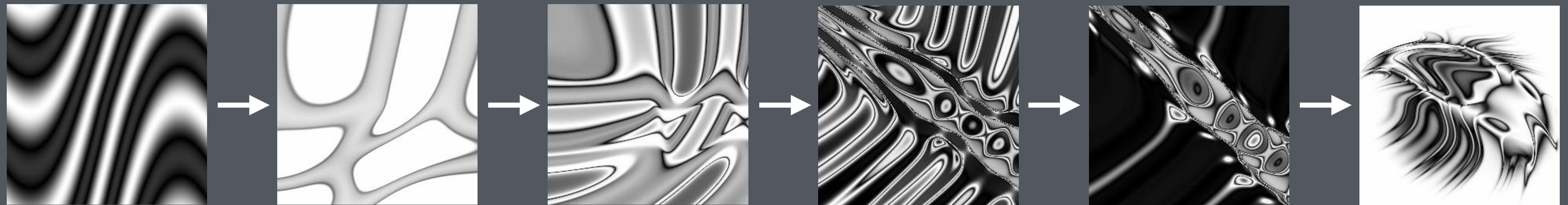


# Cultural Evolution

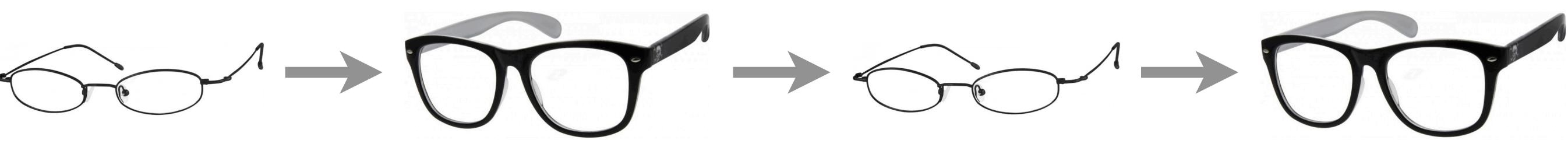
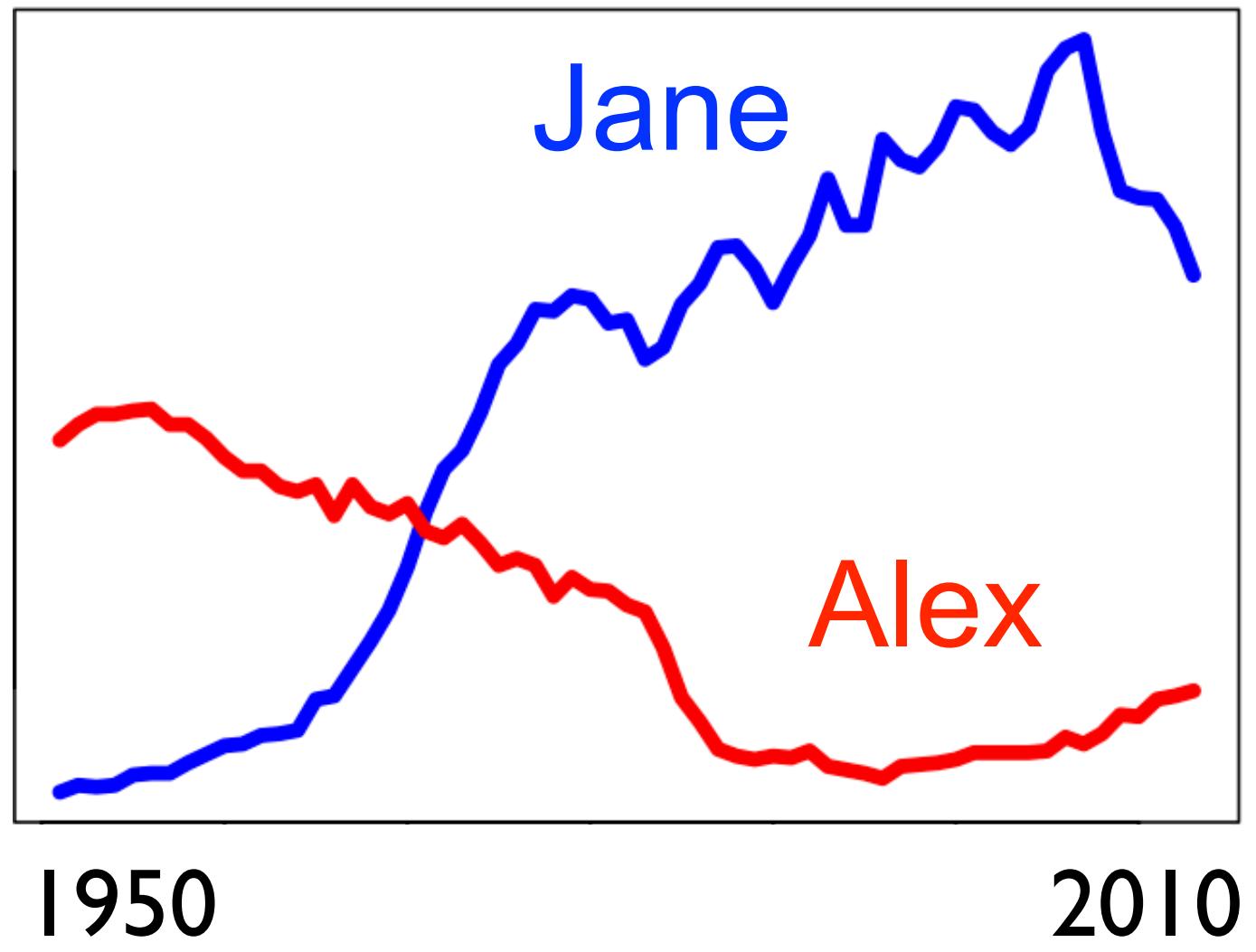
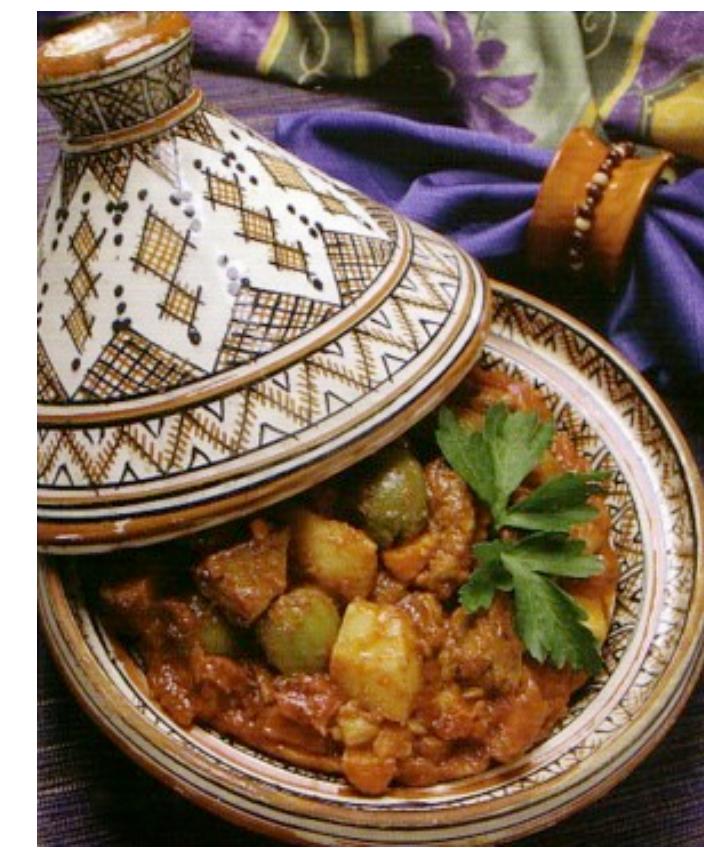


Vanessa Ferdinand

Santa Fe Institute

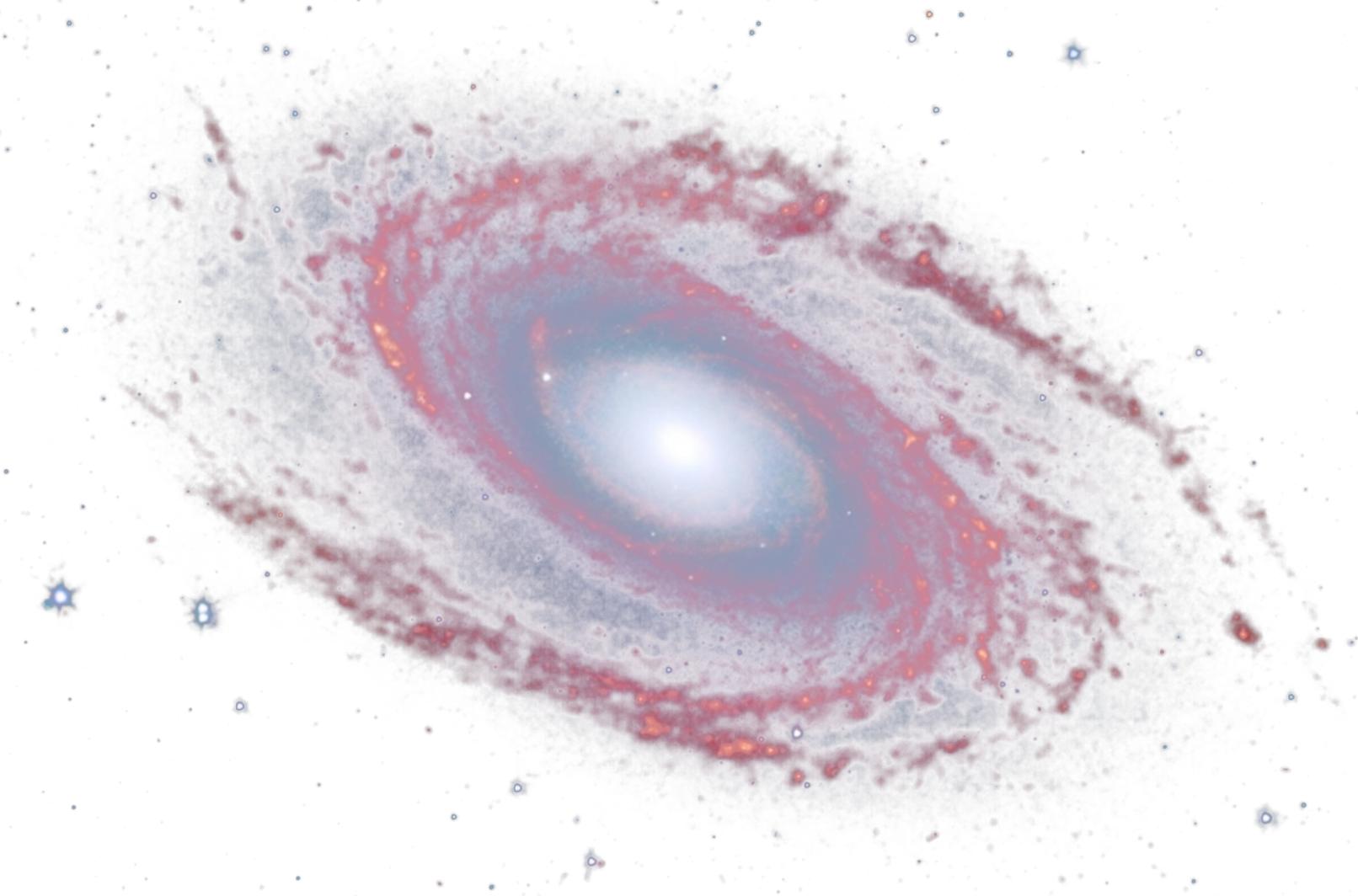


# Culture evolves.



# What is evolution?

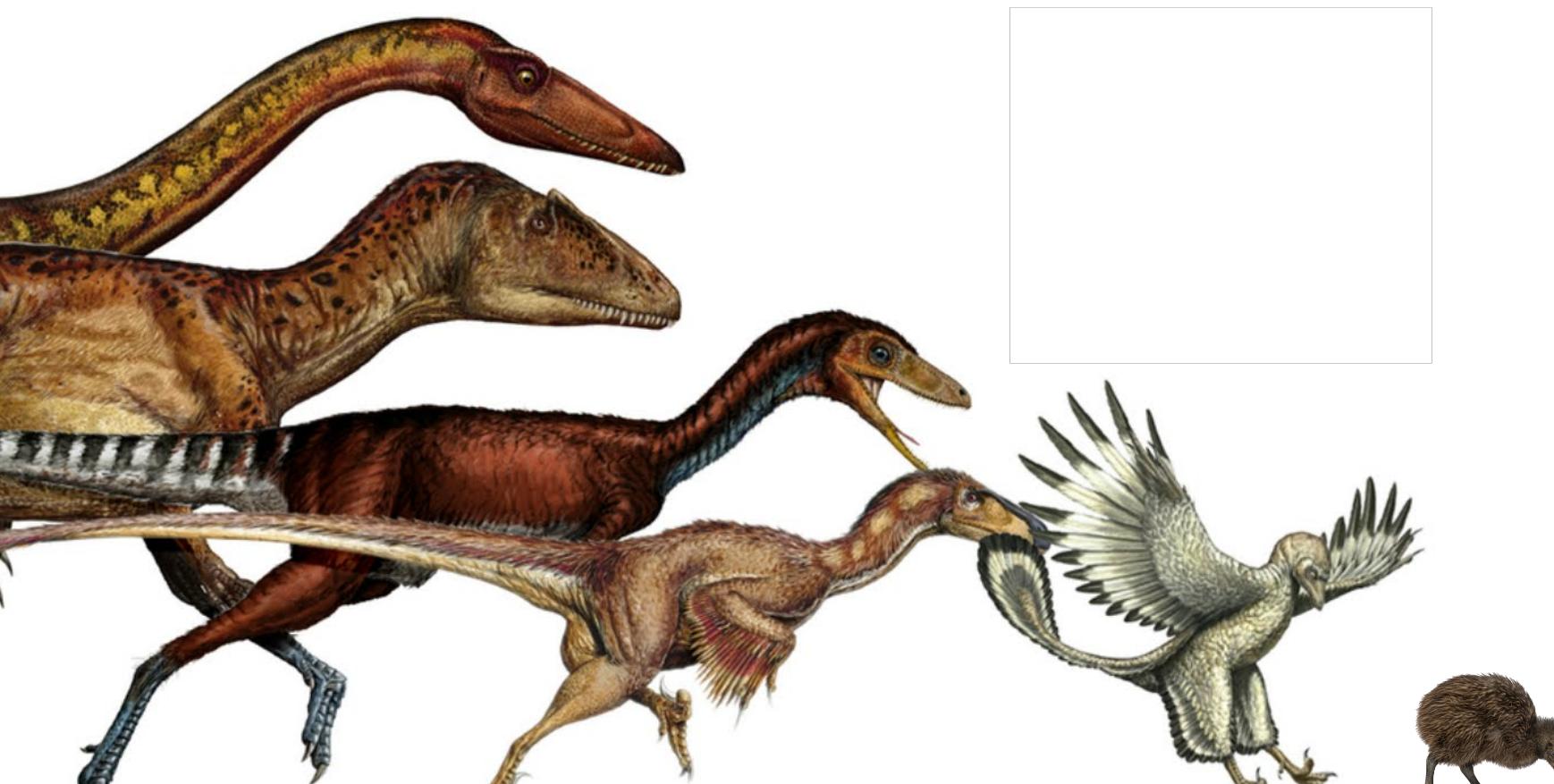
It's change over time.



Galaxies evolve.



Languages evolve.



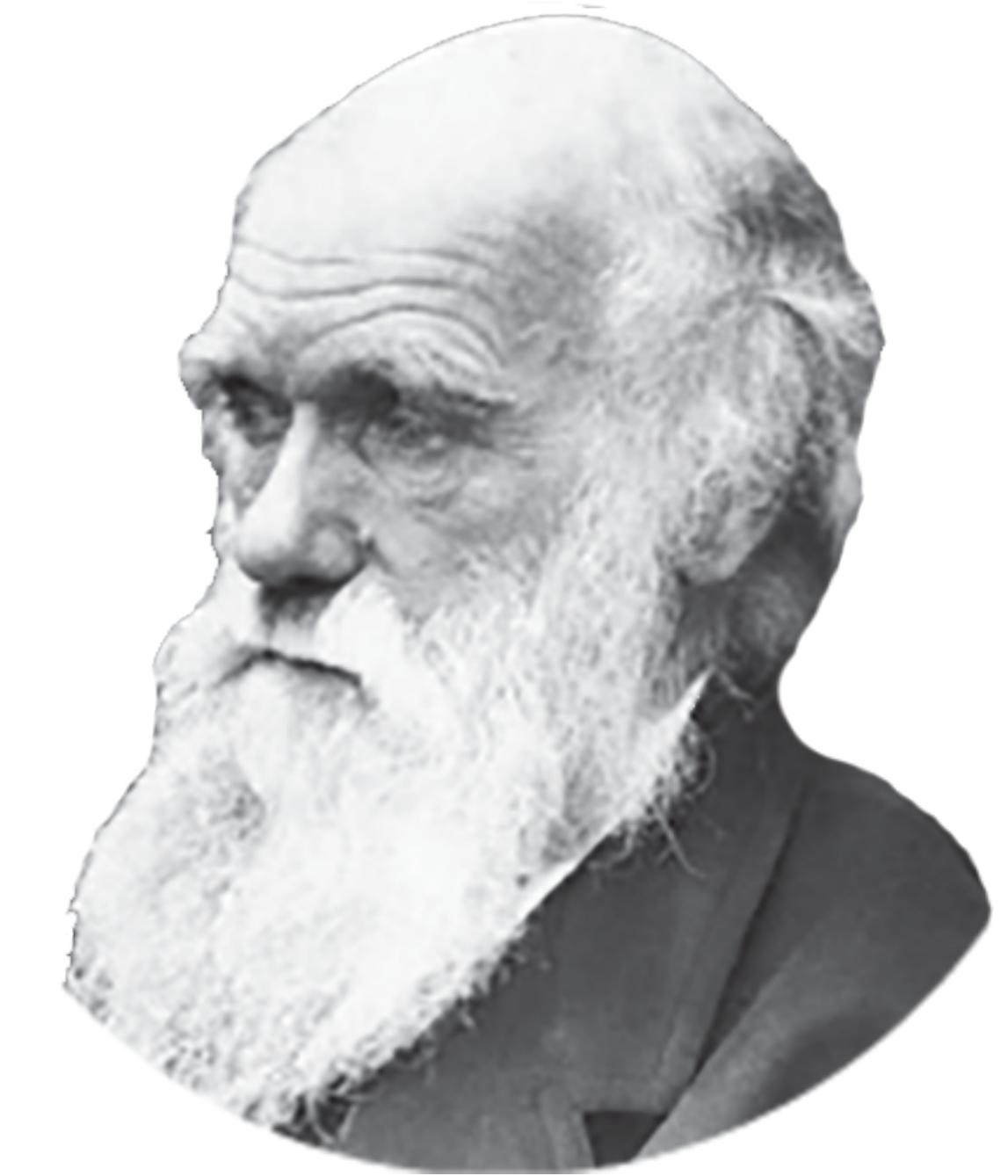
lame.

