

# *WG 1: perceptual decision-making*

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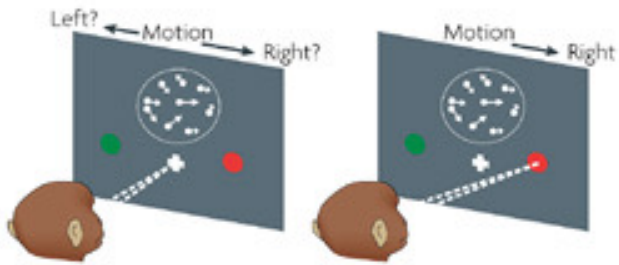


Craig Norton Photography

# What are perceptual decisions?

In perceptual decision making, the subject's task is to resolve uncertainty about the nature of the stimulus.

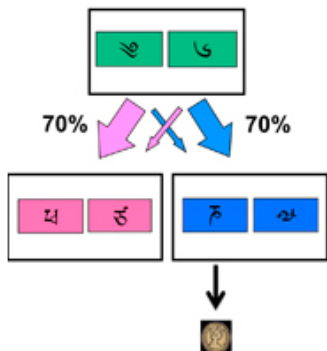
## Perceptual decisions



**I'm not sure what's out there,**  
but if I knew,

I'd know what to do to achieve my goals  
(focus has been on statistical inference, how beliefs  
are shaped and updated by evidence, etc)

## Value-based decisions



I know what's out there, but  
**I don't know what I should do**  
to achieve my goals

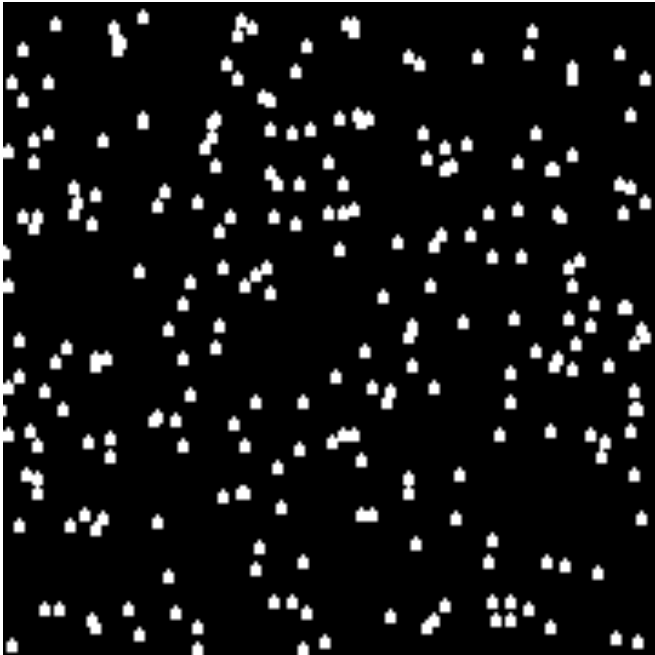
(focus has been on learning about value from past  
experience, exploration/exploitation, model making, etc)



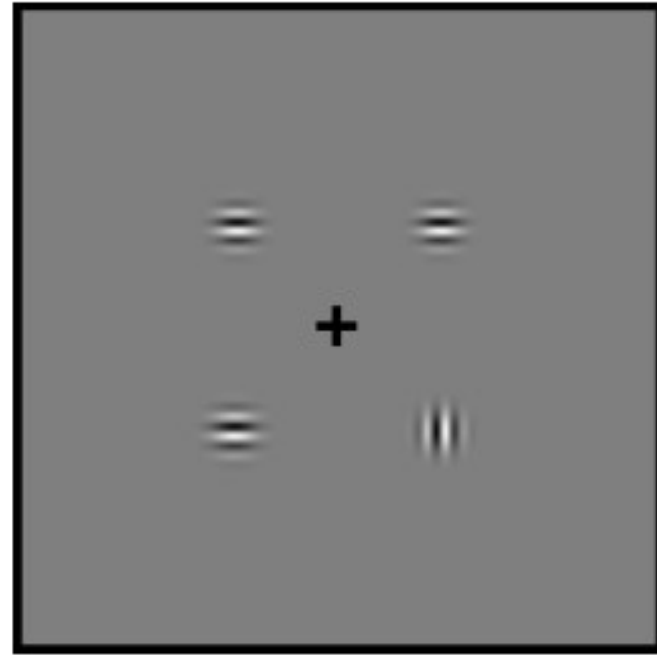
# What are perceptual decisions?

