

# COVID-19 Media Quantitative Data Representations (QDRs)

The COVID-TASER Team

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Scientists (such as Wu and team) estimate the death rate for COVID-19 is between 0.66% and 2.1%. The death rate for the seasonal flu is usually about 0.1% in the U.S.

- a. How should this data impact decision making about social distancing?
- b. Suppose there are two hypothetical situations.  
In one situation 50 million people get the flu. In the other situation 50 million people get the coronavirus. Assuming the death rates of 0.1% and 2.1% how many times as many people will die from the coronavirus as the flu

*0.1% of 50 million is 50,000? Isn't that 20 times as many people die from the coronavirus as the flu?*

2. 아래 데이터들이 사회적 거리두기에 대한 의사결정에 어떻게 영향을 주어야 한다고 생각합니까?

- a. 과학자들은 COVID-19 치사율을 0.66에서 2.1%로 추정했다. 독감으로 인한 치사율은 미국에서 보통 0.1% 정도이다.
- b. 5천만 명의 사람들이 독감에 걸렸고, 5천만 명의 사람들이 코로나 바이러스에 걸렸다고 가정해보세요. 독감 사망률이 0.1%, 코로나 바이러스 사망률이 2.1% 라고 하면 독감보다 코로나 바이러스 때문에 사망하는 사람들이 몇 배나 많을까요?

*not matter. It doesn't matter how many people are infected. We'll take*



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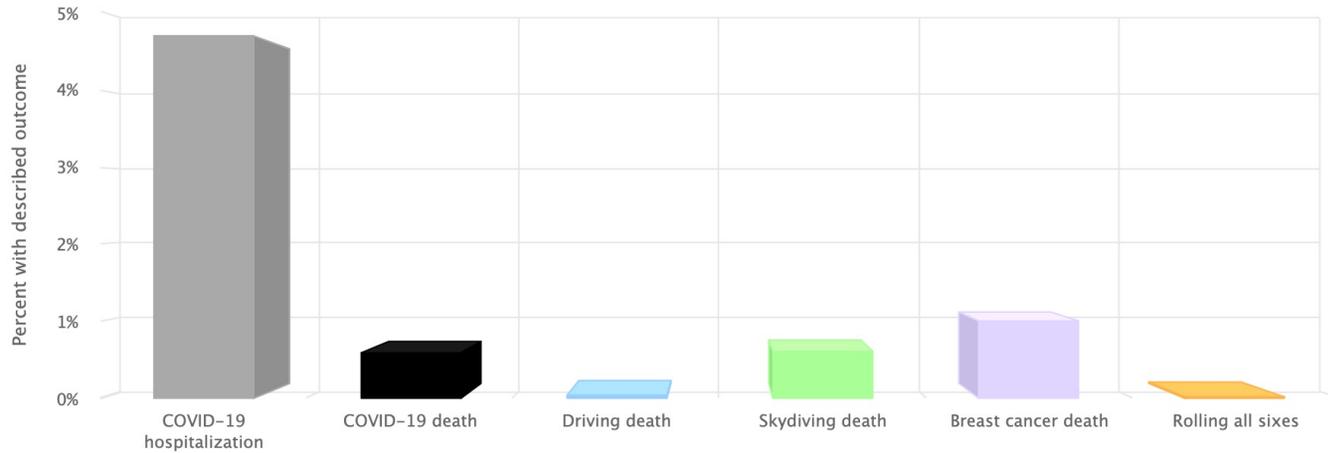
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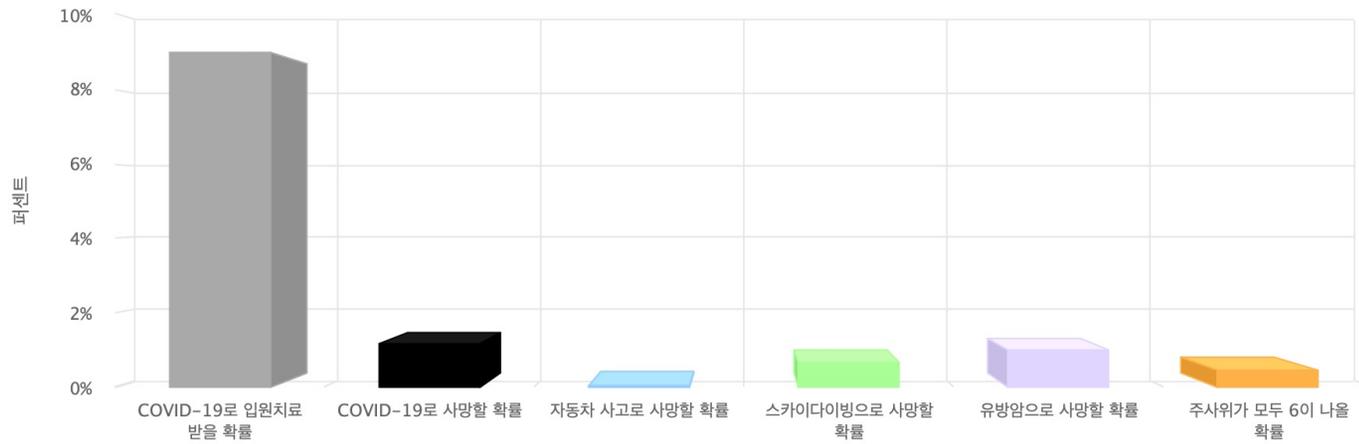
## Interactive COVID-19 Risk Comparison Tool

Adjust sliders to compare your risk of COVID-19 to other situations. Hover over bars for full description



## COVID-19가 얼마나 위험할까?

COVID-19로 사망할 확률을 다른 확률과 비교하기 위해서 컨트롤 바를 이용하여 수치를 조정해 주십시오.  
마우스를 올려 놓으면 해당 확률에 대한 설명을 보실 수 있습니다.