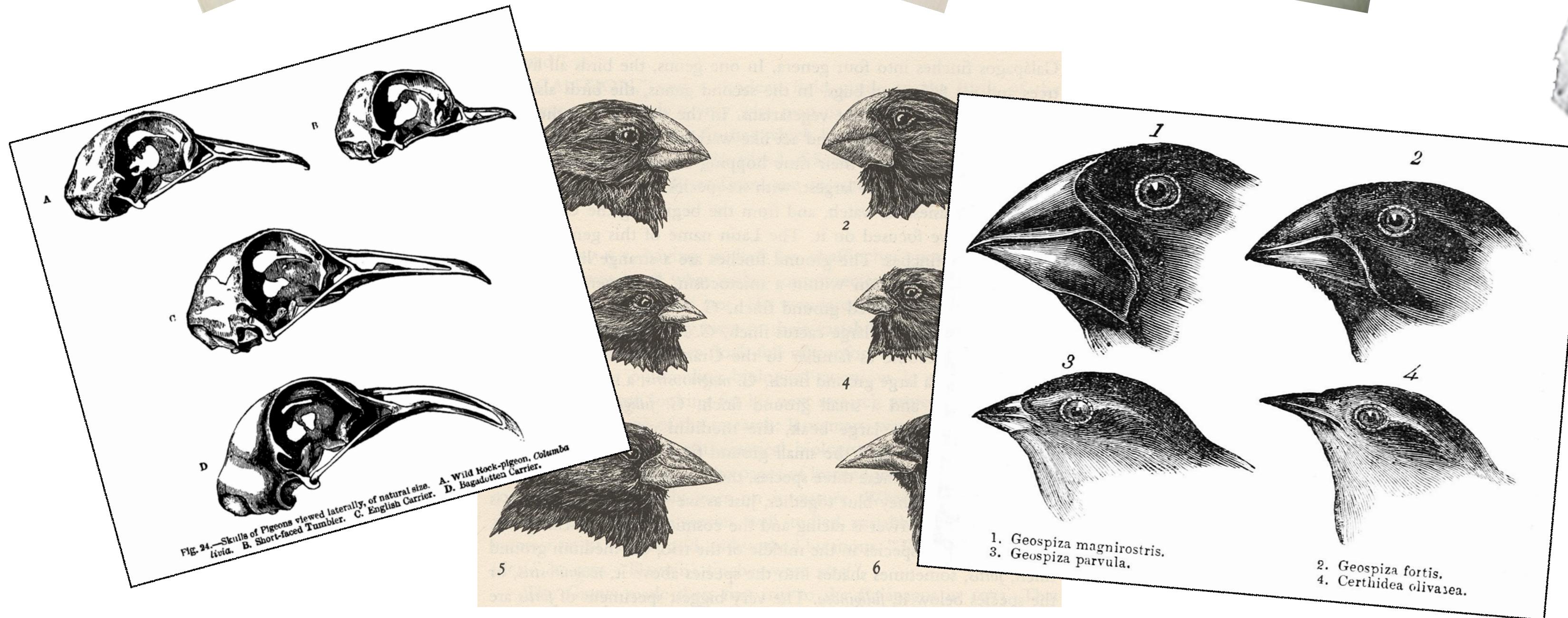
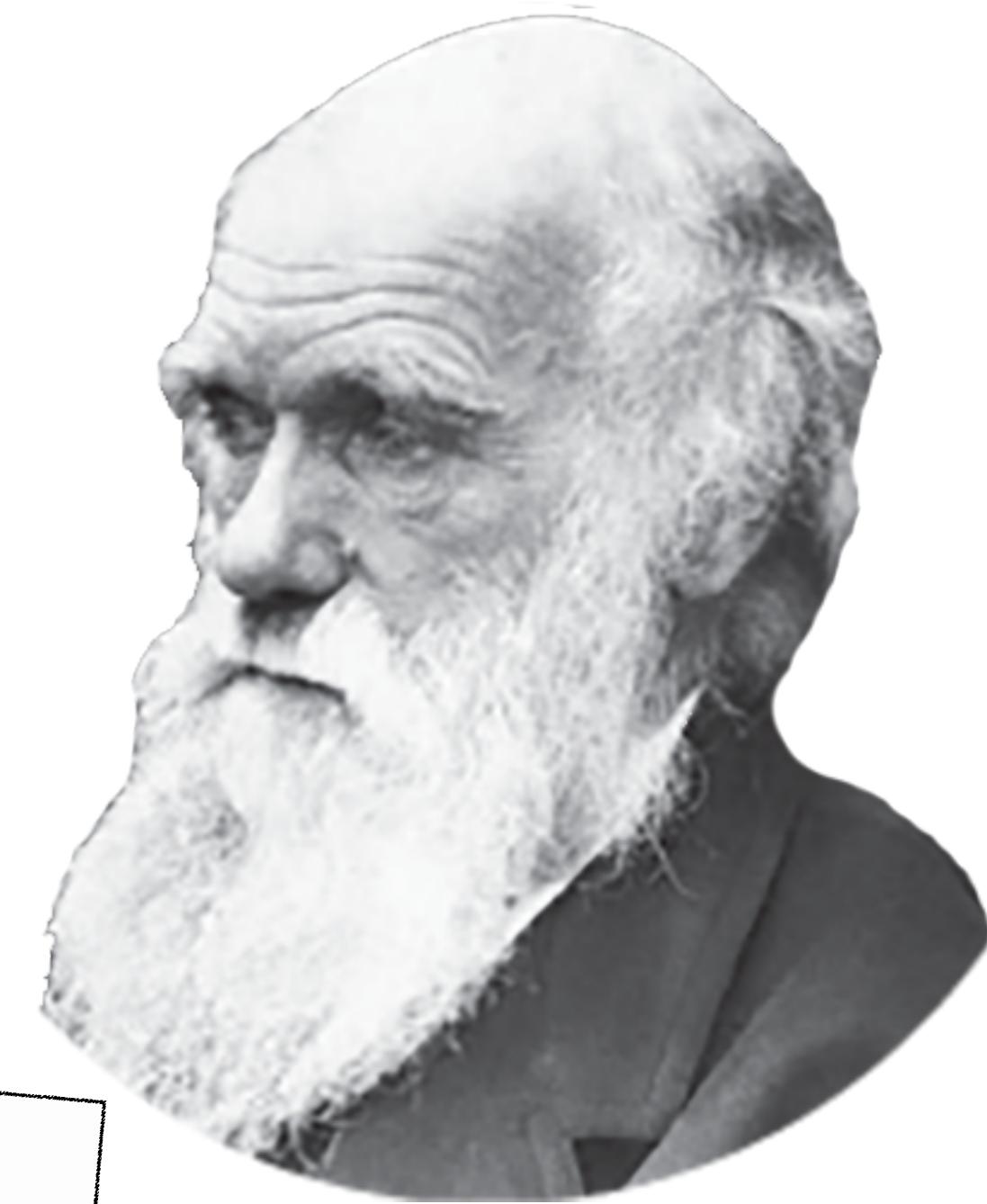


Species evolve.



# Darwinian evolution

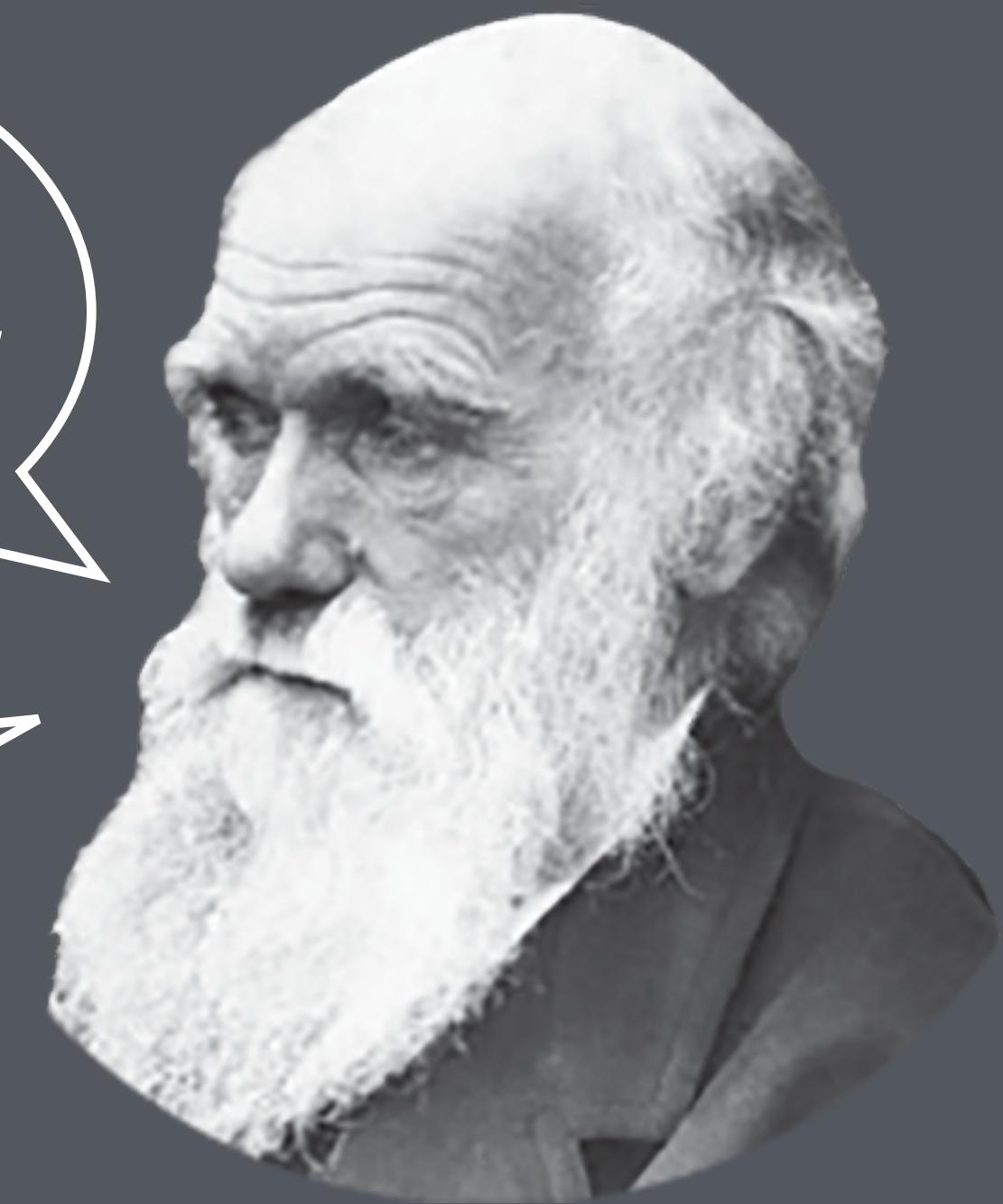




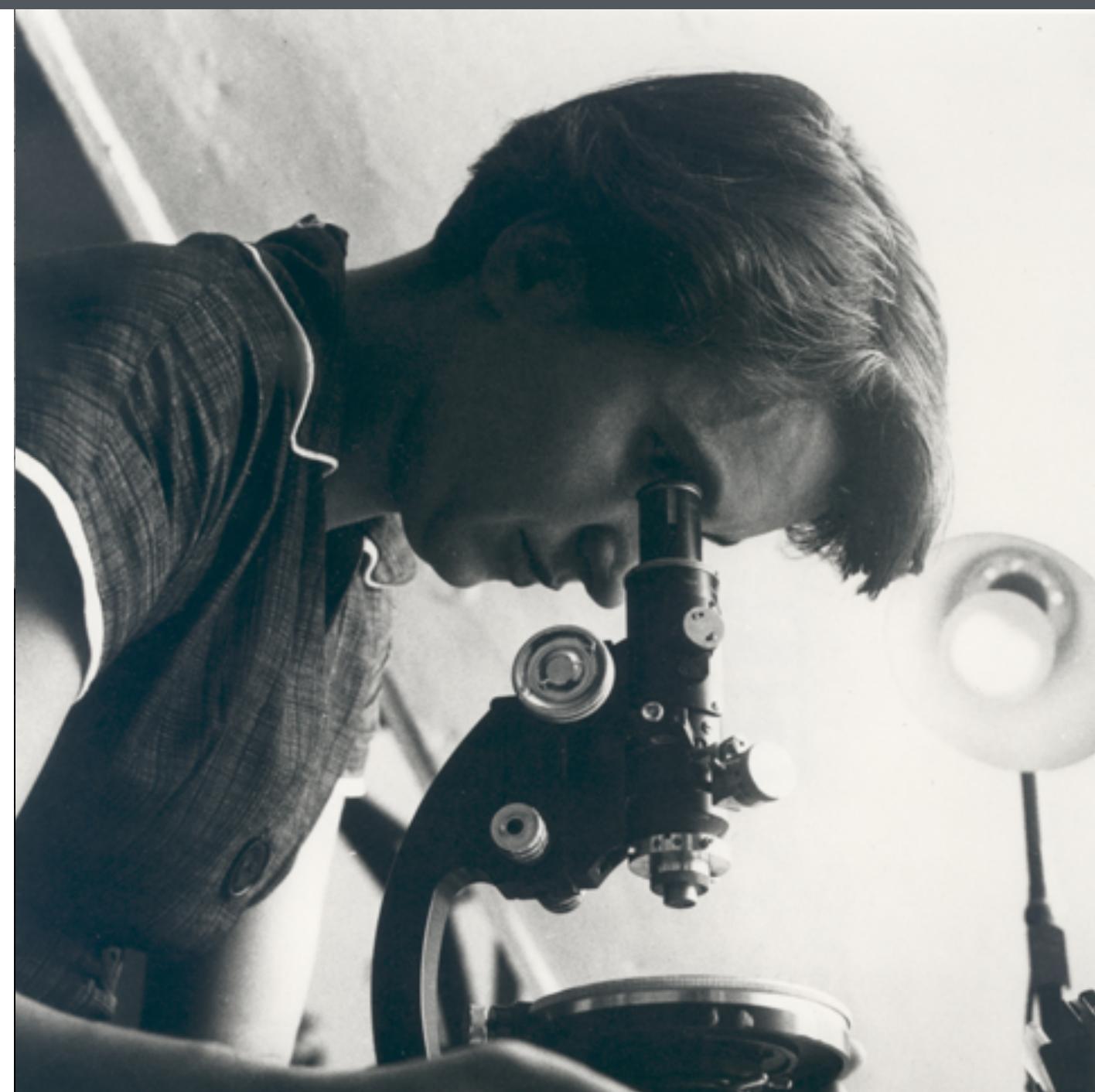
# What is the mechanism of inheritance?

*Dunno.  
It's 1859!*

*But it's  
somewhere in  
reproduction.*



## Answer: It's DNA



# What is the mechanism of *cultural* inheritance?

*Dunno.  
It's 2018!*

*But it's  
somewhere in  
cognition.*

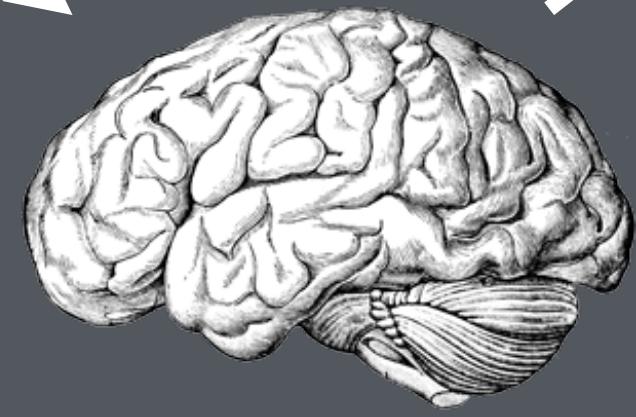


CULTURAL  
EVOLUTION  
SOCIETY

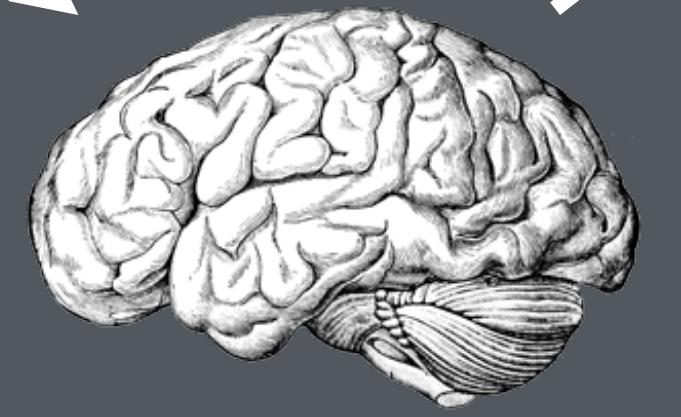
Answer:

??????