In perceptual decision making, the subject's task is to resolve uncertainty about the nature of the stimulus.

Are the dots moving left or right?



Does the display contain a target (vertical Gabor)?



# The simplest case: detection

Consider an experiment in which every trial can be no stimulus (noise) or stimulus, and subjects need to detect

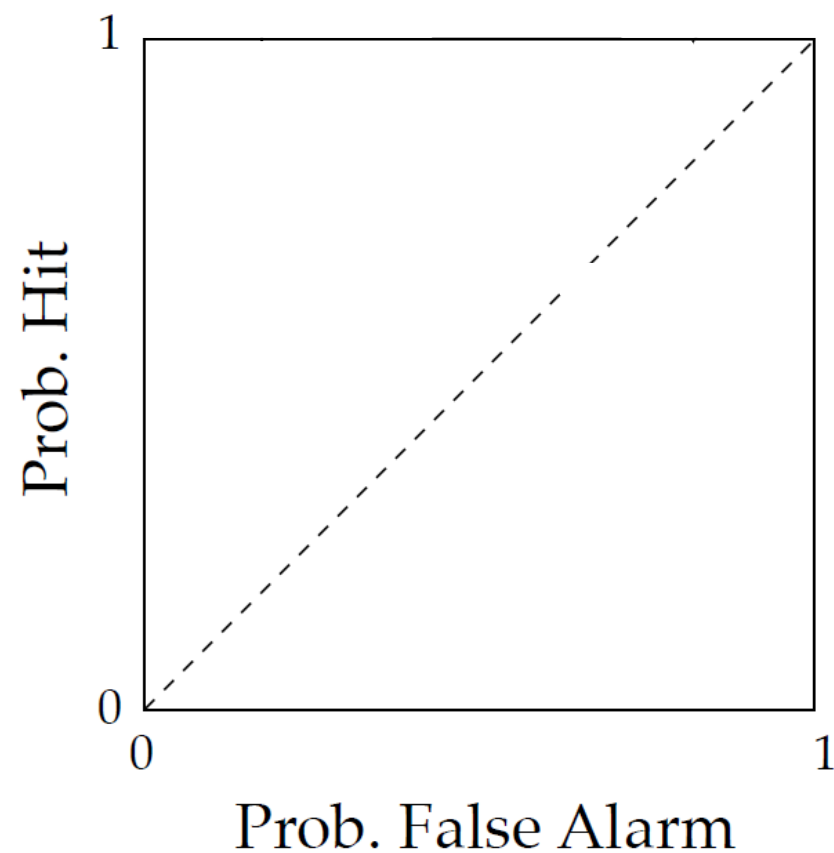
Response	Signal	Noise
“Yes”	Hit	False alarm
“No”	Miss	Correct rejection
<i>Total</i>	<i>100%</i>	<i>100%</i>

Because columns sum to 100%, only 2 independent numbers

The convention is to use hits (H) and false alarms (FA)



# Behavior in H/FA plane



# Signal detection theory

Decision processes depend on extracting information from noisy sensory signals; therefore they are stochastic: the same stimulus will produce a different neural representation from trial to trial.

