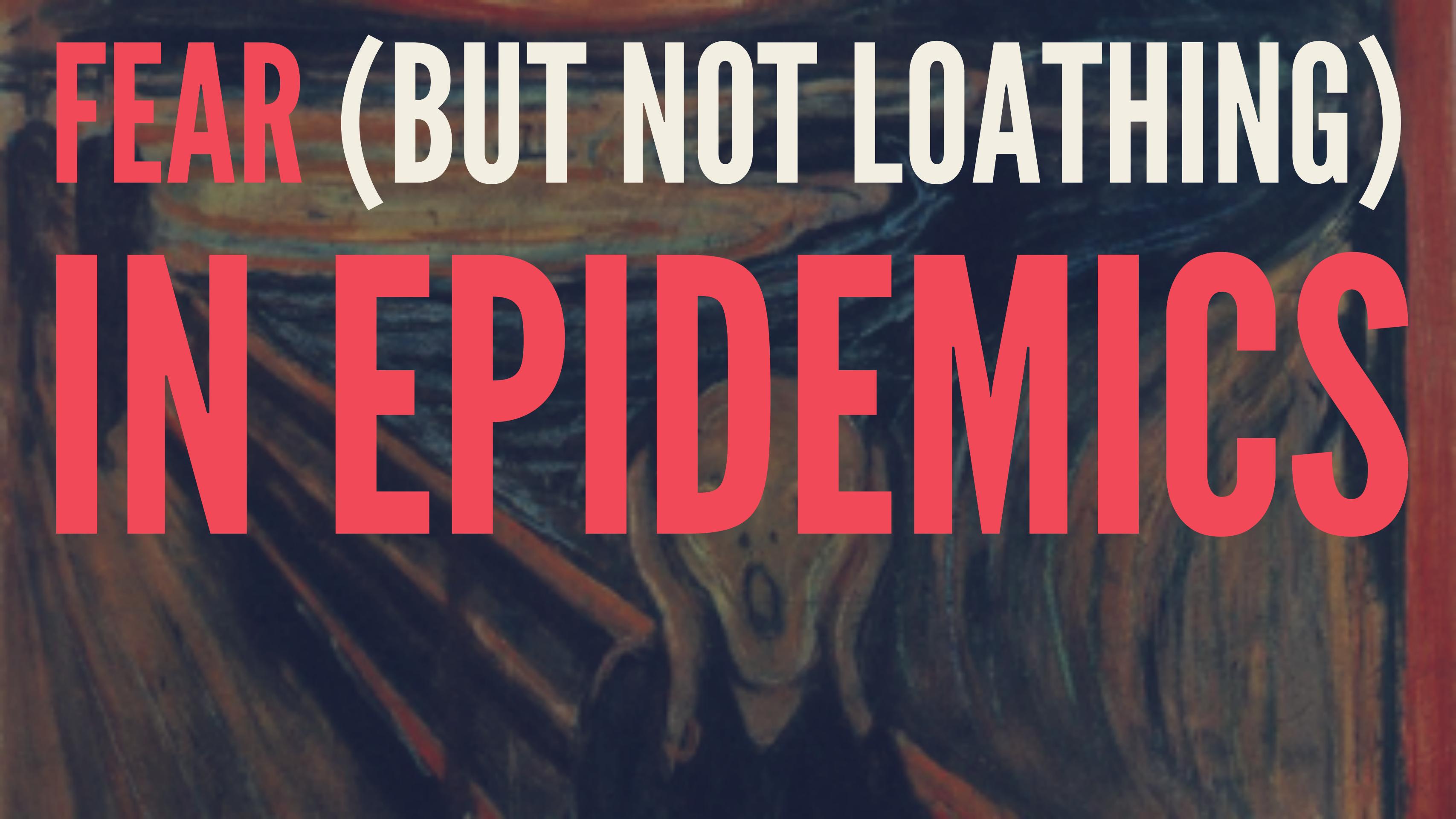
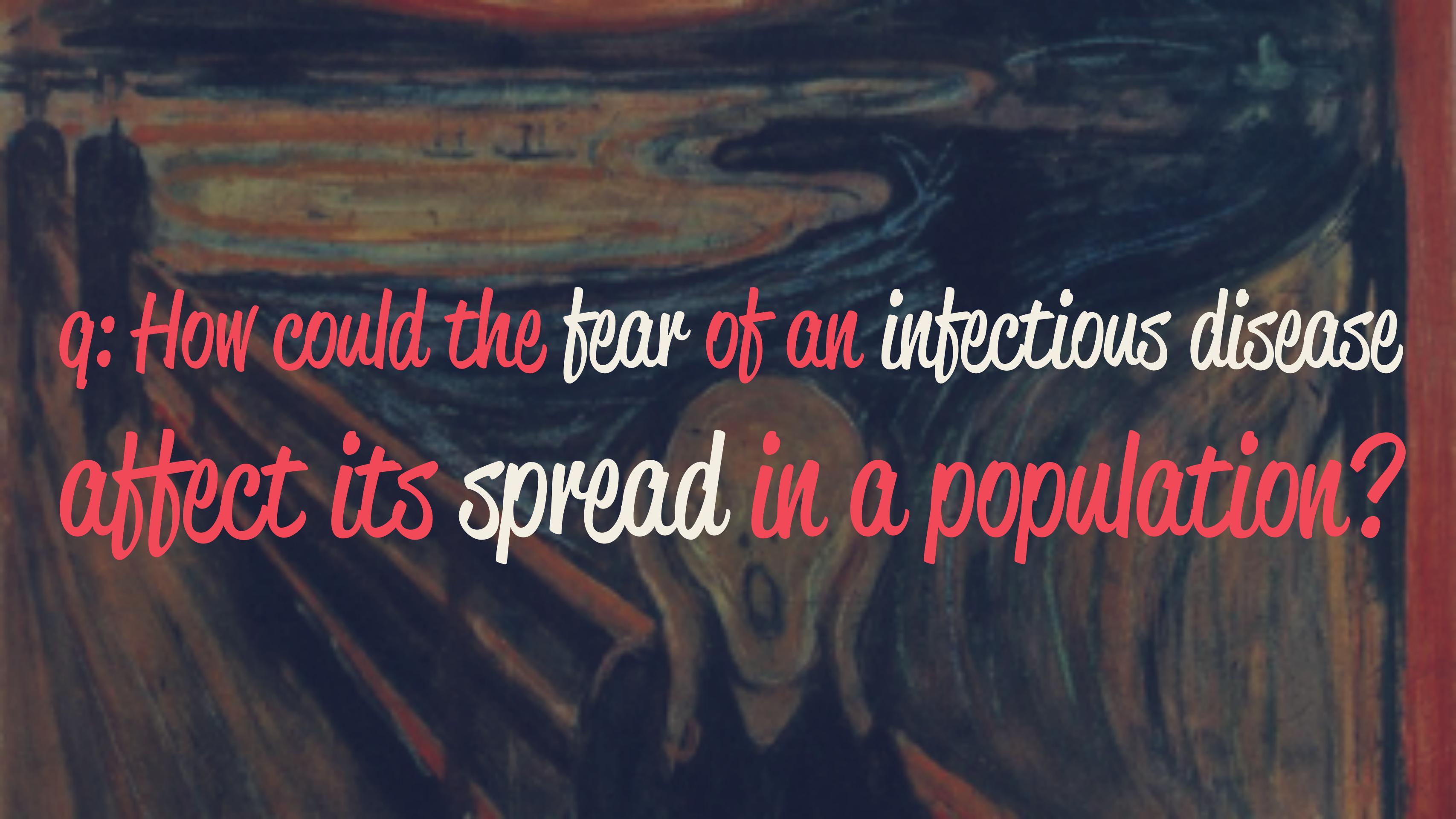


**IRENA PAPST**  
**MATHEMATICS & STATISTICS**  
**MCMASTER UNIVERSITY**

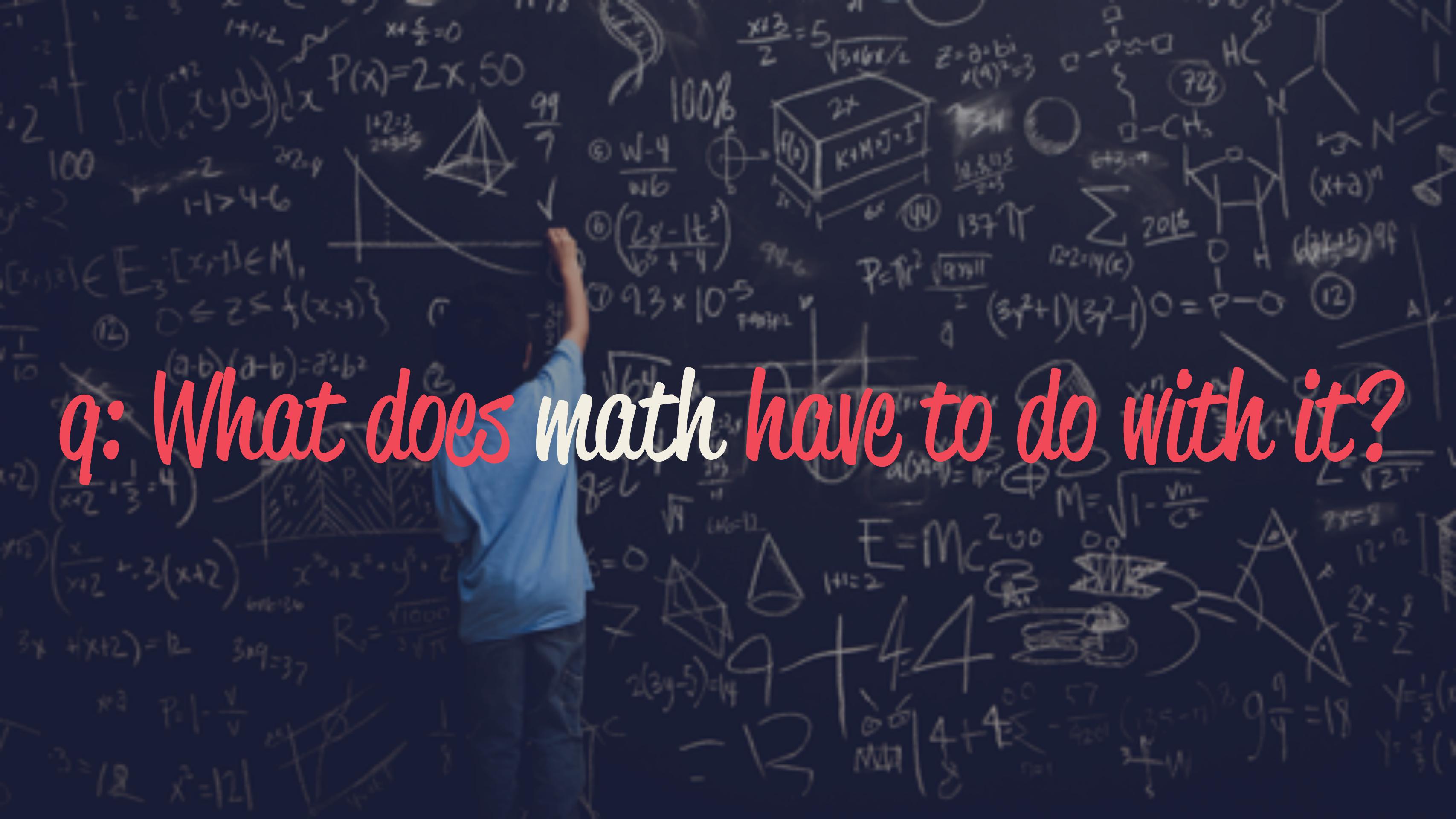
A dark, moody painting of a figure in a landscape. The figure, possibly a woman, is seen from behind, wearing a long, flowing garment. A prominent red ribbon or strap hangs from her shoulder. The background consists of dark, swirling clouds or water, with some lighter, textured areas suggesting land or distant figures.