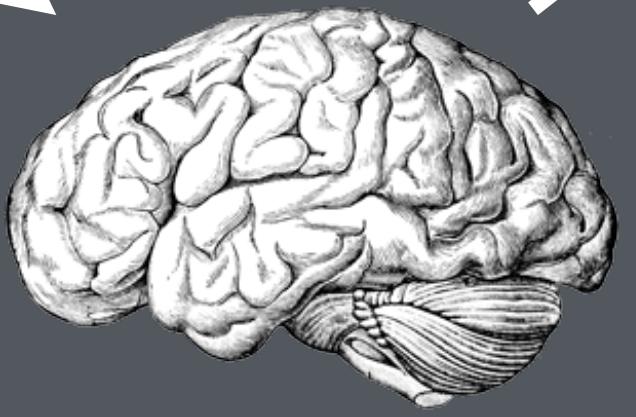
**artifacts**



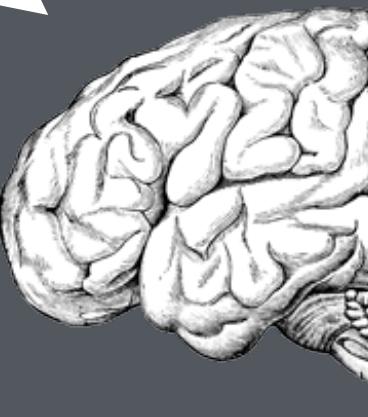
**artifacts**

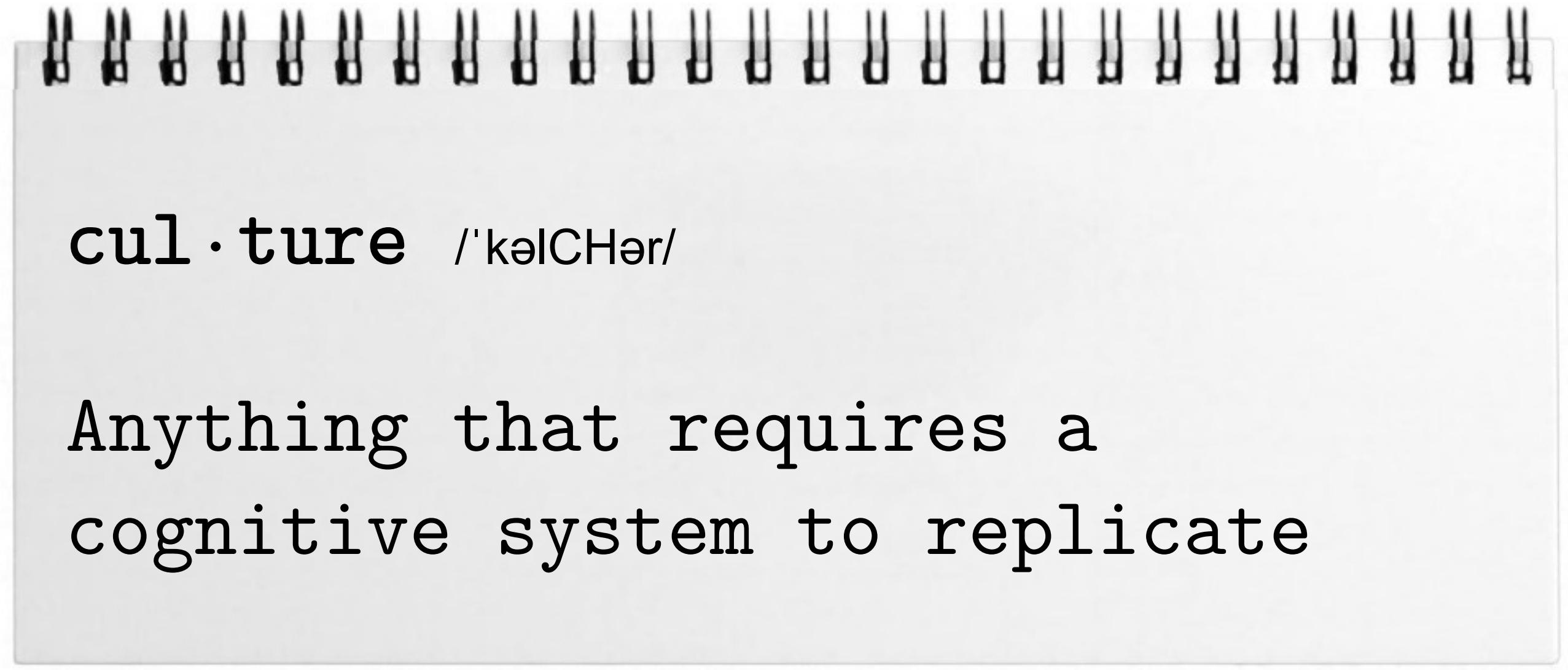


**artifacts**



**artifacts**

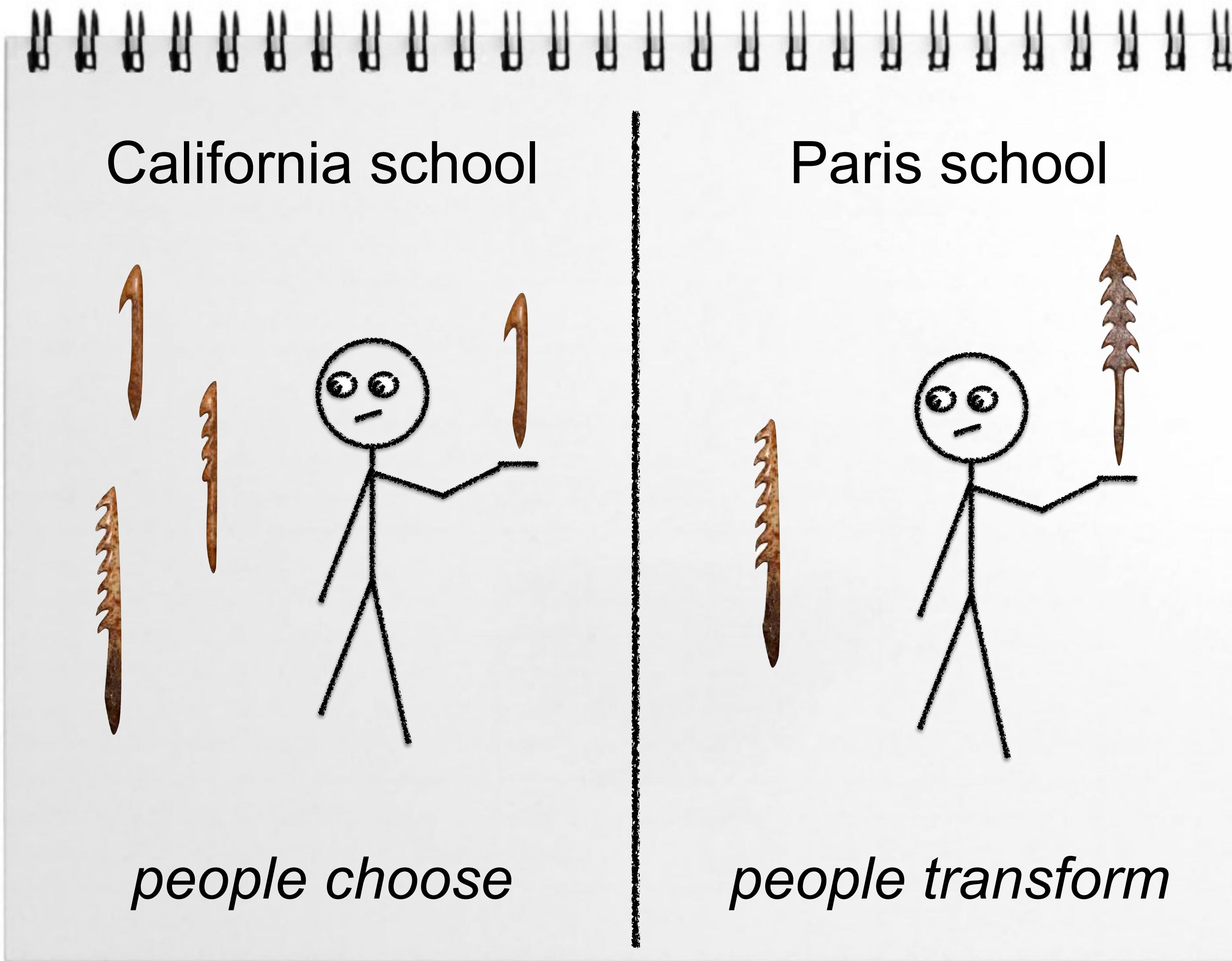




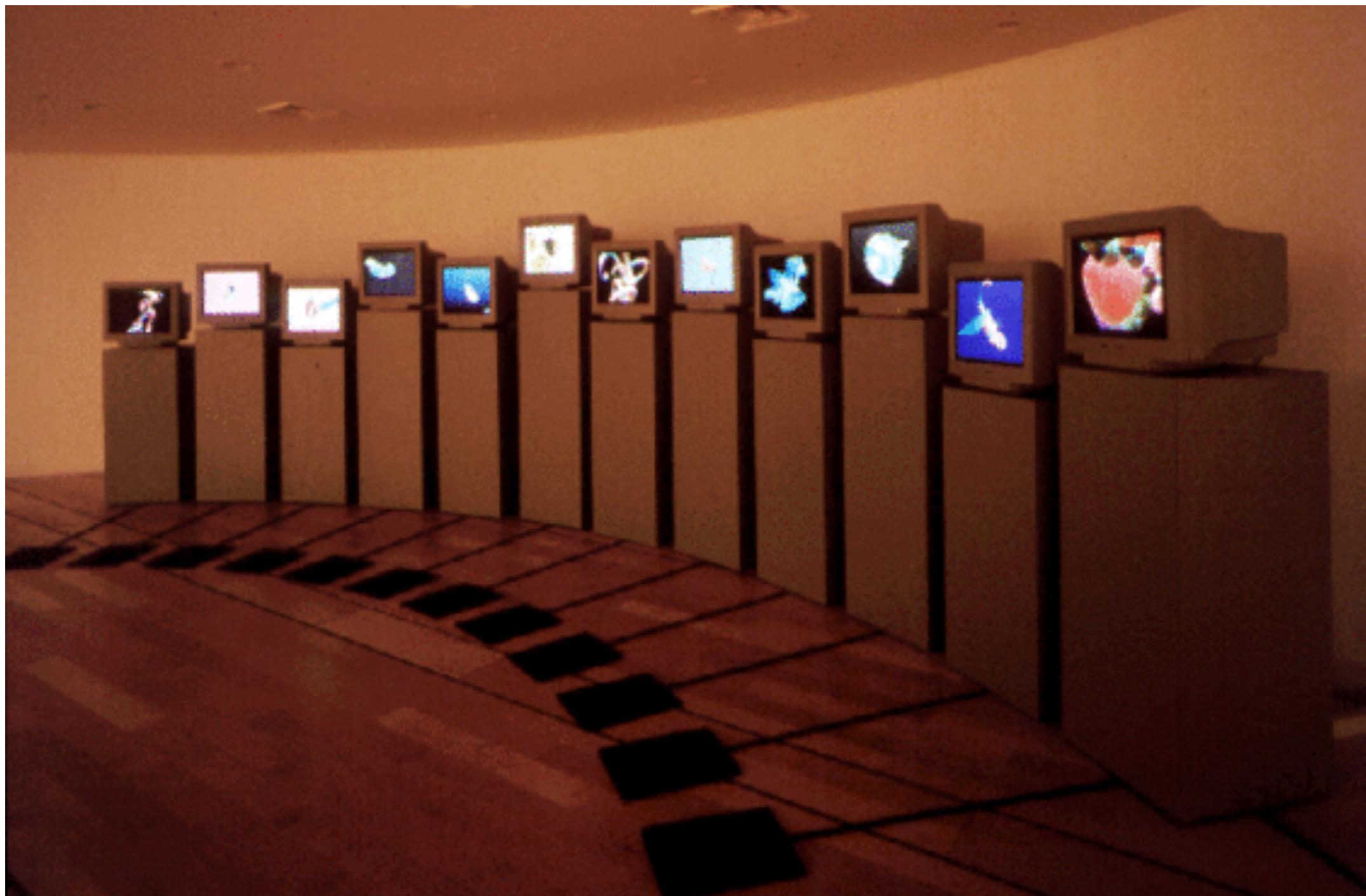
**cul · ture** /'kəlCHər/

Anything that requires a  
cognitive system to replicate

# What drives change in culture?



# Evolutionary art



Karl Sims  
1990s



Genetic Images Interactive Exhibit

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Top Rated Artists:

1. [freewing00](#)

2. [webneat](#)

3. [loca](#)

4. [secretj](#)

5. [ddambro](#)

6. [ken](#)

7. [adeleinr](#)

8. [acampbel](#)

9. [shmoopy](#)

10. [Phiomega](#)

## Newest Images

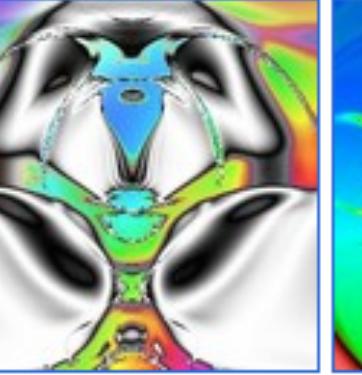
abstract By ranprieur



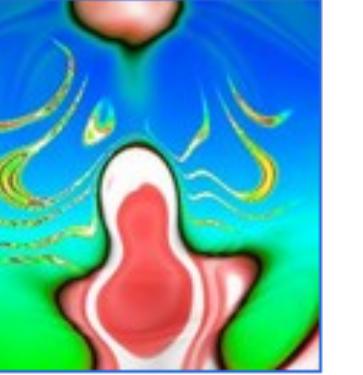
heart beating Heat By novaop



Demon goat Alien By novaop



Magic Woman silhouett... By Crul



Evolve DNA

Evolve DNA

Evolve DNA

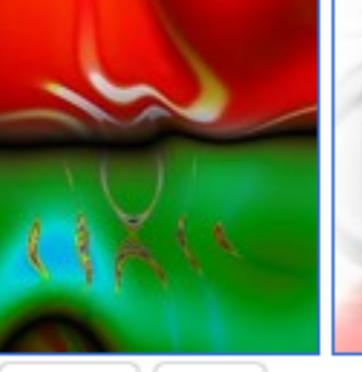
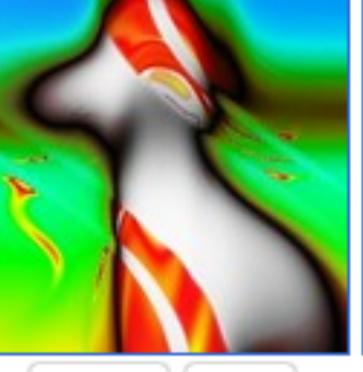
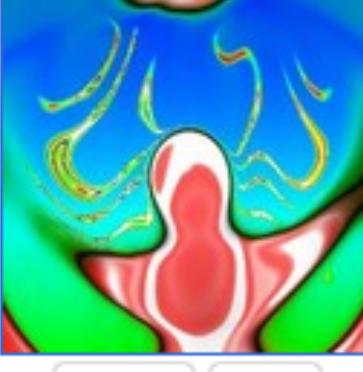
Evolve DNA

Magic Woman By Crul

Dog Animal By Crul

texture photorealism ... By Crul

rose flower By Crul



Evolve DNA

Evolve DNA

Evolve DNA

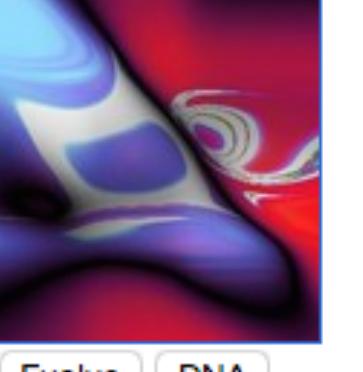
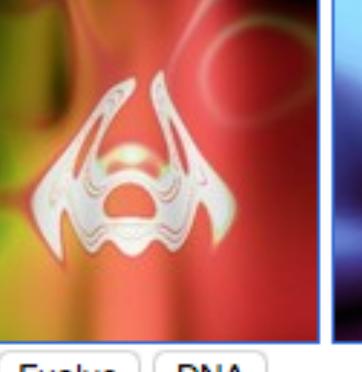
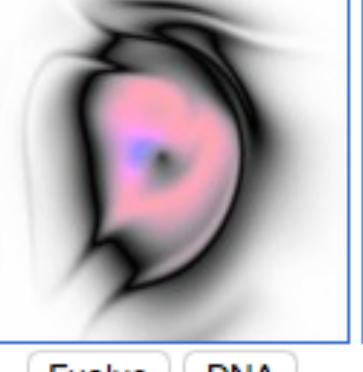
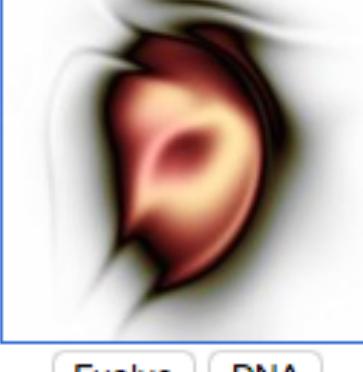
Evolve DNA

head Face By Crul

head Face Hat By Crul

Bat ghost By Crul

dolphin Animal color By Crul



Evolve DNA

Evolve DNA

Evolve DNA

Evolve DNA

Nose Face By Crul

Candy gummy By Crul

leather mask Warrior By Crul

horse leather Animal By Crul



# Ken Stanley 2007

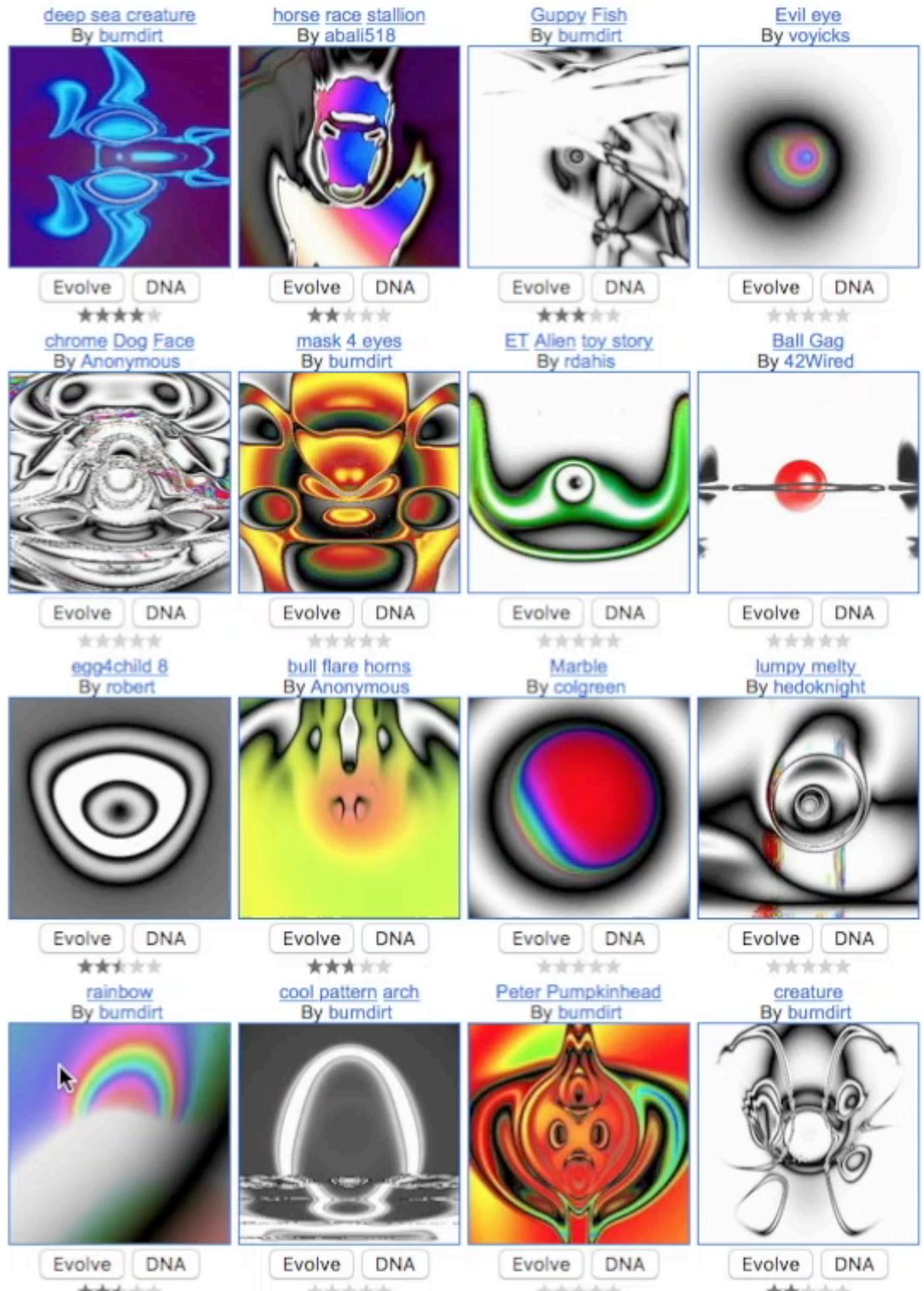




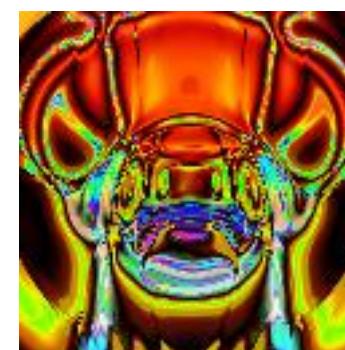
TM

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[My Profile](#)  
[Edit My Profile](#)  
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[Sign out](#)**Top Rated Artists:**

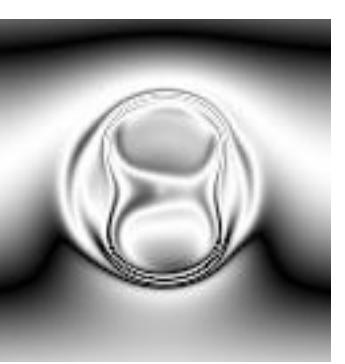
1. [freewing00](#)
2. [webneat](#)
3. [loca](#)
4. [secretj](#)
5. [ddambro](#)
6. [ken](#)
7. [adeleinr](#)
8. [acampbel](#)
9. [shmoopy](#)
10. [Phiomega](#)