*Psychological Review*  
Vol 61, No 6, 1954

## A DECISION-MAKING THEORY OF VISUAL DETECTION <sup>1</sup>

WILSON P. TANNER, JR. AND JOHN A. SWETS

*University of Michigan*

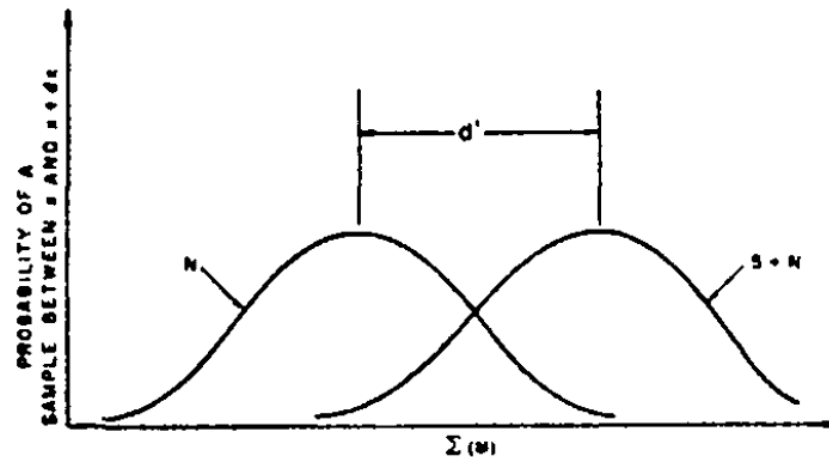


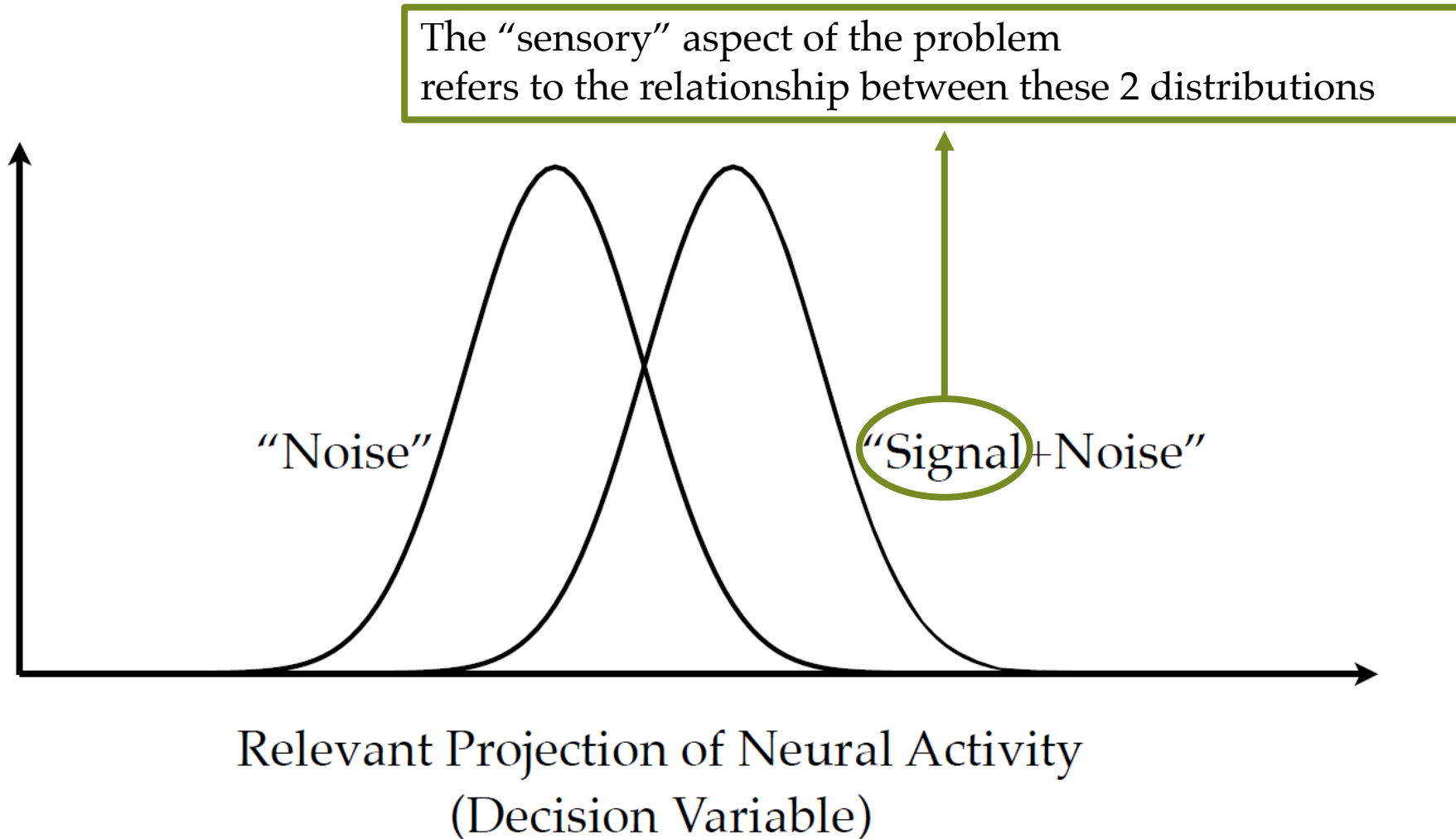
FIG. 3. Hypothetical distributions of noise and signal plus noise

