

Supplementary material for

**“Trait Specialization, Innovation and the Evolution
of Culture in Fluctuating Environments”**

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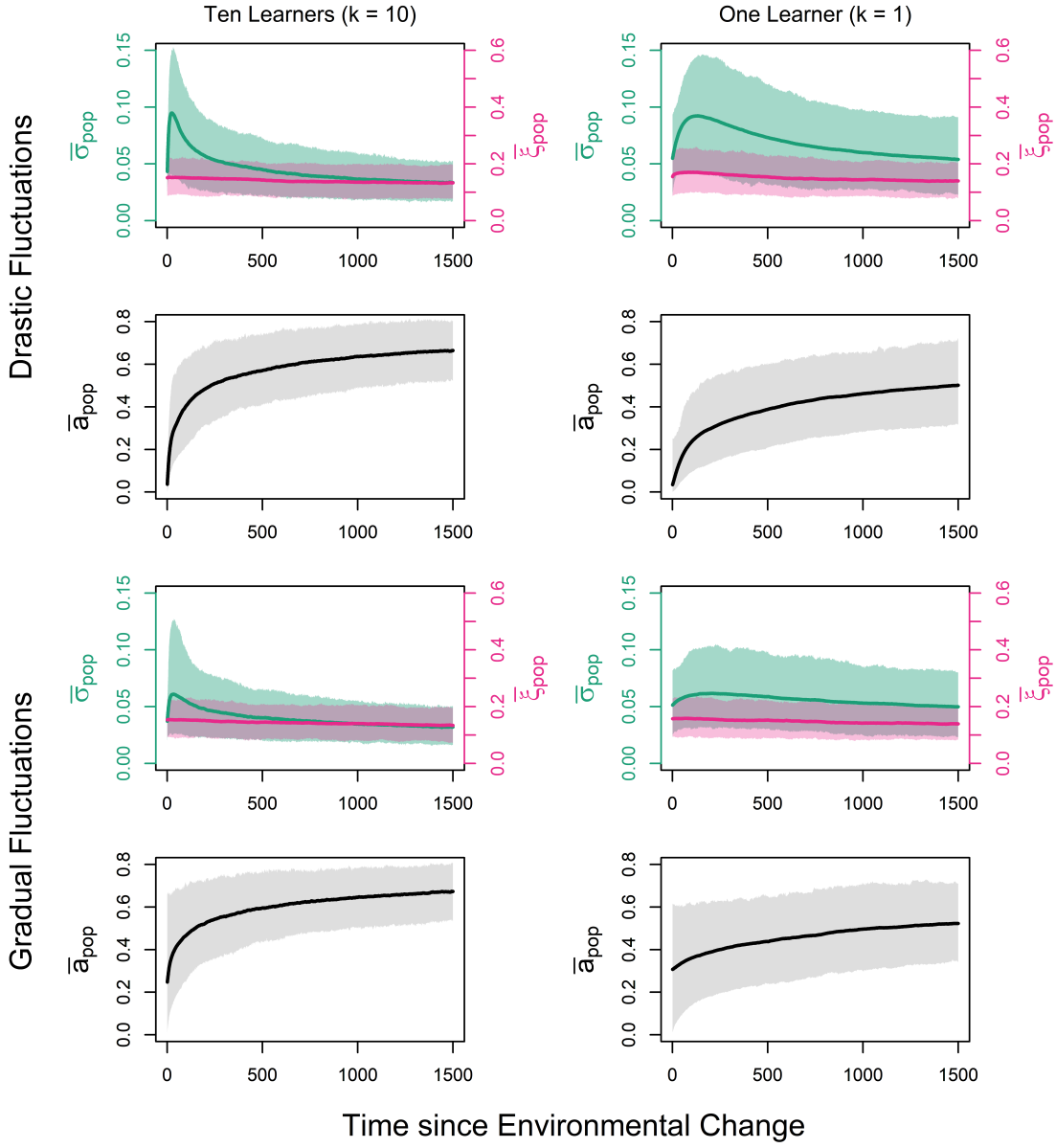


Figure A1. Adaptation dynamics for simulations where individuals can learn from whole population at any time for $k = 10$ (left column) and $k = 1$ (right column). Top panels show drastically changing environments, bottom panels gradually changing environments (with $\sigma_\varepsilon = 0.05$). The solid pink lines illustrate the mean level of innovation, $\bar{\xi}_{\text{pop}}$, in the population over time, the solid green lines show the mean level of generality, $\bar{\sigma}_{\text{pop}}$, and black lines show the mean adaptation level, \bar{a}_{pop} . The shaded areas represent the corresponding 90% PIs obtained from 500 independent simulations.

