

Species

What is a species?

A species is a population of organisms that can _____ and _____ under natural conditions. There are _____ million species on earth.

- How is an **endangered** species different from a **threatened** species?

What causes extinction and how are species protected?

Factors that can cause extinction:

- What type of protection is offered by the **Endangered Species Act of 1973**?

What is speciation?

A _____ is the combined genetic information for a particular population of organisms. Each _____ has a common gene pool.

Speciation: If the gene pool of two populations are _____ and cannot be shared through _____, the populations may develop into a _____.

- What causes the differences in these groups to heighten over time?

What are causes of speciation?

Speciation is caused by the following types of isolation:

- Behavioral -
- Mechanical -
- Temporal -
- Geographic -



What is interspecific competition?

Interspecific competition is the competition _____ species.

- What is the principle of **competitive exclusion** and how does it impact species?

Summary:

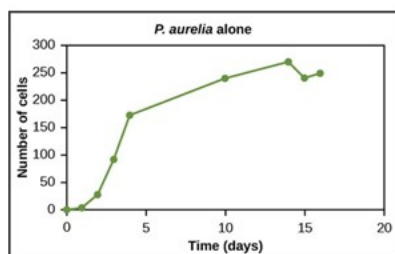
A species is a _____ of organisms that can reproduce. _____ occurs when the gene pool of two populations is _____ and can no longer be shared through _____. Interspecific competition is the competition _____ species.

Data Analysis: Interspecific Competition

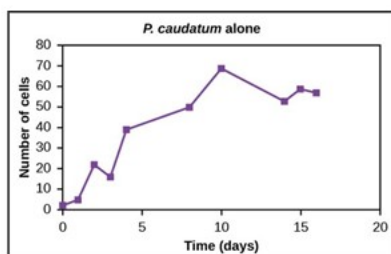
The **principle of competitive exclusion** states that two species competing for the same limited resource cannot both have thriving populations. In order to survive, **interspecific competition** (competition between species) results. If one species has even a slight advantage for survival, it will outcompete the other species and eventually dominate. An example of this principle can be seen in the graphs below, which illustrate the populations of two species of aquatic single-celled microorganisms: *Paramecium aurelia* and *Paramecium caudatum*. In each experiment documented below, the organisms were provided with fresh water and a steady flow of food.



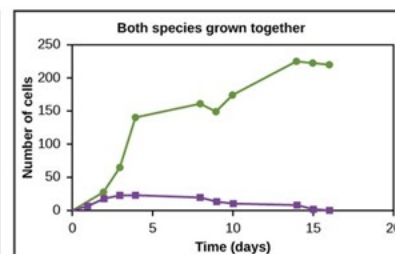
A sample of *Paramecium caudatum*



(a)



(b)



(c)

By CNX OpenStax
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Wikimedia
Commons

Often, interspecific competition does not result in one species dying. In a recent study, ornithologists observed the Common Nightingale and the Thrush Nightingale. Both of these species were originally found in brushy areas on the wooded edge of prairies. After a few months, the Common Nightingales were found mostly in the dry, warmer areas of the prairie while the Thrush Nightingales were found mostly in the cooler wooded portions of the habitat.

Discussion Questions:

1. Look at graph (a). What do you notice about the growth of *P. aurelia* during days 0-5 as opposed to days 5-15?
2. What accounts for the differences in growth during these 2 periods?
3. What resources were limited in this experiment?
4. Describe what happened in graph (c). Give specifics for the first 2 days and the last 14 days.
5. Explain the difference in the Nightingale habitats from the beginning of the study until the end.

Digging Deeper: Speciation

Speciation

A **gene pool** is the combined genetic information for a particular population of organisms. Each species has a common gene pool, although they may be separated into populations in which these genes are not able to be shared. If the gene pool of two populations are separated and the genes are no longer able to be shared through reproduction, the populations may develop into new species. This is known as **speciation**. These new groups will adapt to their environments as separate units, which may cause natural selection to heighten their differences over time.