# FEAR (BUT NOT LOATHING) IN EPIDEMICS

A dark, moody painting of a stormy sea with figures on a boat.

*q: How could the fear of an infectious disease  
affect its spread in a population?*

q: What does math have to do with it?



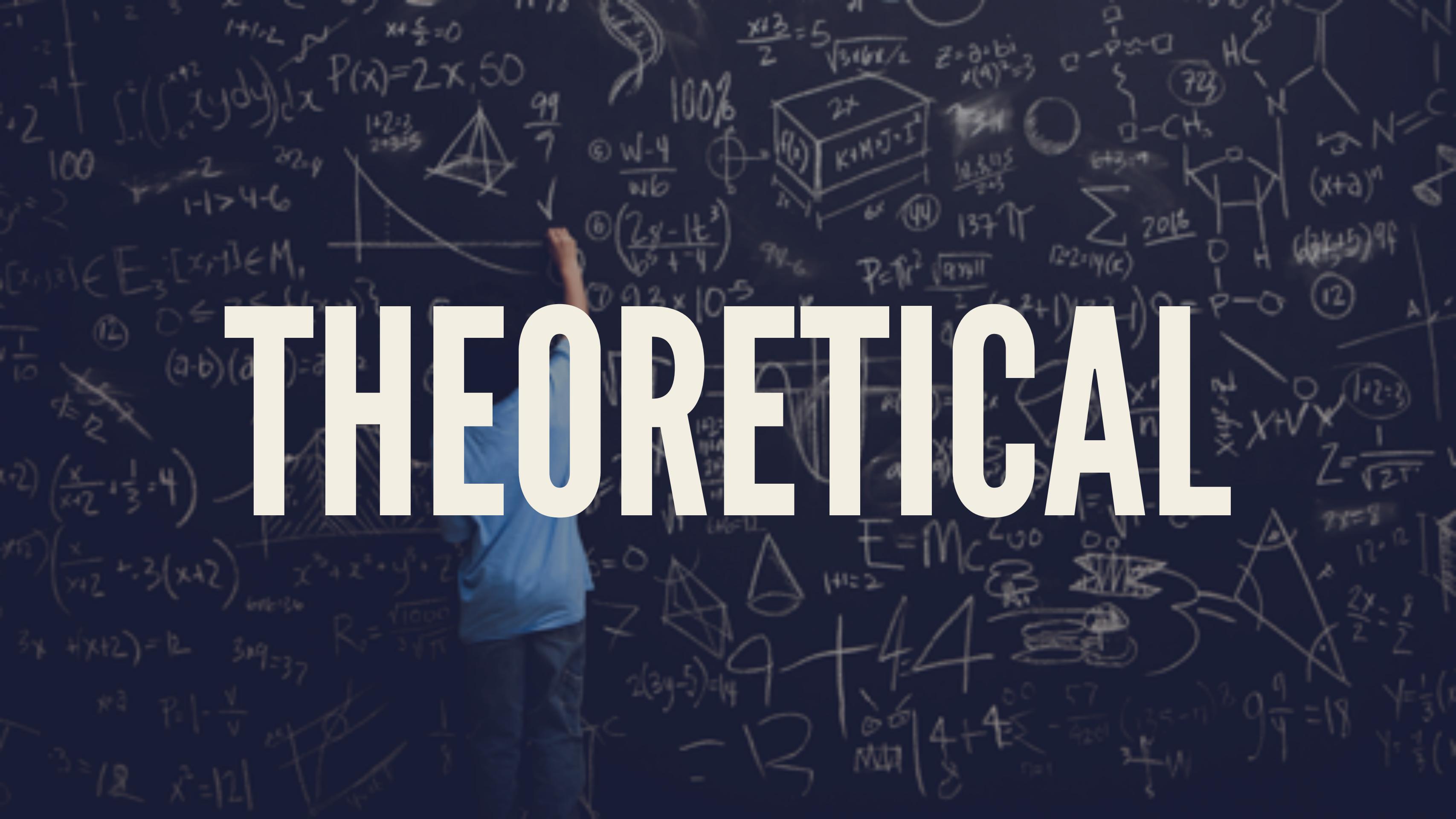
A group of firefighters in full protective gear, including yellow suits and helmets, stand behind a chain-link fence. They appear to be on a construction site or near a brick wall. The word "EXPERIMENTAL" is overlaid in large white letters across the center of the image.

# EXPERIMENTAL

A photograph showing three beekeepers in full protective gear—yellow suits, white hats, and blue respirators—standing behind a wire mesh fence. They appear to be inspecting a beehive or working in an apiary. The background is filled with the dark, textured shapes of bees.