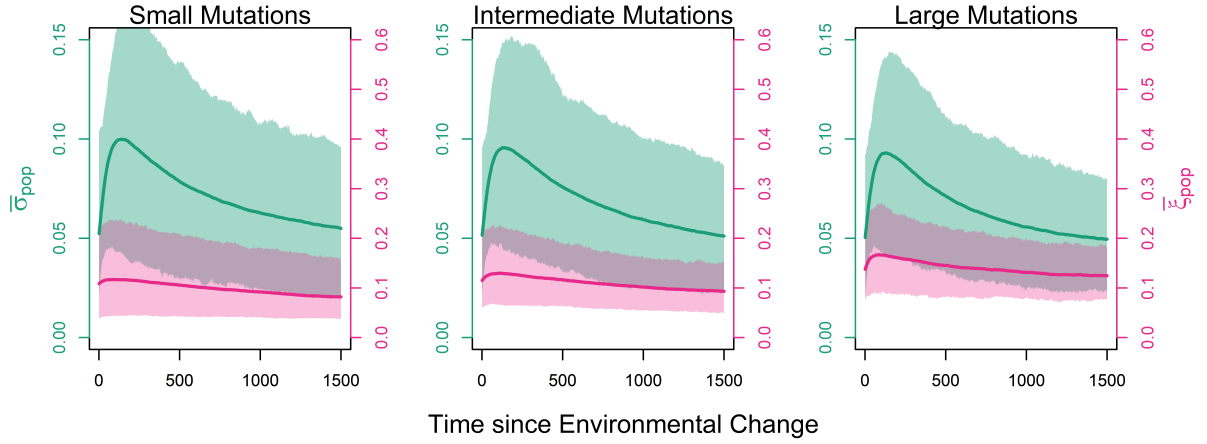


Figure A2. Results for different magnitudes, δ of gradual mutations with $k = 1$ and drastically changing environments. Small magnitudes on the left ($\sigma_\xi = 0.05$), intermediate magnitudes in the middle ($\sigma_\xi = 0.1$) and large magnitudes on the right ($\sigma_\xi = 0.3$) The solid pink lines illustrate the mean level of innovation, $\bar{\xi}_{\text{pop}}$, in the population over time and the solid green lines show the mean level of generality, $\bar{\sigma}_{\text{pop}}$. The shaded areas represent the corresponding 90% PIs obtained from 500 independent simulations.

