# Signal Detection Theory

A very important question: Is "IT" there?

Good "IT"s
      Food
      Mate
      Safety
Bad "IT"s
      Predator
      Storm
      A Lie

# Signal Detection Theory
# Is That Other Mind Lying?

Trust: Key component of social interactions

   Without trust, society disintegrates (e.g. corruption)

   Without trust, tribal bonds disintegrate (e.g. war, murder)

   Without trust, individual relationships disintegrate (e.g. divorce)


How do we know if someone is lying?

   Eyes

   Face

   Voice

   Body

   Physiology (Lie detectors)

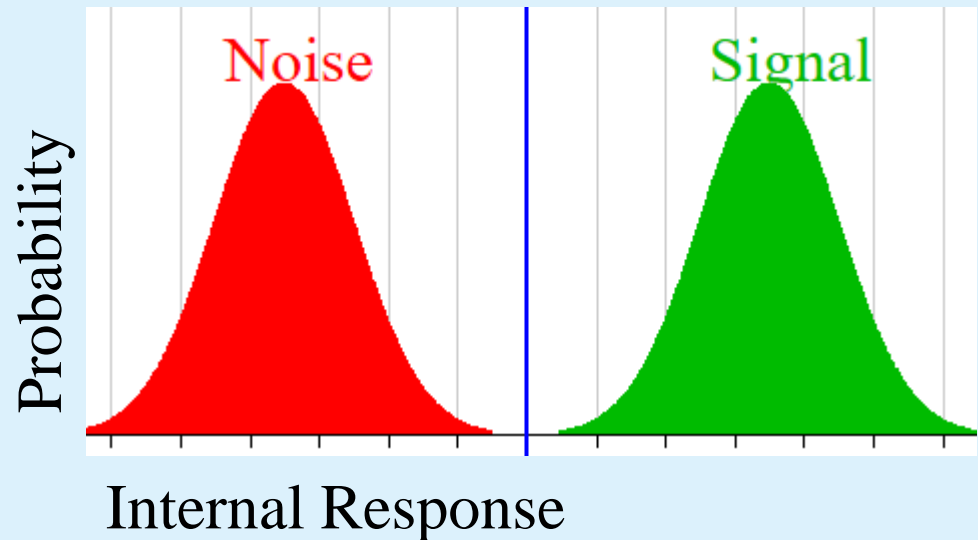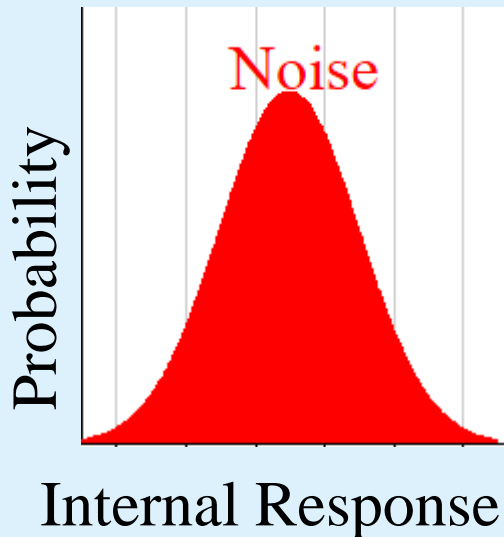# Signal Detection Theory Distributions Of Truth and Lying

