Developmental psychobiology

- Basic concepts
- Artificial selection experiments
- Early individual learning
- Imprinting in birds
- Early learning in primates
- Song learning in birds
• Basic concepts

• Artificial selection experiments

• Early individual learning

• Imprinting in birds

• Early learning in primates

• Song learning in birds
BASIC CONCEPTS IN DEVELOPMENT AND EVOLUTION

(from Chapter 4, not a required reading)
Traditional view of evolution (neo-Darwinism or modern synthesis):

- Mutation
- Genetic recombination
- Selection
- Migration
- Reproductive isolation

Where is development in this picture?
Garstand’s (1928) view of development and evolution
Nature-nurture dichotomy

Behavior is EITHER innate OR acquired.

Nature
- Innate behavior
- Reflexes
- Genetic predispositions
- Personality
- IQ…

Nurture
- Learning
- Memory
- Attitudes
- Preferences
- Language…
Epigenetic view of development (Weiss, 1959)
Phenotypic plasticity in plants

Plasticity within the same plant

Aquatic

Terrestrial

Schmalhausen’s (1949) classic observations on phenotypic plasticity in the marsh plant *Sagittaria sagittifolia*.
Role of phenotypic plasticity in evolution: Diet and morphology

_Cichlasoma managuense_

https://www.youtube.com/watch?v=uMK-iYKFI2g
Role of phenotypic plasticity in evolution: Diet and morphology

Cichlasoma managuense

Fed shrimp (group I)   Fed flakes (group II)
After 8.5 months of eating differential diets

Waddington’s concept of canalization

https://www.youtube.com/watch?v=KUvuv74_E1U
Gottlieb’s (1992) view of evolution

Changes in Structural Genes

Natural selection acts on new phenotypic traits

Reproductive isolation

Behavioral Neophenotypes

New environments are entered

Changes in diet, daily patterns of activity, social interactions, etc.

Original Phenotypes
Developmental psychobiology

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Relationship between genes and behavior

Behavior

Cell-network

Protein

Gene

Environment (stimuli, nutrients, temperature, etc.)
Artificial selection

https://www.youtube.com/watch?v=nVSJNhUhV-4
Artificial selection

<table>
<thead>
<tr>
<th>Character</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>P (parental population)</td>
<td>F&lt;sub&gt;1&lt;/sub&gt; (first filial generation)</td>
</tr>
</tbody>
</table>

- **High** characters are selected in the parental population (P).
- The first filial generation (F<sub>1</sub>) shows a shift towards higher frequency of characters.
- The second filial generation (F<sub>2</sub>) further increases the frequency of the selected characters.
Effectiveness of artificial selection

Table 10.1

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative brain size</td>
<td>Mice</td>
</tr>
<tr>
<td>Audiogenic seizures</td>
<td>Mice</td>
</tr>
<tr>
<td>Geotaxis, phototaxis</td>
<td>Fruitflies</td>
</tr>
<tr>
<td>Tonic immobility</td>
<td>Quail</td>
</tr>
<tr>
<td>Exploratory behavior, activity levels</td>
<td>Fruitflies, mice</td>
</tr>
<tr>
<td>Mating behavior</td>
<td>Fruitflies, quail, chickens</td>
</tr>
<tr>
<td>Nest building</td>
<td>Mice</td>
</tr>
<tr>
<td>Aggressive behavior</td>
<td>Stickleback fish, mice</td>
</tr>
<tr>
<td>Sensitivity to alcohol consumption</td>
<td>Mice</td>
</tr>
<tr>
<td>Frustration in consummatory contrast</td>
<td>Rats</td>
</tr>
<tr>
<td>Appetitive conditioning</td>
<td>Fruitflies, honeybees</td>
</tr>
<tr>
<td>Avoidance learning</td>
<td>Mice, rats</td>
</tr>
<tr>
<td>Maze learning performance</td>
<td>Rats</td>
</tr>
<tr>
<td>Anxiety behavior</td>
<td>Rats</td>
</tr>
<tr>
<td>Learned helplessness</td>
<td>Rats</td>
</tr>
</tbody>
</table>
Artificial selection for aggressive behavior and early experience

Figure 1. Failure to maintain selectively bred line difference in aggression when rearing environment changed from social isolation (usual rearing environment) to social grouping. Data are from Hood and Cairns (1989). Adapted from “The Significance of Biology for Human Development: A Developmental Psychobiological Systems View,” by G. Gottlieb, D. Wahlsten, and R. Lickliter. In Handbook of Child Psychology: Theoretical Models of Human Development (p. 249, Figure 5.9), by R. M. Lerner (Ed.), 1998, New York: Wiley. Copyright 1998 by Wiley. Adapted with permission.
Role of early experience: Handling

Comparative psychologists since the 1950s have shown that a variety of early experiences alters the behavioral phenotype, even into adulthood.

Handling

- Rodents
- Handled a few min every day
- Increased exploratory behavior
- Increased resistance to stress
- Improved learning
- Enhanced HPA axis activity
- Sensitive period
- Key factor: extra attention by the mother
Environmental enrichment

https://www.youtube.com/watch?v=vsV_D0Sd7gg
Early environmental enrichment

Environmental enrichment

- Rodents, primates
- Reared in complex vs. simple environments
- Increased problem-solving skills
- Thickening of neocortex
- Increased availability of some neurotransmitters
- Sensitive period
Neural effects of early environmental enrichment