*Tigerness*

*Motion direction*

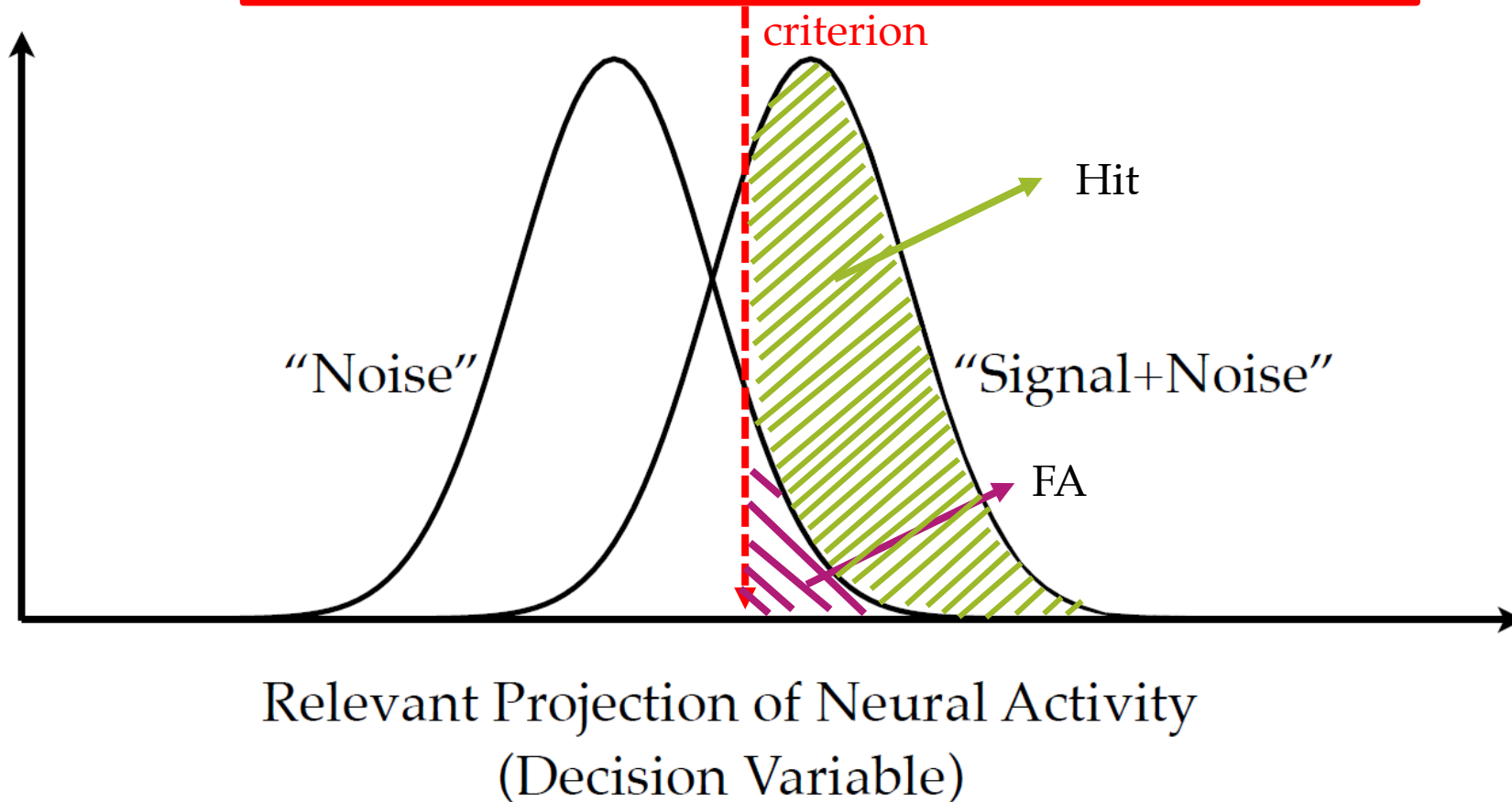
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# Signal detection theory