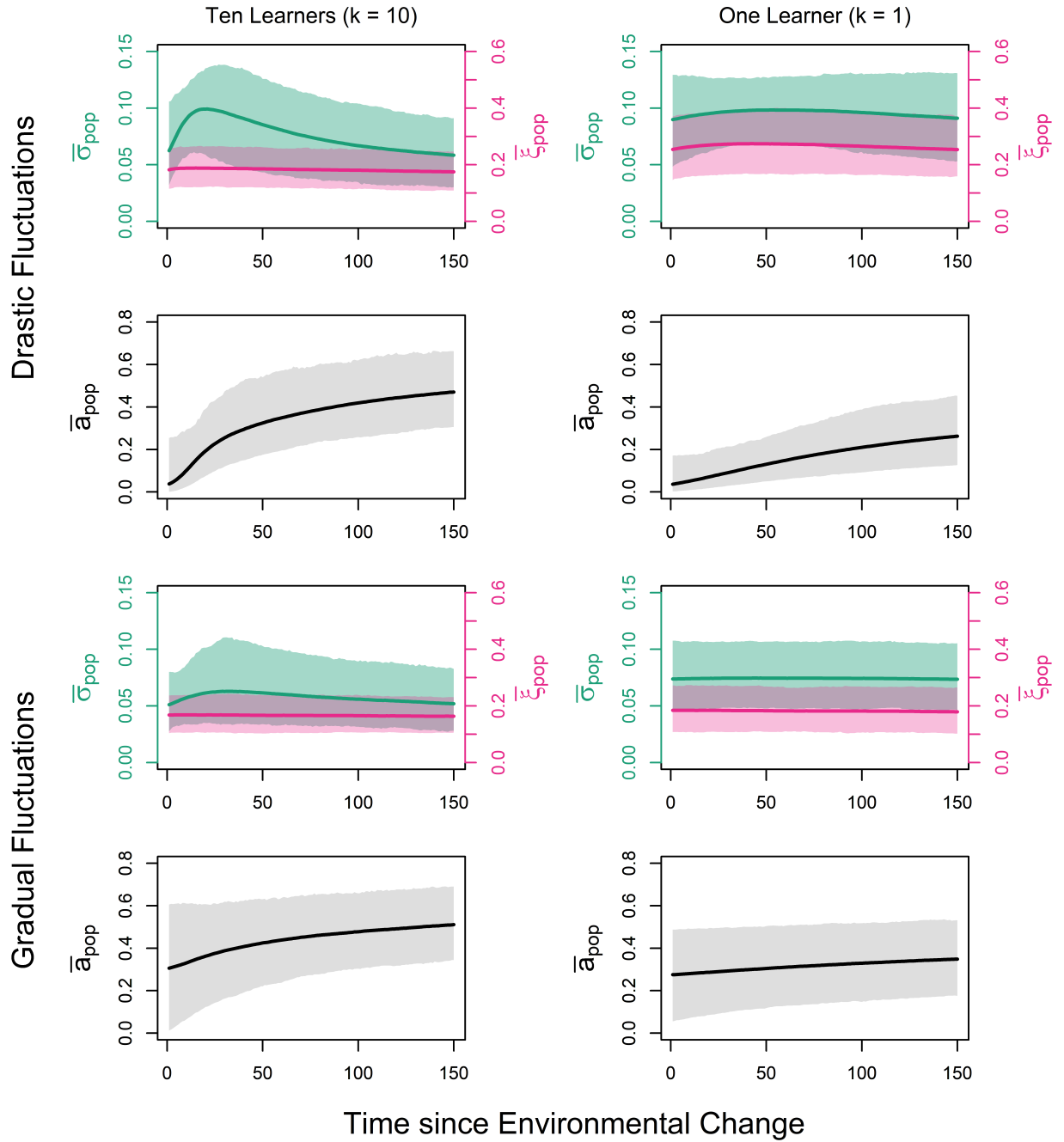


Figure A3. Adaptation dynamics in relatively unstable environments ($\varepsilon = 0.01$) for $k = 10$ (left column) and $k = 1$ (right column). Top panels show drastically changing environments, bottom panels gradually changing environments (with $\sigma_\varepsilon = 0.05$). The solid pink lines illustrate the mean level of innovation, $\bar{\xi}_{\text{pop}}$, in the population over time, the solid green lines show the mean level of generality, $\bar{\sigma}_{\text{pop}}$, and black lines show the mean adaptation level, \bar{a}_{pop} . The shaded areas represent the corresponding 90% PIs obtained from 1,000 independent simulations.

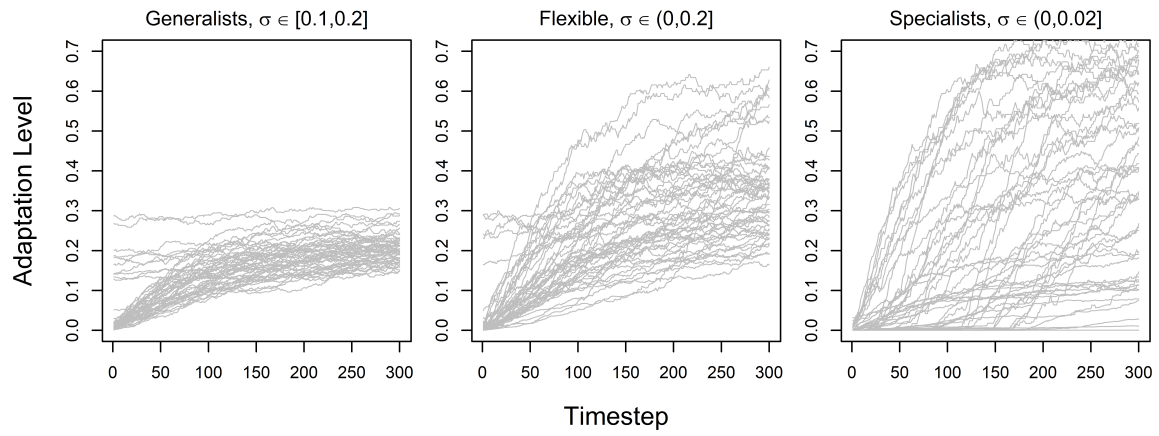


Figure A4. Adaptation levels for 50 randomly selected simulation runs. Results for generalist variants are shown in the left figure, for flexible variants in the middle figure and for specialist variants in the right figure.

