Anti-predator behavior in two brown frogs: differences in the mean behaviors and in the structure of animal personality variation.

Sergio Castellano (1)*, Luca Falbo (1), Daniele Seglie (2) and Olivier Friard (1)

(1) Department of Life Science and Systems Biology, University of Turin, Via Accademia Albertina 13, 10123 Torino (Italy)
(2) ELEADE Soc. Coop. - C.le Montresco 1, 10010 Chiaverano (TO)

(*) sergio.castellano@unito.it

Parameter used to describe tadpoles' movements

We analyzed the recorded videos with the semi-automatic tracking software DORIS v.0.0.19 (https://github.com/olivierfriard/DORIS.program), an open-source program in Python, which uses the OpenCV library for image processing and a user-friendly graphical interface (GUI) to set the input parameters of the analysis. The program saves, for each video, a table with frame-by-frame Cartesian coordinates of the tracked objects. From the entire set of coordinates, we computed two new variables: the inter-frame speed, which is the Euclidean distance between the tadpole positions in frames f and frame f+1, multiplied by the video frame rate; and the activity state, a binary variable that scores "1" ("moving state") if the inter-frame speed is greater than or equal to 2 cm/s and "0" ("resting state") otherwise. We used this binary variable to compute movement-bout durations. In this case, we considered a bout of movement only when the tadpole was in a moving state in at least five consecutive frames (i.e. we considered only bouts longer than 0.5 s). From these variables, we derived the eight descriptors of tadpole activity.

The first three descriptors were computed on the entire sample of frames and were (i) the mean speed (**mSPEED**), (ii) its standard deviation (**sdSPEED**); and (iii) the activity index (**IND**), defined as the proportion of frames with tadpoles in a "moving state". The remaining five descriptors were computed on the subsample of frames that described the bouts of movements and included: (iv) the number of bouts (**nBOUTS**), (v) their mean duration (**mD_BOUT**), (vi) the mean speed within a bout (**mS_BOUT**), (vii) the mean acceleration (mA_BOUT), and (viii) the mean change in direction (**MCD_BOUT**). To calculate MCD_BOUT, for each frame (with coordinate *x* and *y*), we first computed the angular direction as:

$$D_{i,j} = arctg\left(\frac{y_{i,f} - y_{i,f-1}}{x_{i,f} - x_{i,f-1}}\right)$$

Where *i* indicates the bout and *f* the frame within that bout. We then computed the absolute values of the differences in direction between successive frames, and defined TORTUOSITY as the mean of these differences.

$$MCD\_BOUT = \frac{1}{B}\sum_{i}^{B}\frac{1}{N_i - 1}\sum_{j=2}^{N_i}\left|D_{i,f} - D_{i,f-1}\right|$$

Where *B* is the total number of bouts and N_i is the total number of frames within the bout *i*.