=0.011$). After AS, NFO-k presented a higher increase in resting postures and spent more time in escape attempts ($p=0.034$). In general, OSA-k receded more than NFO-k ($p<0.0001$), but in the latter breed the behavior increased after AV ($p=0.003$). The Binomial Model showed that in both breeds, for all behaviors and among weeks, the longer time animals spent performing a behavior (results from ANOVA), the higher the number of animals that exhibited it.

Analyzing evolution of behaviors with the Gamma Model, interesting changes appeared with time: in NFO-k emerged a strong variation in exploration levels, that increased during the first weeks, achieved its maximum value during central weeks and then decreased in the last weeks. In OSA-k such a modulation did not appear clearly, denoting less interest for the environment. Conversely, in OSA-k this pattern appeared for the behavior escape attempts, whereas in NFO-k this behavior was maintained at the same higher level until the last week.

Conclusions

Globally examined, our results match well with similar results on temperament obtained in other species [3]. A future

research development would be to use a *Multivariate Regression Model* to analyze behavior as a whole, exploring the covariance structure among several behaviors during a fixed time period and the extent of correlation between this structure and the other explanatory variables.

References

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