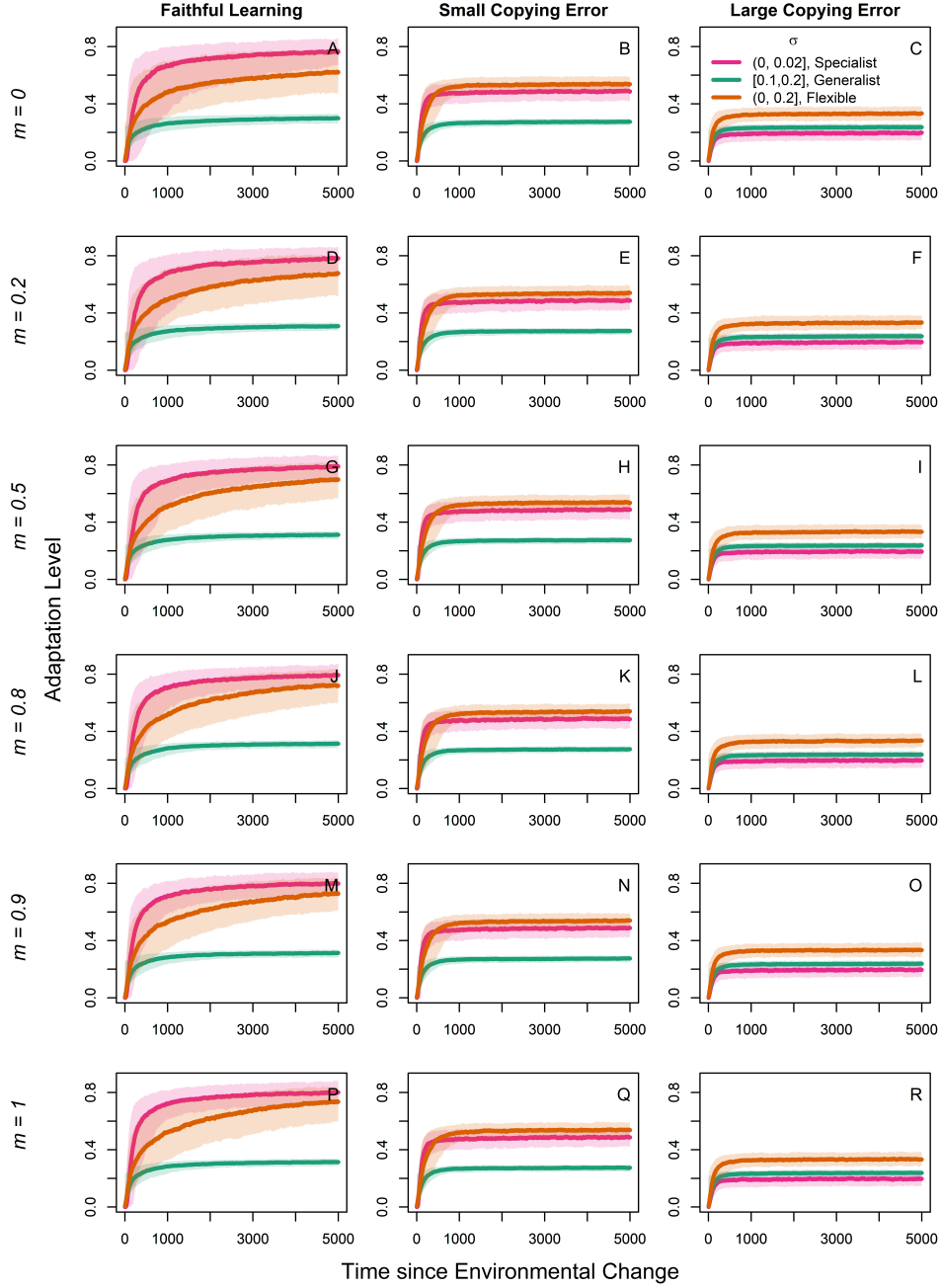


Figure A5. Comparison of mean adaptation levels (and 90% PIs) of populations with $k = 1$, specialist variants ($\sigma_i \in (0, 0.02]$, solid pink lines and light pink-shaded areas), flexible variants ($\sigma_i \in (0, 0.2]$, solid yellow lines and light yellow-shaded areas) and generalist variants ($\sigma_i \in [0.1, 0.2]$, solid green lines and green-shaded areas). Rows show results for 0%, 20%, 50%, 80%, 90% and 100% modifications, respectively. Columns show results for faithful learning (left), small copying error ($\sigma_{\text{error}} = 0.01$; center) and large copying error ($\sigma_{\text{error}} = 0.05$; right).