Simulation description

The goal of the simulation was to find optimal plasticity for different values of the environmental cue received at time 1 ($C_1$). The value of $C_1$ was varied from −4 to +4 in 100 steps of 0.08 each. Individual plasticity ($P$) was varied from 0 to 1.5 in 75 steps of 0.02 each. For each combination of $C_1$ and $P$, environmental states at time 1, 2, and 3, and environmental cues at time 2, were generated stochastically for 10,000 individuals as described by Eq. 1-4.

The true state of the environment at time 1 ($E_1$) was computed as

$$E_1 = r_c C_1 + X_1$$  \hspace{1cm} (Eq. 1)\]

where $r_c$ is cue reliability and $X_1$ is a normally distributed random variable with mean = 0 and variance = 1. As a result, environmental states were also normally distributed, with mean = $r_c C_1$ and variance = 1.

The true environmental state at time 2 ($E_2$) was computed as

$$E_2 = \sqrt{r_E} E_1 + (1 - r_E) X_2$$  \hspace{1cm} (Eq. 2)\]

where $r_E$ is a parameter quantifying environmental stability and $X_2$ is a normally distributed random variable with mean = 0 and variance = 1. This ensures that environmental states at time 2 also have variance = 1. Note that $r_E$ is defined as the autocorrelation between environmental states at time 1 and time 3 (see Figure 2 in the main article); accordingly, the autocorrelation between $E_1$ and $E_2$ and that between $E_2$ and $E_3$ are both set to $\sqrt{r_E}$.

The environmental cue received at time 2 and the true environmental state at time 3 ($E_3$) were computed as

$$C_2 = r_c E_2 + (1 - r_c^2) X_3$$  \hspace{1cm} (Eq. 3)\]

and

$$E_3 = \sqrt{r_E} E_2 + (1 - r_E) X_4$$  \hspace{1cm} (Eq. 4)\]

where $X_3$ and $X_4$ are normally distributed with mean = 0 and variance = 1.

For each simulated individual, the adult phenotype ($A$) was determined by a crossover interaction between plasticity and the cue received at time 2 ($C_2$):
\[ A = PC_2. \] \hspace{1cm} (Eq. 5)

The crossover point (i.e., the point at which reaction norms with different plasticity cross) corresponds to \( C_2 = 0 \).

Individual fitness \( (W) \) was computed with a Gaussian fitness function with mean \( E_3 \) and standard deviation \( = 2 \), as follows:

\[
W = \frac{1}{2\sqrt{2\pi}} e^{\frac{(A-E_3)^2}{16}}. \hspace{1cm} (Eq. 6)
\]

In Eq. 6, fitness is maximized when the adult phenotype matches the state of the environment at time 3 (i.e., when \( A = E_3 \)). A standard deviation of 2 for the fitness function was chosen to ensure a gradual fitness decline over the range of simulated environmental states (Figure A1). However, the qualitative results of the simulation were not affected by the exact value of this parameter.

![Fitness function for different values of the adult phenotype.](image)

\( Figure \ A1. \) Fitness function for different values of the adult phenotype. \( A = \) adult phenotype; \( E_3 = \) environmental state at time 3; \( W = \) fitness.

For each combination of \( C_1 \) and \( P \), expected fitness was computed as the average fitness \( (\bar{W}) \) of the 10,000 simulated individuals. Finally, the optimal level of plasticity \( (P^*) \) was determined for each value of \( C_1 \) as the value of \( P \) with the maximum expected fitness.

The simulation was performed in R\textsuperscript{TM} 2.15 (R Core Team, 2012. \textit{R: A language and environment for statistical computing}. R Foundation for Statistical Computing, Vienna, Austria).