Isolating Mechanisms

Speciation may occur through a few ways including:

- Behavioral isolation- the two populations are incapable of interbreeding due to differences in courtship or reproductive behaviors
- Mechanical isolation- the reproductive organs of the two groups have become so different that they can no longer mate.
- Temporal isolation- the populations mate at different times or seasons
- Geographic isolation- the populations have been separated by geographic barriers (rivers, mountains, or roads) that prevent reproduction

Discussion Questions:

1. Look at the picture at the top. This is called a “wildlife overpass”. What type of isolation are engineers and ecologists trying to prevent with this structure?
2. What is the disadvantage of isolating populations? (Hint: How does the gene pool change after isolation and why might this be a problem?)



Real Life Scenario: The Ozarks' Collared Lizard

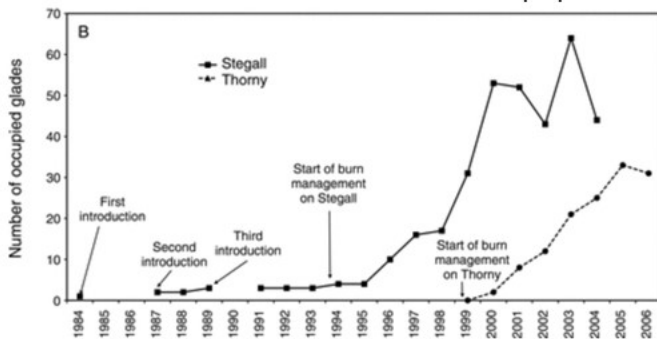
A Case Study on Isolated Populations

In his childhood years in the Ozark Mountains, Alan Templeton loved watching collared lizards. These lizards are colorful and able to run fast on their hind legs. Templeton went to further his education and earn a PhD, but after returning to the Ozarks as an adult, he found that the collared lizards had become difficult to find. Their populations had declined.

Upon further investigation, Templeton realized the problem. Collared lizards live in small patches of desert called glades. Throughout the past 100 years, fire suppression had become a hot topic within the forest service. Red cedar trees, which had been kept to small numbers prior to the firefighting efforts had grown to create large patches of forest. These cedar forests divided the lizard populations.



Templeton tried to help the collared lizard populations expand by bringing in new lizards to recolonize the glades. Eventually, Templeton's research on the declining lizard populations was used to convince local residents that prescribed burns were required on two mountains (Stegall & Thorny) to quell the red cedar forests, allowing greater dispersal of the collared lizards that remained.



Discussion Questions:

1. What type of isolation was occurring in the collared lizard population?
2. What might have happened to the collared lizard populations in the Ozarks if Templeton hadn't noticed a problem?
3. When did Templeton attempt to reintroduce new lizards? Were these methods successful? Give evidence from the graph to explain your answer.
4. Explain why the number of occupied glades rises quickly after 1994.
5. If you had lived in the Ozarks during the time of Templeton's lizard reintroduction, would you have voted to allow prescribed burns in the forests? Why or why not?

Species

What is a species?

1. What is the biological species concept?
2. What is the morphological species concept?
3. Name 2 problems that scientists have when classifying species.
4. Why hasn't gene sequencing solved the issues with categorizing species?
5. What are 2 other "species concepts" that can be used to identify species?
6. If identifying a species is so complicated, what is the point? What is the benefit of identifying an organism's species?

How many species are there?

7. Current estimates for the total number of species on Earth is around _____ million species, with an uncertainty of _____ million species.
8. How many of these species are estimated to live in the ocean?
9. Scientists agree most on species within groups such as mammals, birds, and reptiles. What groups have the most disagreement?

Population Growth

How are linear and exponential growth different?

Linear growth (or _____) shows a pattern increasing in a _____.



Exponential growth (or _____) shows a pattern increasing at _____.



Sketch line graph shapes.

How do populations increase?

Populations increase _____ and can be graphed on a _____ curve.



The rate at which a species increases is its _____, and this is based on its _____ requirements and _____ rates.

Why don't populations increase indefinitely?

