Supplementary material of:
J. Tariel, S. Plénet and É. Luquet (2020)
How do developmental and parental exposures to predation affect personality and immediate behavioural plasticity in the snail Physa acuta?
Proceedings of the Royal Society B
doi: 10.1098/rspb.2020.1761

11/11/2020

Contents

Model equations

In all linear mixel models (LMMs), Y_{jkl} is a single measurement of escape behaviour (time to crawl-out of the water in seconds) of:

- the individual j (j spreads from 1 to 80),
- in the immediate environment k (k = 1 for immediate environment control C and k = 2 for immediate environment predator-cue P),
- at the trial number l (l = 1 for the first trial, l = 2 for the second trial in the immediate environment k).

E_{jkl} is the residual value of the measurement Y_{jkl}. σ^2_{res} is the residual variance.

In our paper, fixed effects parameters were estimated with the LMM3. They are then only detailed in this model.

Linear model 0 (LMM0, null model)

$-log10(Y_{jkl}) = \beta_0 + \text{fixed effects} + E_{jkl}$

$[E_{jkl}] \overset{i.i.d.}{\sim} \mathcal{N}(0, \sigma^2_{res})$

β_0 is the parameter for average intercept.

Linear mixed model 1 (LMM1, random intercept model)

$-log10(\mathrm{Y}_{jkl}) = \beta_0 + \text{fixed effects} + \mathrm{U}_{0j} + \mathrm{E}_{jkl}$

$[\mathrm{E}_{jkl}] \overset{i.i.d.}{\sim} \mathcal{N}(0, \sigma^2_{res})$

$[\mathrm{U}_{0j}] \overset{i.i.d.}{\sim} \mathcal{N}(0, \sigma^2_i)$

U_{0j} is the random intercept value of the individual j. σ^2_i is the variance in intercept, representing group diversity in personality.

Linear mixed model 2 (LMM2, random slope model)

$-log10(\mathrm{Y}_{jkl}) = \beta_0 + \text{fixed effects} + \mathrm{U}_{0j} + \mathrm{U}_{1j} \times x^{(I)}_{jkl} + \mathrm{E}_{jk}$

$[\mathrm{E}_{jkl}] \overset{i.i.d.}{\sim} \mathcal{N}(0, \sigma^2_{res})$

$\begin{bmatrix} \mathrm{U}_{0j} \\ \mathrm{U}_{1j} \end{bmatrix} \overset{i.i.d.}{\sim} \mathcal{N}(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma^2_i & cov_{is} \\ cov_{is} & \sigma^2_s \end{bmatrix})$

$x^{(I)}_{jk}$ is the immediate environment for the individual j with:

- $x^{(I)}_{jk}$ = -0.5 for k = 1 (immediate environment control C)
- $x^{(I)}_{jk}$ = 0.5 for k = 2 (immediate environment predator-cue P)

U_{1j} is the random slope value of the individual j. σ^2_s is the variance in slope, representing group diversity in immediate plasticity.

cov_{is} is the covariance between intercept and slopeand it uses for the calculation of the correlation between intercept and slope: $cor_{is} = \frac{cov_{is}}{\sqrt{\sigma^2_i \times \sigma^2_s}}$.

Linear mixed model 3 (LMM3, model with random intercepts for each combination of developmental and parental environments)

$-log10(\mathrm{Y}_{jkl}) = \beta_0 + \beta_1 \times x^{(W)}_j + \beta_2 \times x^{(I)}_{jk} + \beta_3 \times x^{(D)}_j + \beta_4 \times x^{(P)}_j + \gamma_1 \times x^{(I)}_{jk} \times x^{(D)}_j + \gamma_2 \times x^{(I)}_{jk} \times x^{(P)}_j + \gamma_3 \times x^{(D)}_j \times x^{(P)}_j + \delta_1 \times x^{(I)}_{jk} \times x^{(D)}_j \times x^{(P)}_j + \mathrm{U}_{0j}^{\mathrm{CC}} \times \mathrm{I}^{\mathrm{CC}} + \mathrm{U}_{0j}^{\mathrm{CP}} \times \mathrm{I}^{\mathrm{CP}} + \mathrm{U}_{0j}^{\mathrm{PC}} \times \mathrm{I}^{\mathrm{PC}} + \mathrm{U}_{0j}^{\mathrm{PP}} \times \mathrm{I}^{\mathrm{PP}} + \mathrm{E}_{jkl}$

$[\mathrm{E}_{jkl}] \overset{i.i.d.}{\sim} \mathcal{N}(0, \sigma^2_{res})$

$[\mathrm{U}_{0j}^{\mathrm{CC}}] \overset{i.i.d.}{\sim} \mathcal{N}(0, \sigma^{2,\mathrm{CC}}_i)$

$[\mathrm{U}_{0j}^{\mathrm{CP}}] \overset{i.i.d.}{\sim} \mathcal{N}(0, \sigma^{2,\mathrm{CP}}_i)$

$[\mathrm{U}_{0j}^{\mathrm{PC}}] \overset{i.i.d.}{\sim} \mathcal{N}(0, \sigma^{2,\mathrm{PC}}_i)$

$[\mathrm{U}_{0j}^{\mathrm{PP}}] \overset{i.i.d.}{\sim} \mathcal{N}(0, \sigma^{2,\mathrm{PP}}_i)$

Fixed effects:

β are parameters for main fixed effects, γ are parameters for double-interaction terms and δ is the parameter for the triple-interaction term.

$x^{(W)}_j$ is the snail total weight for the individual j.