# EXPERIMENTAL EXPERIMENTATION

# THEORETICAL





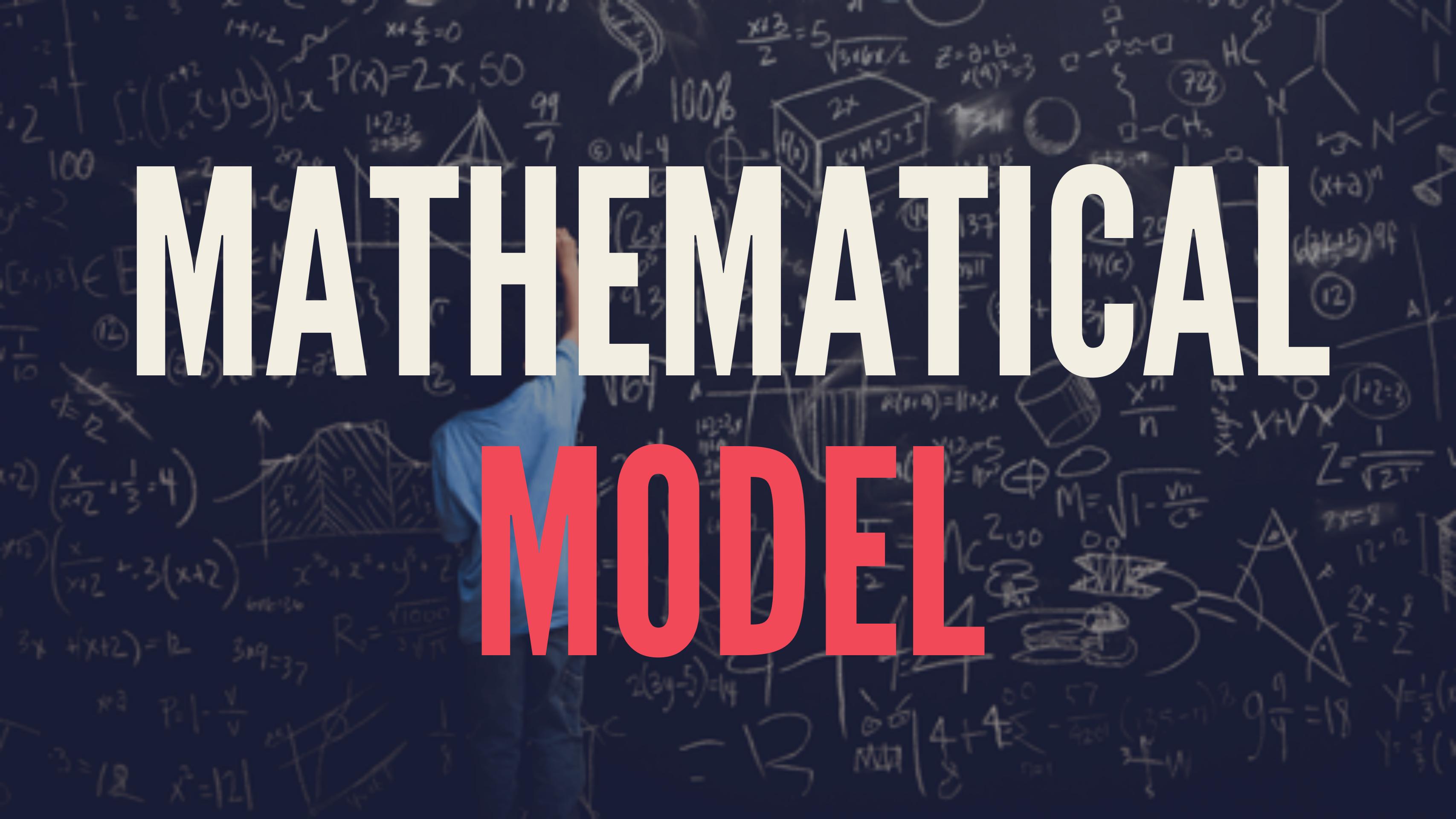


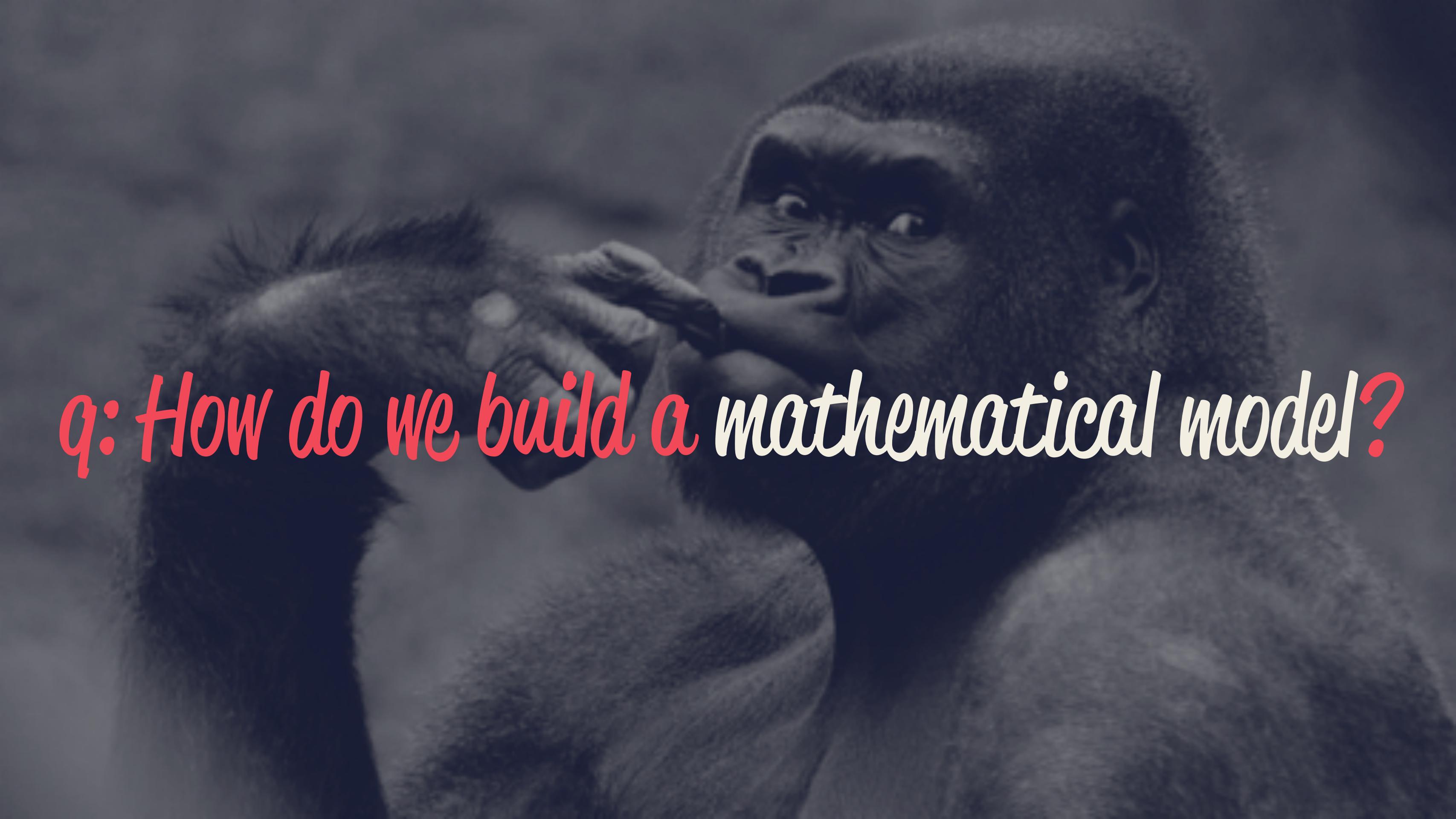
# PATTERNS

The background of the image is a collage composed of three distinct abstract patterns. On the left, there is a close-up photograph of a textured, reddish-brown surface, possibly a rock or mineral formation, showing intricate, branching structures. In the center, a chain-link fence is shown from a low angle, with the perspective creating a series of overlapping, curved lines that lead towards the horizon. On the right, there is a detailed view of a traditional Islamic geometric tile pattern, featuring a repeating design of red, blue, and white tiles forming complex star and diamond shapes.

ABSTRACT

# MATHEMATICAL MODEL





*q: How do we build a mathematical model?*



## Translate

Translate

[English](#) [French](#) [Croatian](#) [Detect language](#)[Greek](#) [English](#) [French](#)

Translate

disease transmission  
recovery  
the spread of fear

μετάδοσης της νόσου  
ανάκτηση  
η εξάπλωση του φόβου

☆  Ä ↪

Wrong?

metádosis tis nóstou  
anáktisi  
í eklípsi tou fóvou

CAUTION CAUTION CAUTION

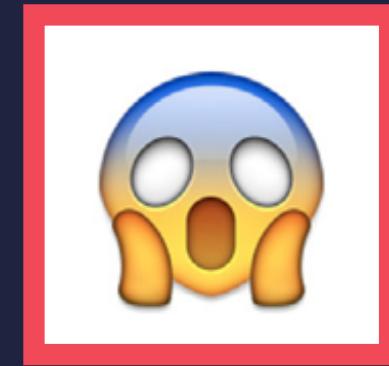
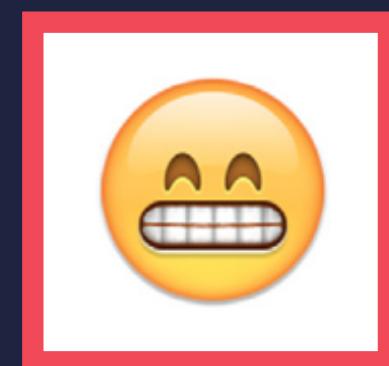
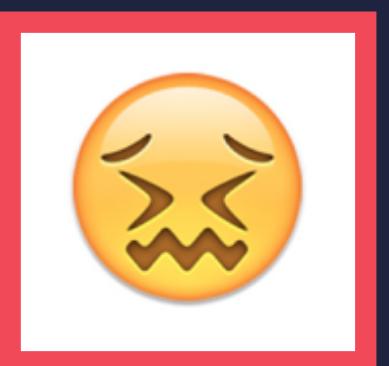
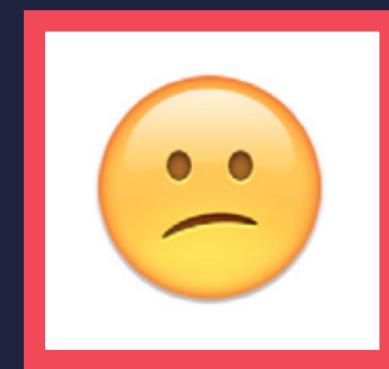
The background of the image is a painting of a ship on a turbulent sea. The sky is filled with dark, swirling clouds, and the water is depicted with heavy, textured brushstrokes in shades of blue, green, and white. Several figures are visible on the deck of the ship, looking out over the horizon. The overall mood is one of drama and unease.

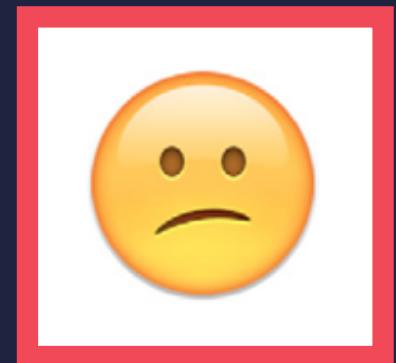
*q: What happens when people get scared?*

A close-up photograph of a person's hands holding an open book. The person is wearing a brown leather jacket over a light-colored shirt. The book has a dark cover and is open to a page with visible text. The lighting is dramatic, with strong highlights and shadows.