The environment keeps populations from increasing forever with limits called _____. Limiting factors may cause organisms to _____ or _____ out of an area.

Eventually, the population will _____ at the _____.

- What is carrying capacity?

What types of limits regulate population size?

_____ - _____ factors have an increasing effect as the population increases.

- Example: _____ (These are usually _____).

_____ - _____ factors affect all populations, regardless of how large.

- Example: _____ (These are usually _____).

Summary:

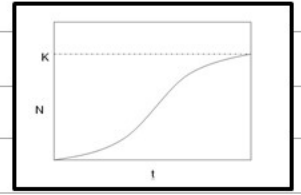
Populations increase _____ at a rate known as biotic potential. Populations don't increase indefinitely because of _____. These factors cause populations to _____ at the carrying capacity. There are two types of limits that regulate population size: density-_____ & density-_____ factors.

Populations: Survivorship

What is the logistic model of growth?

When the limiting factors LIMIT the population, the J curve will not continue to _____. It levels off at the _____.

This is called an _____ curve. →



What factors affect population growth?

Populations are made of _____, each with a particular life span.

When discussing an individual's life in terms of population size, there are a few terms ecologists use:

- Natality -
- Fecundity -
- Fertility -
- Mortality -
- Life expectancy -

What does a survivorship curve show?

A survivorship curve shows the _____ of _____ for a given group or species. There are _____ survivorship curves based on the _____ of individuals.

- Draw the 3 curves:

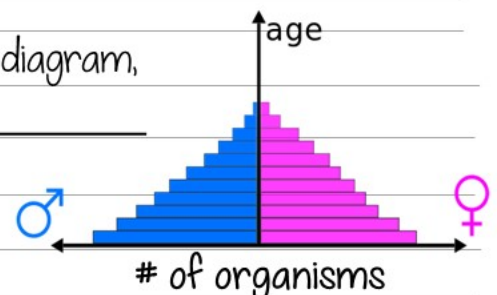
How are K and R strategists different?

K Strategists	R Strategists

What does a population pyramid show?

A population pyramid, or age structure diagram, shows a snapshot of the _____.

- What does this diagram show?

