Fish Handicap: if there is an interaction between mutational burden and tempearture shock?

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Background

In experiments 1 and 2 main parameters (temperature, duration, ENU concentration) were tuned. Q - should we tune also the period of the exposition (eye stage - or before or after)? Here, we analyze results of experiment number 3 performed in Dmitrovo There are 4 families (two females and two males) there are 60 Petri dishes: 5 replications * 3 ENU (0,1,2) * 4 temperature conditions (38 degrees for 0, 30, 40 and 50 minutes; the base temperature is ~21) For each of four families (female X male) sefveral combinations of parameters were used: ENU (0,1,2) and temperature shocks (temperature and duration) For each family five replications were used (5 Petri dishes) with 4 independent phenotypes, approximating fitness: (i) fertilized or not, (ii) hatched or not, (iii) swimming normally or not, (iv) swimming weirdly or not? Shock was applied on day 2-3 (eye stage) after fertilization and before hatching. several fishes from 8 combinations (family x ENU) will be maintained in aquariums for one year to approximate fitness better. Q: is it ENU or shock? The key question: does decrease in fitness due to ENU interact with increase in fitness due to temperature?

1. Read and describe data from the main (third) experiment

```
Fish = read.table('../data/fishes_shok.txt', header=TRUE)

head(Fish)
```

```
##   petri family    mode mode_scr temperature time enu dead alive total
## 1     1    1x1 control     ctrl           0    0   0    9    45    54
## 2     2    1x1 control     ctrl           0    0   0    4    20    24
## 3     3    1x1 control     ctrl           0    0   0    4    40    44
## 4     4    1x1 control     ctrl           0    0   0    2    20    22
## 5     5    1x1 control     ctrl           0    0   0    5    21    26
## 6     6    1x2 control     ctrl           0    0   0    2    14    16
##   fertilization_per hatched hatched_per swimming freaks swim_per freaks_per
## 1          83.33333      26    57.77778       23      3 88.46154  11.538462
## 2          83.33333       9    45.00000        5      4 55.55556  44.444444
## 3          90.90909      11    27.50000       10      0 90.90909   0.000000
## 4          90.90909       9    45.00000        8      1 88.88889  11.111111
## 5          80.76923      12    57.14286       11      1 91.66667   8.333333
## 6          87.50000       8    57.14286        4      4 50.00000  50.000000
```

```
table(Fish$family)
```

```
##
## 1x1 1x2 2x1 2x2
##  60  60  60  60
```

```
table(Fish$temperature)
```

```
##
##   0  38
##  60 180
```

```
table(Fish$time)
```

```
##
##  0 30 40 50
## 60 60 60 60
```

```
summary(Fish$fertilization_per)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00   50.00   72.85   66.89   86.89  100.00
```

```
summary(Fish$hatched_per)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   5.801  40.270  39.836  65.868 100.000
```

```
summary(Fish$swim_per)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   6.818  58.477  52.766  84.531 240.000
```

PROBLEMS: 1. there is one Fish$swim_per == 240 which we need to delete 2. there is one where

```
Problem1 = Fish[Fish$swim_per > 100,]
Problem2 = Fish[Fish$swimming + Fish$freaks > Fish$hatched,]
Problem3 = Fish[Fish$hatched > Fish$alive,] # 0
Problem4 = Fish[Fish$alive > Fish$total,]   # 0

Problems = rbind(Problem1,Problem2)
Problems
```

```
##      petri family            mode   mode_scr temperature time enu dead alive
## 139    139    2x2 38_30_min_ENU_1  38_30_en1          38   30   1   24    19
## 30      30    1x2   control_enu_1    ctrl_e1           0    0   1   63    34
## 31      31    2x1   control_enu_1    ctrl_e1           0    0   1    3    34
## 36      36    2x2   control_enu_1    ctrl_e1           0    0   1    3    13
## 38      38    2x2   control_enu_1    ctrl_e1           0    0   1    7    57
## 39      39    2x2   control_enu_1    ctrl_e1           0    0   1   15    22
## 87      87    1x2  38_40_min_ctrl 38_40_ctrl          38   40   0   20    71
## 133    133    2x1 38_30_min_ENU_1  38_30_en1          38   30   1    7    26
## 1391   139    2x2 38_30_min_ENU_1  38_30_en1          38   30   1   24    19
##      total fertilization_per hatched hatched_per swimming freaks  swim_per
## 139     43          44.18605      10    52.63158       24      5 240.00000
## 30      97          35.05155      16    47.05882       12      5  75.00000
## 31      37          91.89189      30    88.23529       30      8 100.00000
## 36      16          81.25000      13   100.00000        2     12  15.38462
## 38      64          89.06250      50    87.71930       22     30  44.00000
## 39      37          59.45946      22   100.00000        7     16  31.81818
## 87      91          78.02198      46    64.78873       36     11  78.26087
## 133     33          78.78788      21    80.76923       13     12  61.90476
## 1391    43          44.18605      10    52.63158       24      5 240.00000
##      freaks_per
```

```
## 139    50.00000
## 30     31.25000
## 31     26.66667
## 36     92.30769
## 38     60.00000
## 39     72.72727
## 87     23.91304
## 133    57.14286
## 1391   50.00000
```

```
dim(Fish)
```

```
## [1] 240  17
```

```
Fish = Fish[!Fish$petri %in% Problems$petri,]
dim(Fish)
```

```
## [1] 232  17
```

2. turn the Petri-dish table to the individual level table, where each line is dedicated to one egg

---

```
for (i in 1:nrow(Fish))
{ # i = 3
  OnePetriDish = Fish[i,]

  New = cbind(
    rep(OnePetriDish$petri,OnePetriDish$total),
    rep(OnePetriDish$family,OnePetriDish$total),
    rep(OnePetriDish$temperature,OnePetriDish$total),
    rep(OnePetriDish$time,OnePetriDish$total),
    rep(OnePetriDish$enu,OnePetriDish$total),
    c(rep(1,OnePetriDish$alive),rep(0,OnePetriDish$dead)),
    c(rep(1,OnePetriDish$hatched),rep(0,OnePetriDish$alive - OnePetriDish$hatched),rep(NA,OnePetriDish$
    c(rep(1,OnePetriDish$swimming + OnePetriDish$freaks),rep(0,OnePetriDish$hatched - OnePetriDish$swimm
    c(rep(1,OnePetriDish$swimming),rep(0,OnePetriDish$freaks),rep(NA,OnePetriDish$total-OnePetriDish$sw

  )
  New = data.frame(New)
  names(New)=c('petri','family','temperature','time','enu','FertilizedOrNot','HatchedOrNot','SwimmingOr

  if (i == 1) {Final = New}
  if (i >  1) {Final = rbind(Final,New)}
}
```

3. run analyses