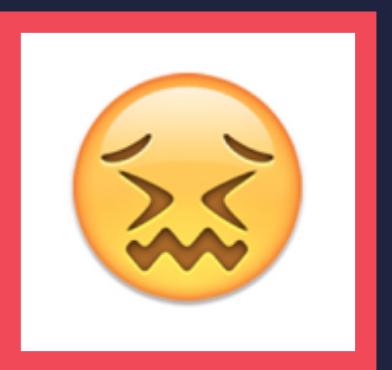
THEY BECOME MORE CAREFUL

# THE MODEL

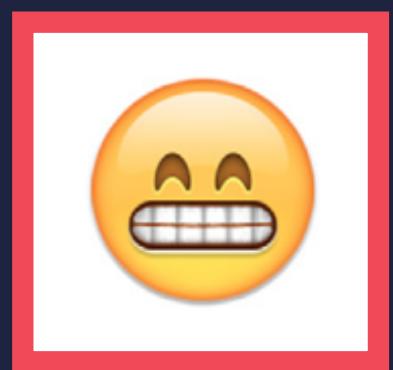




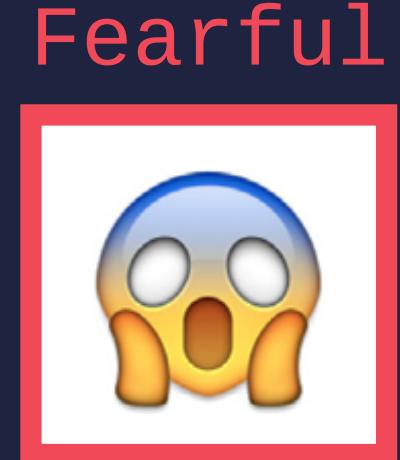
Susceptible



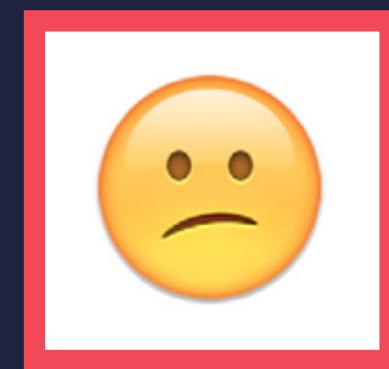
Infected



Removed

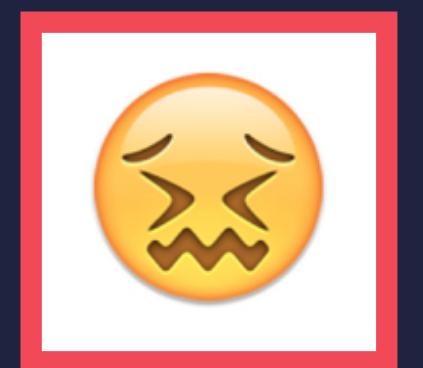


Fearful

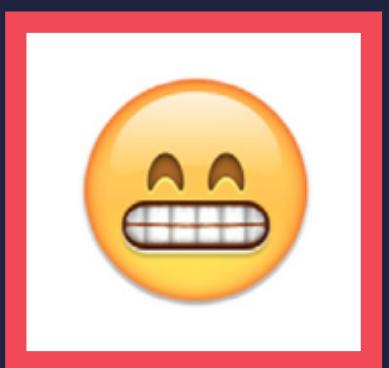


Susceptible

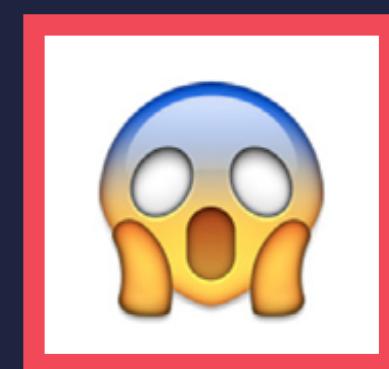
*Transmission  
of disease*



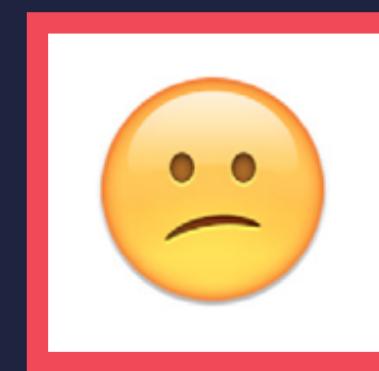
Infected



Removed



Fearful



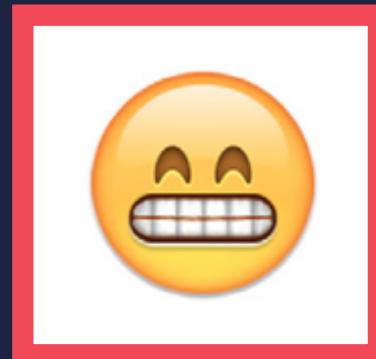
Susceptible

*Transmission  
of disease*

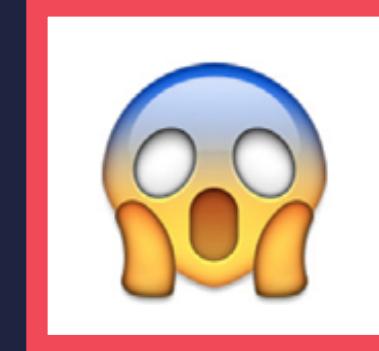


