**Week 9: Plasticity**

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| 7 groups | 27+ participants |

**Summary:** Groups discussed phenotypic plasticity based on Waddington’s classic work (*Evolution* 1953) and Schaum and Collins 2014 paper on evolution in marine algae (*Proc. Of the Royal Society B*).

**1. Compare and contrast the two experiments. In what ways are they similar and different?**

* Both experiments empirically demonstrated genetic assimilation in an environmentally induced trait. However, there were some fairly significant differences among studies:
  + Waddington chose trait with no ecological relevance or fitness consequence, while Schaum paper chose ecologically relevant traits with fitness consequences.
  + Waddington used artificial selection, Schaum used natural selection.
  + Waddington focused on stable exposure to environmental stressor, Schaum focused on fluctuating exposure.
  + Schaum used 7 starting strains, while Waddington used only one.
  + Waddington performed back crosses to identify genetic architecture, Schaum did not.
  + Waddington showed that direction of selection is unidirectional while Schaum showed that evolved trait was in opposite direction of the evolved response.

**2. How does plasticity in ancestral populations determine evolutionary trajectory?**

* The more plastic the population, the more those populations seemed to evolve.
  + In Schaum paper, Ostreococcus lineages founded from more plastic ancestors evolved more in high pCO2 environments than lineages founded on less plastic ancestors.
  + Plasticity can reveal underlying genetic variation that selection can act upon. If no underlying variation, then they may not adapt.
  + For large jumps in environmental change, plasticity may more easily bridge the gap, and promote evolution by buying time.
* Likely some limits: an all-purpose phenotype with high fitness in every environment may prevent adaptive evolution because there is no selection on a fit phenotype.
* May be some scenarios where plasticity is cyclical. In some environments it could be beneficial to be increasingly plastic, while in others it may be beneficial to canalize around phenotype.
  + Canalization may be periodic point of evolution, but there could be sufficient variation maintained around slope that could allow for plasticity to re-evolve if it because adaptive again.
* Timing of environmental inducer may also play important role: some traits become fixed if expressed during development, while others remain vagile throughout the organism’s life and allow for more continuous trait expression.

**3. Do empirical results agree or disagree with theoretical arguments?**

* Past theoretical arguments converged on plasticity hindering a population’s ability to evolve by shielding phenotype from selection, but more recent theoretical work seems to demonstrate the opposite (starting around West-Eberhard’s 2003 work).
  + Plasticity may promote innovation, which is supported by Schaum paper.
* These papers agree with recent theoretical work that suggests that plasticity enhances ability to evolve.
* Role of epigenetics also may be important to this debate as this mechanism can affect whether or not observed patterns follow theoretical predictions.
* If plasticity is a quantitative trait that is subject to selection, idea that responses to evolution through either plasticity OR evolution seem odd.

**Key unknowns:**

* How do epigenetics shape traits that appear to be plastic and evolving?
* How does direction of selection interact with plasticity? In other words, plasticity may evolve if plasticity matches direction of selection, but may not always be the case.