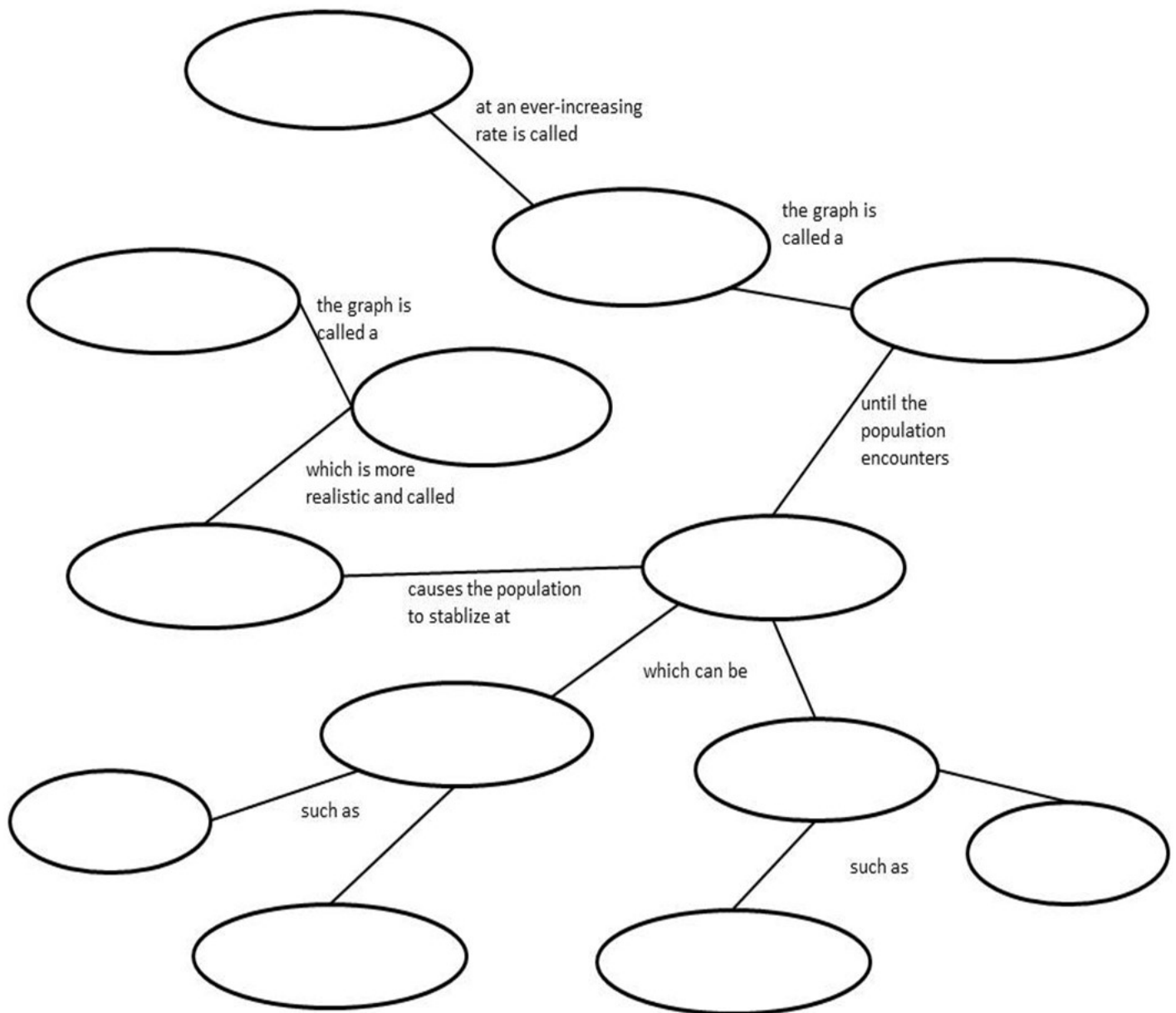


Summary:

Limiting factors cause a population curve to level off at the _____, creating an _____ curve. Populations are made of individual organisms with particular _____. Organisms can be _____ or _____ strategists. A population _____ shows a snapshot of the current population.

Population Growth Concept Map

Fill in the concept map with the following terms: population growth, density-independent, exponential growth, J curve, predators, S curve, carrying capacity, limiting factors, natural disasters, density-dependent, disease, logistic growth, temperature



R Strategists v K Strategists Card Sort

Sort the cards provided into one of 2 the two categories.
Don't use your notes! When finished, have them checked by your teacher.

R Strategist

K Strategist

R Strategists v K Strategists Cards

**Small
organism size**

**Long parental
care**

**Large
organism size**

**Short life
expectancy**

**Type 3
survivorship
curve**

**High
energy/offspring
expended**

**Low
energy/offspring
expended**

**Type 1 or 2
survivorship
curve**

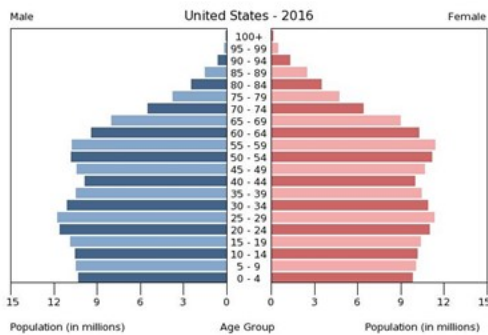
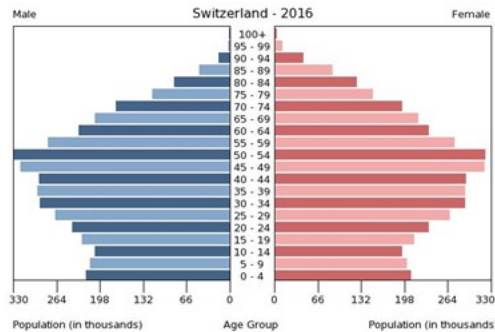
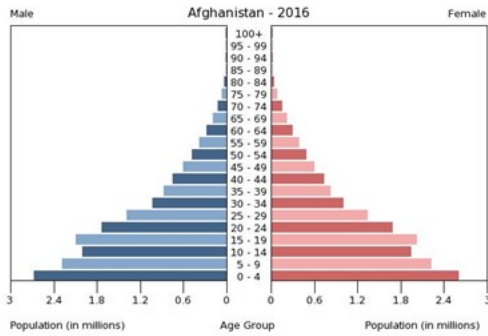
**Long life
expectancy**