Infected

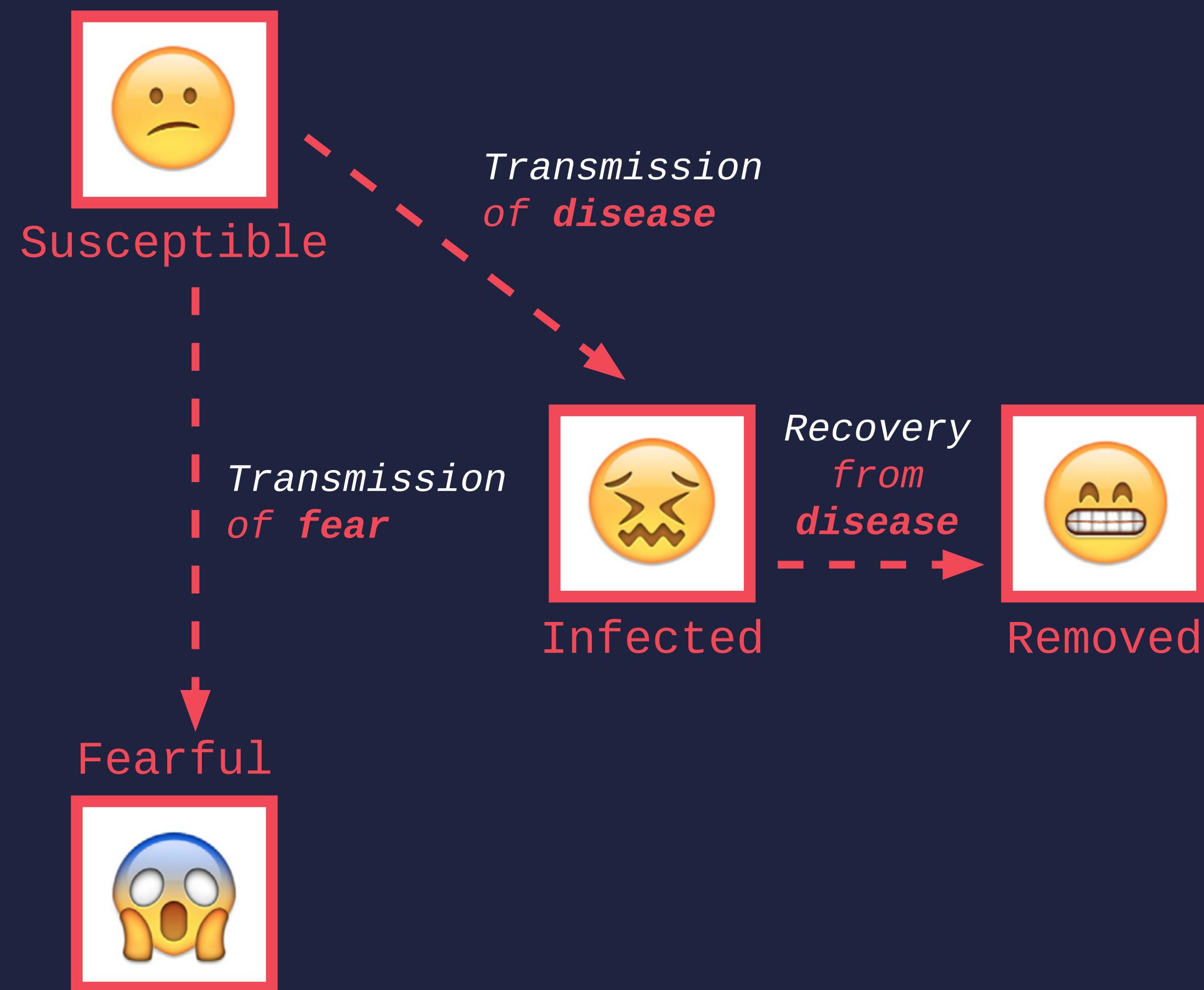
*Recovery  
from  
disease*

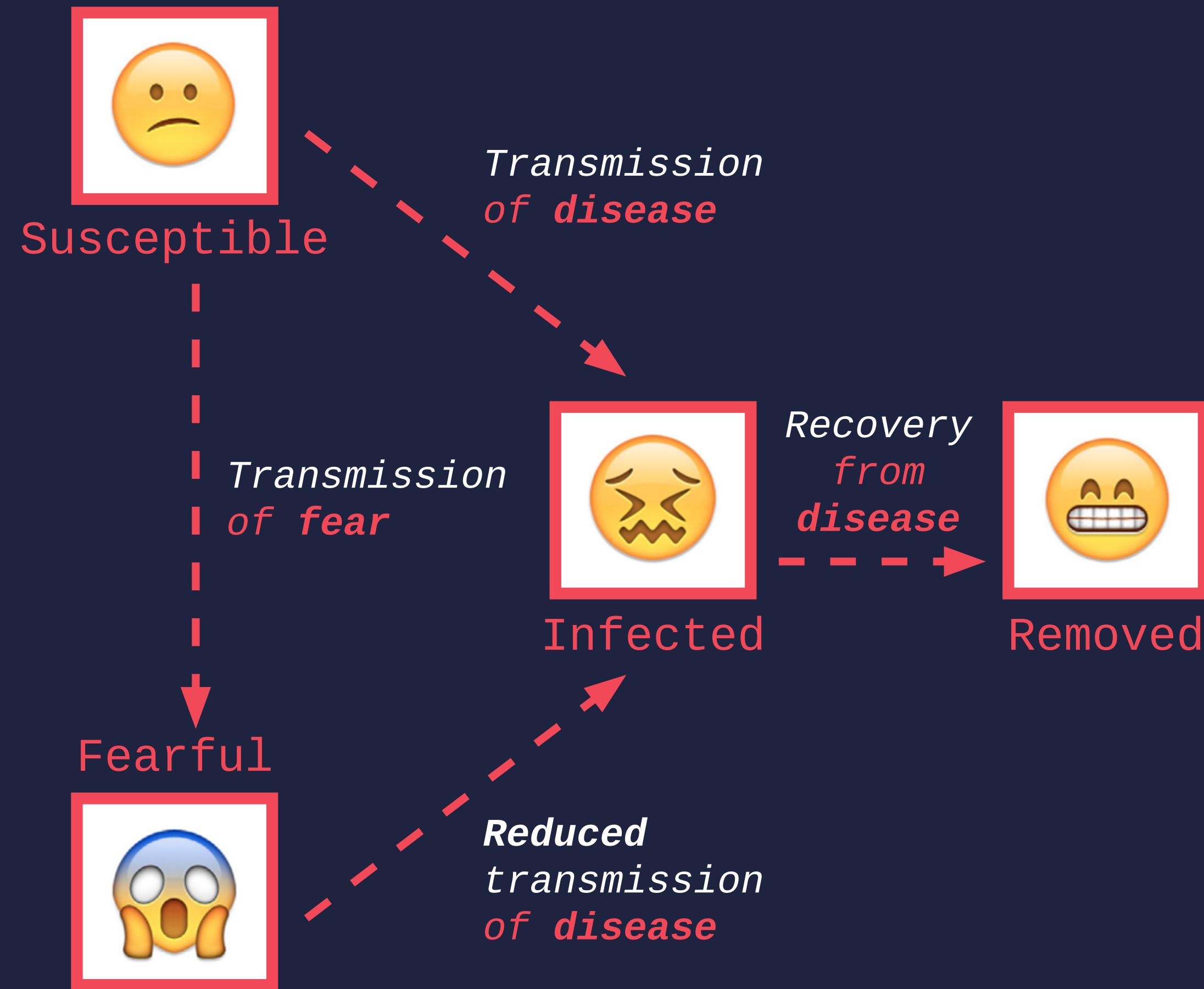


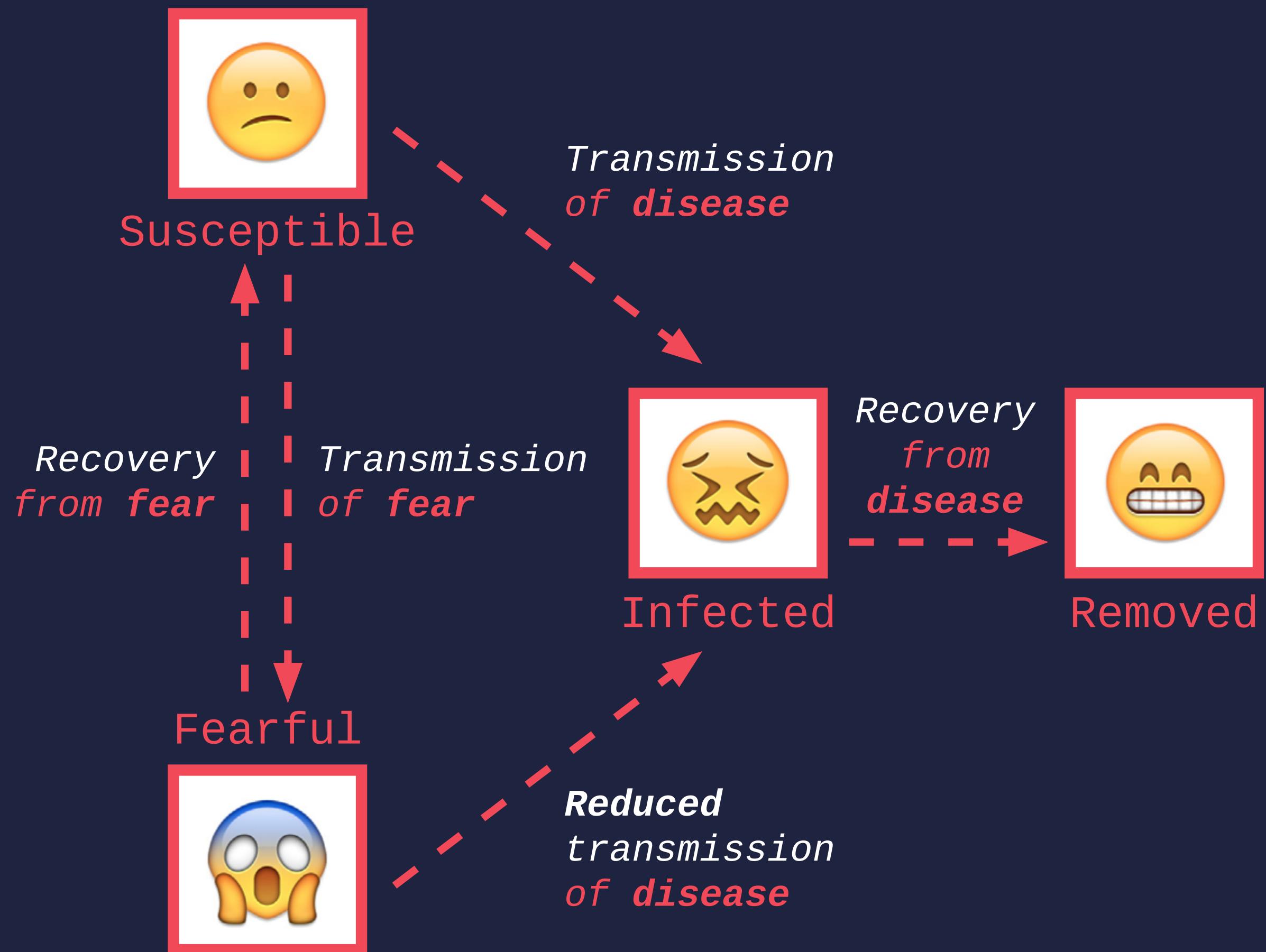
Removed



Fearful



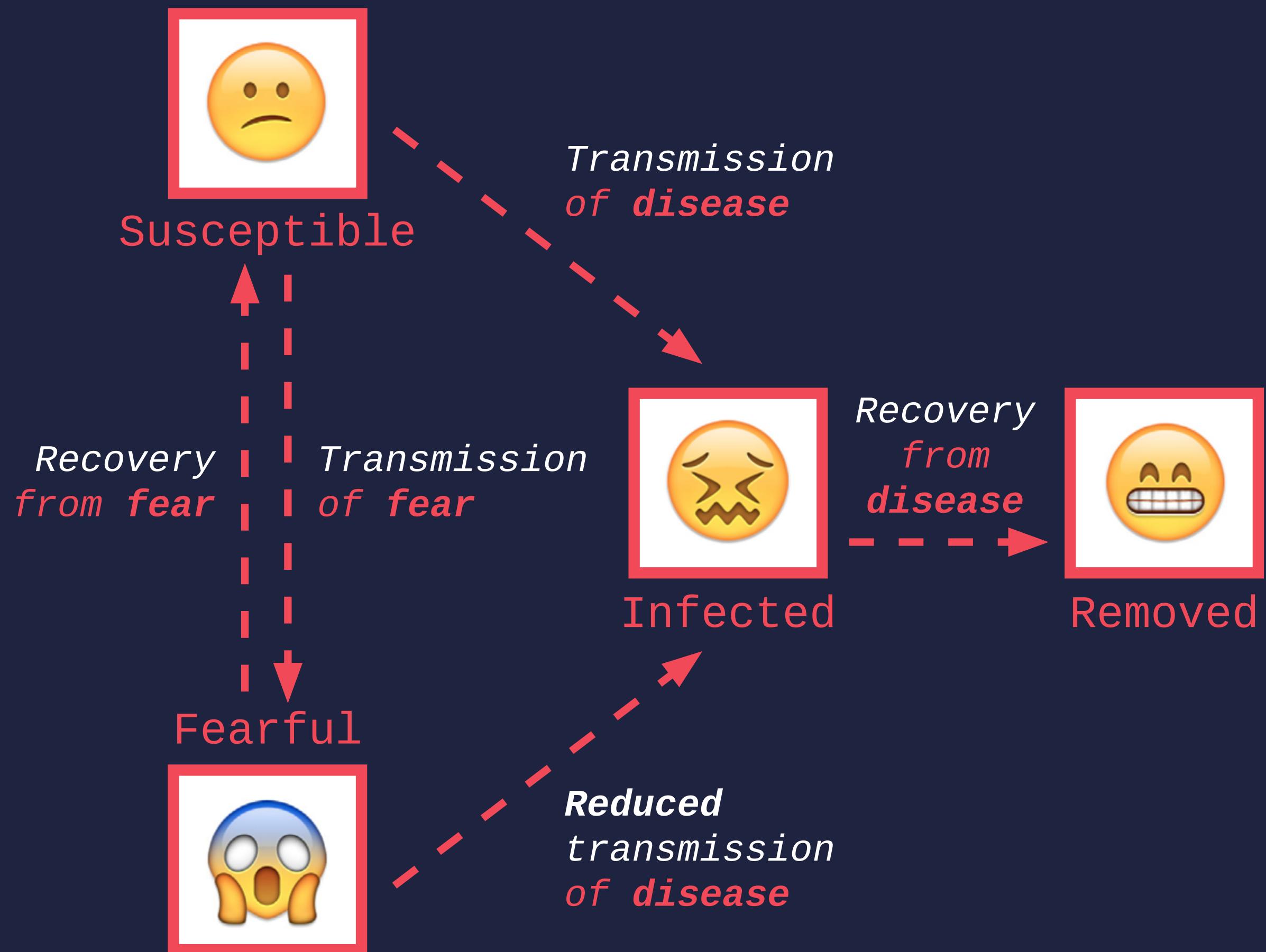




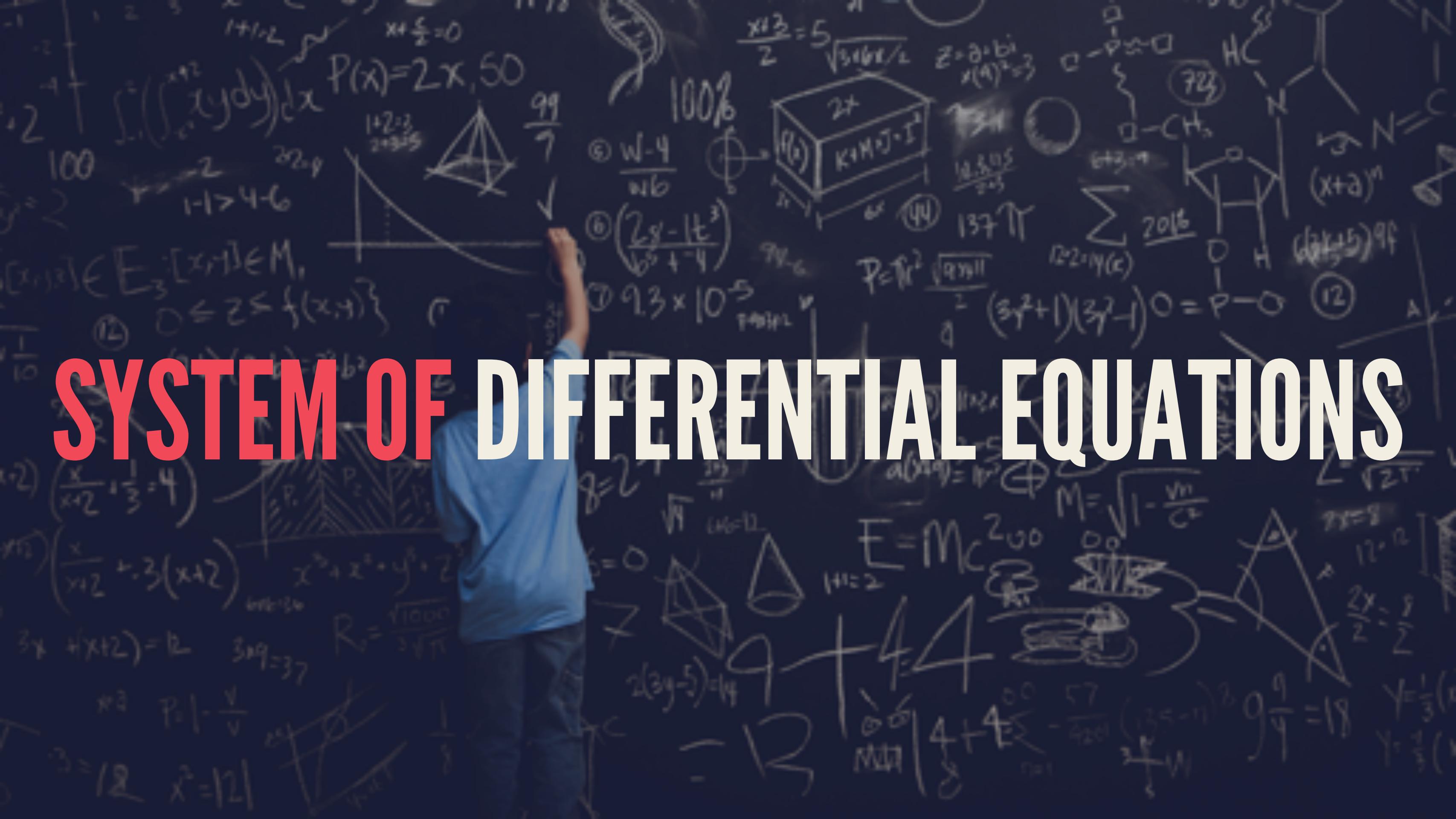
A close-up photograph of a car's instrument cluster. The main focus is a speedometer with markings at 0, 20, 40, 60, 80, 100, 120, and 140. Below it is a tachometer with markings from 0 to 6,000 RPM. To the right is a fuel gauge with markings at E (Empty) and F (Full). The cluster is illuminated with a blue light, and the background is dark.