# Signal detection theory

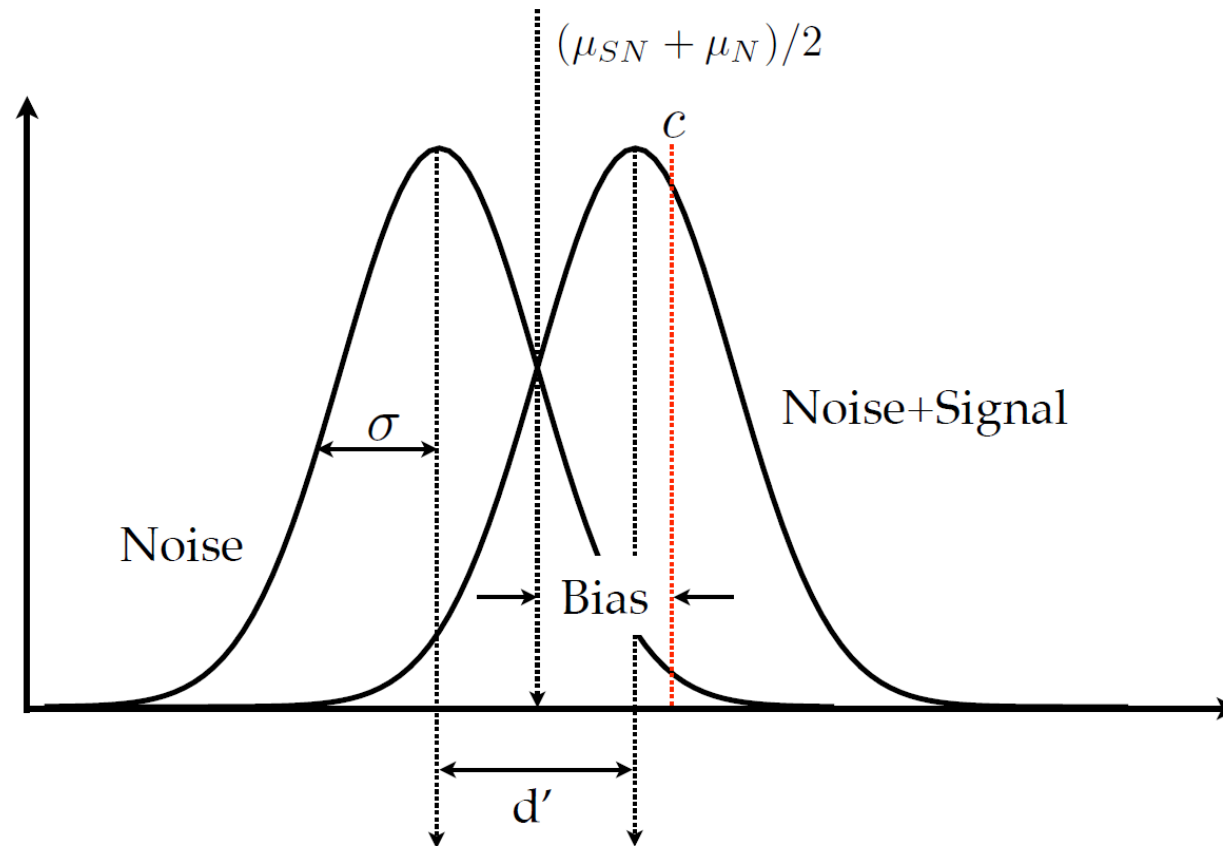
The “decision” aspect of the problem has to do with the mapping between the ‘decision variable’ and actions