**Few offspring
produced**

**Little parental
care**

**Many offspring
produced**

Data Analysis: Age Structure Diagrams



An age structure diagram (or population pyramid) is a graphical illustration showing the distribution of various age groups in a population. Although ecologists use these to monitor the growth of plant and animal populations, they are also useful for monitoring human populations.

When reading an age structure diagram, the males can be found on the left and females on the right. The three diagrams on the left of this page show the population demographics for Afghanistan, Switzerland, and the United States, respectively. Note that the scale on the bottom of the diagram is not the same for each of the populations.

These three diagrams are typical of the three types of populations. The first diagram represents an expanding population, the second is a diminishing population, and the third is a stable population.

Discussion Questions:

- Which diagram represents the following characteristics of natality and mortality?
 - Natality = Mortality _____
 - Natality < Mortality _____
 - Natality > Mortality _____
- Which diagram would be common to most developing countries? Why?
- What might cause populations to stabilize? Think of legislative, lifestyle, and industrial causes.
- What might cause populations to decline? Think of legislative, lifestyle, and industrial causes.

Digging Deeper: Is there a human carrying capacity on Earth?

Thomas Malthus was a well-known academic in the late 1700s. Rather than focusing his scientific studies on individuals as many did during that time, he paid attention to trends in populations. His research on human populations and growth rates led him to conclude that the human population was headed for inevitable famine, as food production would not be able to outpace the human birth rate.

Directions: Research the claims made by Malthus and modern-day scientists to answer this question- Is there a human carrying capacity on Earth? Some guiding questions are provided for you below.

Guiding questions:

1. What similarities are there in the growth of the human population compared to animal/plant populations?
2. What differences are there in the growth of the human population compared to animal/plant populations?
3. Do populations grow at the same rate in various parts of the world? Do they consume the same amount of resources? Why or why not?



Digging Deeper: Is there a human carrying capacity on Earth?

Summarize: Provide an answer to the posed question above and provide an explanation based on your research.



List your research sources here:

Population Growth

How fast do populations grow?

1. When exponential growth is graphed, the trend line created looks like what letter of the alphabet?
2. Which has a greater biotic potential- humans or mice? Why?
3. What is carrying capacity?
4. What are the two types of limiting factors and how do they differ?
5. When limiting factors exhibit pressure on a population, what happens to the growth graph?
6. Match the following terms to the correct description.

_____ natality	a. death rate
_____ fecundity	b. predicted length of survival
_____ fertility	c. ability to reproduce
_____ mortality	d. birth of new individuals
_____ life expectancy	e. number of offspring
7. Which type of survivorship curve would be represented by a population of elephants? A population of frogs?

Population Growth

Why are limiting factors important?

8. Run the sheep simulation a few times with various conditions. Adjust some of the variables including "reaping", amount of grass, and birthrate to see if you can make a more stable population. What is the highest carrying capacity of sheep possible? What conditions are required to allow this carrying capacity?
9. Take a snapshot of your simulation and paste it below. Describe the image including analysis of limiting factors and growth/carrying capacity.

What can we learn from a population pyramid?

10. A population can be divided into three important categories on a population pyramid. What are these three categories?
11. If a population pyramid is shaped like a true pyramid, what can we determine about that population's growth?

Deer Ecology Analysis



In this activity, you will analyze data from the MSU Deer Lab.