**EACH PROCESS HAS AN ASSOCIATED RATE**

# RATE OF CHANGE = DERIVATIVE



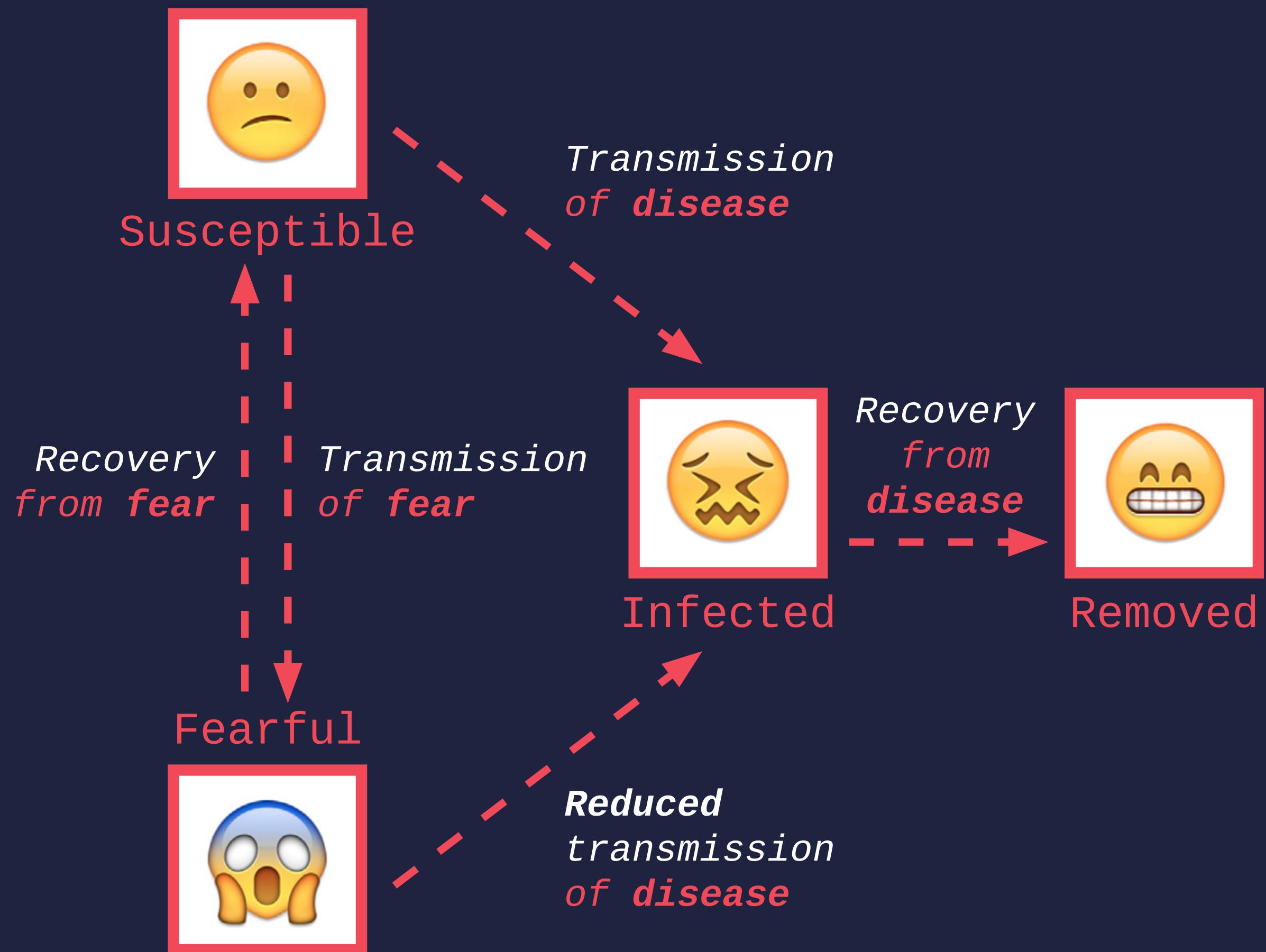
# SYSTEM OF DIFFERENTIAL EQUATIONS

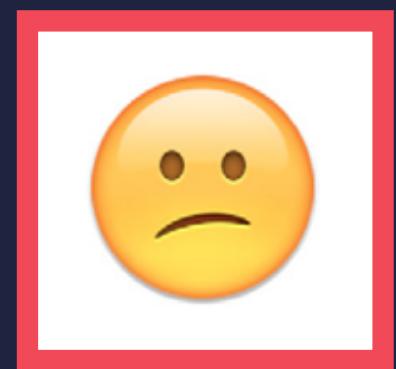




# 3 POSSIBILITIES

# 1. NO EPIDEMIC

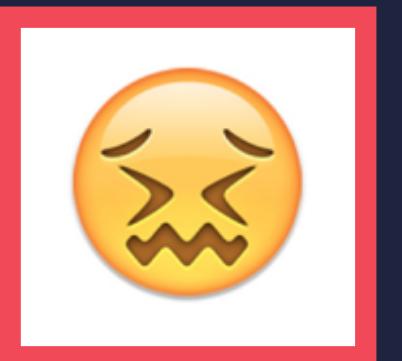




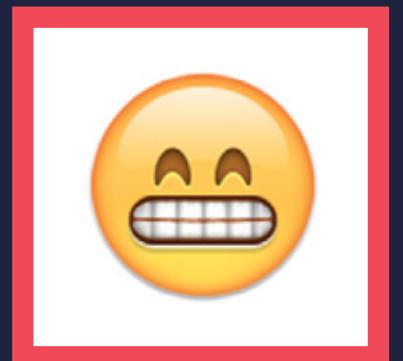
Susceptible



*Transmission  
of disease*

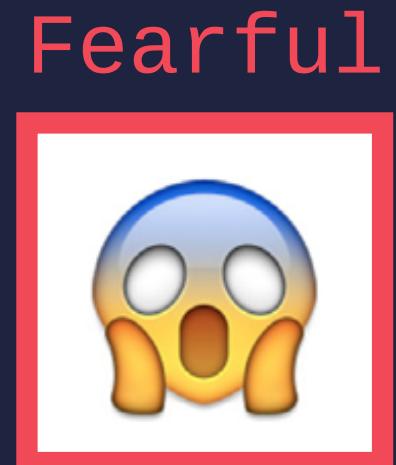


Infected



Removed

*Recovery  
from fear* | | *Transmission  
of fear*



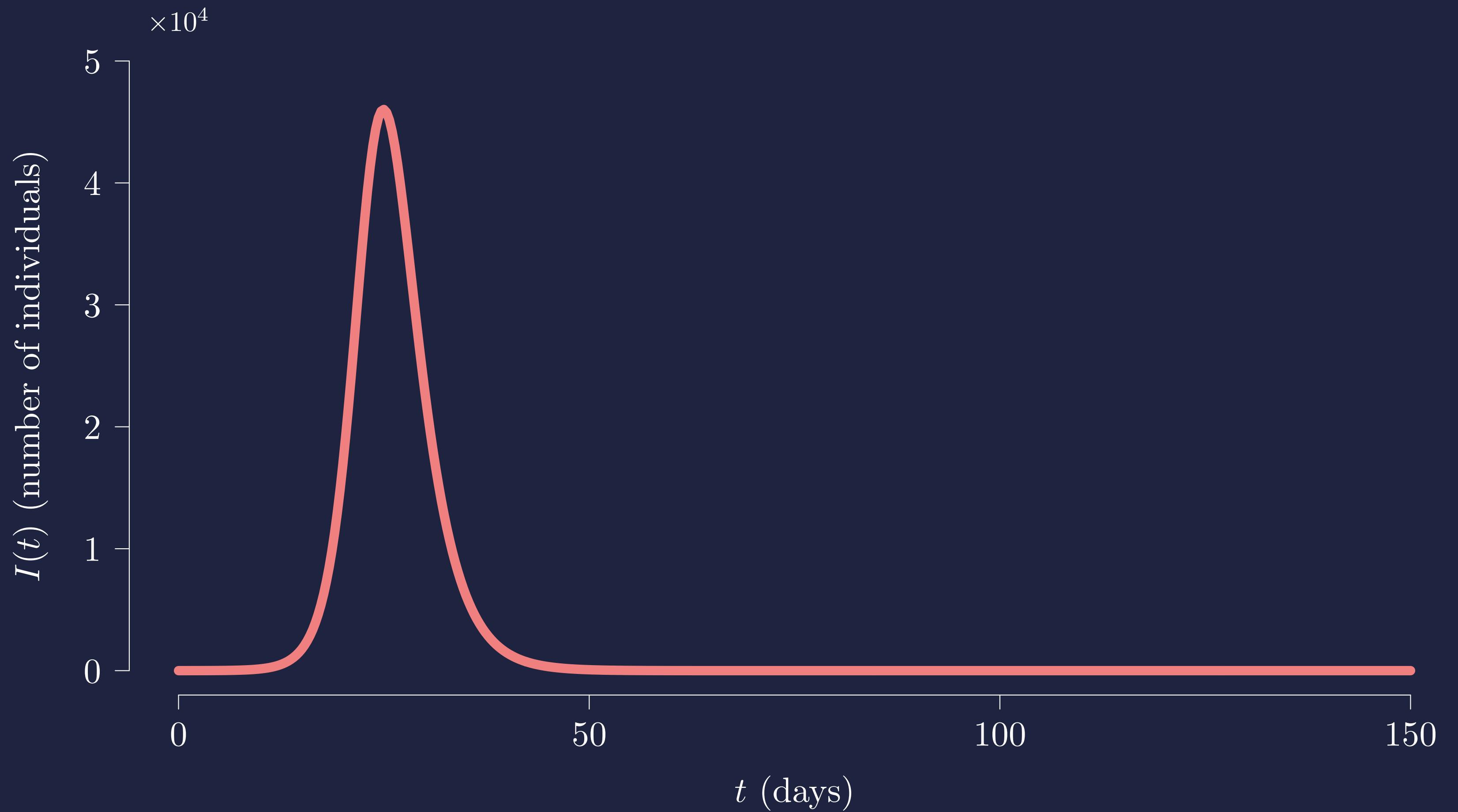
Fearful

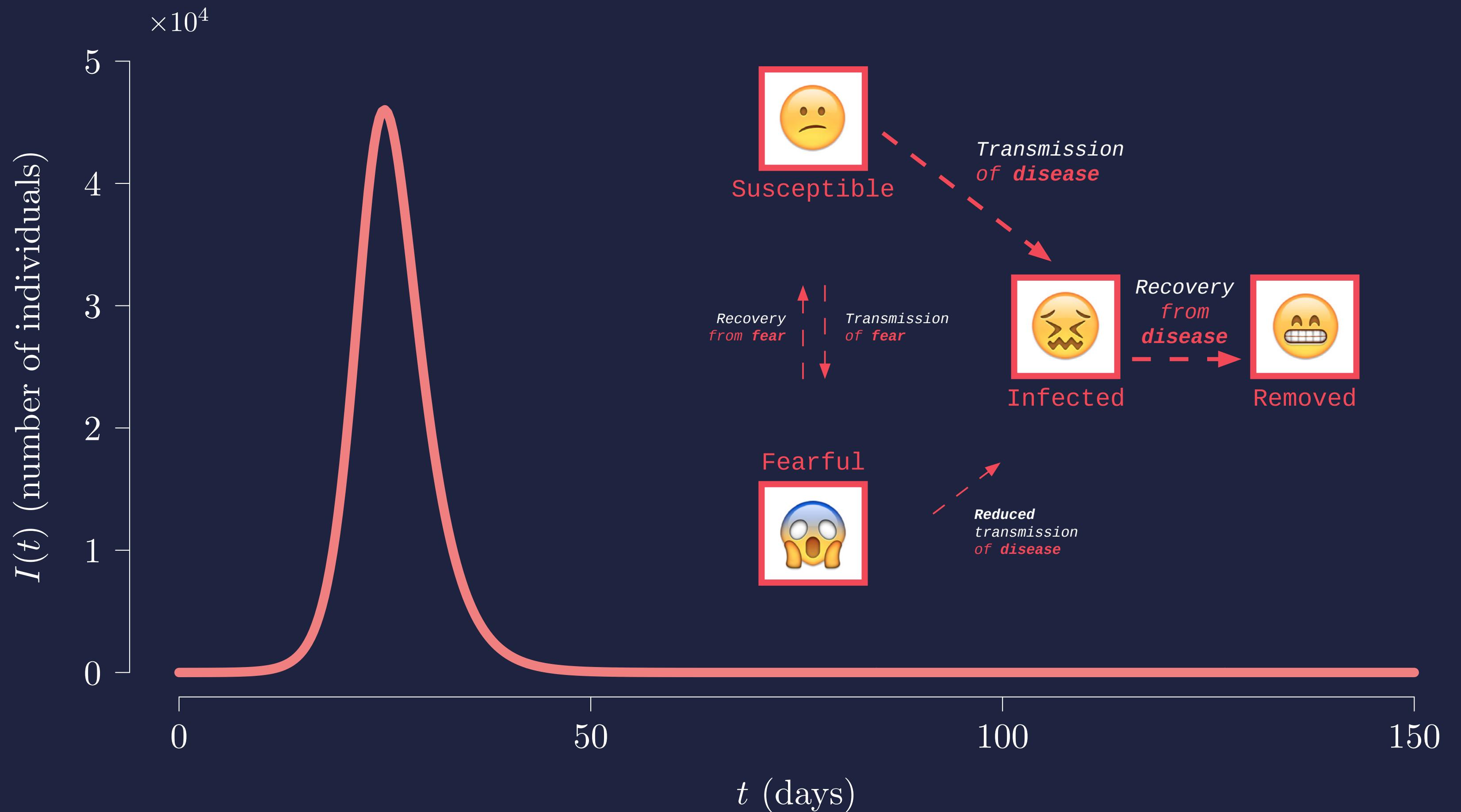


*Recovery  
from  
disease*

*Reduced  
transmission  
of disease*

# 2. ONE EPIDEMIC



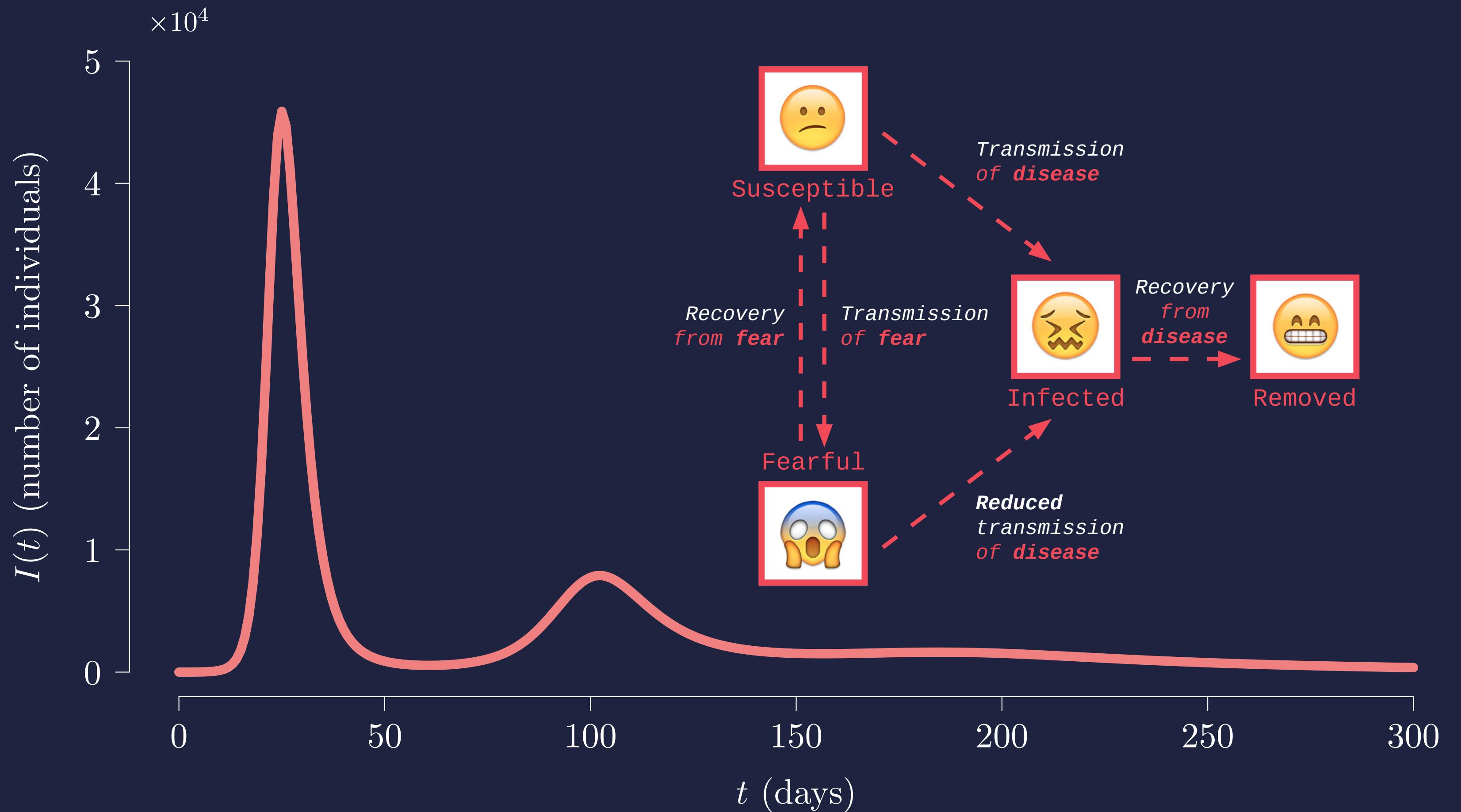


# 3. MULTIPLE WAVES OF INFECTION

$I(t)$  (number of individuals) $\times 10^4$ 5  
4  
3  
2  
1  
0

0 50 100 150 200 250 300

 $t$  (days)



Does fear help or hurt?