$x^{(D)}_j$ is the developmental environment for the individual j with:

- $x_j^{(D)}$ = -0.5 for unexposed snails
- $x_j^{(D)}$ = 0.5 for predator-exposed snails

$x_j^{(P)}$ is the parental environment for the individual j with:

- $x_j^{(P)}$ = -0.5 for snails from unexposed parents
- $x_j^{(P)}$ = 0.5 for snails from predator-exposed parents

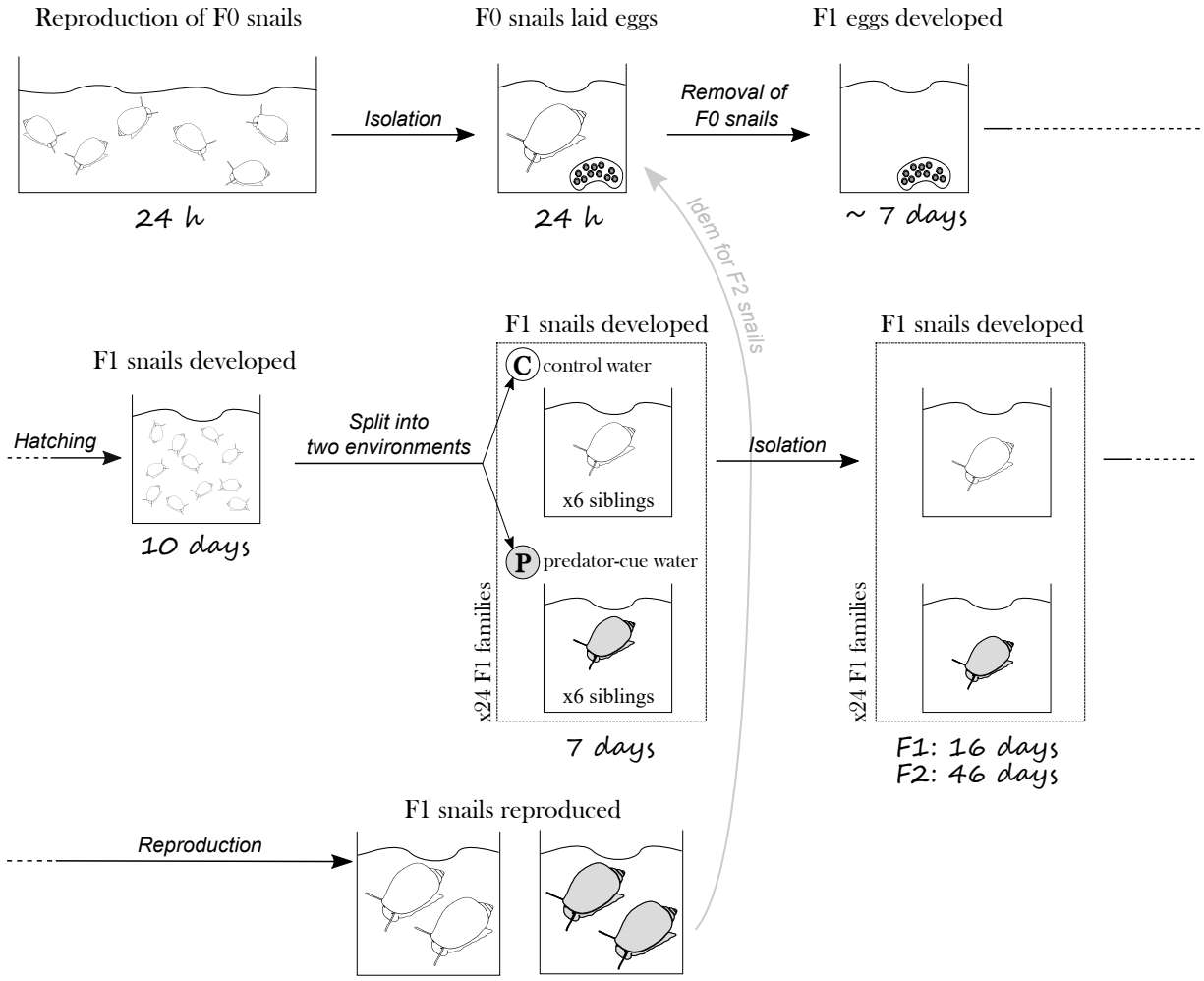
Random effects:

For unexposed snails from predator-exposed parents, U_{0i}^{PC} is the random intercept value of the individual j.$\sigma_i^{2,PC}$ is the variance in intercept, representing group diversity in personality when snails were not exposed to predator cues and from predator-exposed parents. The same logic applied for CC, CP and PP snails.

I^{CC}, I^{CP}, I^{PC}, I^{PP} are dummy variables:

- I^{CC} = 1 if individual j was unexposed from unexposed parents, 0 otherwise
- I^{CP} = 1 if individual j was predator-exposed from unexposed parents, 0 otherwise
- I^{PC} = 1 if individual j was unexposed from predator-exposed parents, 0 otherwise
- I^{PP} = 1 if individual j was predator-exposed from predator-exposed parents, 0 otherwise

Figure of the experimental design



Post-hoc pairwise contrasts for group mean in immediate plasticity

We calculated estimated group means of escape behaviour for each immediate environment and for each combination of parental x developmental environments ("treatment" in the table). We then calculated constrasts between the estimated mean in immediate C environment vs the estimated mean in immediate P environnement for each treatment in order to determine whether the group mean in immediate plasticity was significantly different from 0 (slope different from zero if 95% CI does not overlap zero). We used the package emmeans for the calculations. The table below gives contrasts with their 95% CI.

Treatment	Estimate
CC	0.262 (0.185, 0.336)
CP	0.157 (0.082, 0.229)
PC	0.094 (0.021, 0.169)
PP	0.011 (-0.062, 0.088)