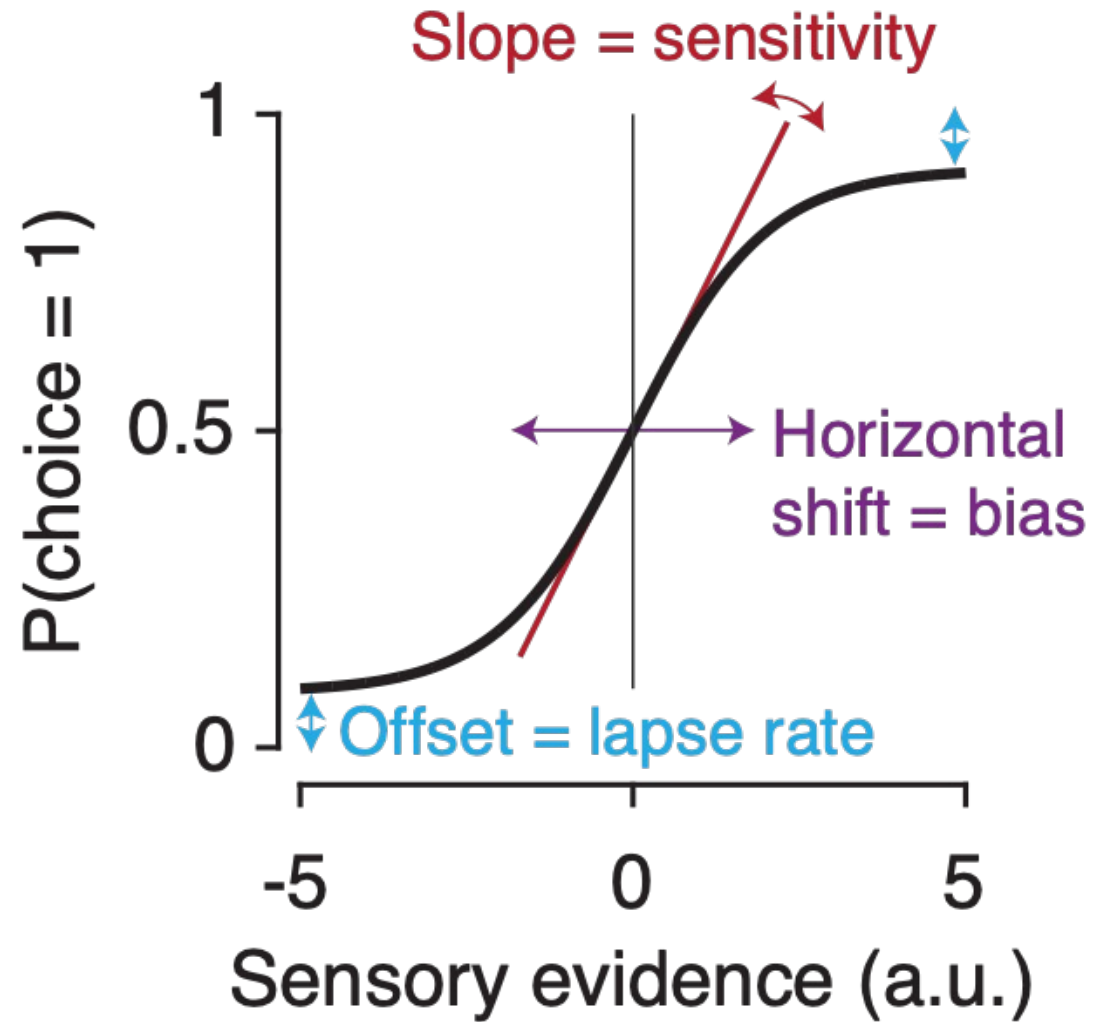


# Parameters in SDT: $d'$ and bias

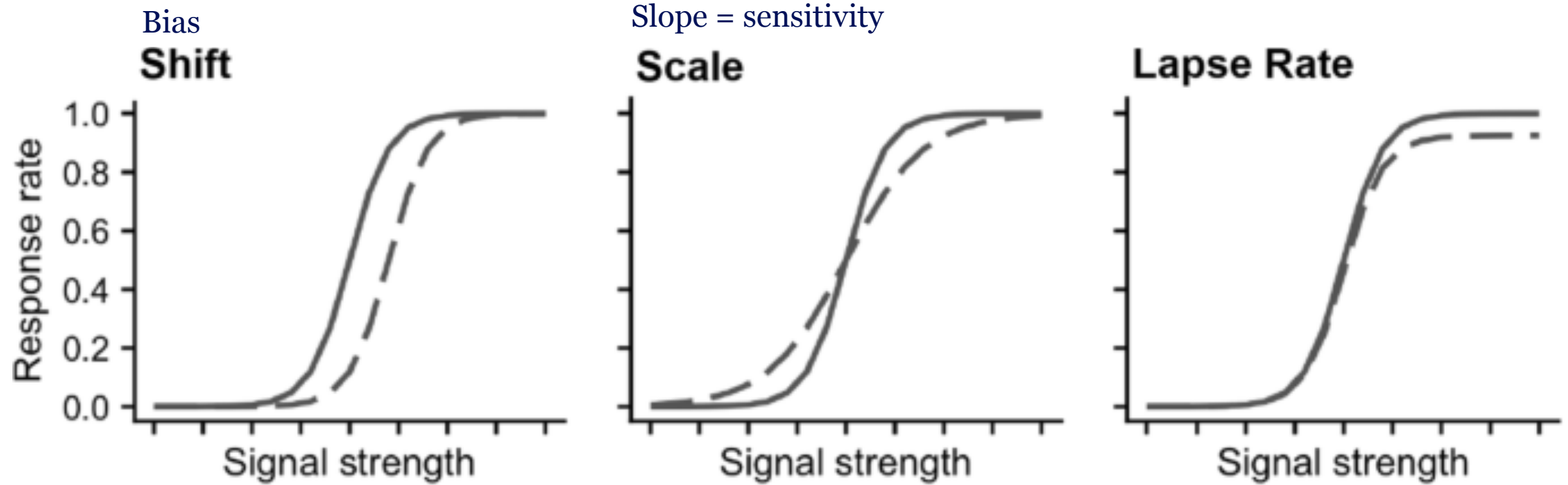
- $d'$  is supposed to represent the true measure of discriminability for a given stimulus strength. It is independent of the subjects strategies.
- The criterion  $c$  (bias) sets the response tendencies of the subject and can vary depending on various factors such as prior probability of stimulus occurrence, pay-offs, etc...