*q: Does fear change the final size of the outbreak?*

*q: Does fear shorten or prolong the epidemic?*



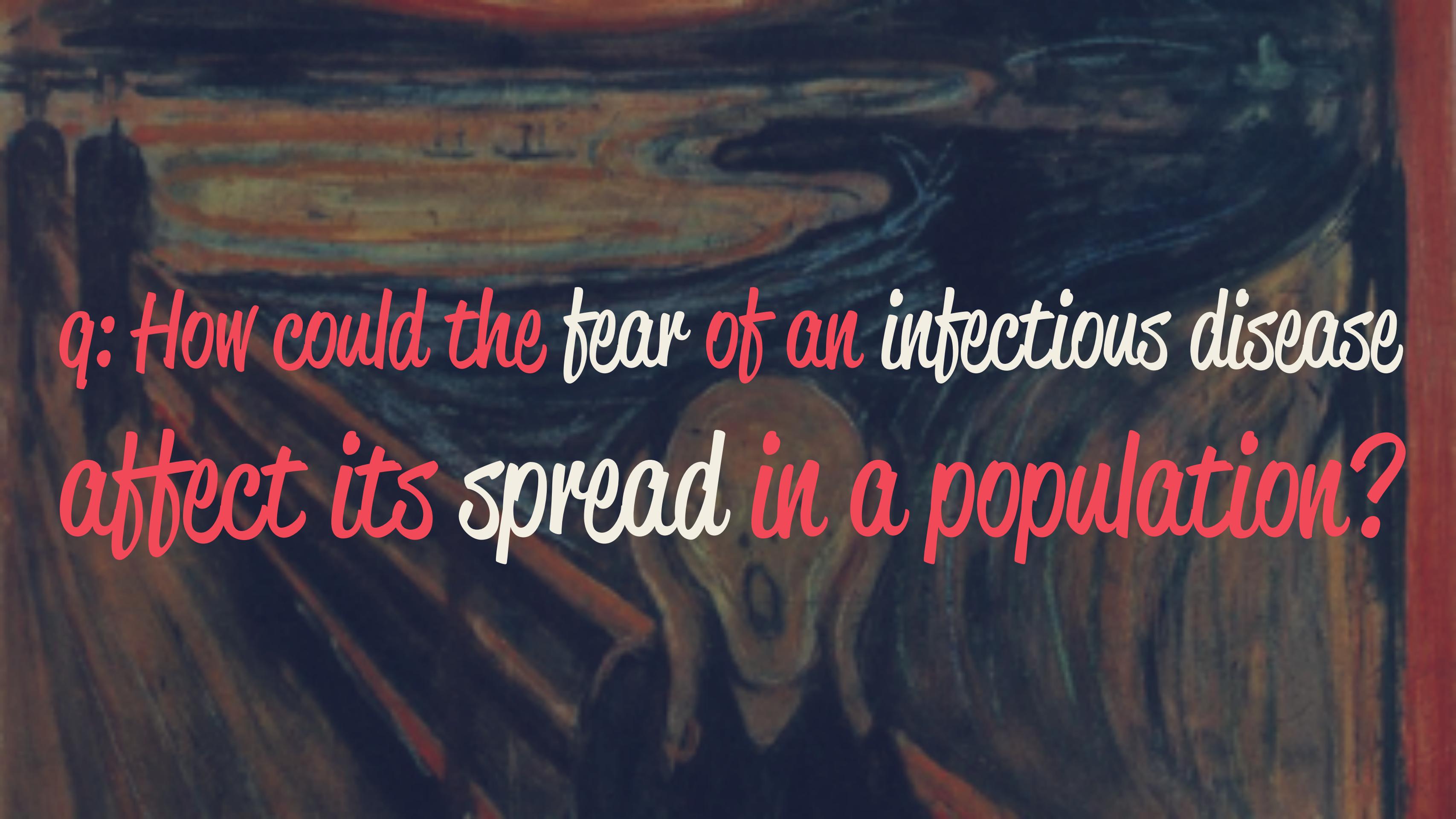




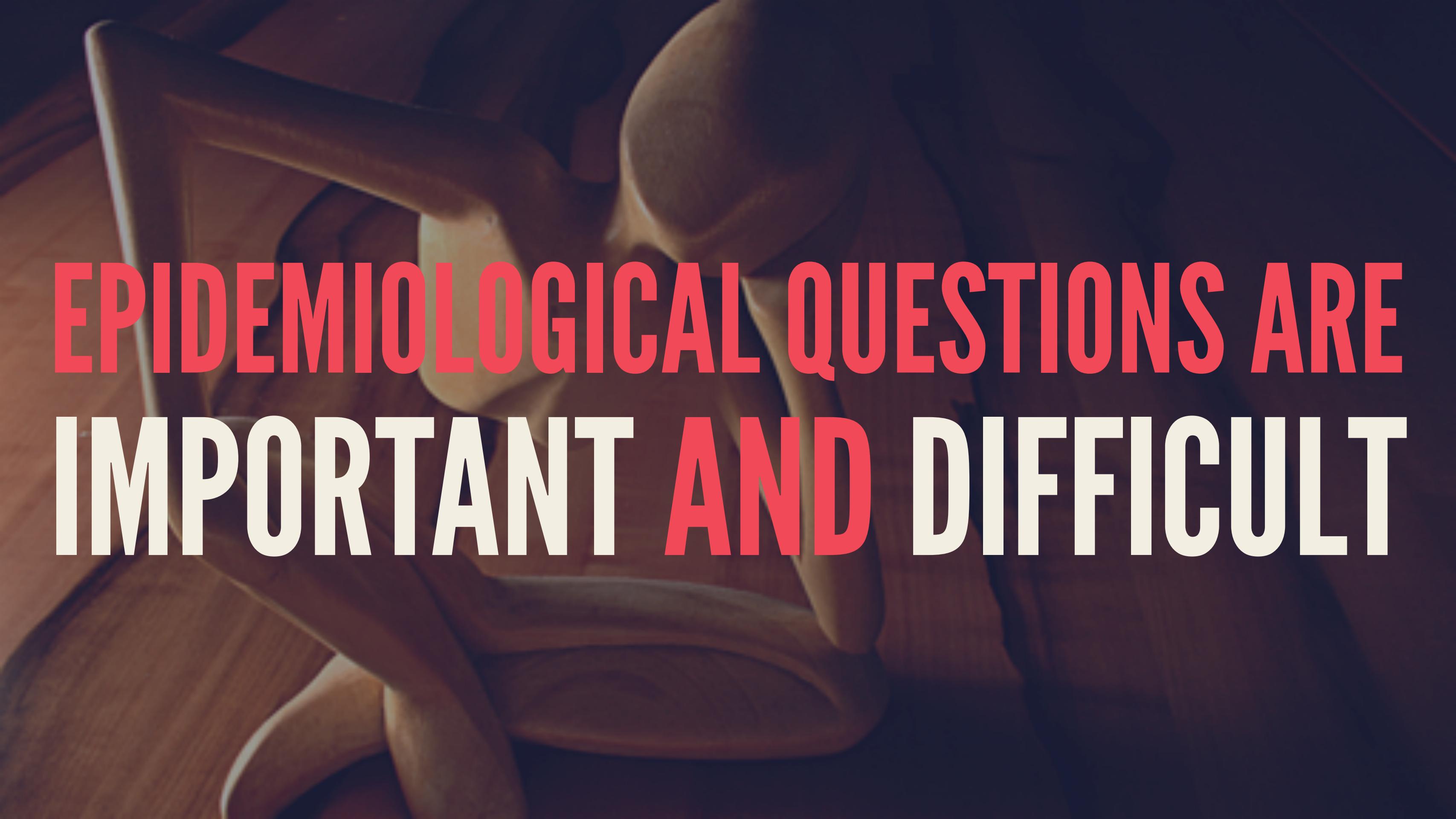
A black and white photograph of a large audience seated in rows, facing right, in a dark auditorium. The people are mostly adults, though some children are visible in the foreground. The lighting is dramatic, coming from the front, which creates strong highlights on the faces of the people in the foreground and deep shadows in the back of the auditorium.

*q: Does the peak prevalence change as a result of fear?*

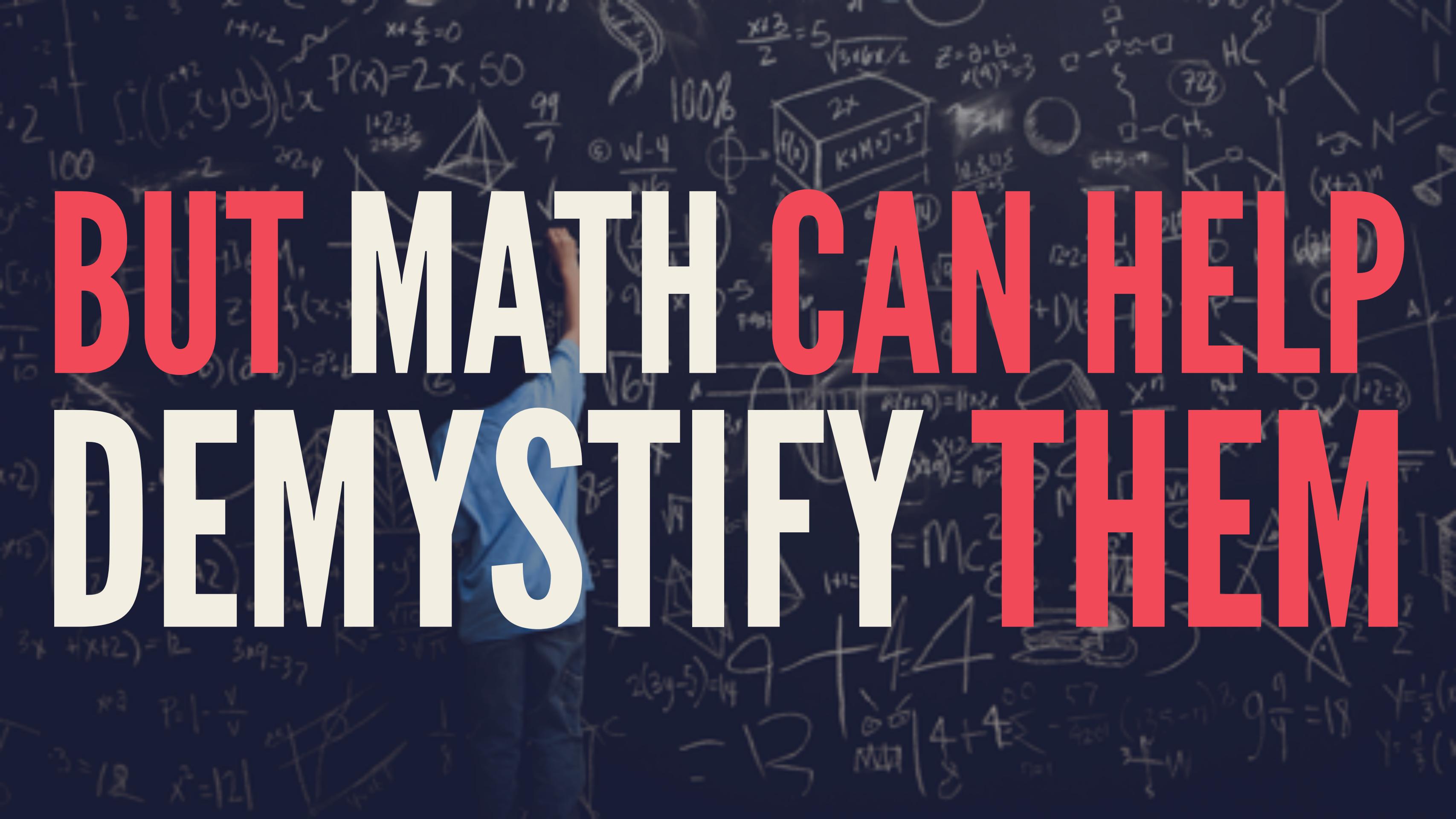


A dark, moody painting of a stormy sea with figures on a boat.

*q: How could the fear of an infectious disease  
affect its spread in a population?*

A close-up photograph of a person's hands holding an open book. The hands are positioned as if turning a page, with fingers visible on the left side. The book has a dark cover and light-colored pages. The background is dark and out of focus.

**EPIDEMIOLOGICAL QUESTIONS ARE  
IMPORTANT AND DIFFICULT**

A person wearing a blue shirt is standing in front of a chalkboard, writing various mathematical equations and diagrams. The chalkboard is covered with mathematical notation, including fractions, percentages, and geometric shapes like triangles and hexagons. The overall theme is education and mathematics.

# BUT MATH CAN HELP DEMYSTIFY THEM