**Random Images**

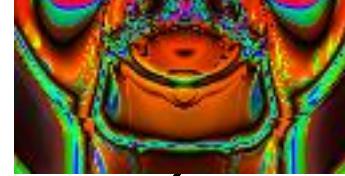
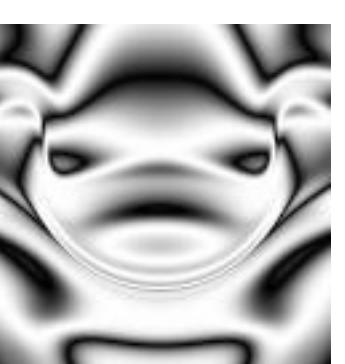
generation 6



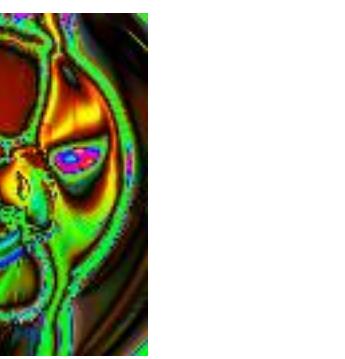
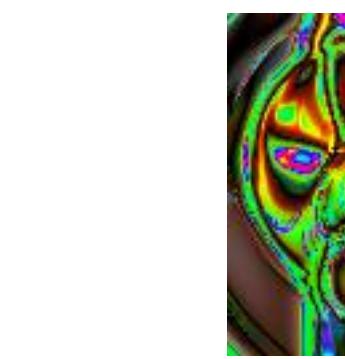
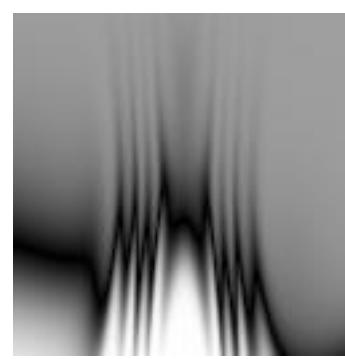
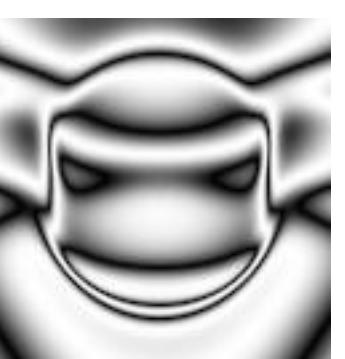
generation 5



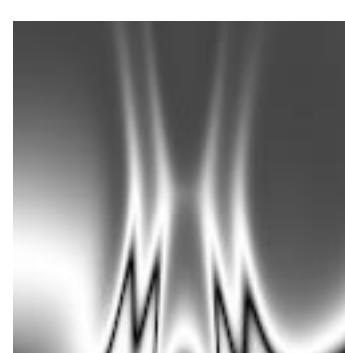
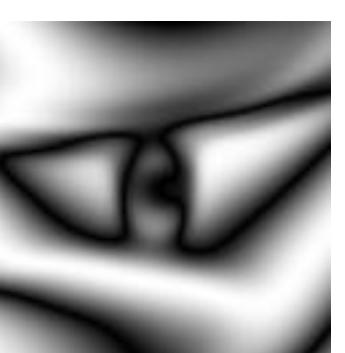
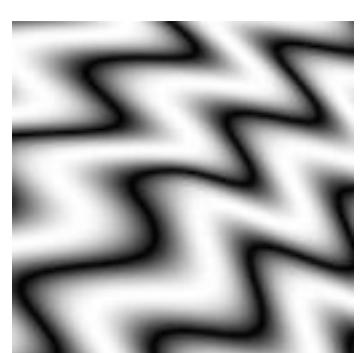
generation 4



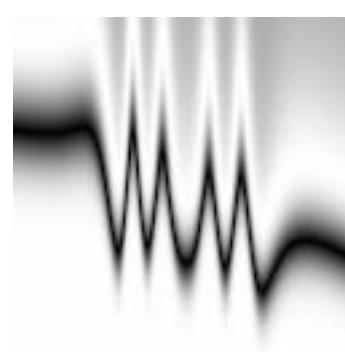
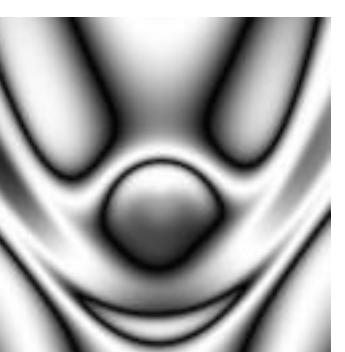
generation 3



generation 2



generation 1



lineage A

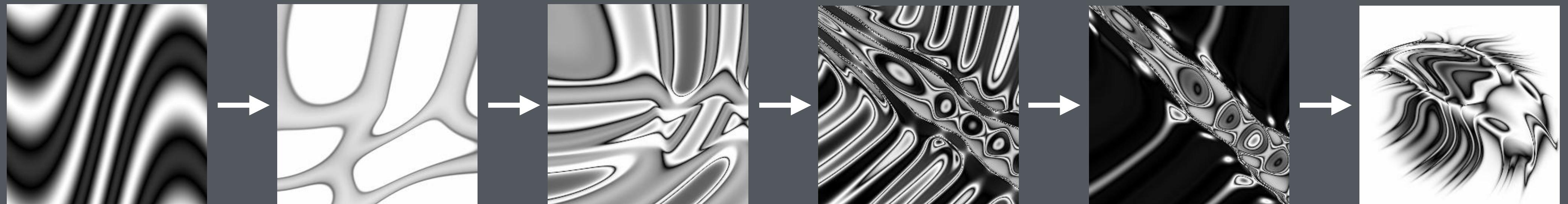
lineage B

lineage C

lineage C

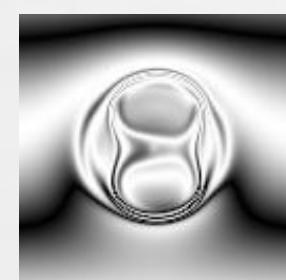
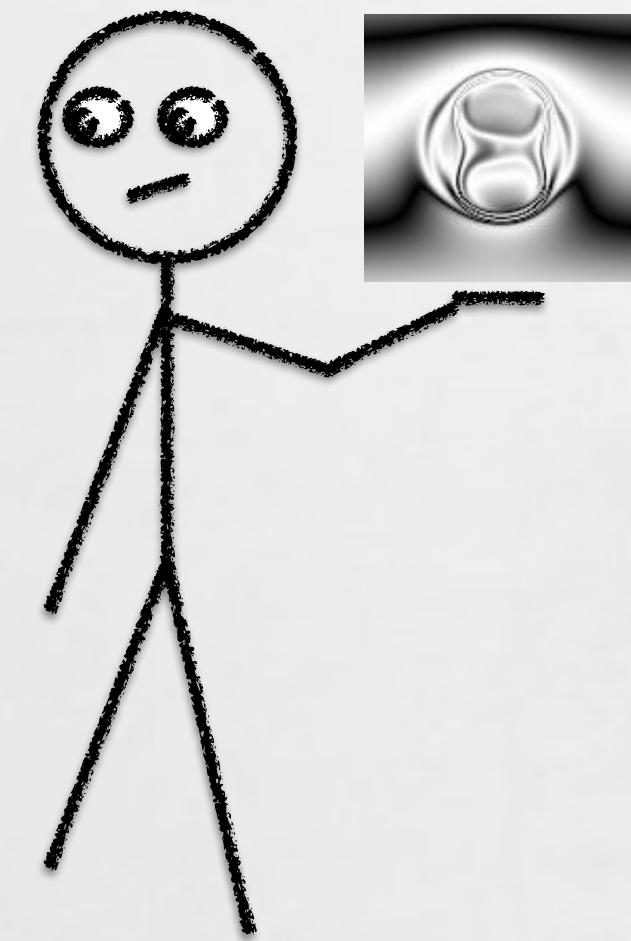
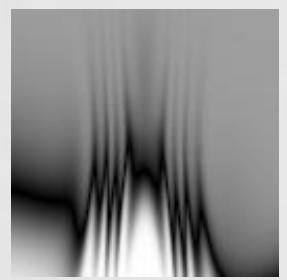
⋮

# Images get more complex over time.

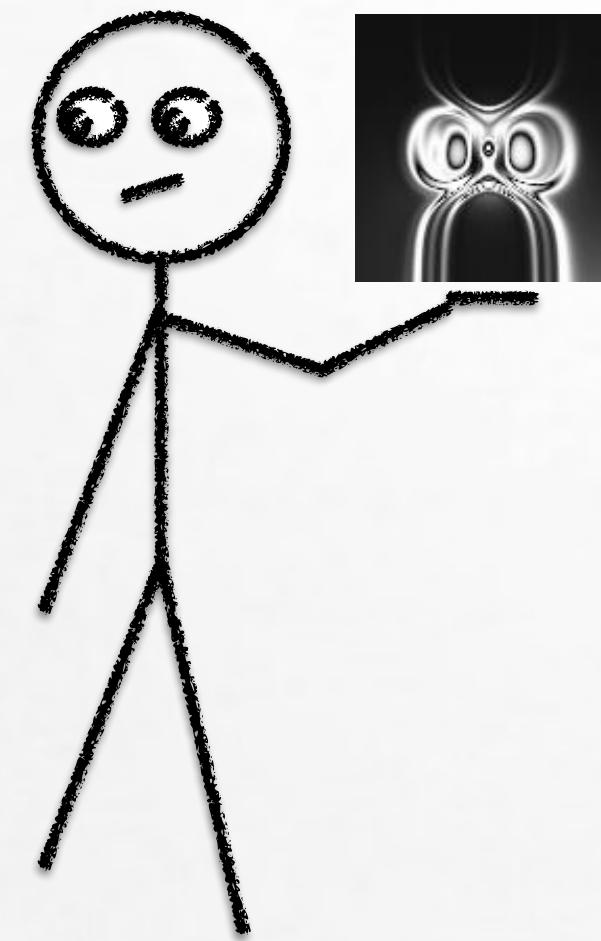
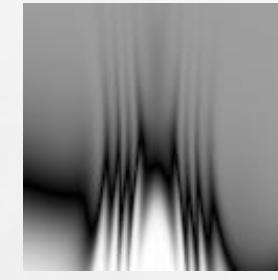


# Why?

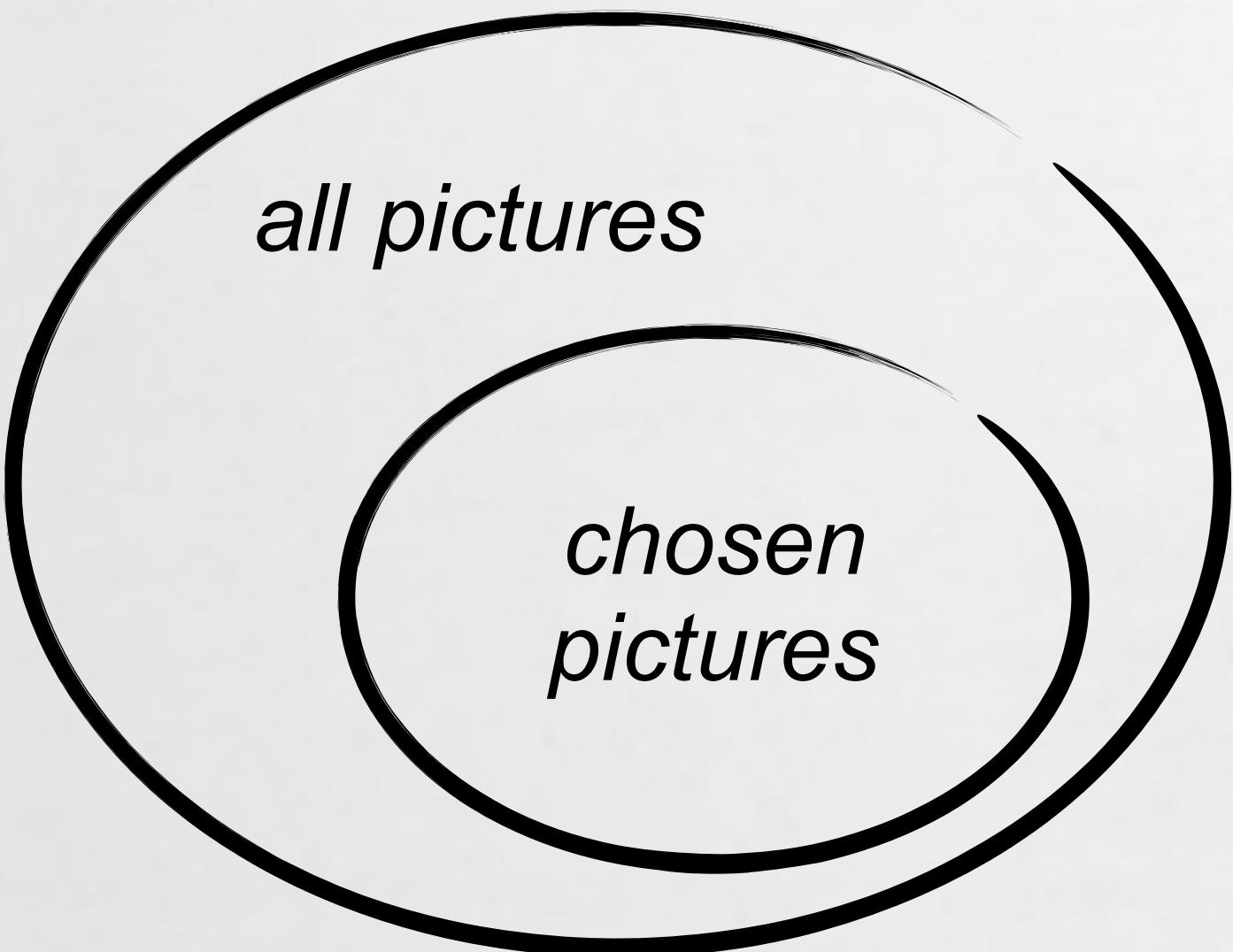
choose



transform

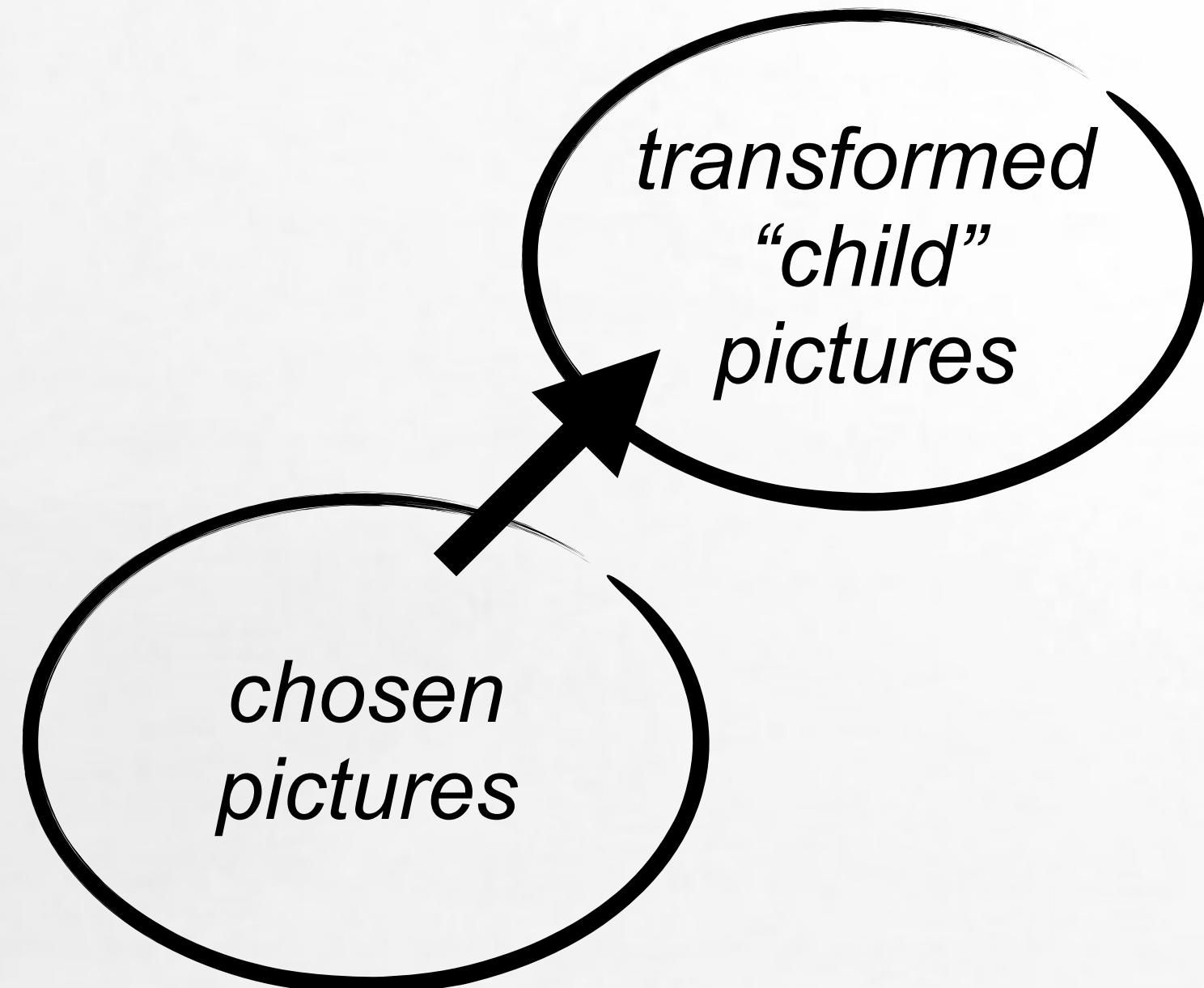


choose



*Is the complexity of the chosen images higher?*

transform



*Is the complexity of the child images higher?*

# Measuring image complexity



Pieter Brueghel, 1559



Mark Rothko, 1970

# Measuring image complexity



*There's a woman in the lower left, wearing a grey dress with red sleeves who is strangling a demon and above her is a man who...*



*A black rectangle is above a grey rectangle.*

# Measuring image complexity

## Description length method:

*It takes more words to describe something complex  
and less words to describe something simple.*