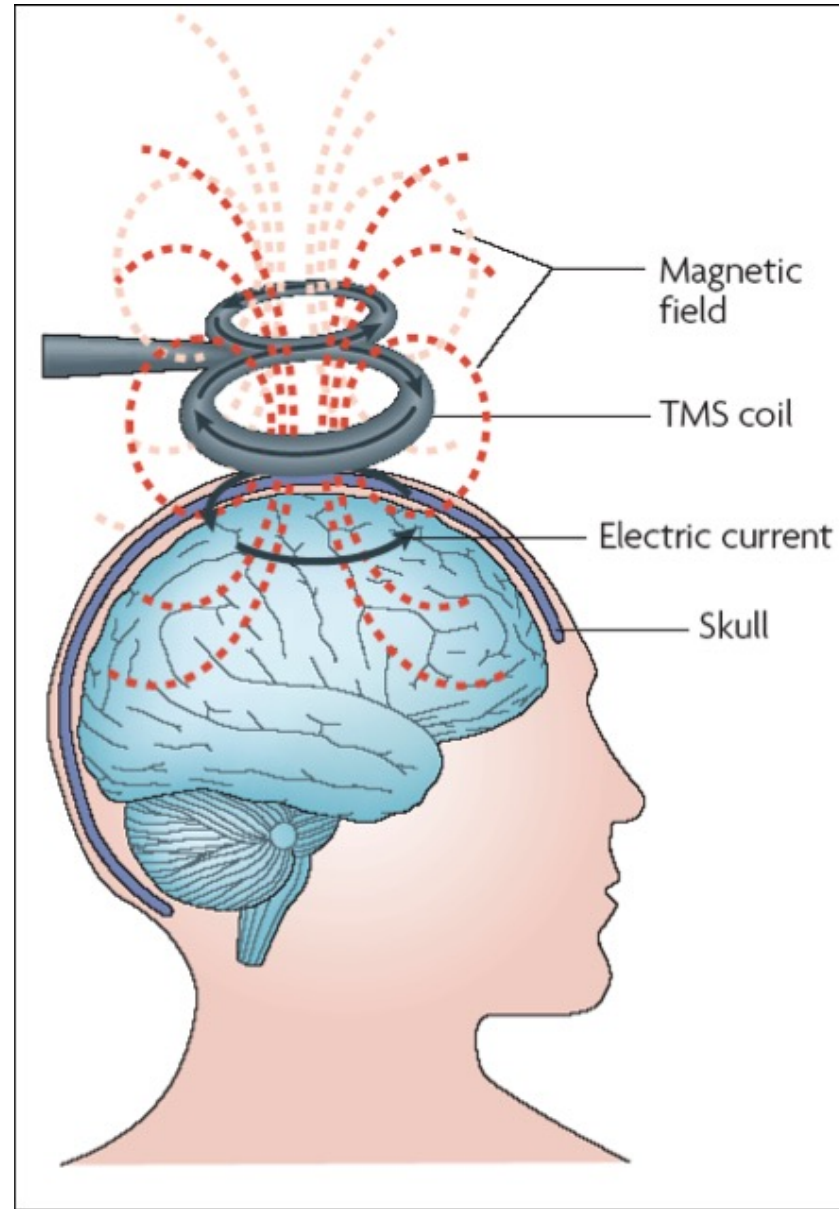
# The psychometric function



# The psychometric function



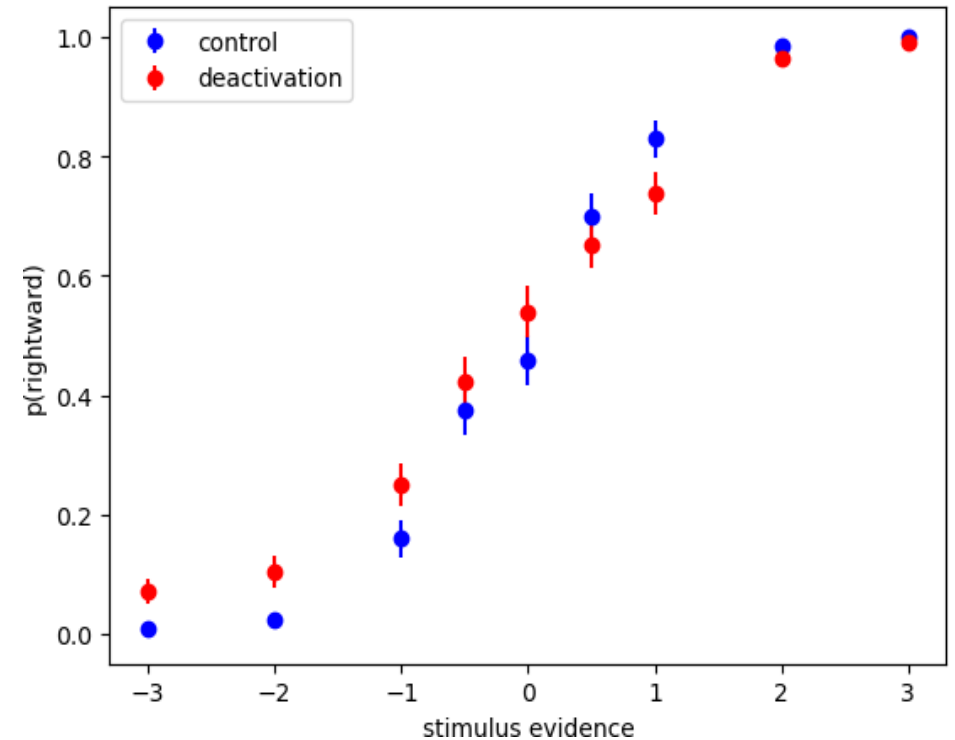
# Let's intervene!





# Preparing for tutorial part 1

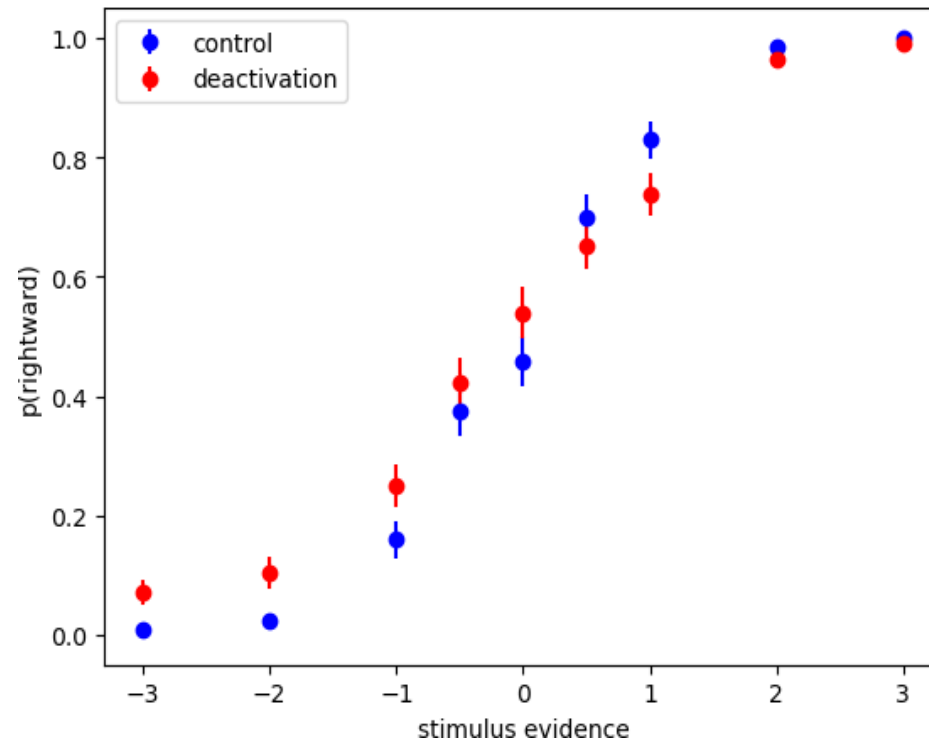
- Standard 2AFC motion discrimination task (left vs right)
- Stimulus evidence is varied across 9 levels
- In half of trials, brain area X is experimentally deactivated
- A reduction in performance is observed in those trials
- ***Is it due to deteriorated sensory processing or to sensory-unrelated effects (lapses)?***



# Defining the models

## 1. Scientific question:

*“Does deactivating brain area X deteriorate sensory processing or provoke sensory-unrelated effects (lapses)?” -> Two models*



# Defining the models

## 2. Modelling objectives:

- which of two models representing each hypothesis better accounts for the data?  
(*relative fit*)
- does the favored model reproduces the change in the psychometric curve during deactivation?  
(*absolute fit*)

# Defining the models (cont'd)

## 3. Defining input and output variables:

- output variable: choice (binary)
- input variables: stimulus evidence, manipulation (*+control variables?*)

## 4. Defining the models as box diagrams:

