Positive & Negative Feedback

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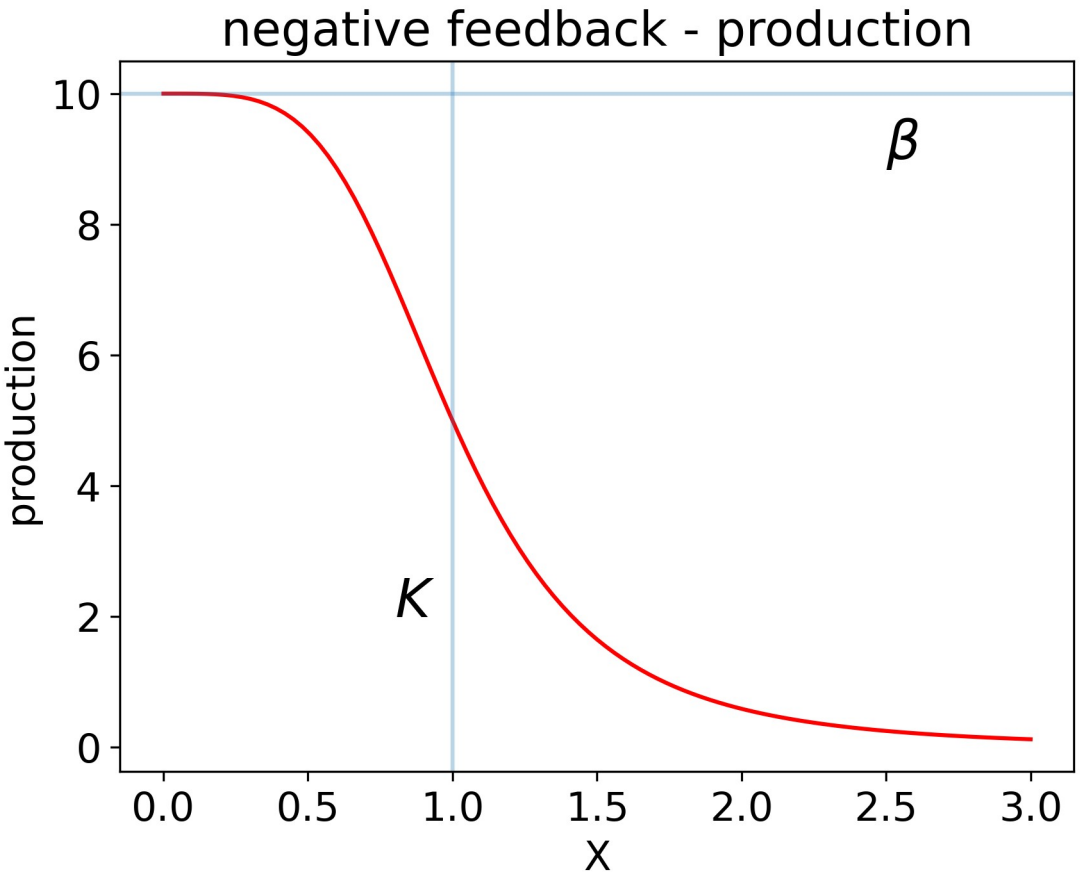
Negative Feedback

$$\frac{dX}{dt} = \frac{\beta}{1 + \left(\frac{X}{K}\right)^n} - \delta X$$

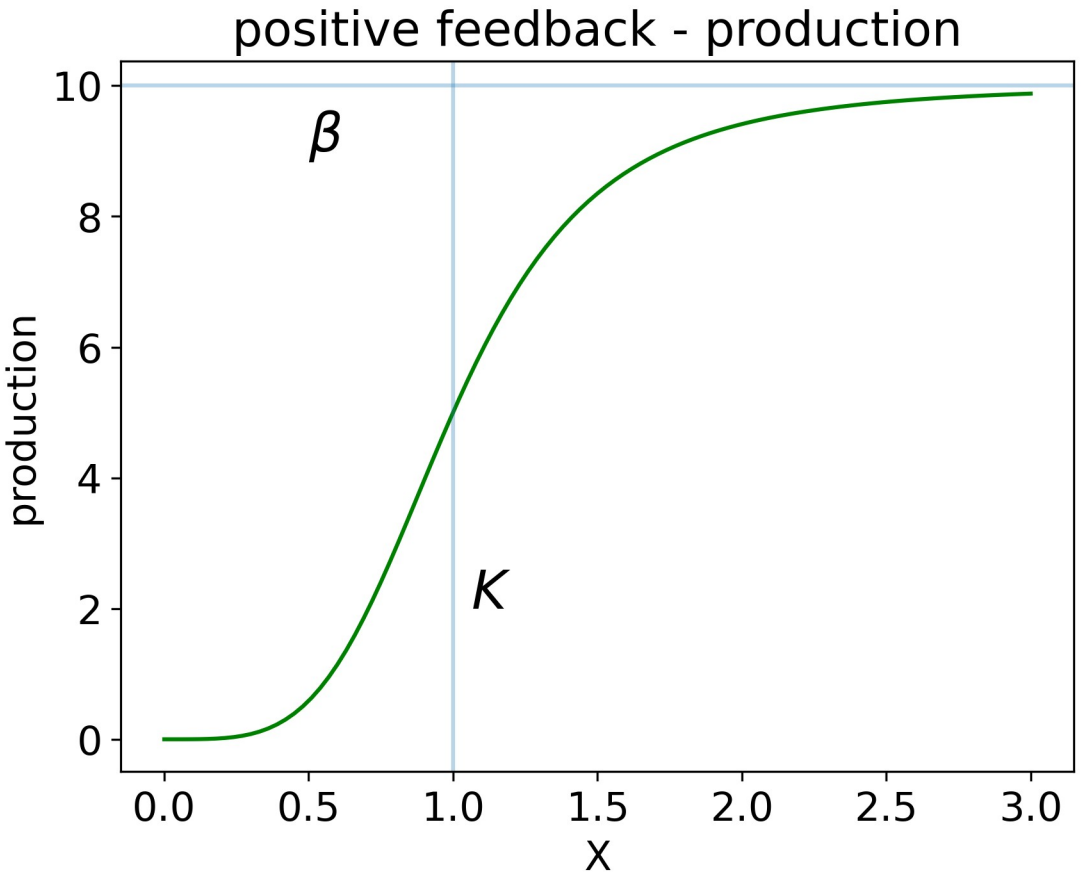
- Production of *X* **decreases** with *X*
- *β* = maximum production
- *K* = feedback threshold



Positive Feedback

$$\frac{dX}{dt} = \frac{\beta X^n}{K^n + X^n} - \delta X$$

- Production of *X* **increases** with *X*
- *β* = maximum production
- *K* = feedback threshold



Negative Feedback

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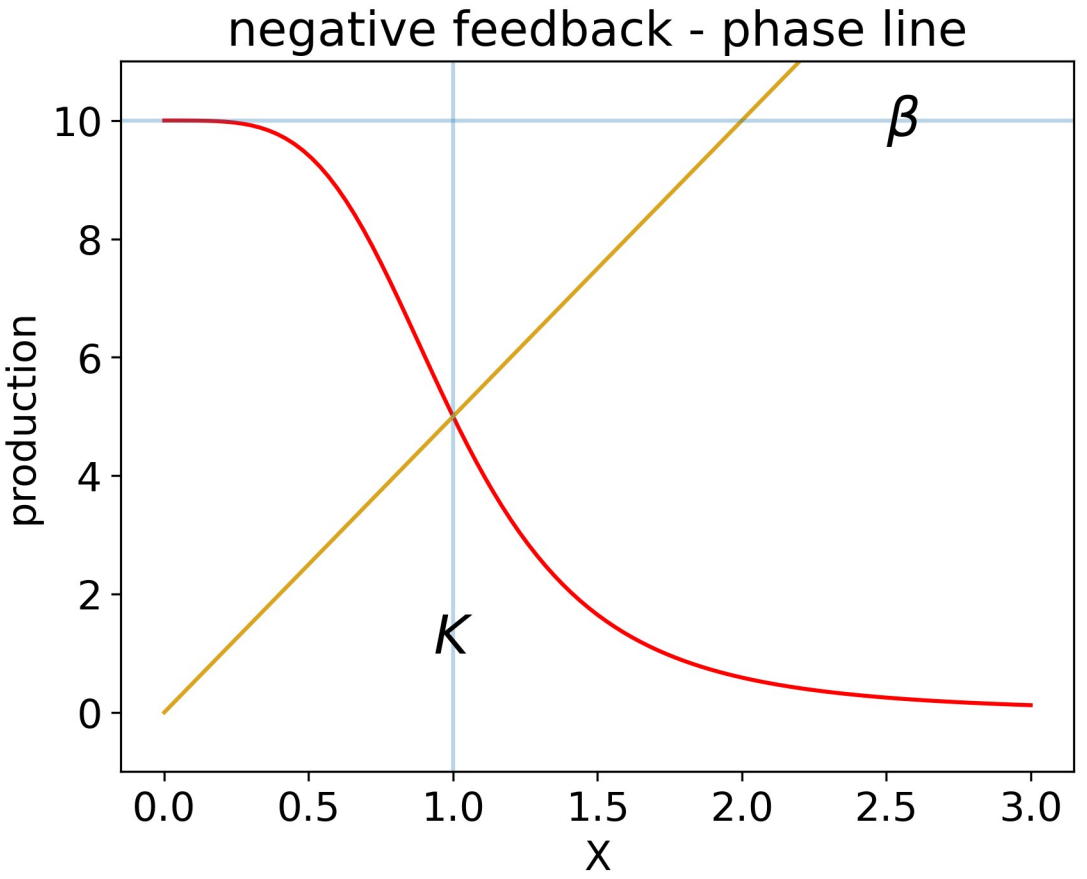

Positive Feedback

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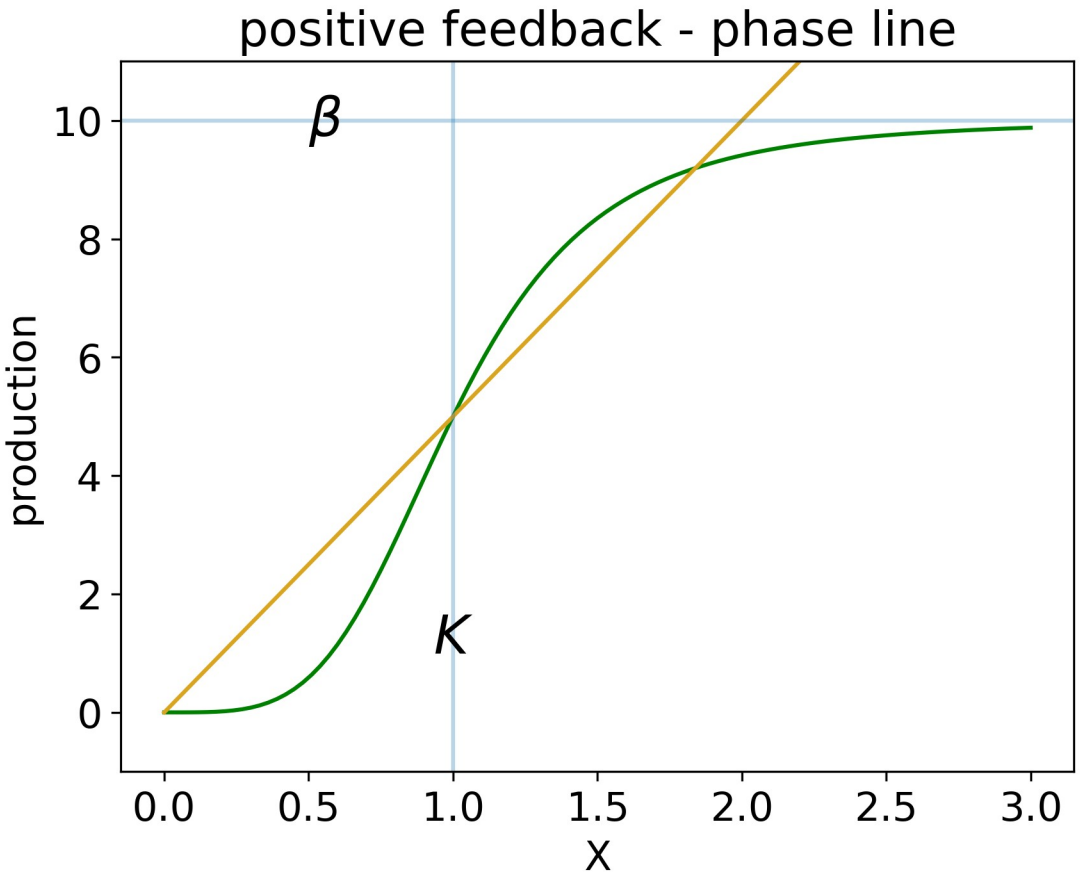
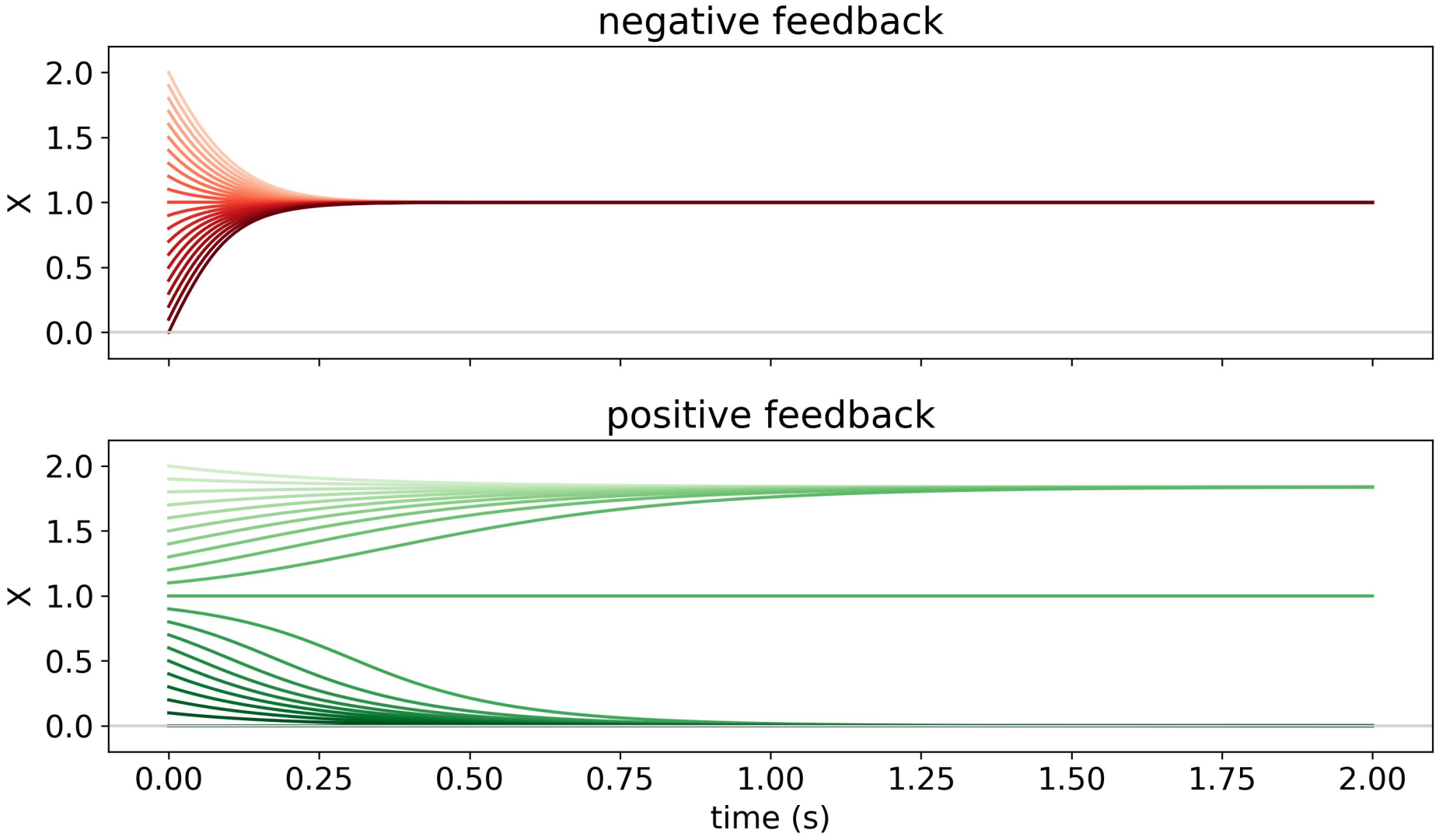
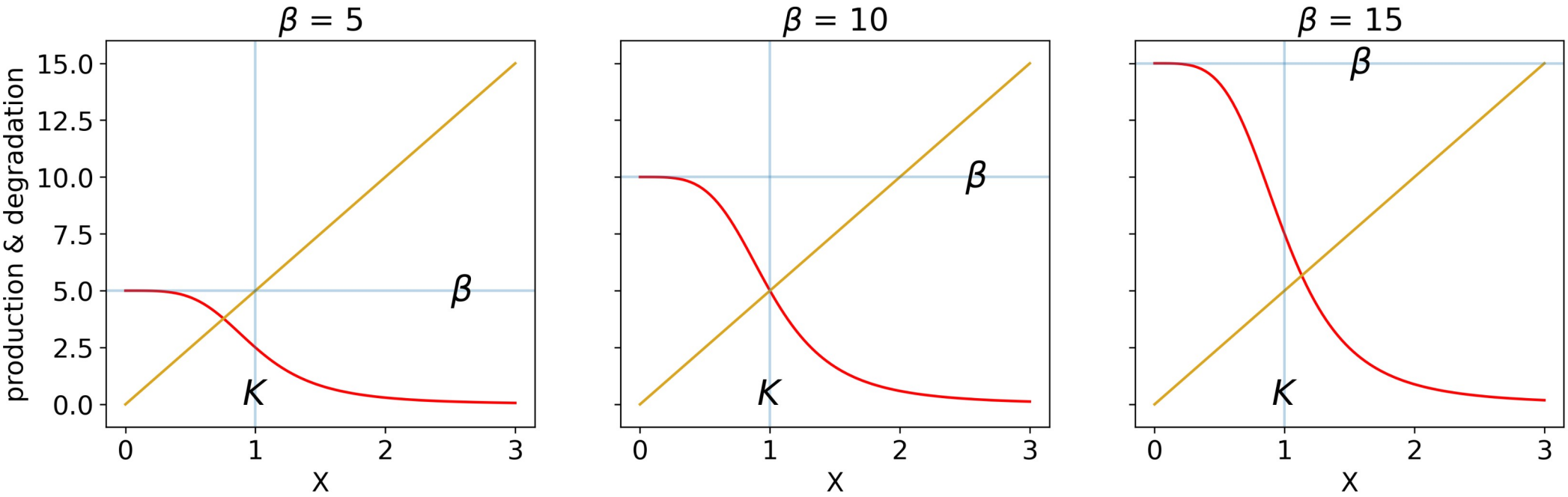
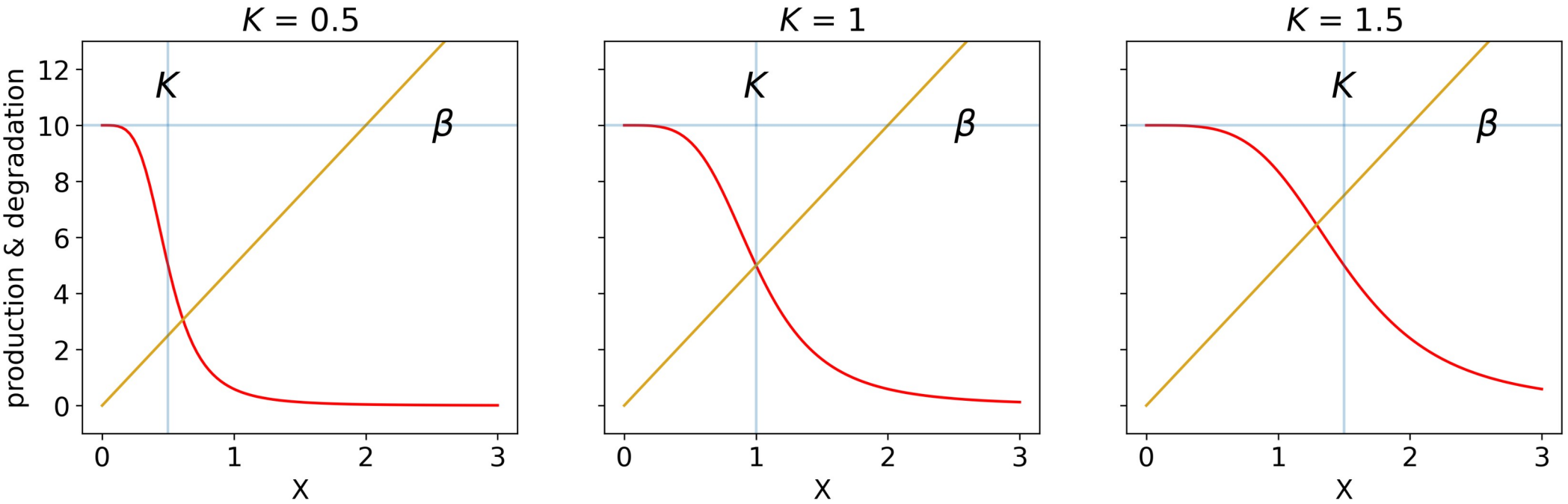



negative feedback
positive feedback
x
2.0
1.5
1.0
0.5
0.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
time (s)

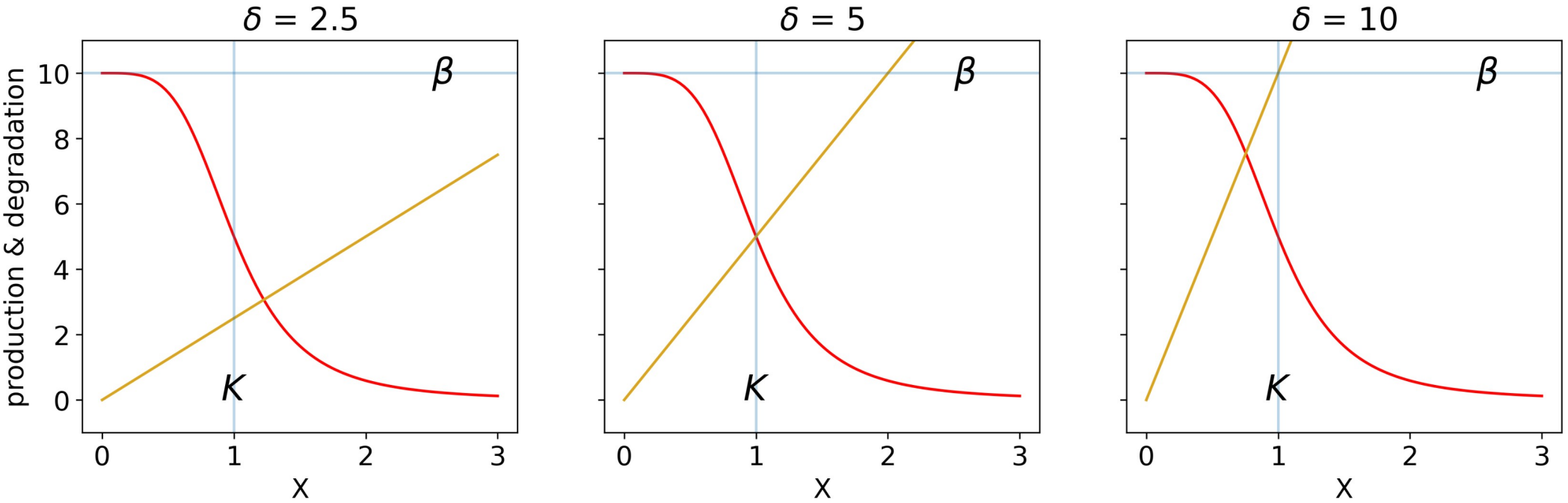
Changing β - Negative Feedback



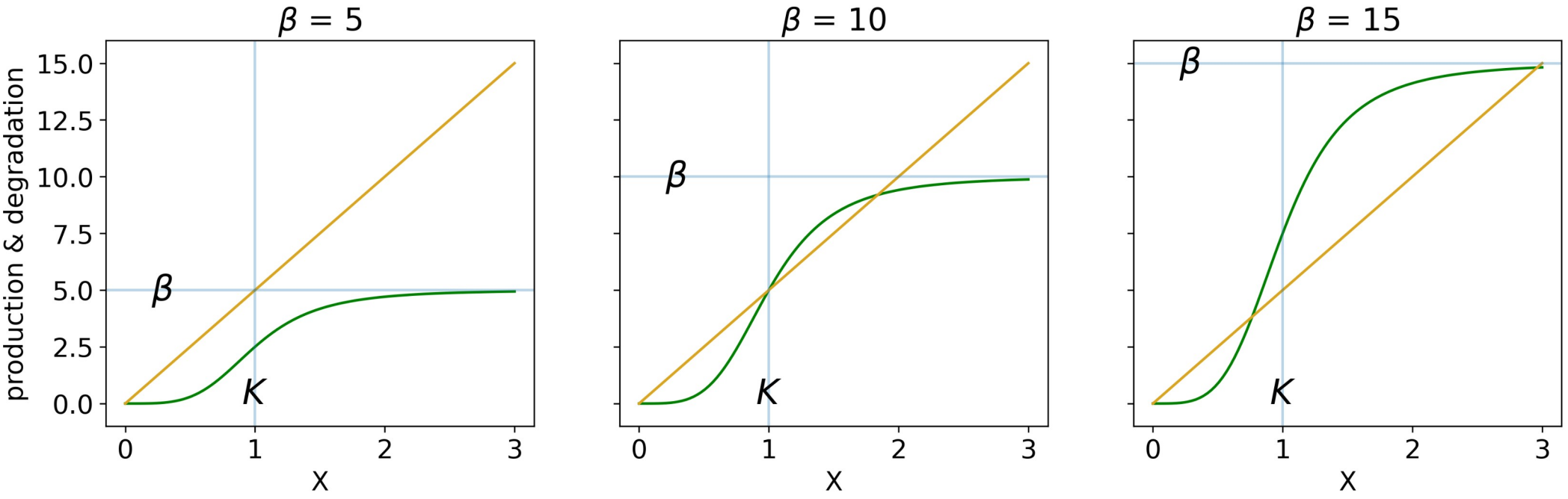
Changing ***K*** - Negative Feedback



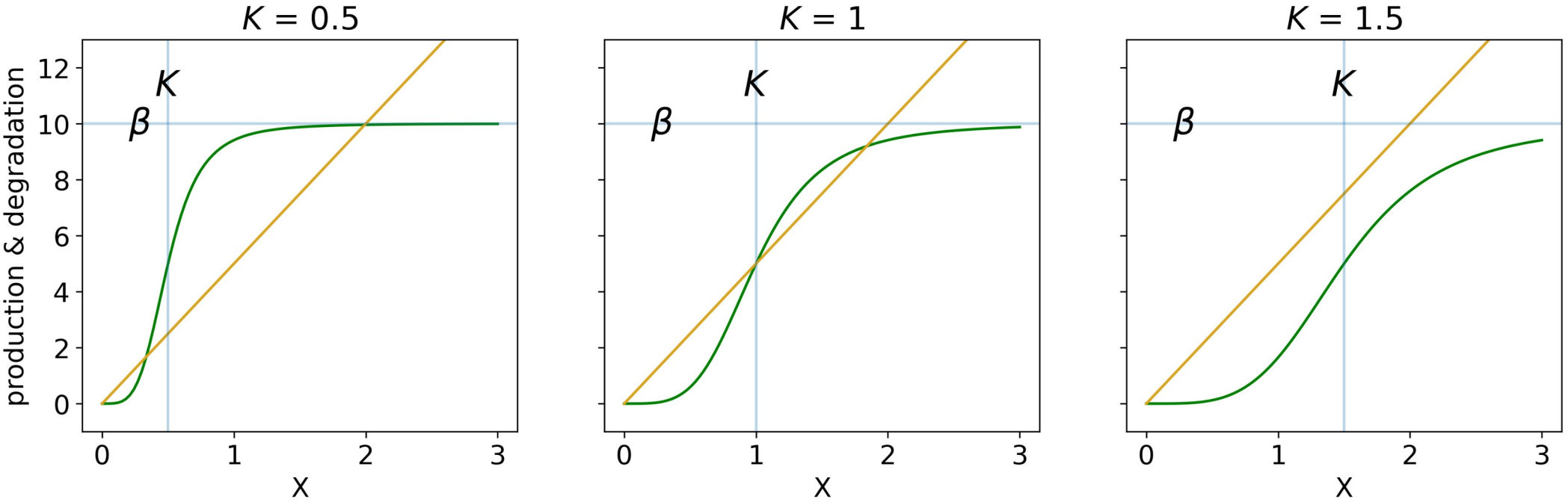
Changing $\boldsymbol{\delta}$ - Negative Feedback



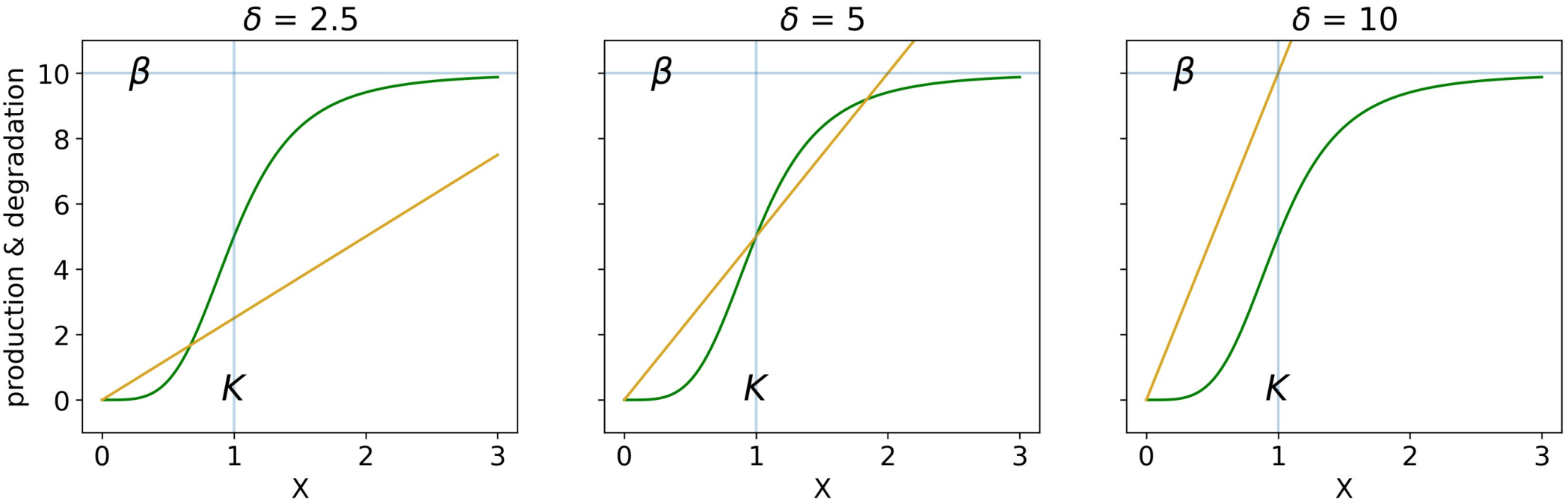
Changing β - Positive Feedback

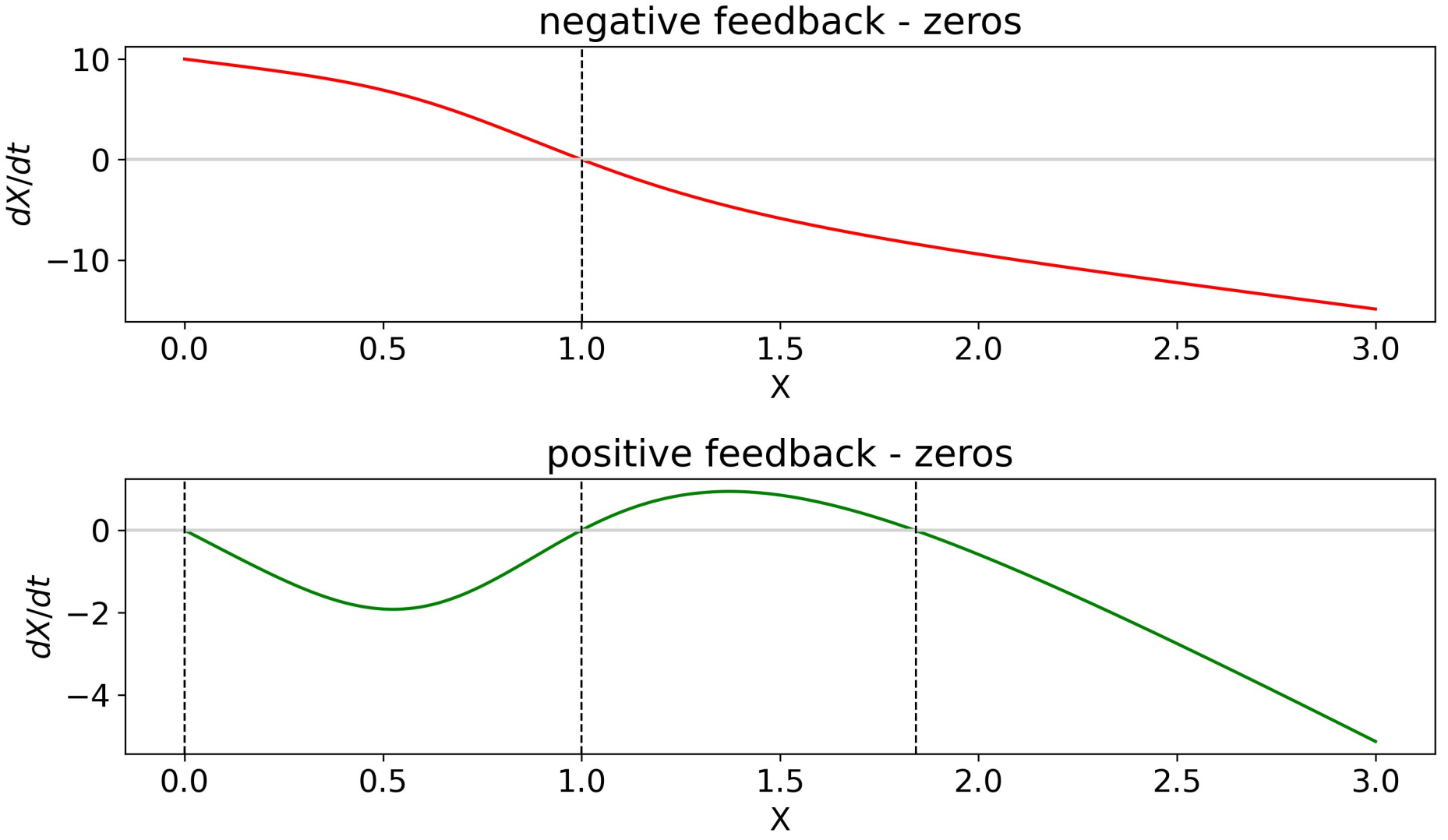


Changing ***K*** - Positive Feedback

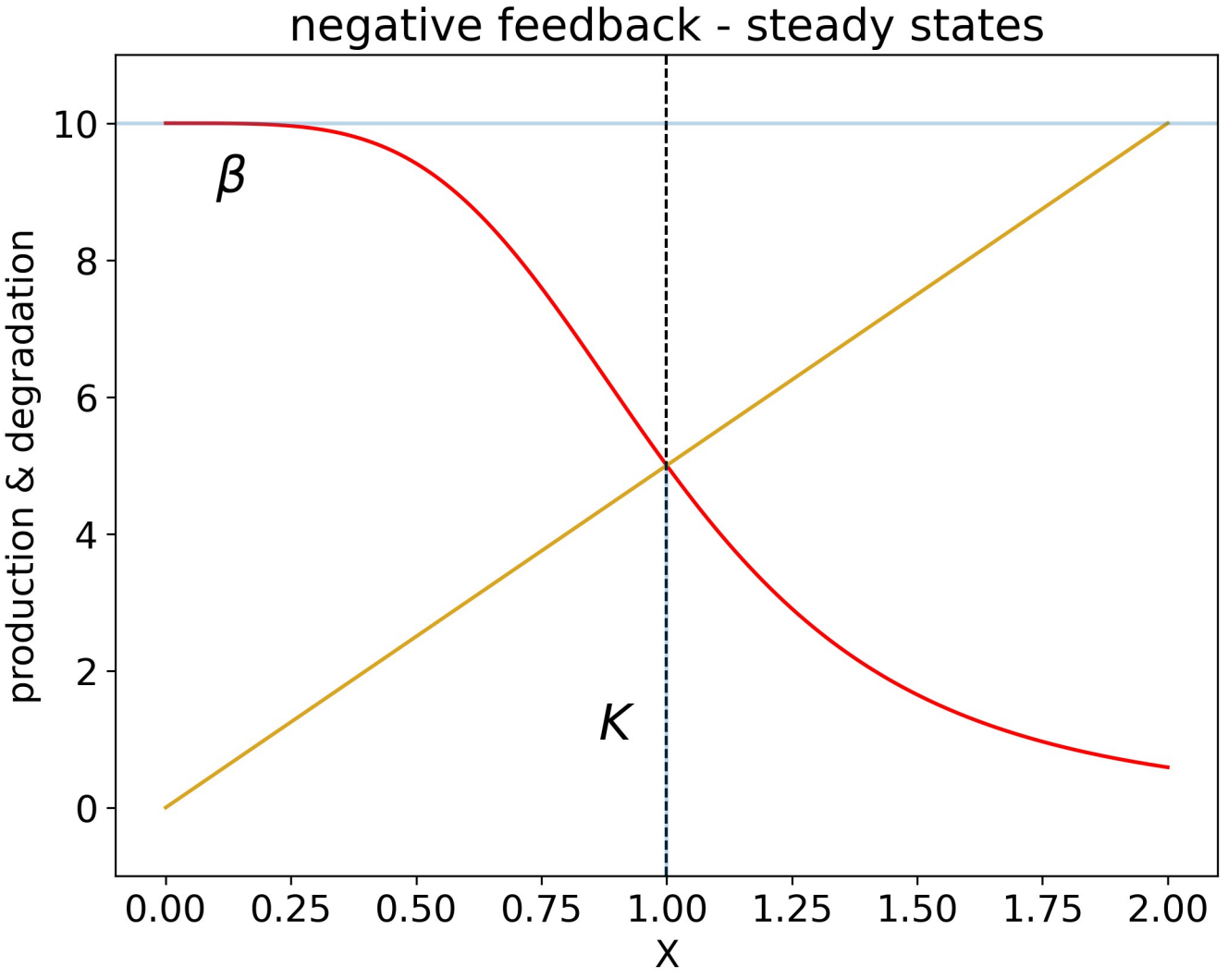


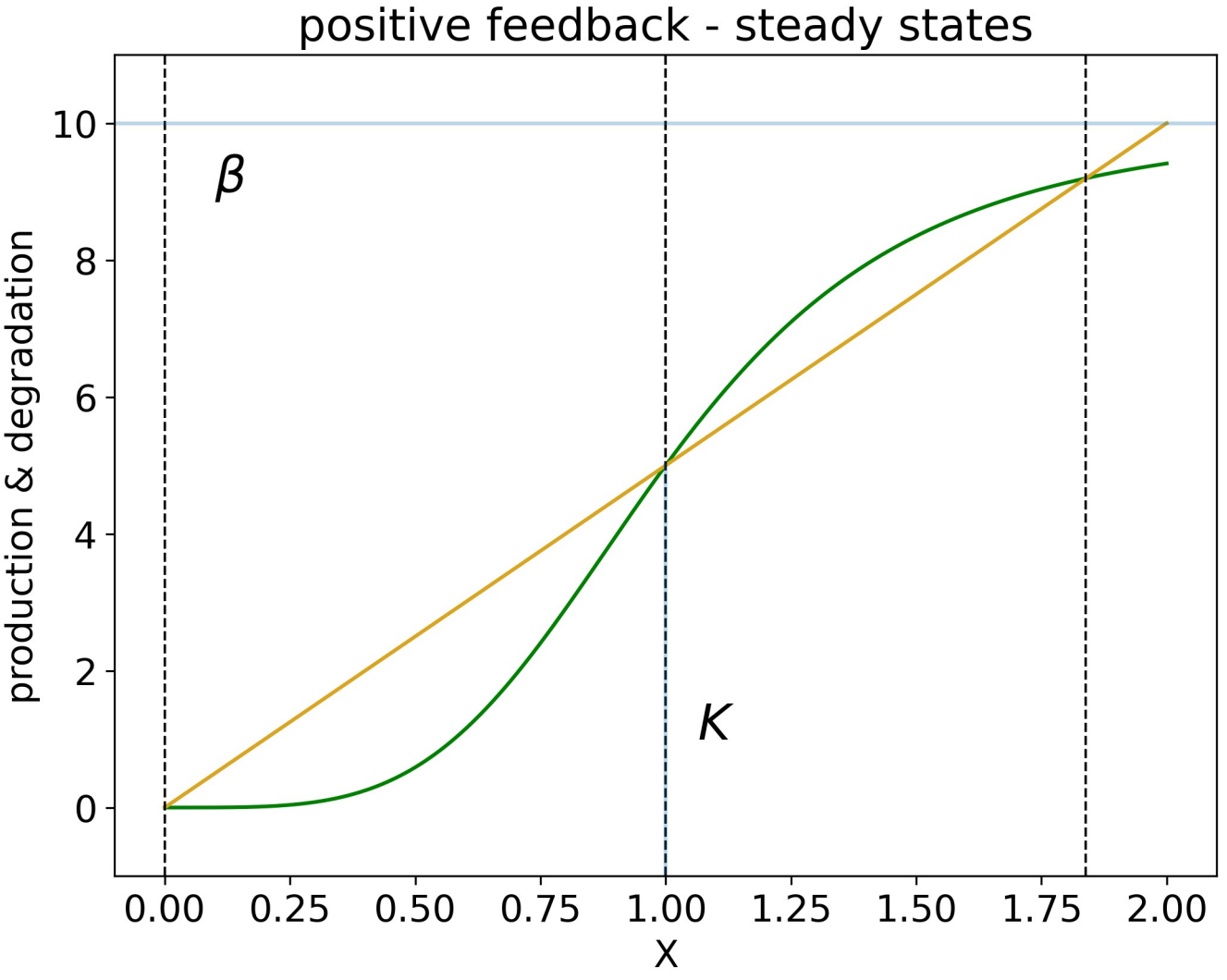
Changing $\boldsymbol{\delta}$ - Positive Feedback





Find the Zeros!


negative feedback - steady states
production & degradation
X
β
K
10
8
6
4
2
0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00


positive feedback - steady states
production & degradation
X
β
K
0
2
4
6
8
10
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00