左下方有一位女士，身穿灰色衣服 穿著紅色袖子的人正在扼殺惡魔在她之上是一個男人



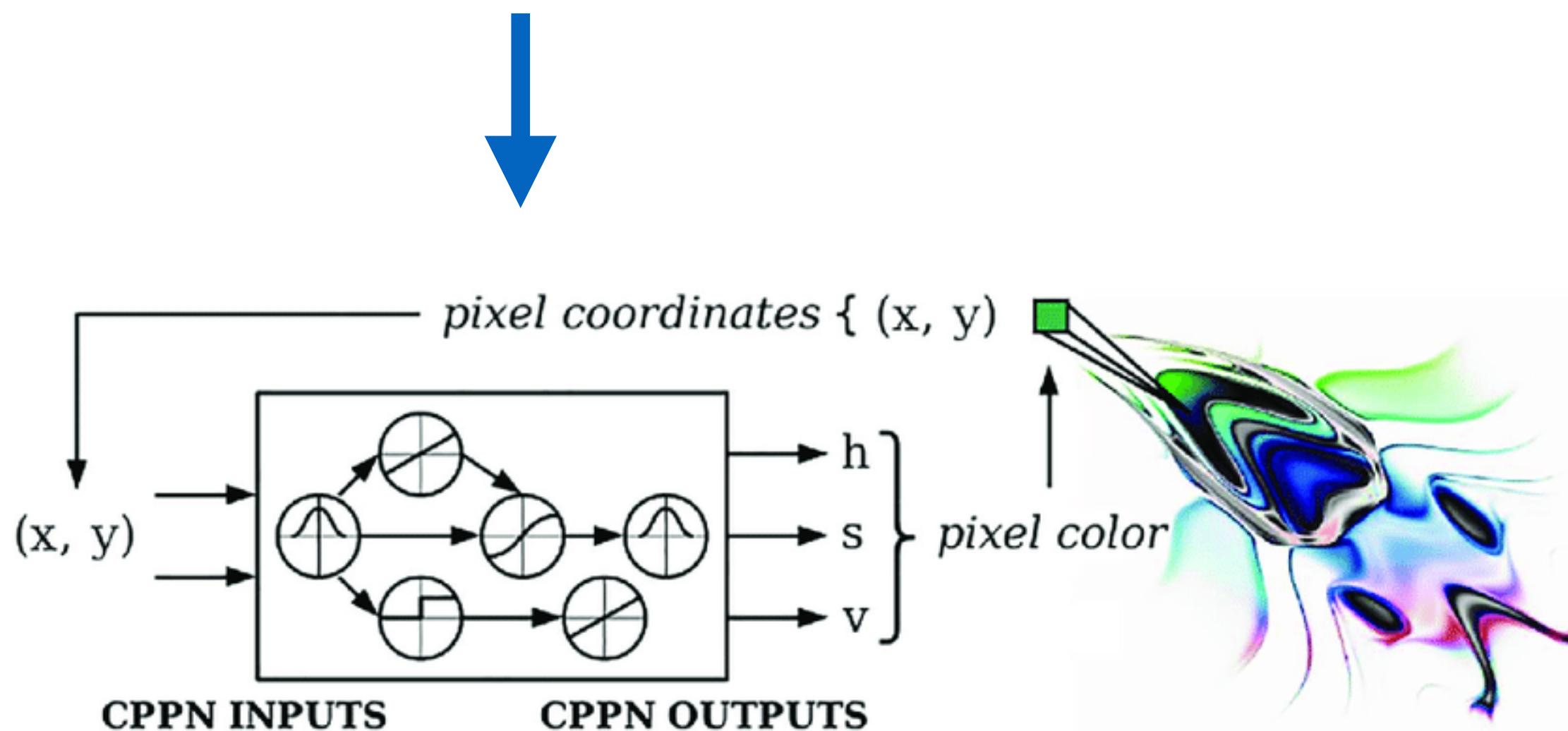
一個黑色的矩形在上面灰色的矩形。

*...but exact length differences are relative to the encoding system*

# Measuring image complexity

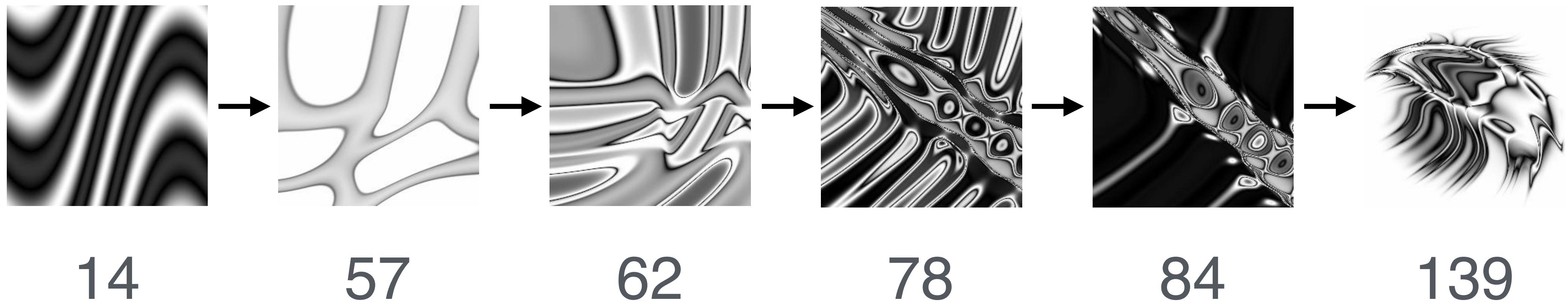
Description length method:

*picbreeder's native encoding scheme for images (a CPPN)*



Program length =  
our complexity measure

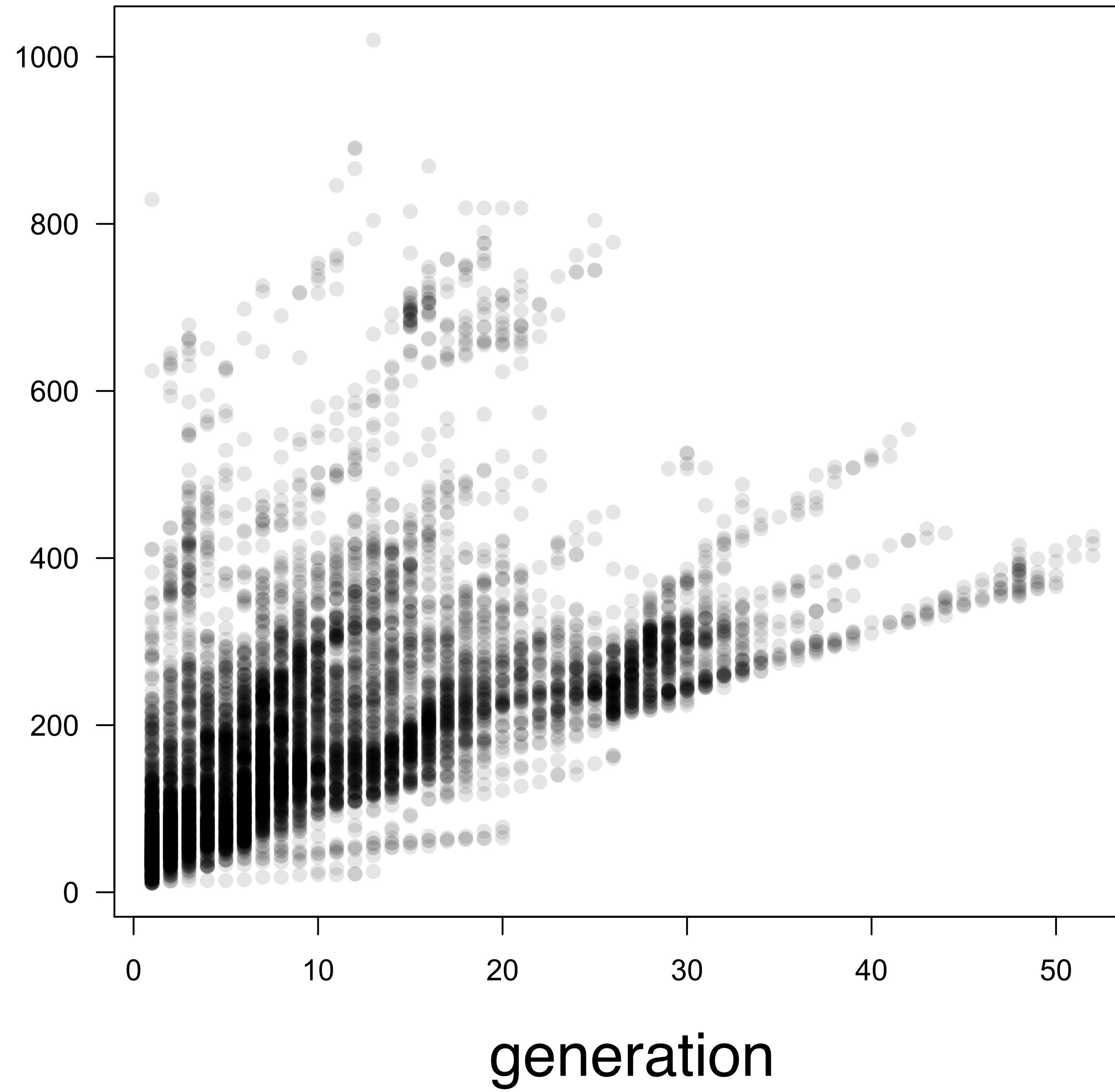
# Measuring image complexity



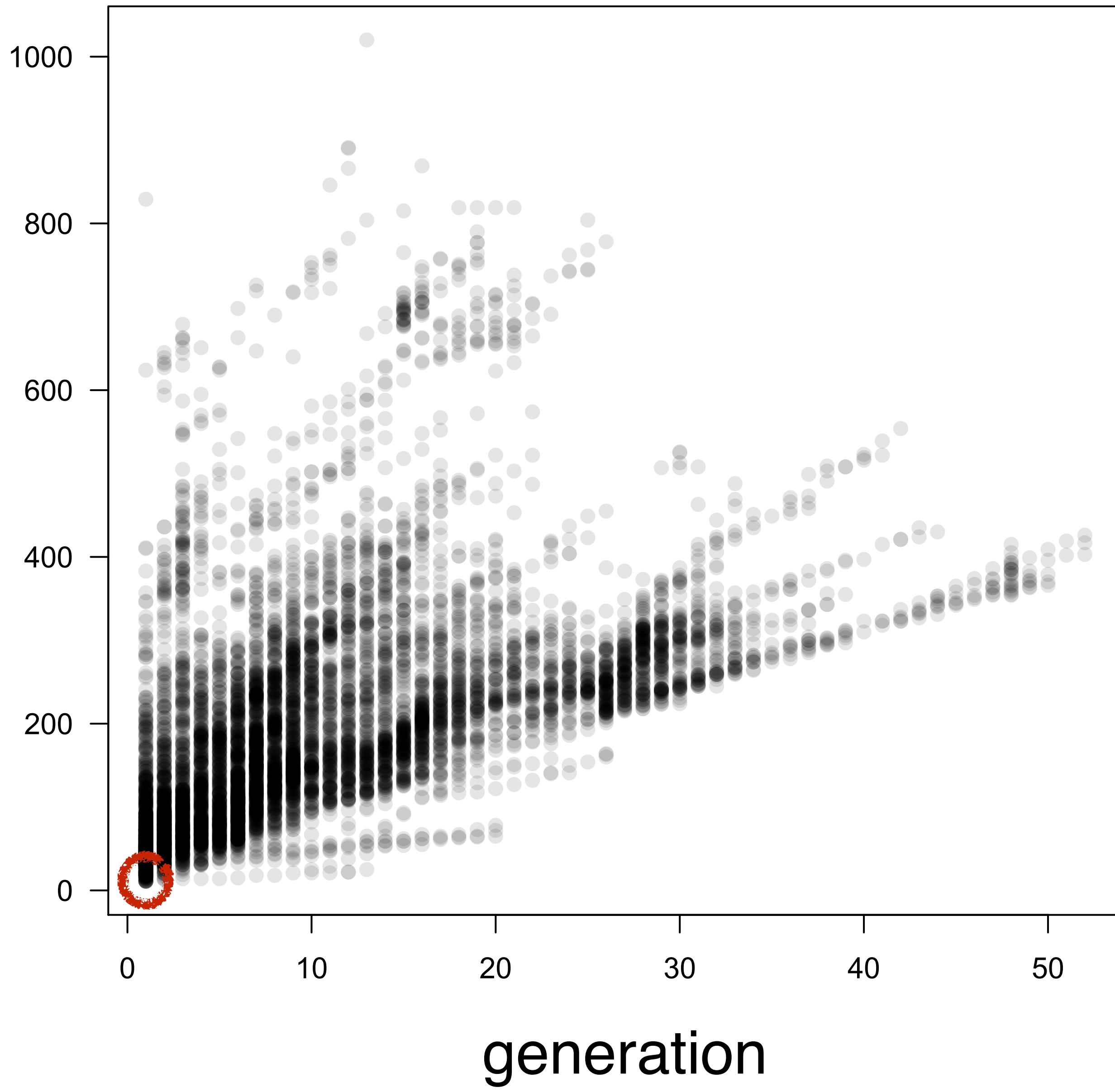
Picbreeder image program length examples

(# nodes + # edges)

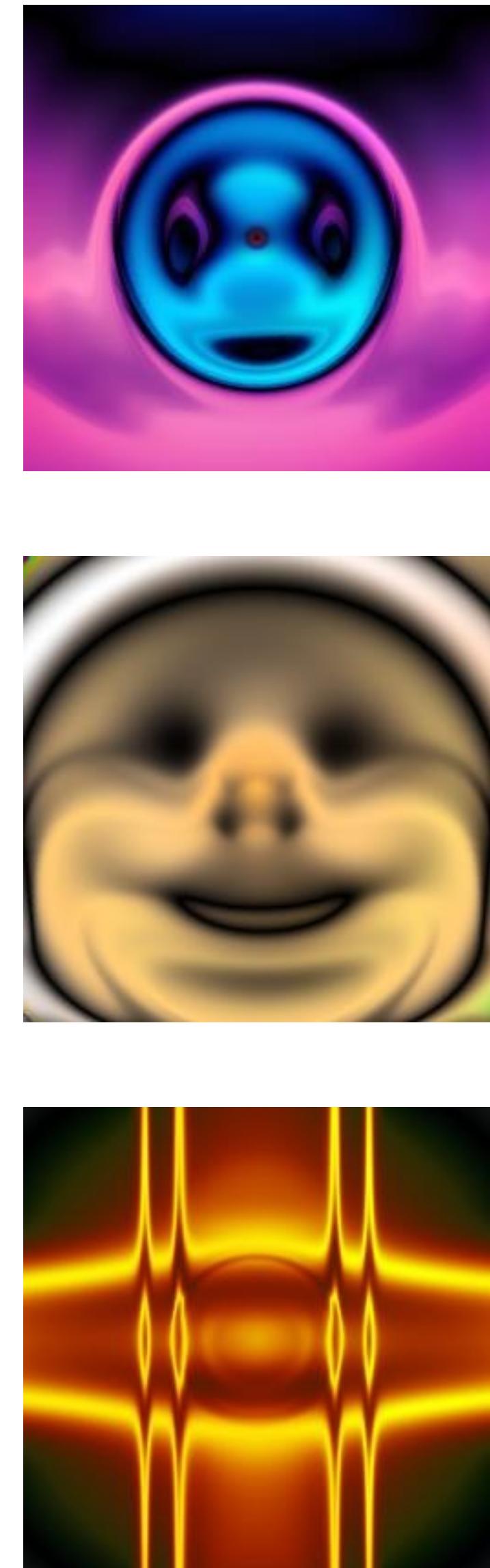
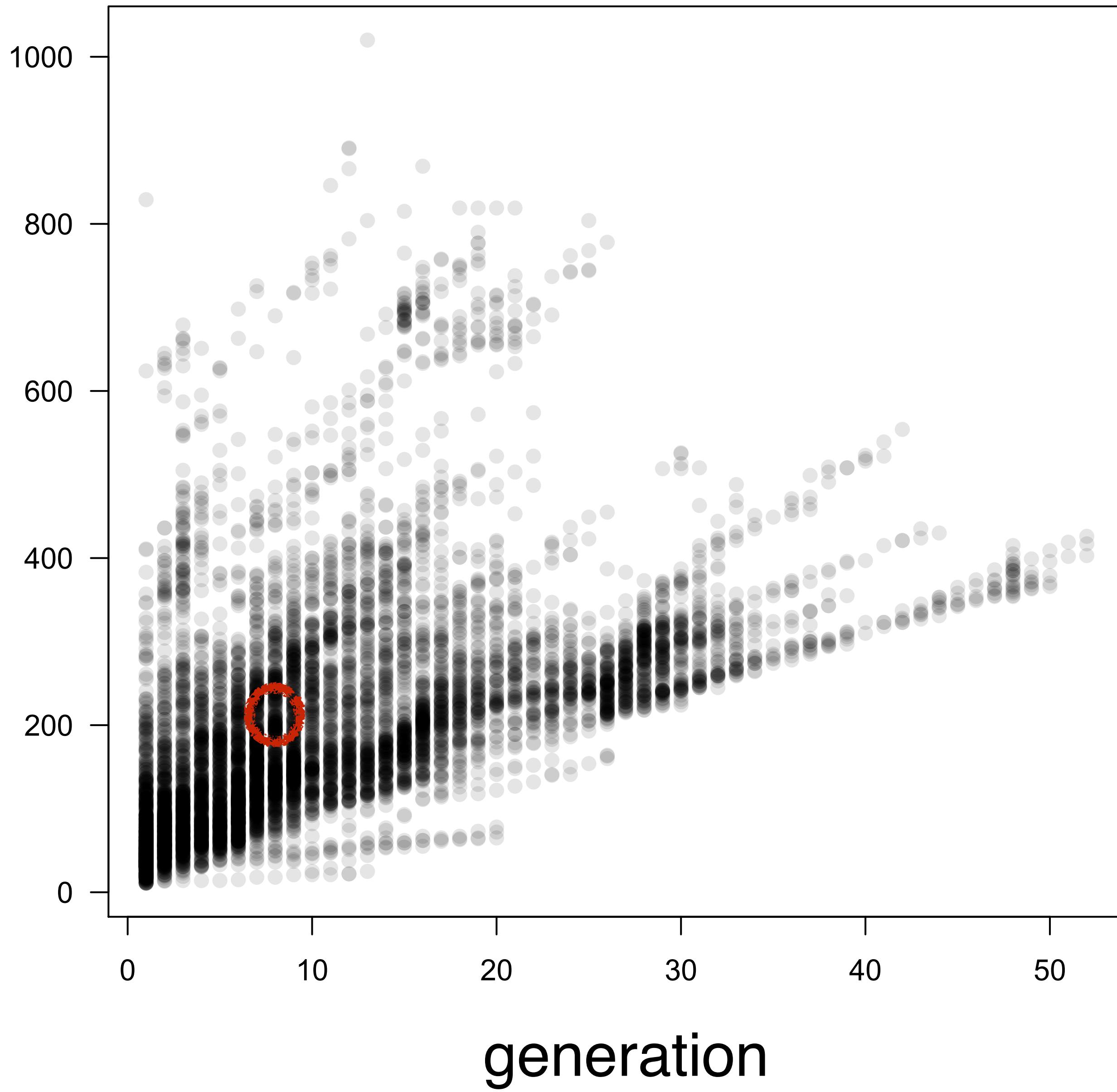
complexity



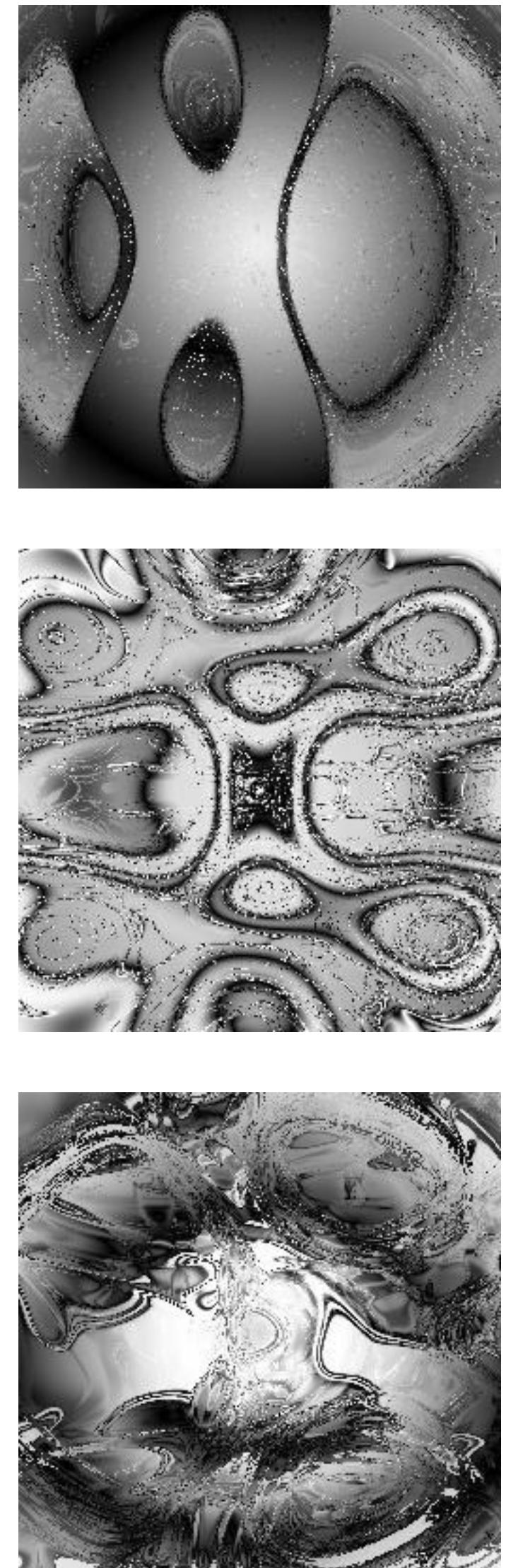
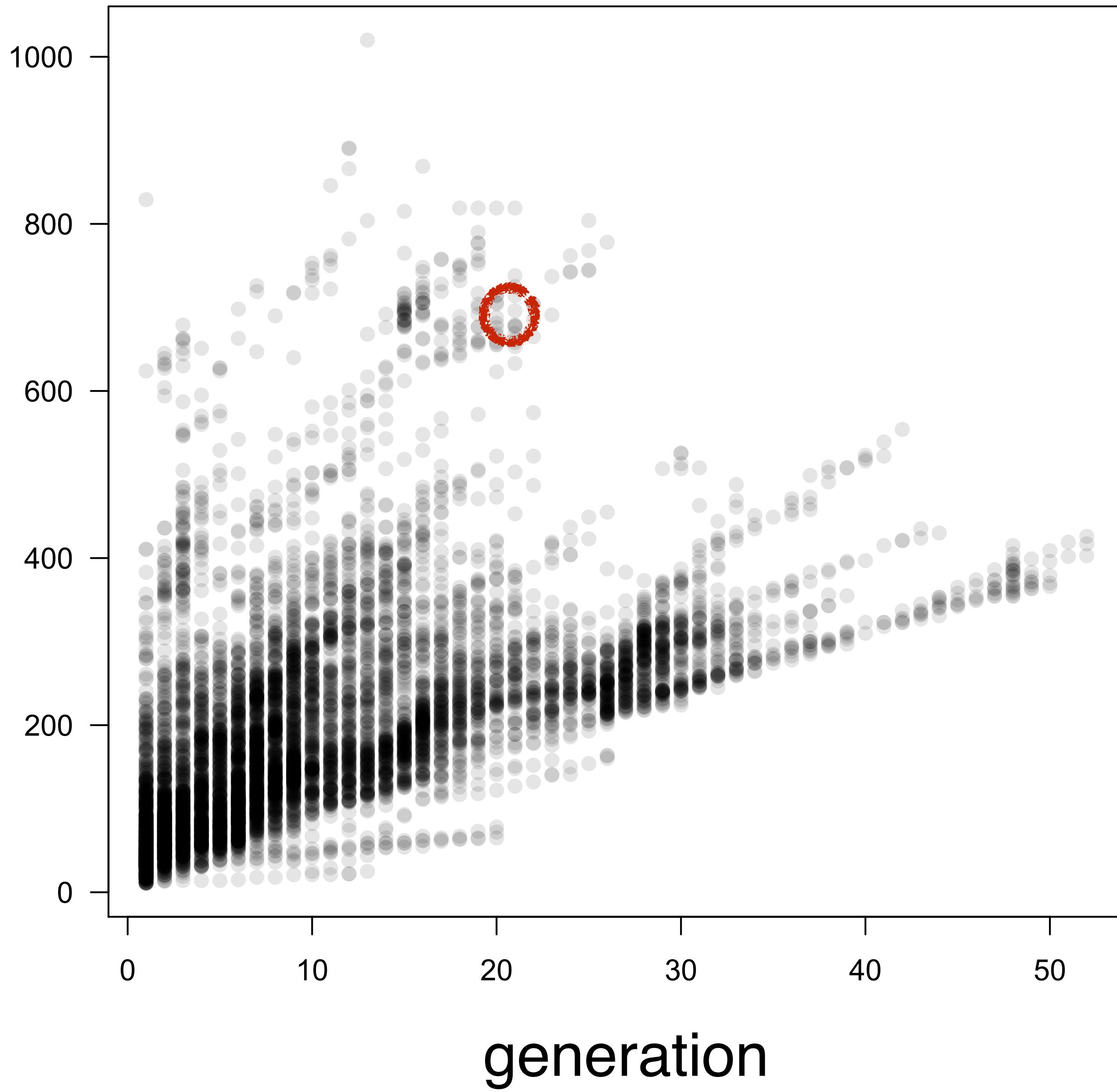
complexity



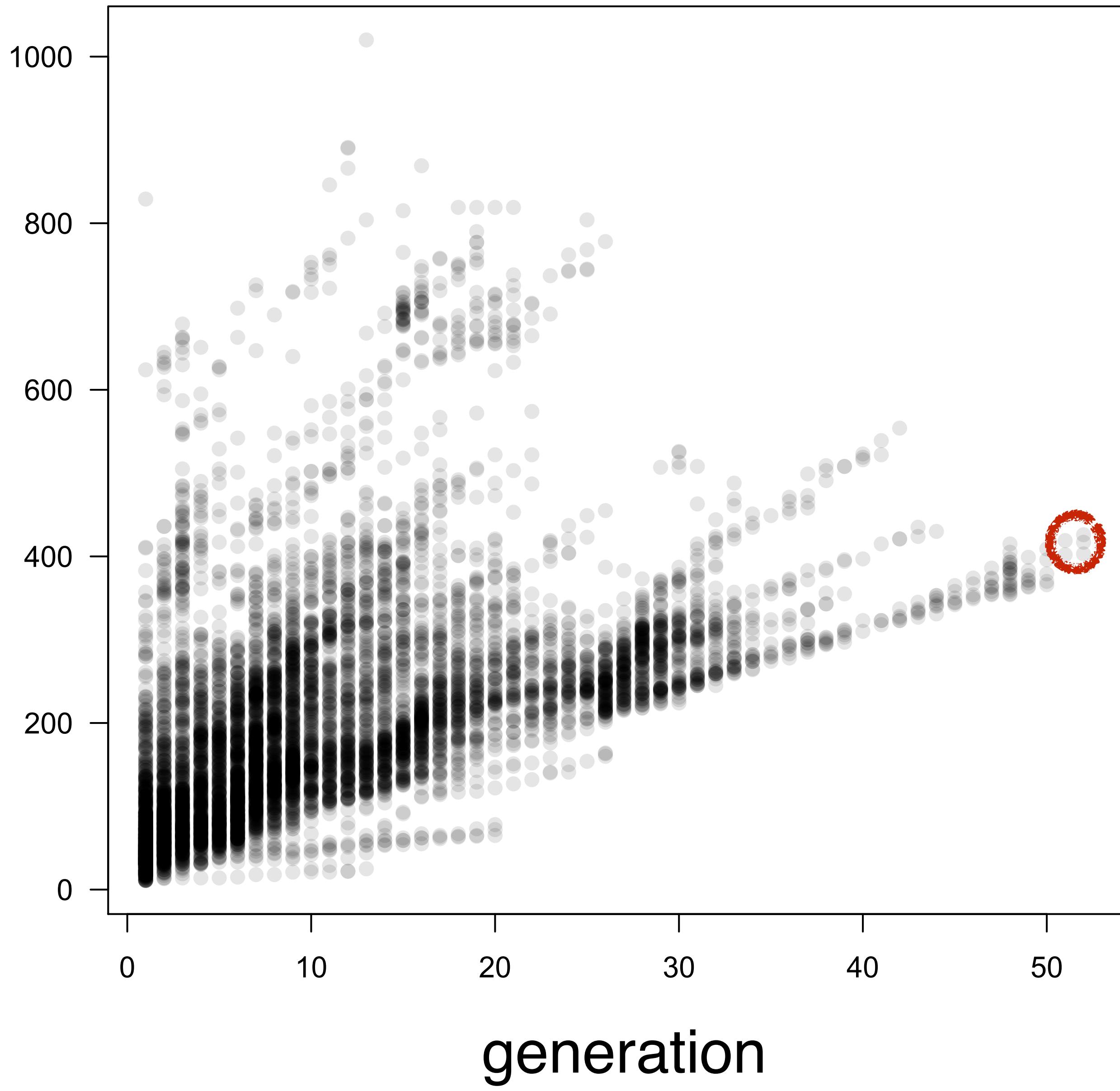
complexity



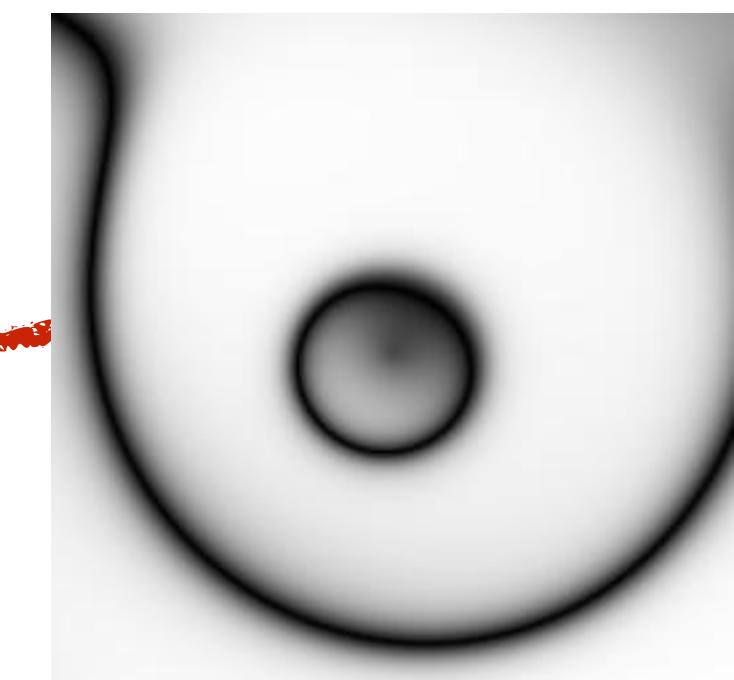
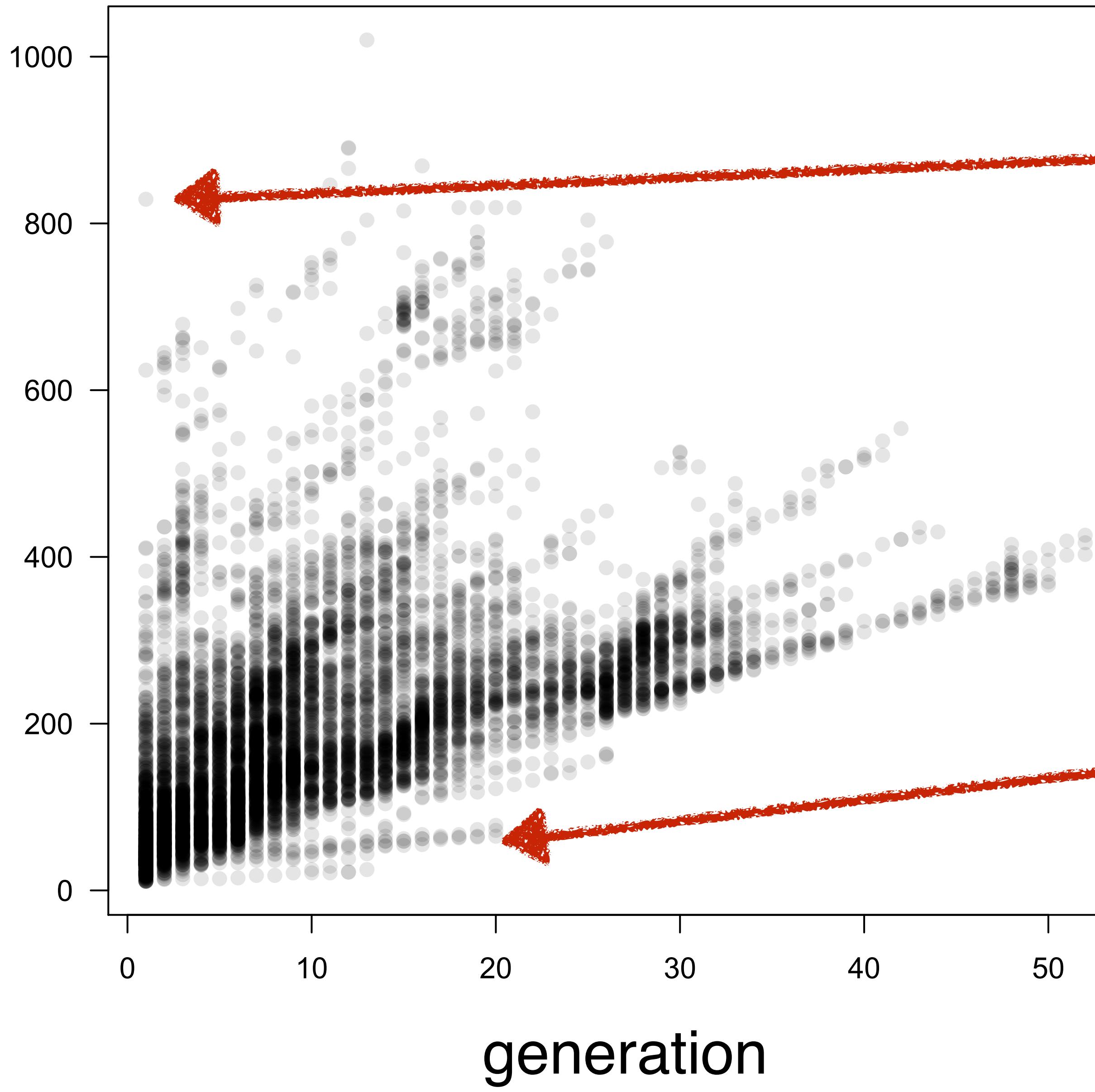
complexity



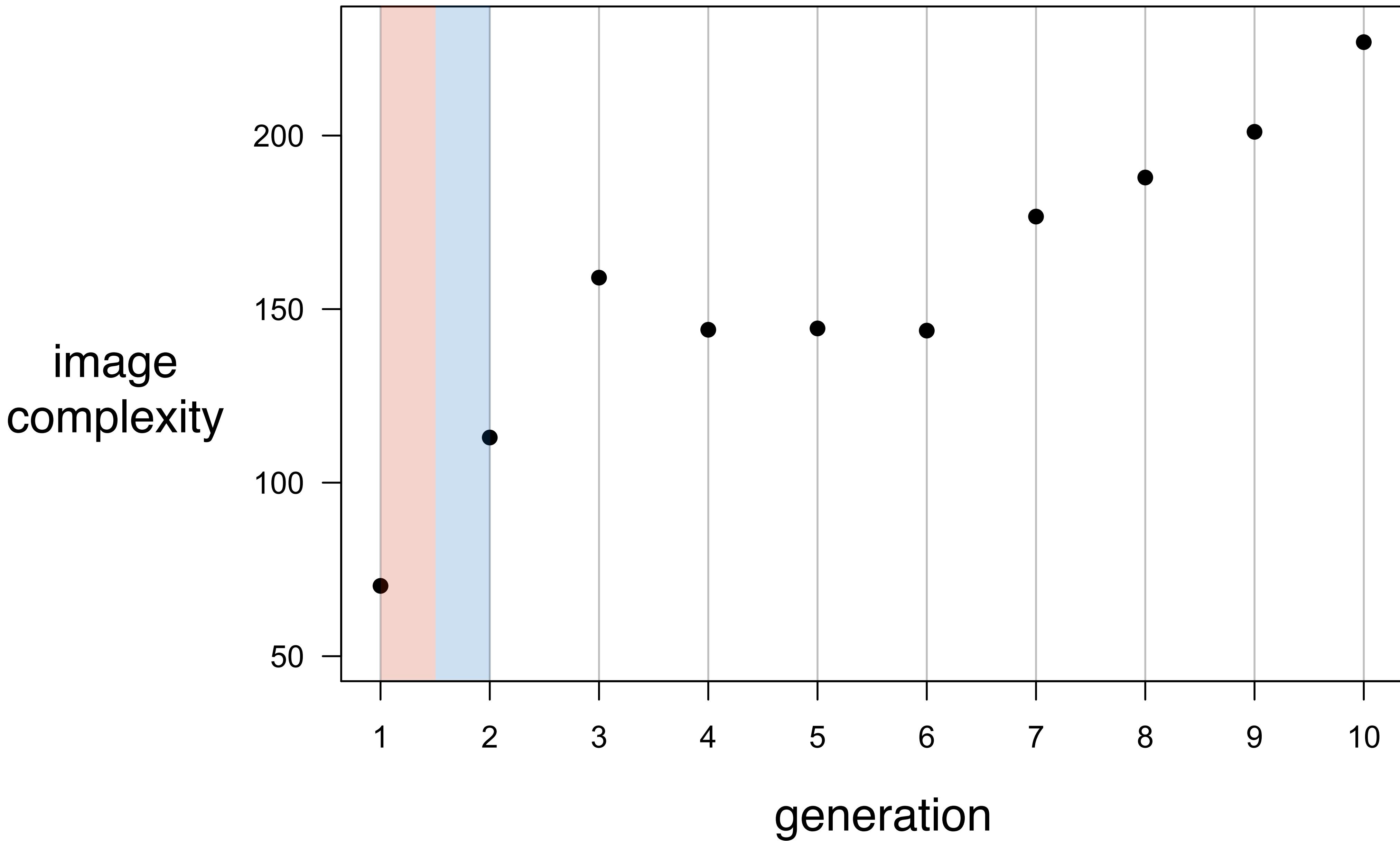
complexity



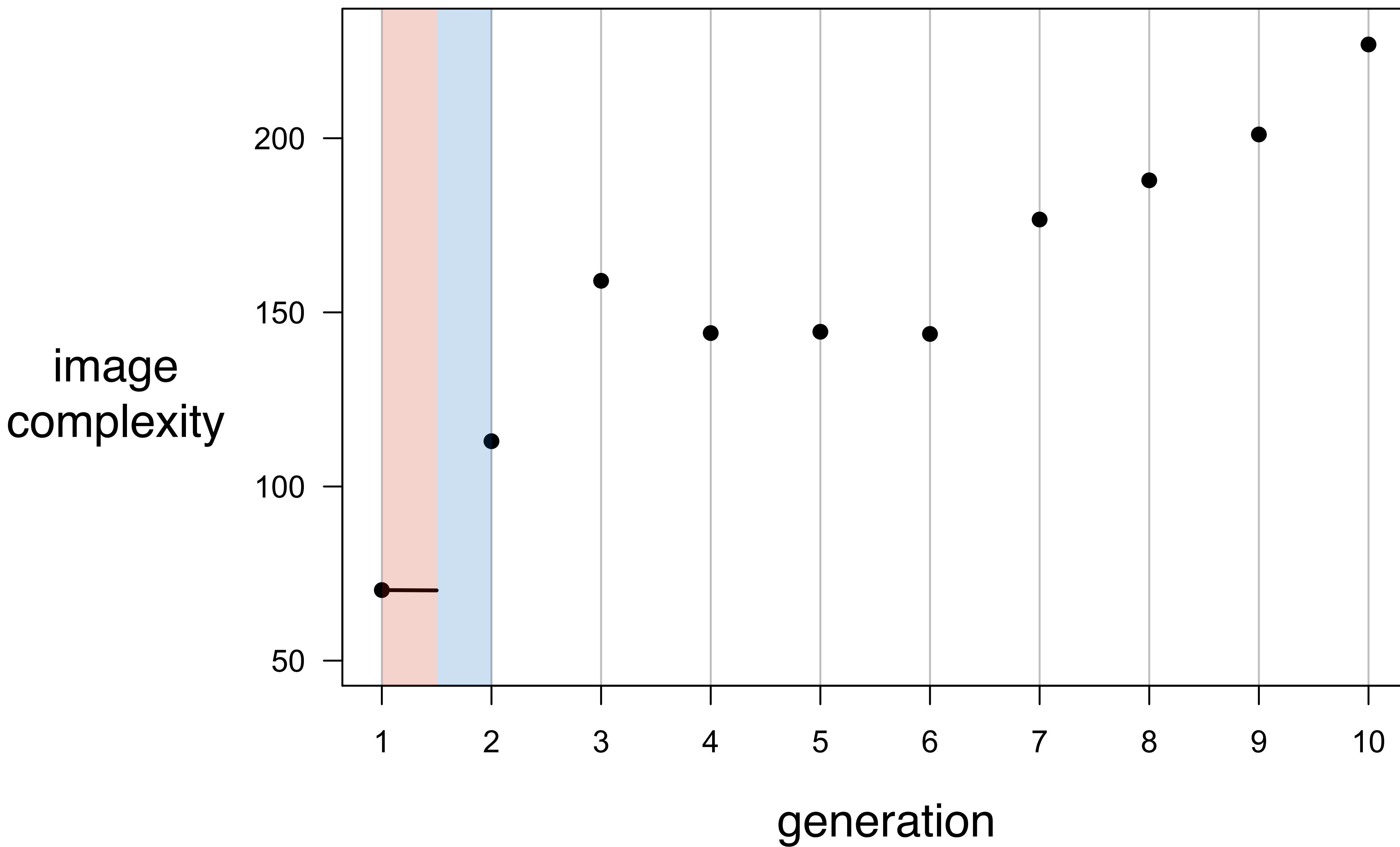
complexity



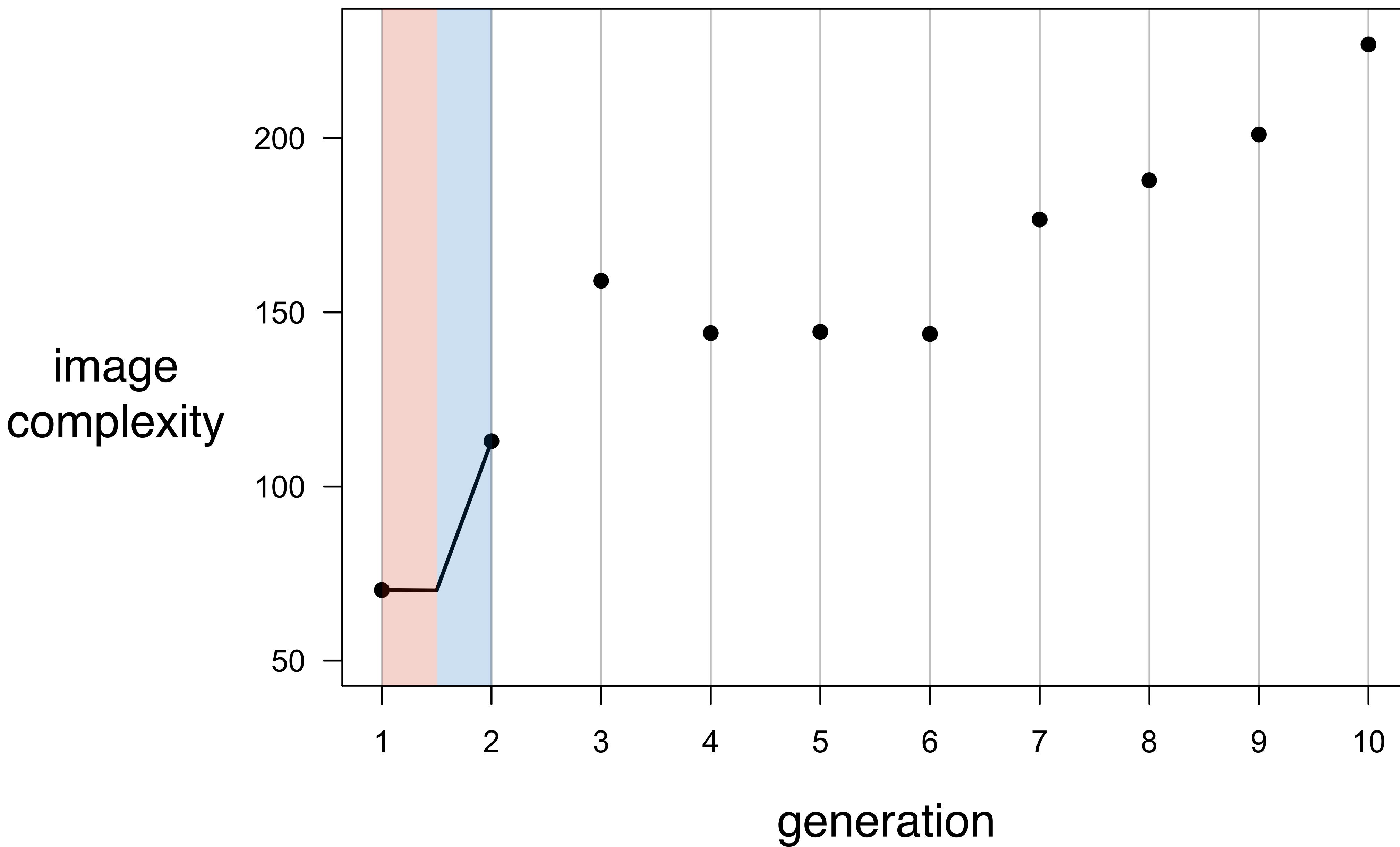
*choose*   *transform*



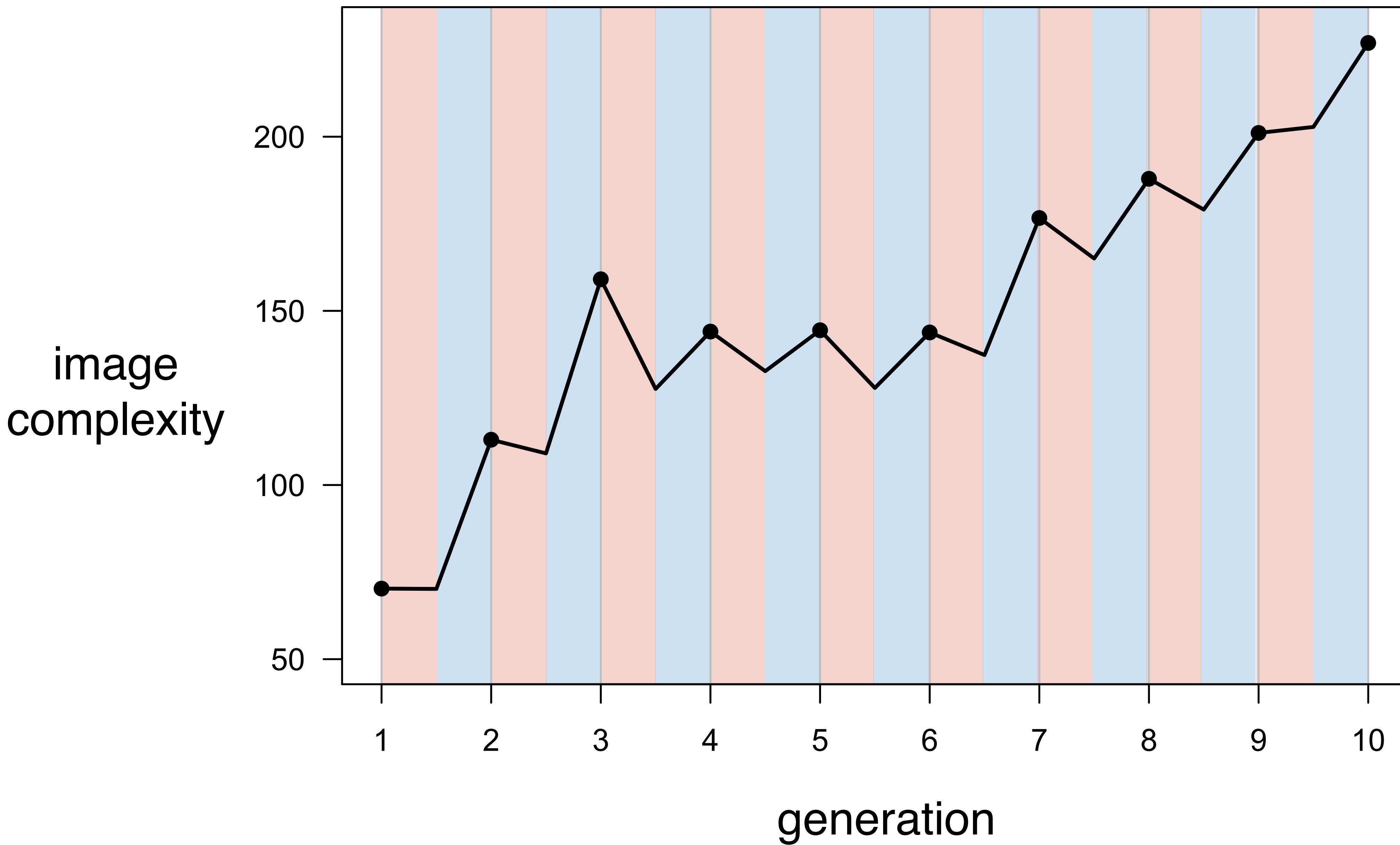
*choose*   *transform*

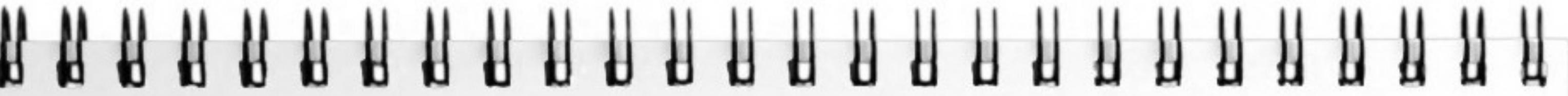


*choose*   *transform*

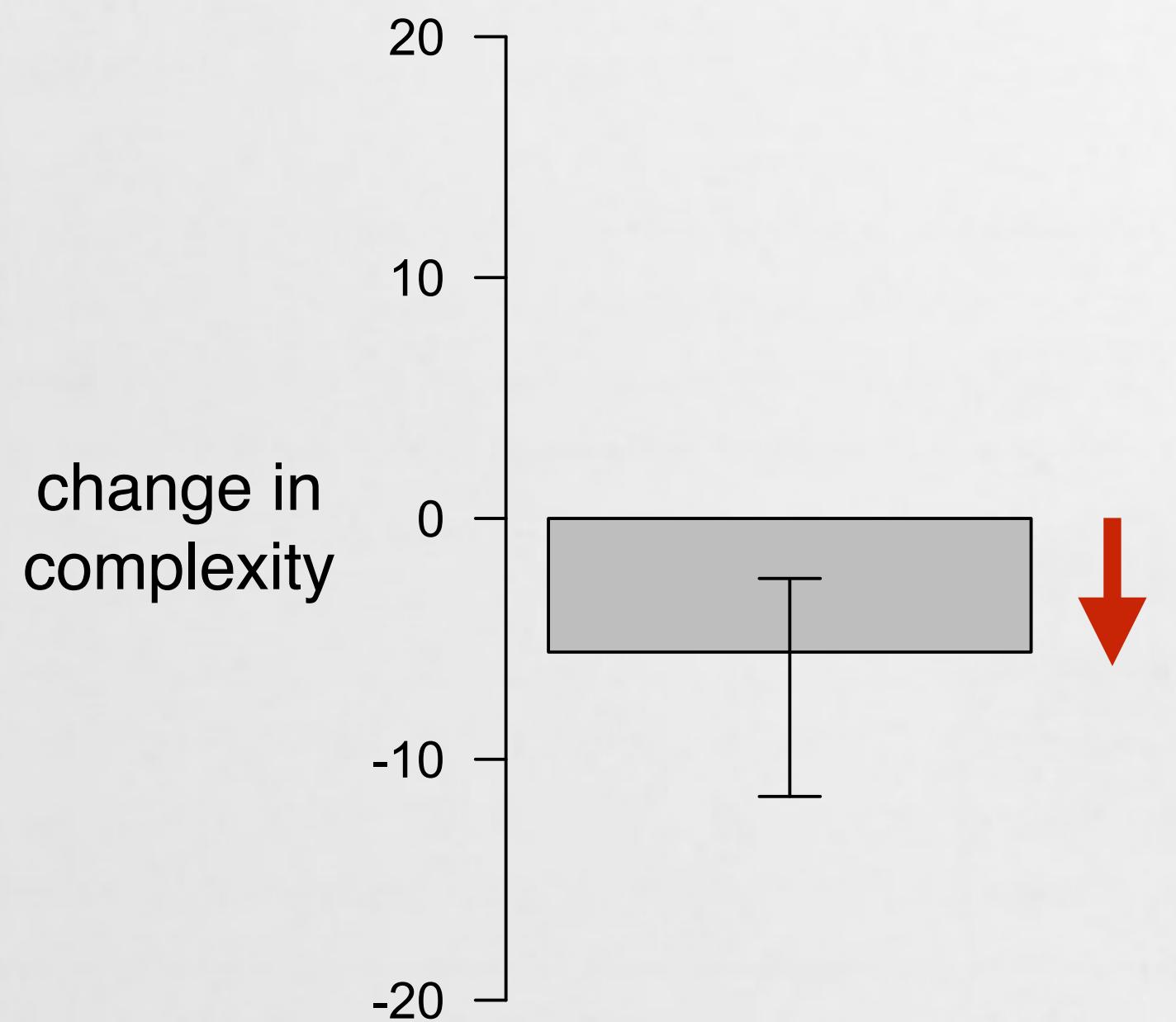


*choose*   *transform*

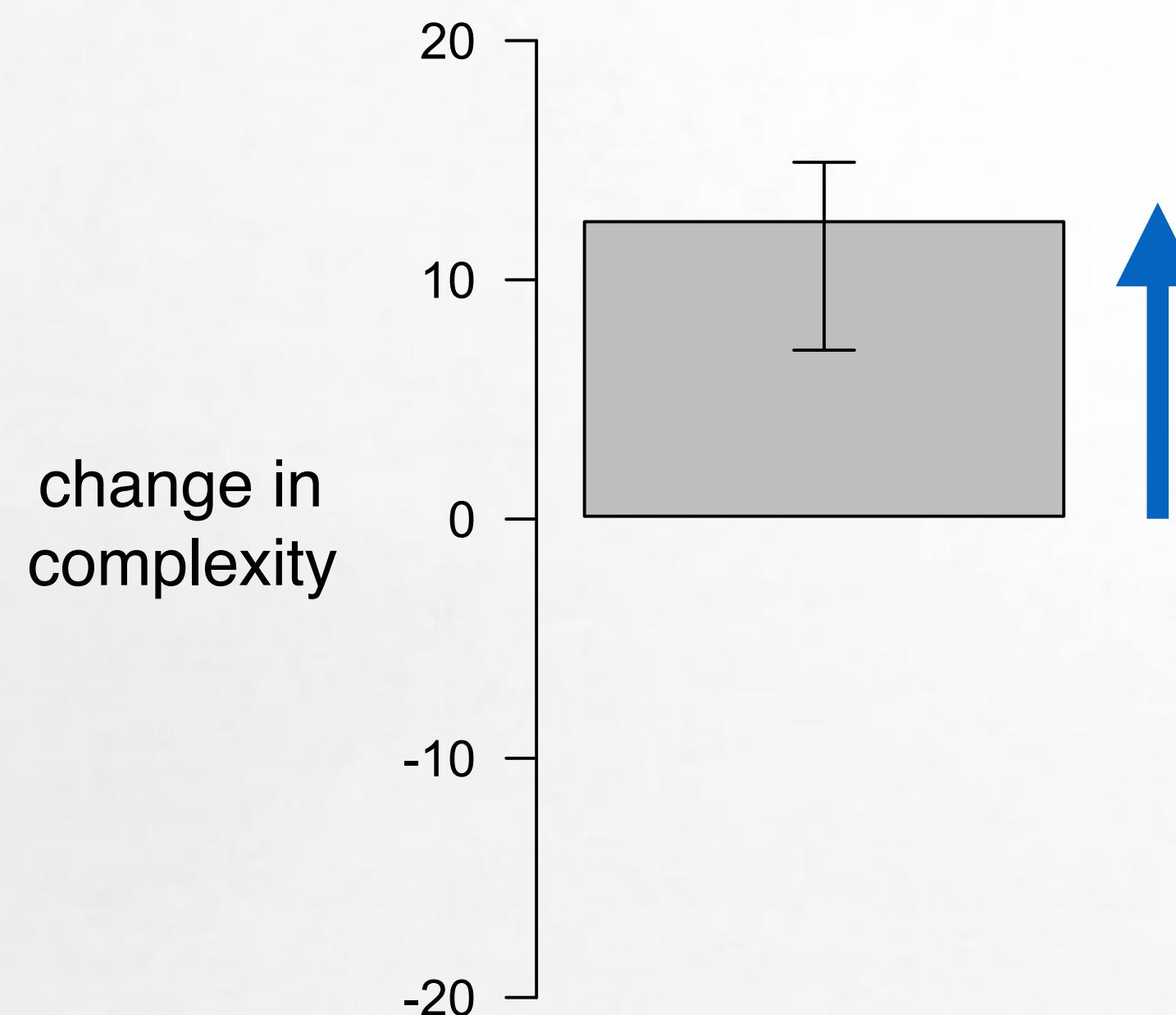


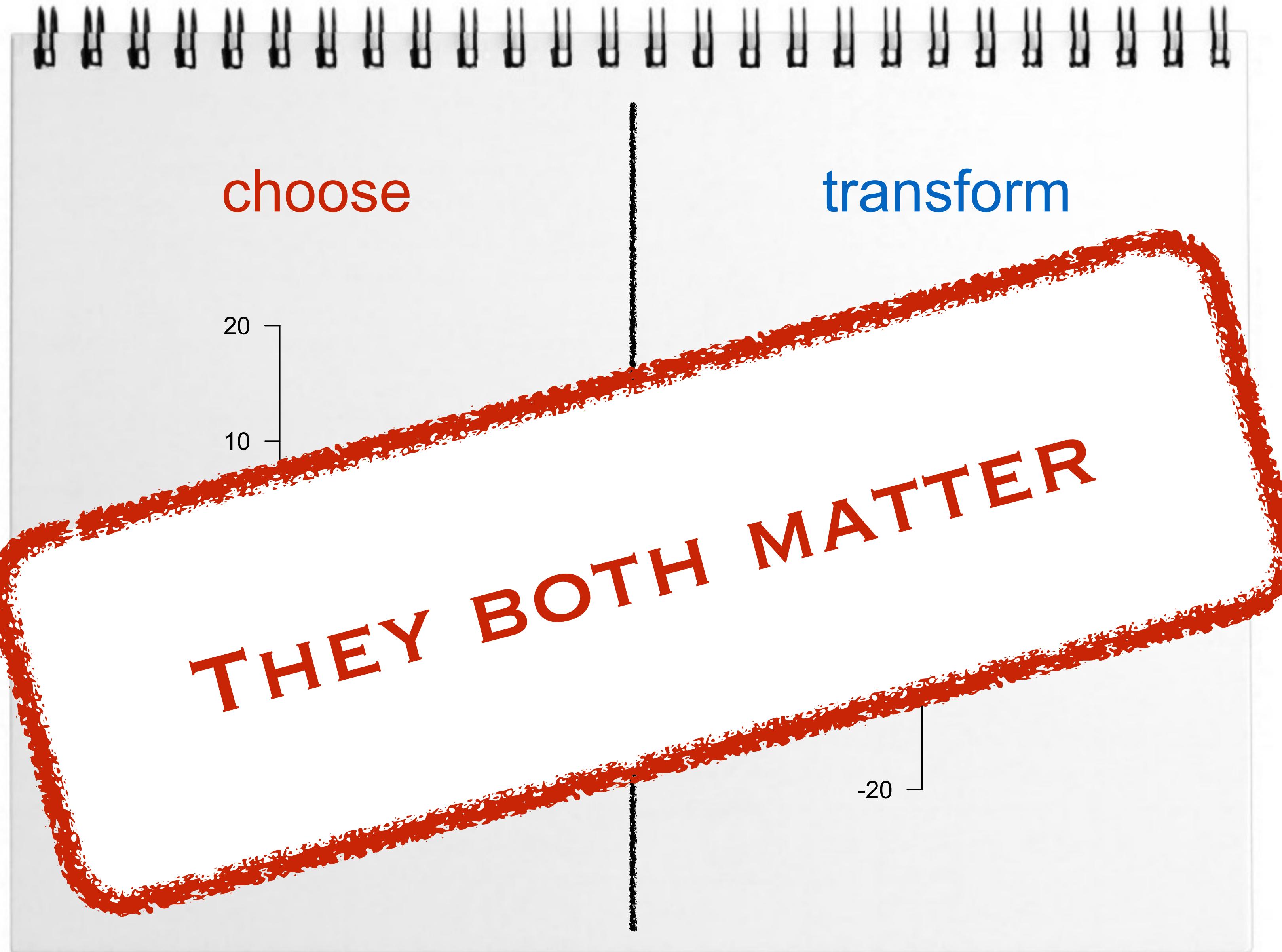


choose



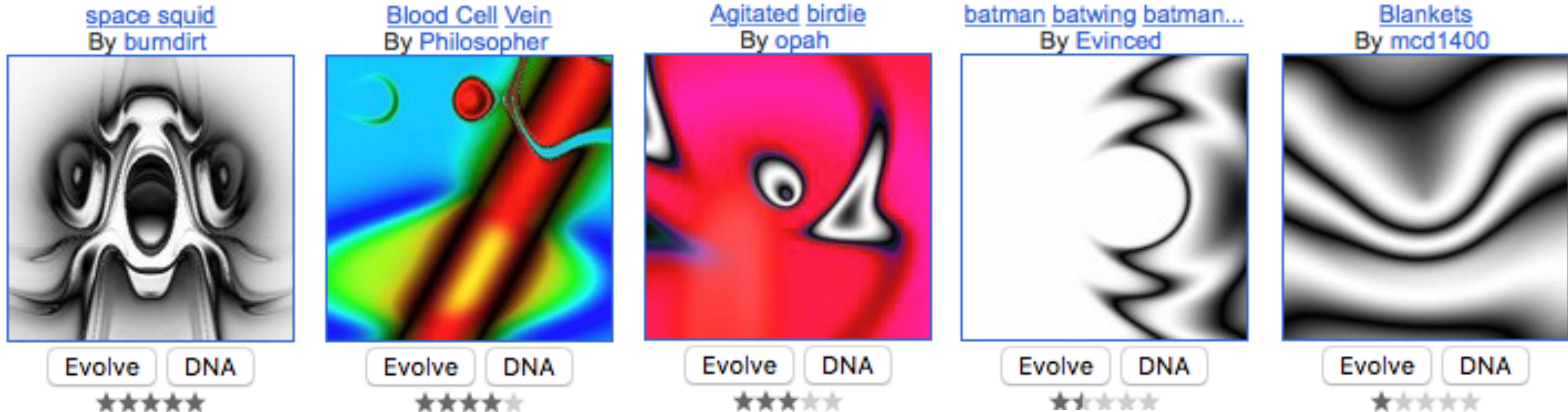
transform



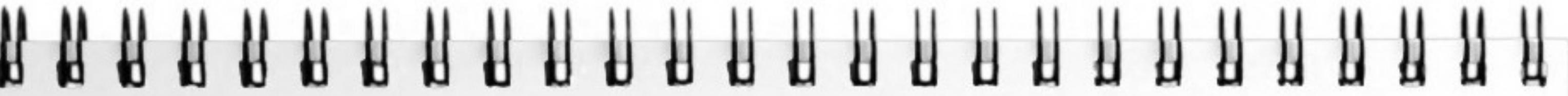


# Community ratings

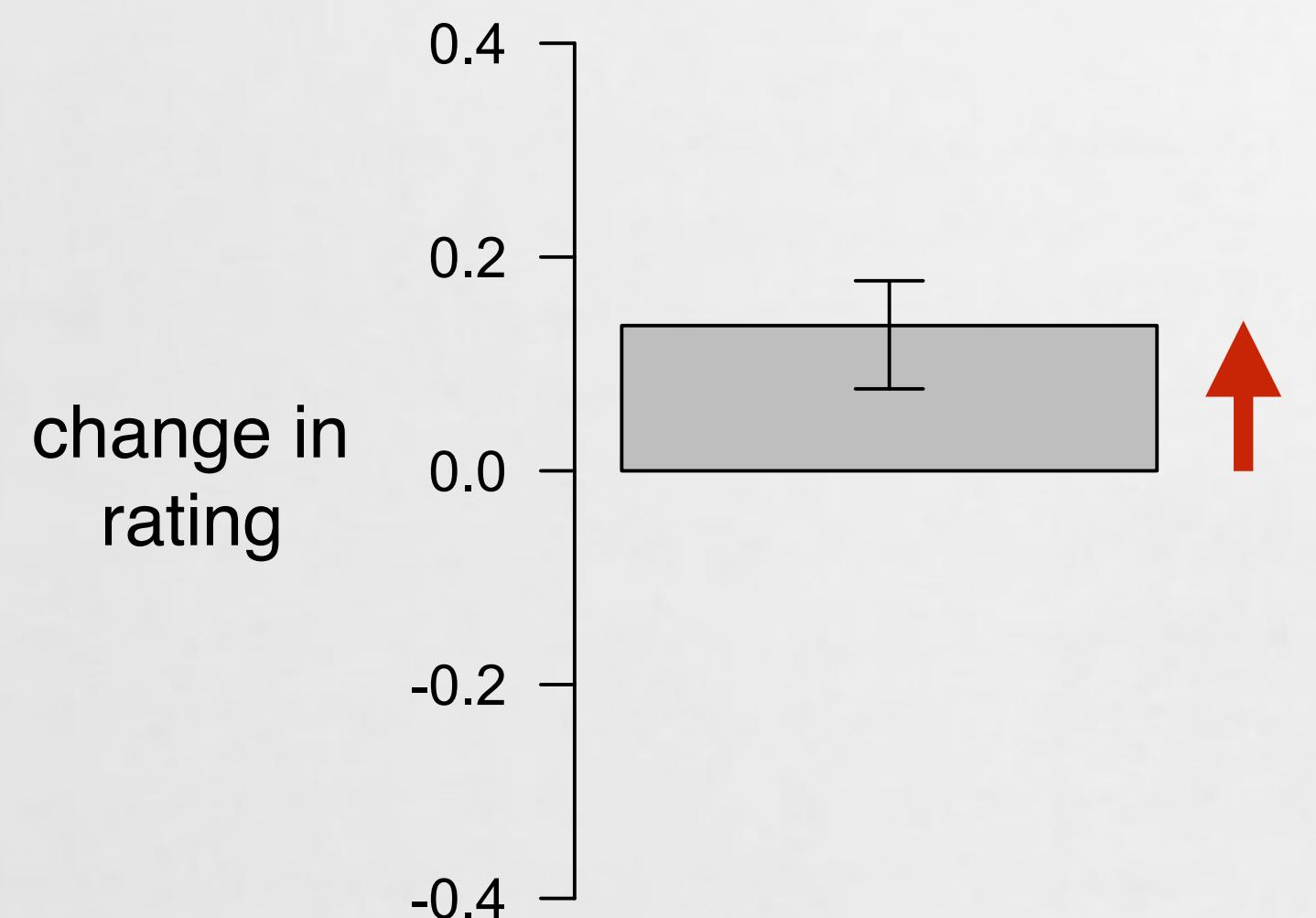
Now let's repeat the analysis for a different evolving variable



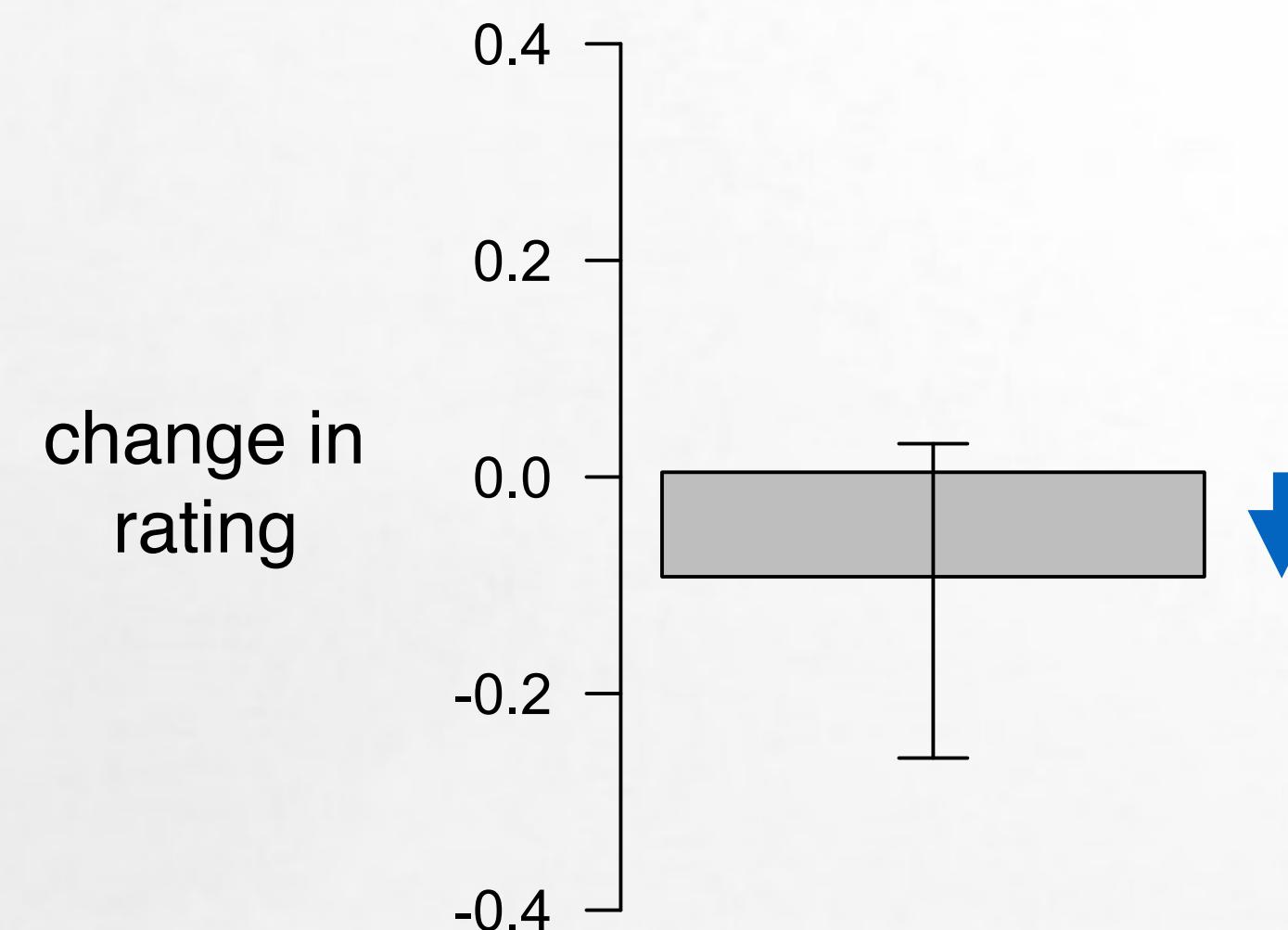
the average rating of the images, among picbreeder members



choose



transform





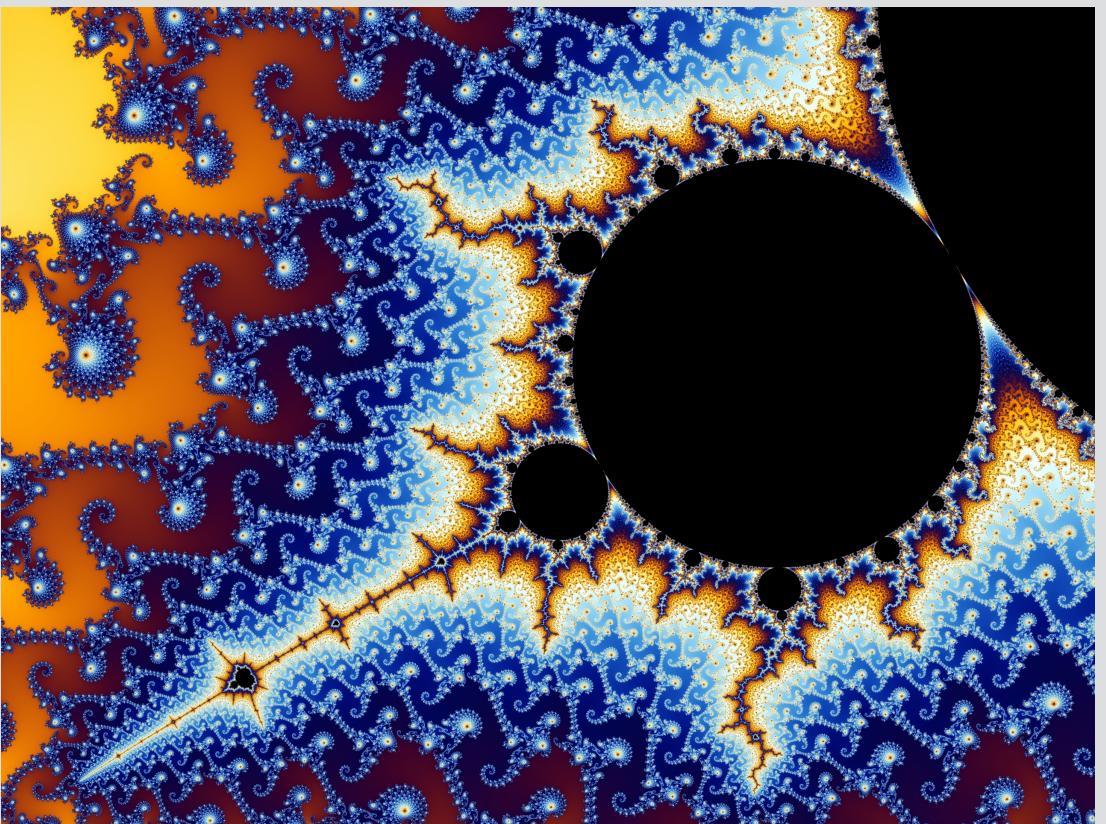
*everyone thinks their baby is the best*



*...but the community's ratings are lower*

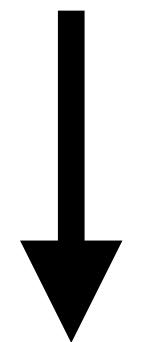
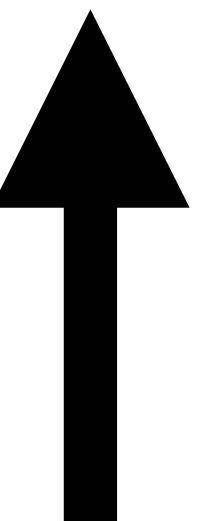
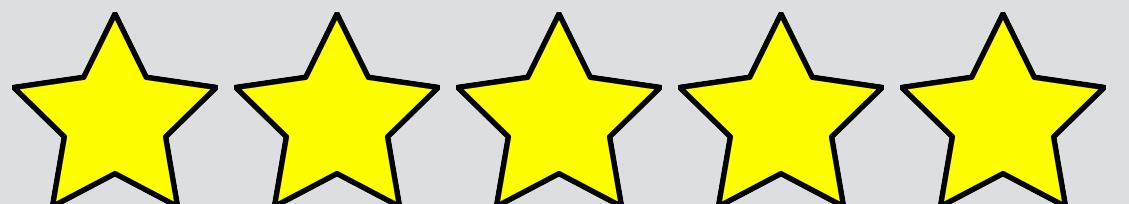
choose

complexity



transform

rating

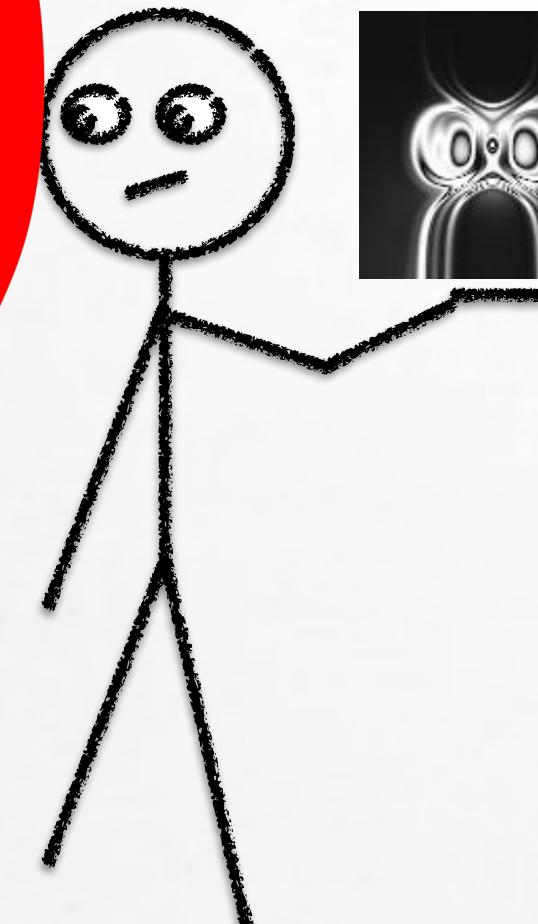


California school

Paris school



CULTURAL  
EVOLUTION  
SOCIETY



*people choose*

*people transform*