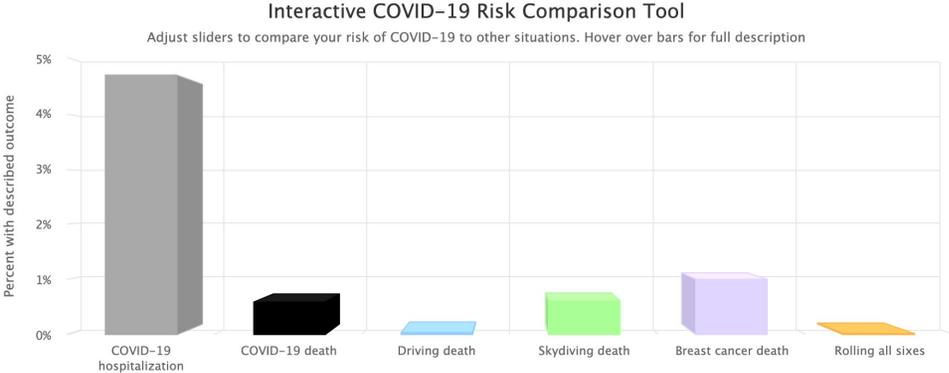


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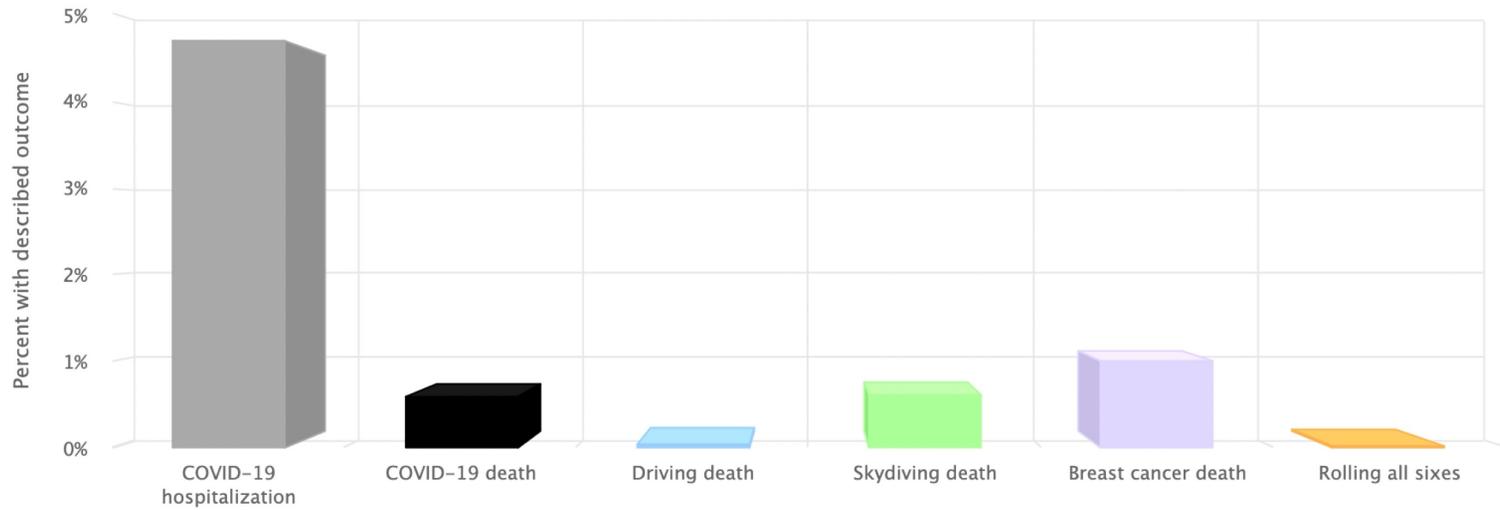
# Why Graphs (interpreted loosely) as our primary QDR?

$\frac{2.1}{0.1}$   $.021 \times 50,000,000$  versus  $.01 \times 50,000,000$



### Interactive COVID-19 Risk Comparison Tool

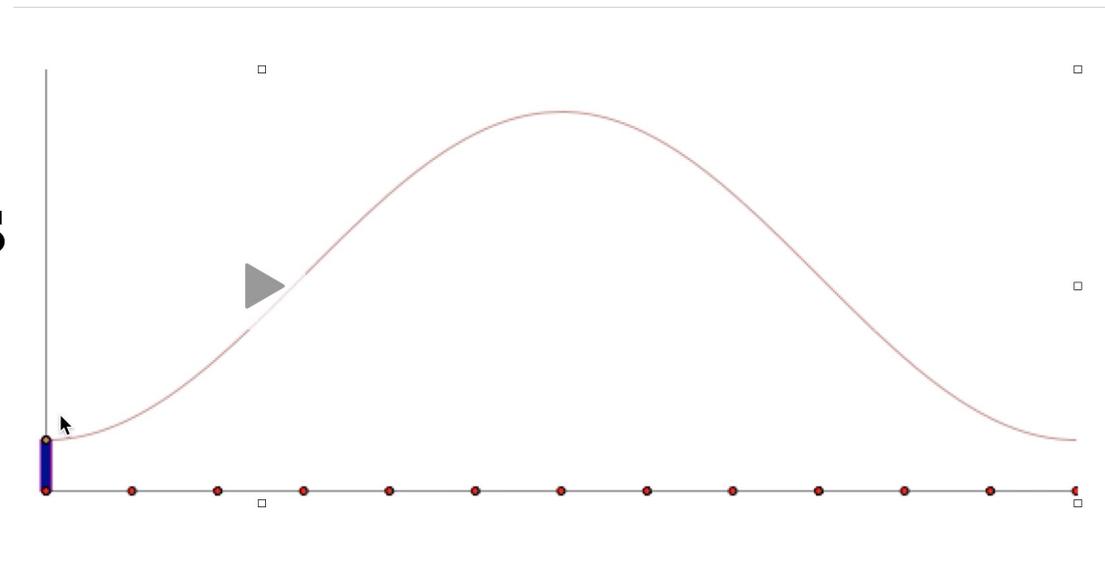
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# Graphical QDRs provide a perceptual grounding for enacting quantitative and covariational operations.

(Carlson et al., 2002; Saldanha & Thompson, 1998; Thompson, 1990)

$$y = 25\sin\left(x - \frac{\pi}{2}\right) + 10 \quad \text{versus}$$



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Why Caution (Critical Incident) occur

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# Project Context



National Science Foundation RAPID grant (DUE- 2032688) focused on applying STEM Education research to investigate how United States (US) and South Korea (SK) citizens understand media-used COVID-19 QDRs.

- Characterize the extent particular meanings are productive for understanding pandemic QDRs.
- Extend constructs developed in our and colleagues' research programs to explain individuals' meanings for pandemic QDRs.
- Create QDRs that better support individuals in understanding the COVID-19 pandemic including its health risks.
- Clarify those ways of thinking that are critical for well-being outside of the mathematics classroom.

# Project Context

Research

Conceptual Analysis of  
(2008)

Semi-structured Clinic  
(Ginsburg, 1997)



## Interactive COVID-19 Risk Comparison Tool

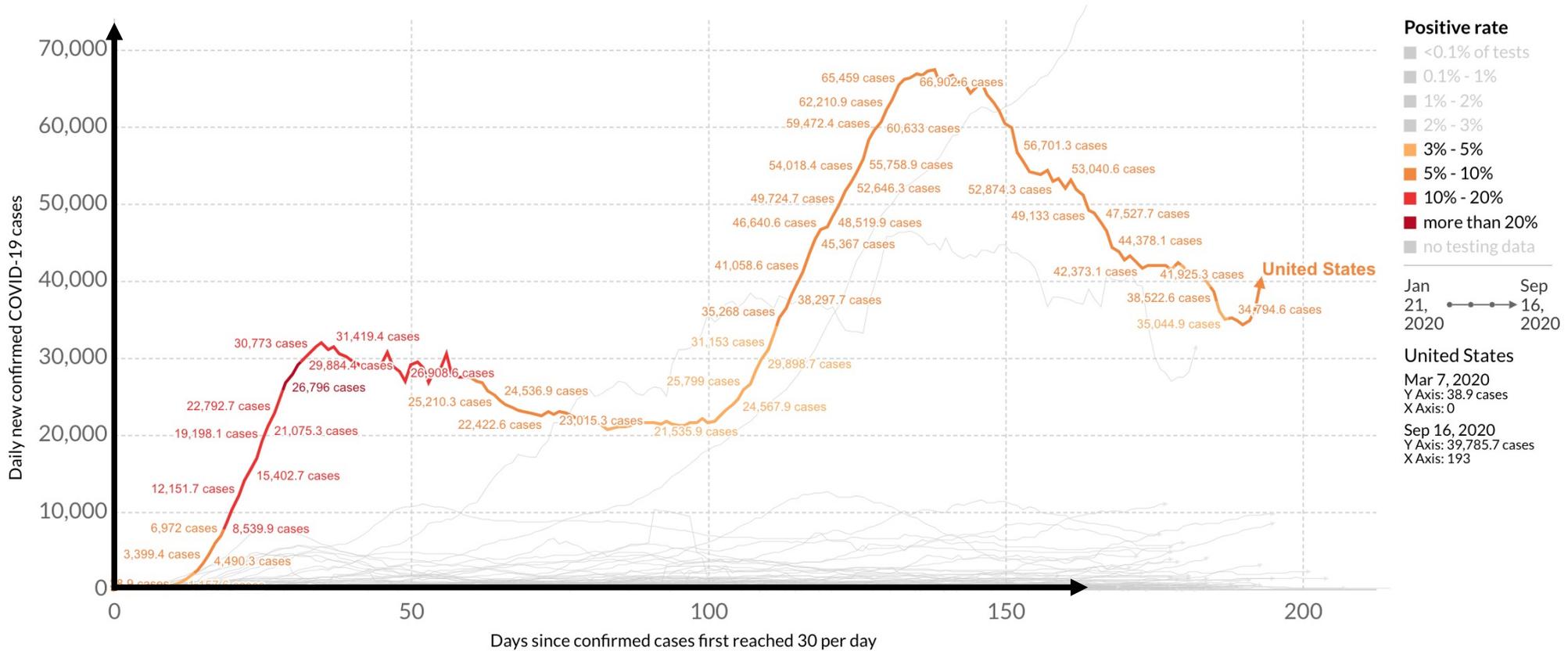
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# Daily new confirmed COVID-19 cases

Shown is the rolling 7-day average. The number of confirmed cases is lower than the number of actual cases; the main reason for that is limited testing.

Zoom to selection
  Hide countries < 1 million people



Source: European CDC - Situation Update Worldwide - Last updated 16 September, 17:05 (London time), Official data collated by Our World in Data

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# What are productive and unproductive meanings for graphical QDRs?

## **Figurative Thought**

(i.e., static shape thinking,  
Moore & Thompson, 2015)

## **Operative Thought**

(i.e., emergent shape thinking,  
Moore & Thompson, 2015)



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# What are productive and unproductive meanings for graphical QDRs?

## **Figurative Thought**

Constrained to states and such that results of actions are not dissociated from the actions themselves.

Actions and inferences often based on perceptual and sensorimotor features including how a graph “looks” and how a graph is physically drawn.

## **Operative Thought**

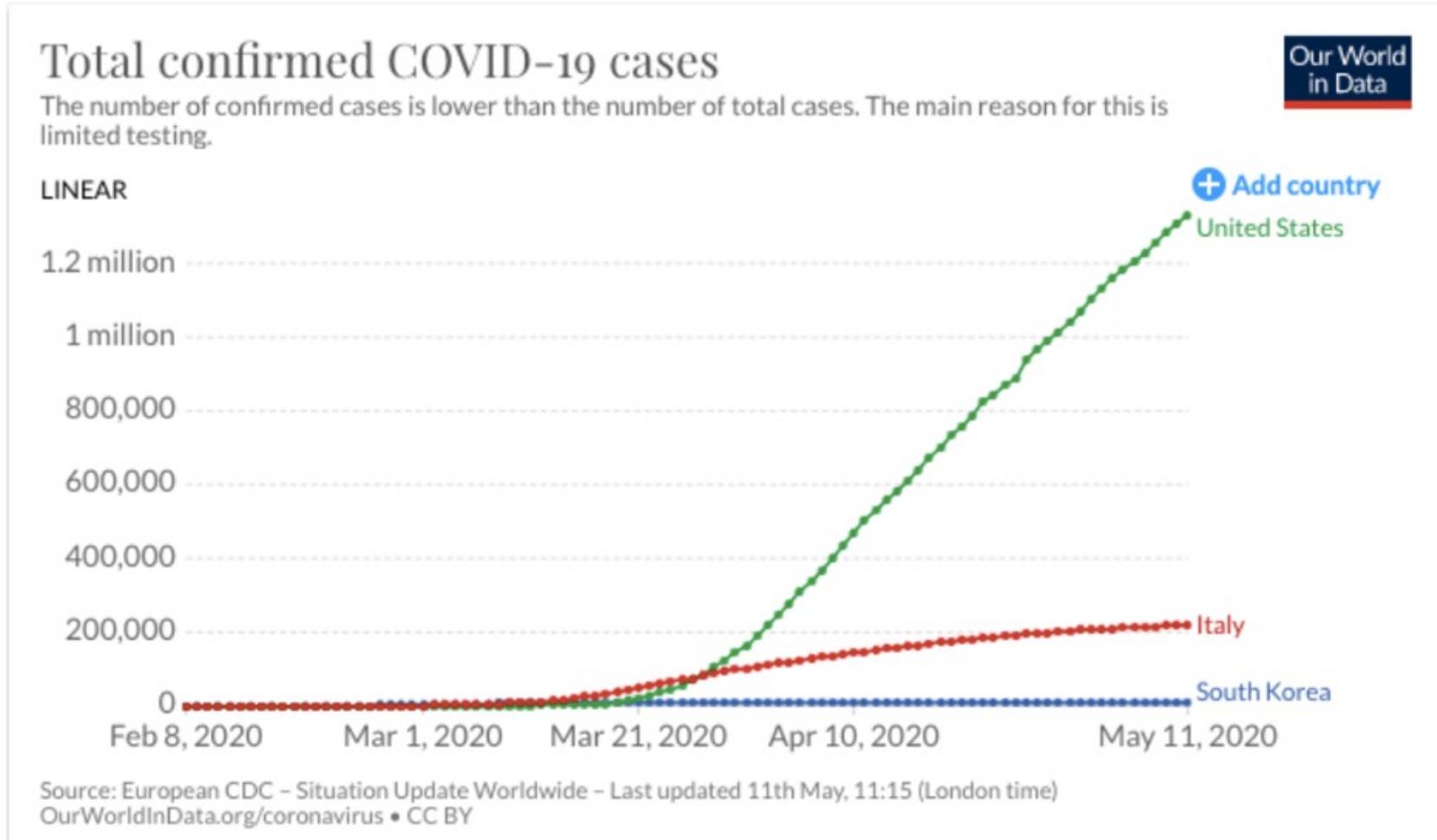
Involve the coordination of mental actions and their transformation so that the results of actions are dissociated from the actions themselves.

Actions and inferences based on logico-mathematical operations including quantitative/covariational reasoning.



# Figurative Thought

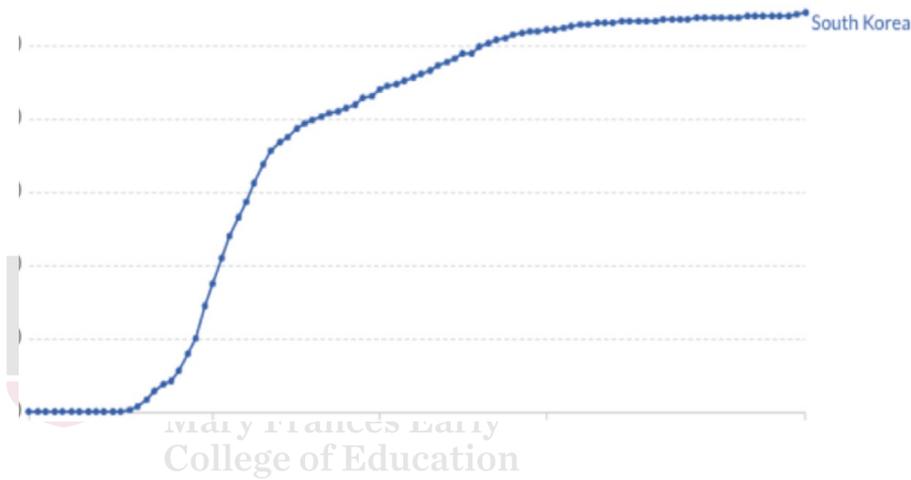
# Operative Thought



## Figurative Thought

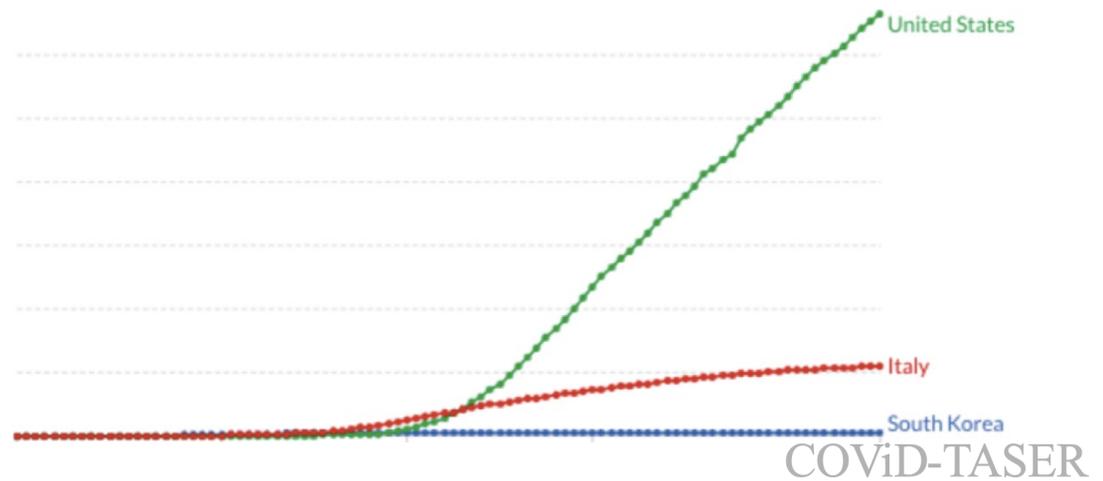
Graph 1 is steep, so it was growing quickly.

But in Graph 2 it is shallow, so it was growing slowly.



## Operative Thought

Graph 1 and 2 are on differently scaled axes, but they show the same SK data and rate of total confirmed cases.



## Figurative Thought

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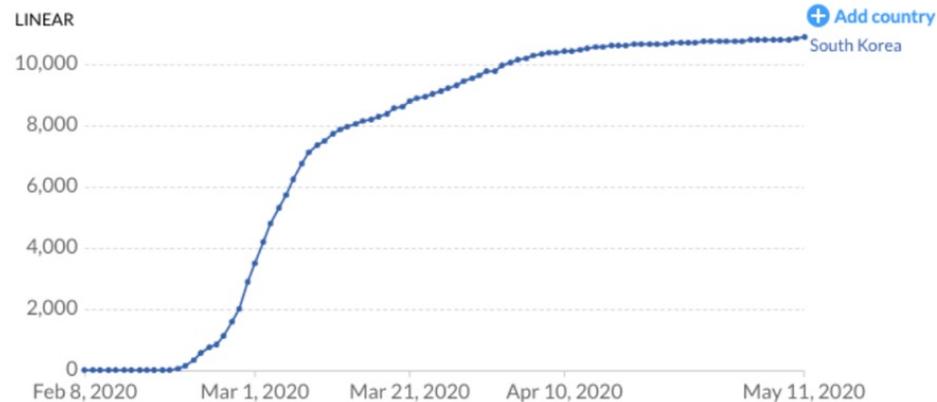
But in Graph 2 it is shallow, so it was growing slowly.

## Operative Thought

Graph 1 and 2 are on differently scaled axes, but they show the same SK data and rate of total confirmed cases.

### Total confirmed COVID-19 cases

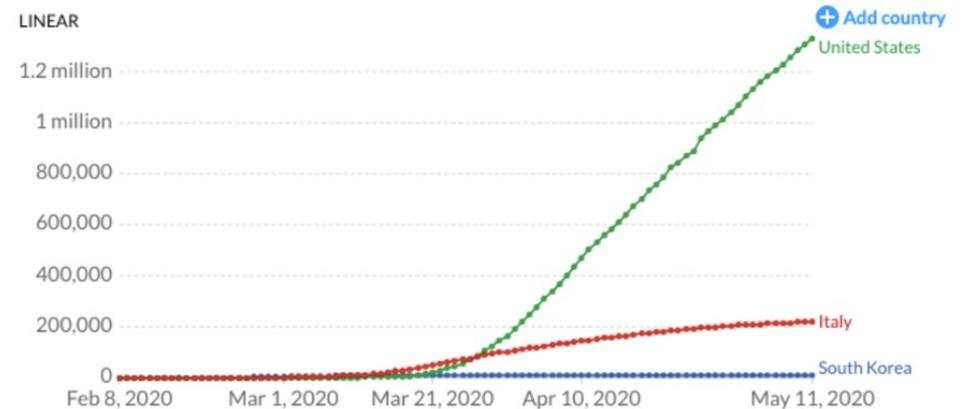
The number of confirmed cases is lower than the number of total cases. The main reason for this is limited testing.



Source: European CDC - Situation Update Worldwide - Last updated 11th May, 11:15 (London time)  
OurWorldInData.org/coronavirus • CC BY

### Total confirmed COVID-19 cases

The number of confirmed cases is lower than the number of total cases. The main reason for this is limited testing.

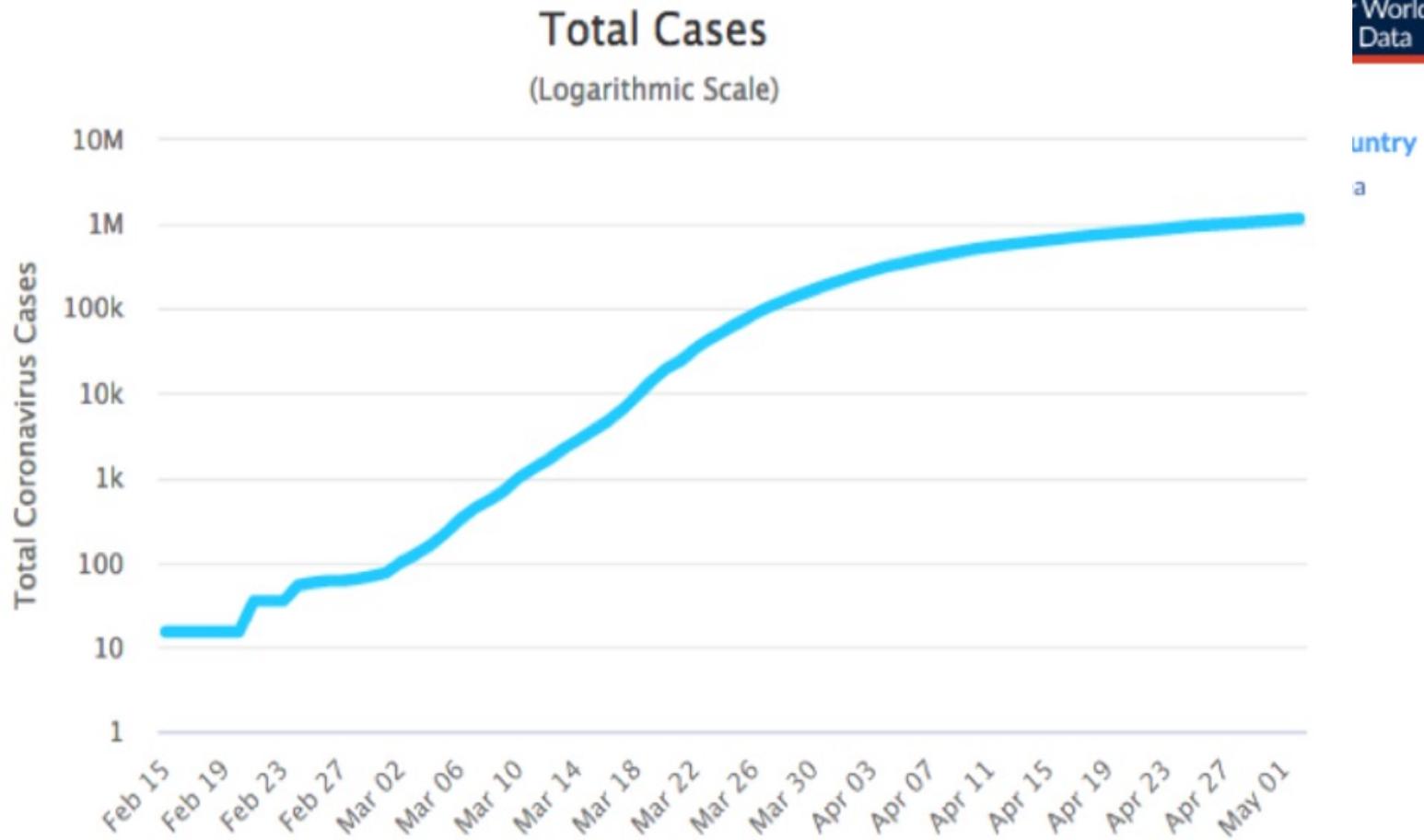


Source: European CDC - Situation Update Worldwide - Last updated 11th May, 11:15 (London time)  
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linear

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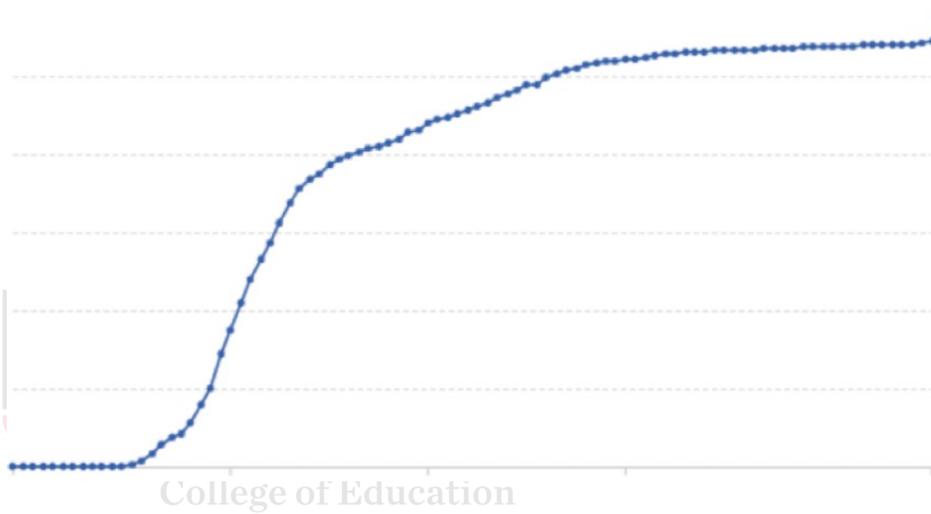


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### Figurative Thought

They are similar so their rates must be close.

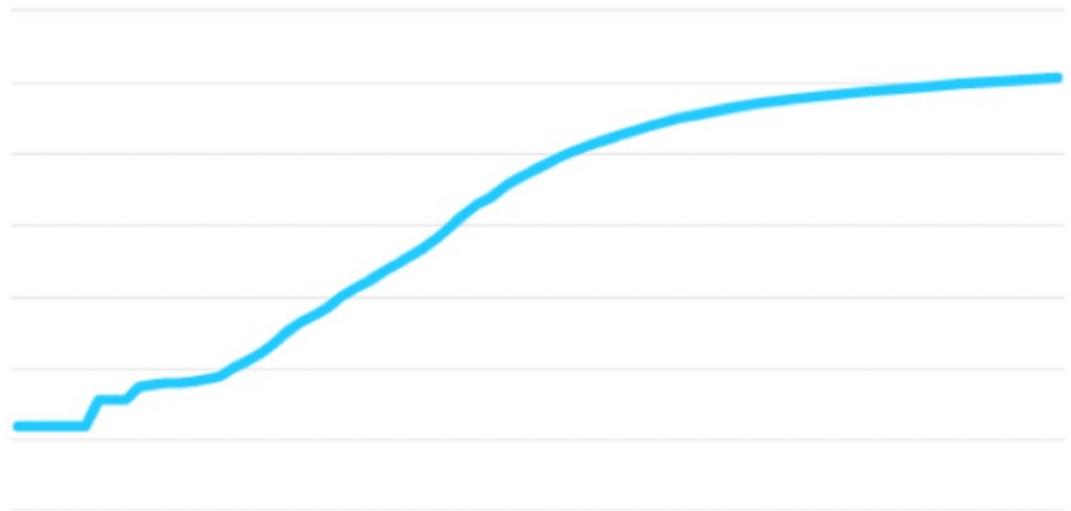
Graphs 1 and 2 are concave down so the rate of change is decreasing.



### Operative Thought

Graph 1 and 2 are on differently scaled axes and Graph 2 is logarithmic.

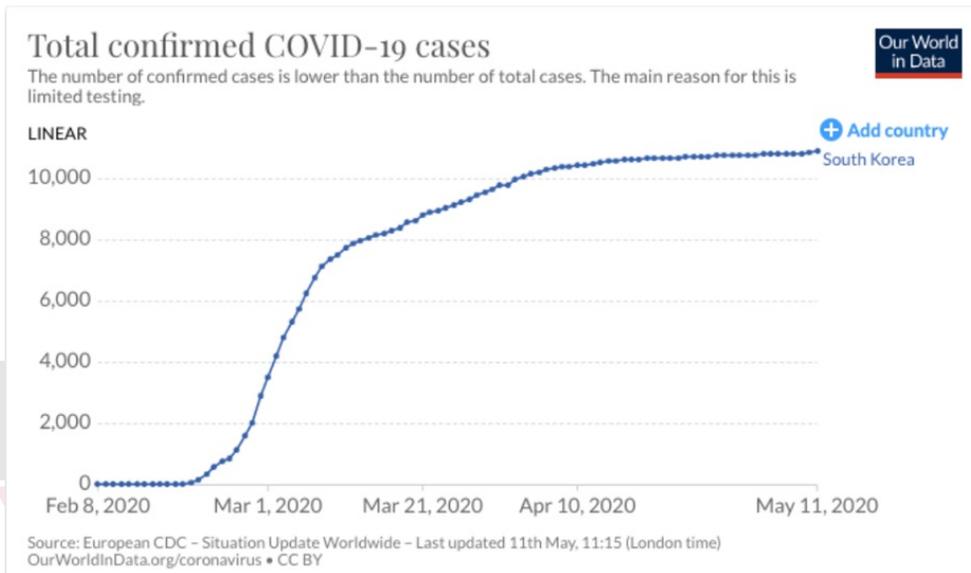
Graph 2 illustrates an increasing rate of change in total cases due to the scale.



## Figurative Thought

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Graph 2 is concave down so the rate of change is decreasing.

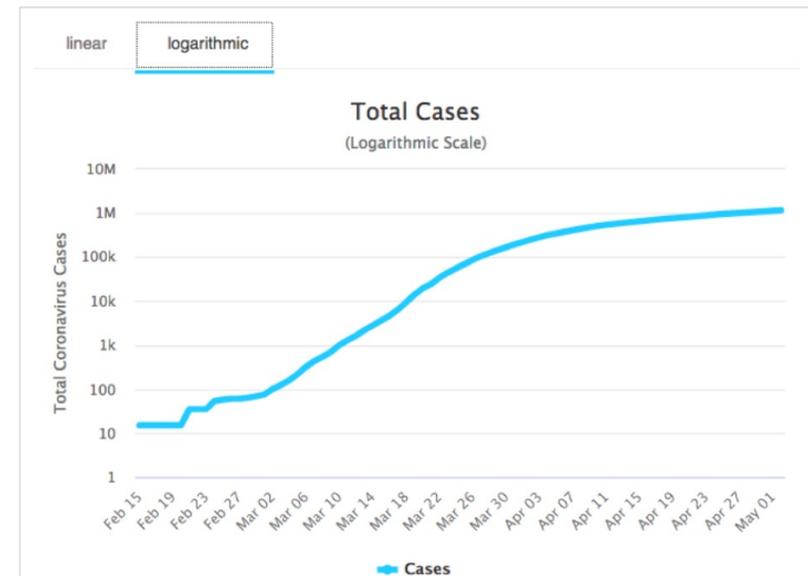


## Operative Thought

Graph 1 and 2 are on differently scaled axes and Graph 2 is logarithmic.

Graph 2 illustrates an increasing rate of change in total cases due to the scale.

Total Coronavirus Cases in the United States



# What are productive and unproductive meanings for graphical QDRs?

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## **Operative Thought**

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# What are productive and unproductive meanings for graphical QDRs?

Table 3. Responses to “South Korea Cases”, “Three Country Cases”, and “Log Scaled Cases” items

“South Korea Cases”, “Three Country Cases”, and “Log Scaled Cases”			
	Focused only on steepness	Gave quantitative meanings to steepness	Unclear
The log scaled graph looks different or less scary than other graphs	10 incl. <u>Bumsoo</u>	5	3
The log scaled graph looks same as other graphs	0	7 incl. Gertrude	0
Unclear	2	2	3
Subtotal	12	14	6



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# What are productive and unproductive meanings for graphical QDRs?

Int. We can look at March 10. What could we say about the, like how long it takes to multiply by 10?

Gertrude Eight days.

Int. Okay, so it took eight days to multiply by ten. What does the slope of the log graph tell us? Like the steepness of it? What... what information is that telling us?

Gertrude It's telling us the rate. How fast it's growing, the rate of change.

Int. Okay and so it took eight days so there's kind of two ways to think about the rate. It took eight days to multiply by ten. You could also say it took eight days to go up by 900.

Gertrude And then here it took from March 10 to 18, it took eight days again.

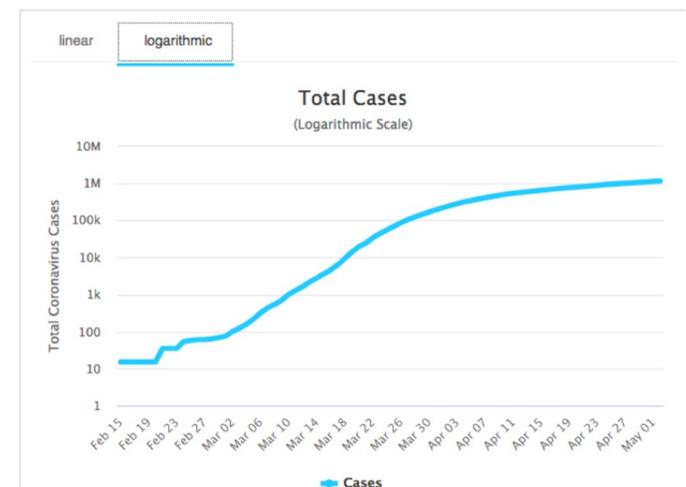
Int. To do what?

Gertrude To multiply by 10.

Int. Okay, and how much did it go up like additively?

Gertrude [Talks to self.] 9000.

Total Coronavirus Cases in the United States



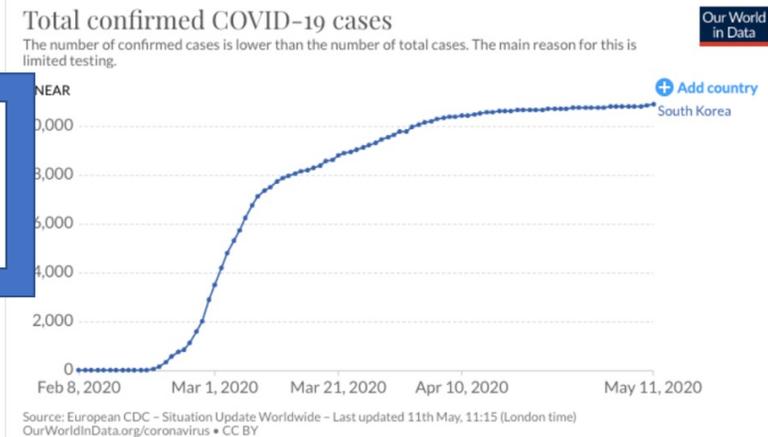
# What are productive and unproductive meanings for graphical QDRs?

Int. How did you determine that “the slope is 2”? You said, “the confirmed cases increased from 2000 to 3000, which means the slope is 2.”

P. Yeah, just a guess. The slope is steeper than 45 degrees and lower than 90 degrees. It looks like about two-thirds. [He gestures to the line cutting the first quadrant into a 1/3 and 2/3 piece]. So [the slope in the SK graph] would be twice as much [as a slope of 1].

Int. Did you draw a hypothetical 45-degree graph?

P. Yes, that's right. [The slope of the SK graph] is steeper than that. Oh, it has increased rapidly. I thought it would be really fast at 90 degrees. The closer the slope is to 90 degrees the worse the pandemic is. But in between, I thought [the slope would] be 2 because it is between 90 degrees and 45 degrees.



OK, so what next?



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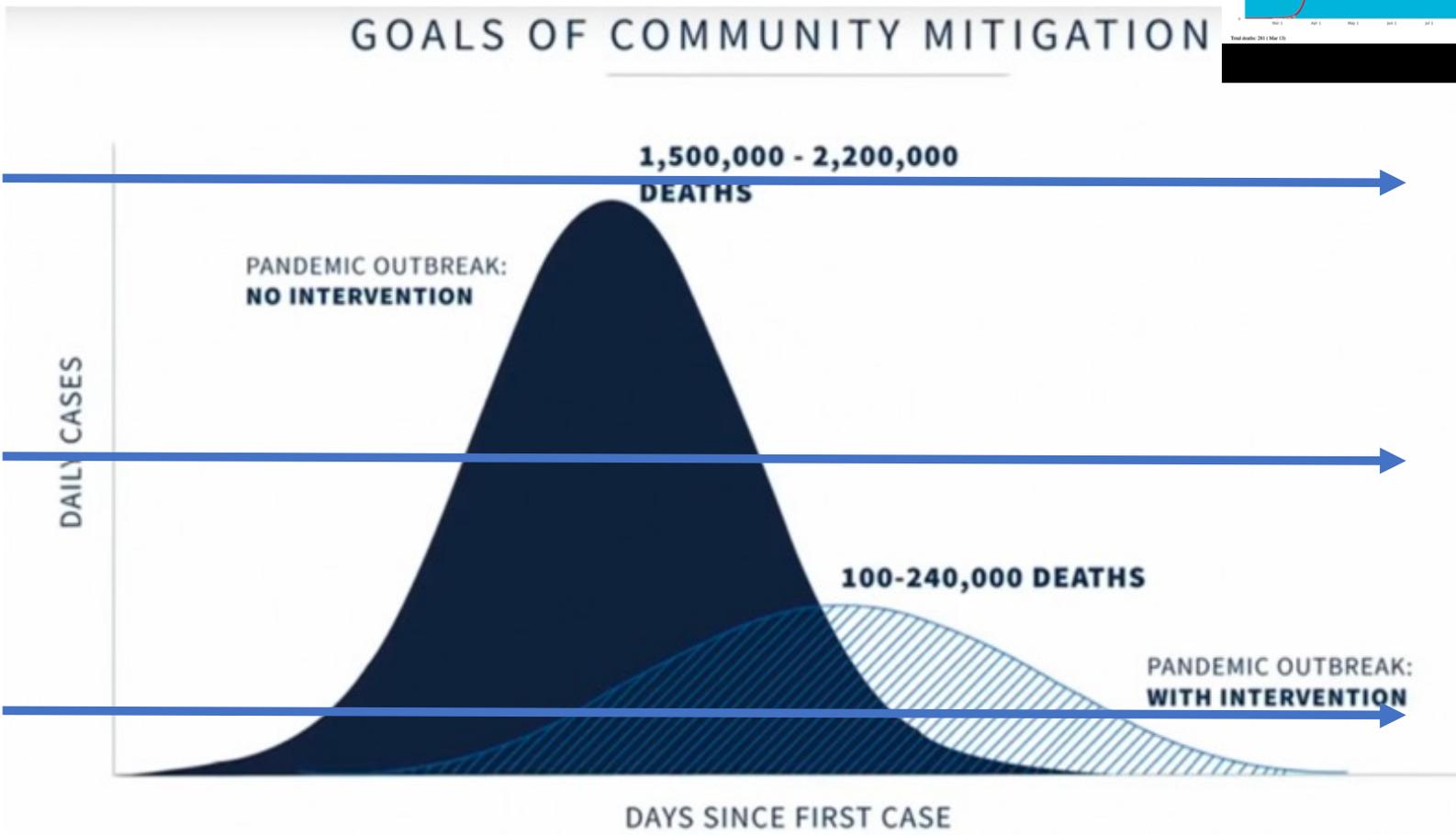
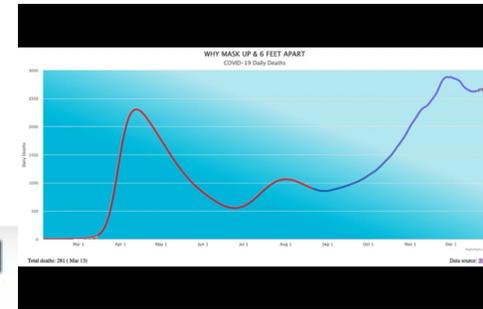
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# Design Improved QDRs

- (a) improving label wording and position;
- (b) adding quantities' values to axes in response to figurative forms of thought;
- (c) supporting operative thought by proportionally scaling graphs to convey appropriate relative size in response to participants having difficulty making relative comparisons of written large numbers;
- (d) simplifying and replacing vague or incorrect terms (intervention, mitigation);
- (e) creating dynamic and narrated QDRs that direct individual's attention *away from perceptual features* of QDRs and *toward quantitative features* of QDRs so that they understand behavior implications.



# Design Improved QDRs



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THANK YOU!  
감사합니다

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