The MSU Deer Lab was started in the 1970s by two biologists. It provides valuable data regarding deer population growth over several decades in the Mississippi region in correlation with changes in deer harvest (hunting) regulations.

Checkpoint: Is hunting a density-dependent or density-independent limiting factor? Explain your answer.

[Go to this site.](#) Read the information provided and examine the images. Then answer the following questions:

1. Which 2 age classes of deer are most affected by habitat quality (limiting factors)?
2. [Now go to this page and look at Figure 27.](#) What happened to the yearling buck weight as doe harvesting increased? Explain why this would be.
3. Look at Figure 29 and read the related information. How did flooding affect the 2-year old doe population?
4. What would have happened to the older doe population as a result of flooding? Why?

SPECIES

What is a species?



Protecting species:

speciation:

Causes of speciation:

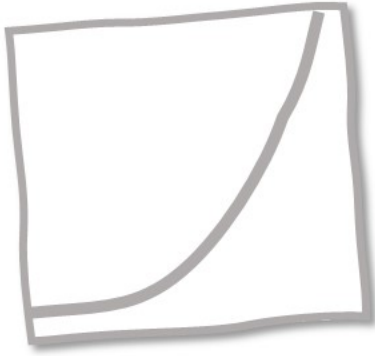


Endangered

interspecific competition



Exponential Growth



Logistic Growth



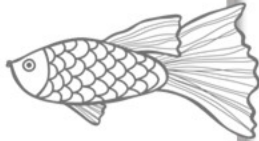
Population Growth

Limiting Factors:

Carrying Capacity:

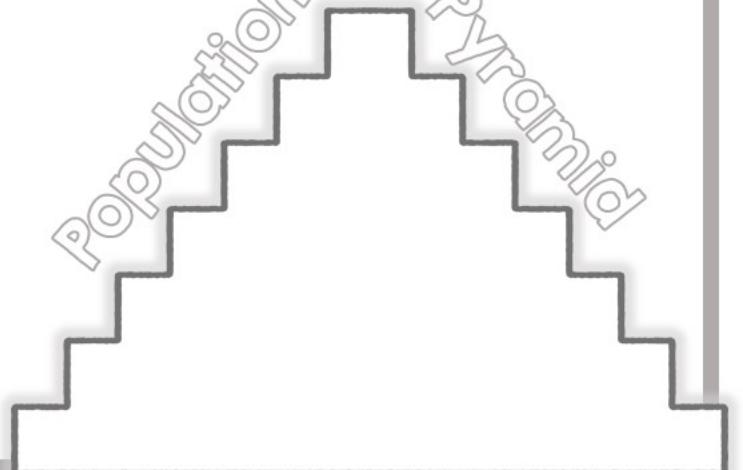
R v. K strategies:

Factors that affect pop. growth:



Draw the 3 survivorship curves:

Population Pyramid



Data Analysis: Barnacle Geese Population



The barnacle goose gets its name from a myth that claimed they arose from barnacles. They primarily live and breed in the Arctic islands of the North Atlantic. They began populating Scandinavian countries in the 1970s and 1980s. Because the species is covered by legislation protecting migratory waterfowl, its populations have been studied and closely monitored. This legislation (known as the African-Eurasian Waterbird Agreement) was passed in 1999.

The data below was gathered from a small population of barnacle geese in the islands near Helsinki, Finland. Use the data below to answer the questions that follow.

In the space below, graph the data from the table to the left.

Year	Pairs
1996	30
1997	58
1998	72
1999	80
2000	107
2001	164
2002	193
2003	289
2004	337
2005	352
2006	409
2007	526
2008	611
2009	673
2010	731
2011	603
2012	651
2013	619
2014	632

Questions:

1. What type of growth curve is represented from 1996 to 2010?
2. What factors do you think contributed to this growth?
3. What type of growth curve is represented from 1996-2014?
4. What is the approximate carrying capacity of this population?
5. What types of limiting factors may have caused the population to level off? Name both density-dependent and density-independent factors.