Distribution with variability = Noise Distribution
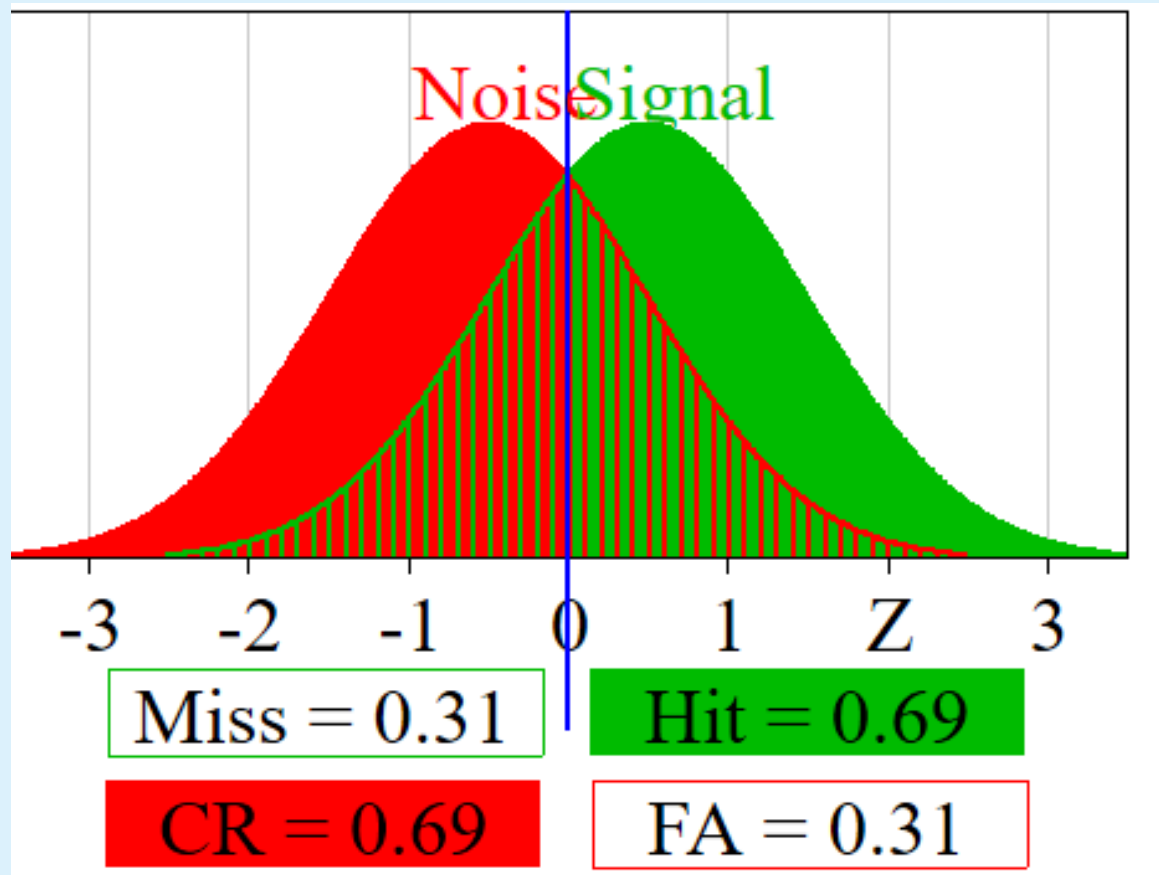
3 year old child

Truth = Noise          Truth = Noise          Signal = Lying

Probability

Noise

Internal Response

Probability

Noise                              Signal

Internal Response

# Signal Detection Theory Distributions Of Truth and Lying

30 year old adult

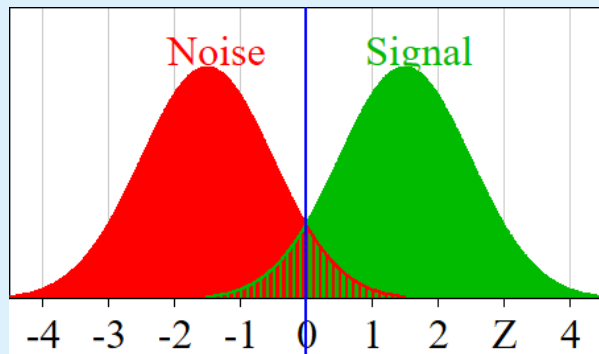# Signal Detection Theory Sensitivity
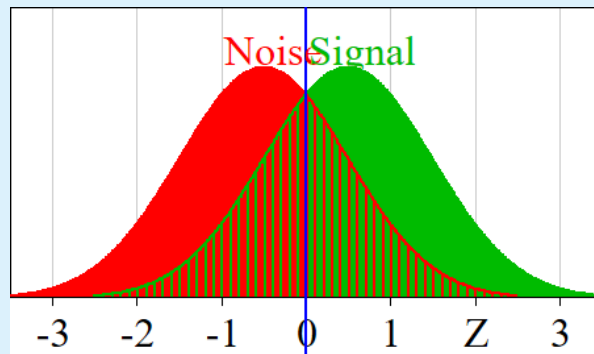
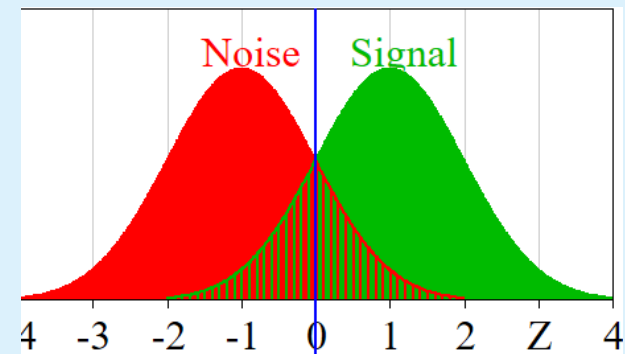Sensitivity (d'): Number of standard deviations Signal is above Noise

d'= 3           d'= 1           d'= 2



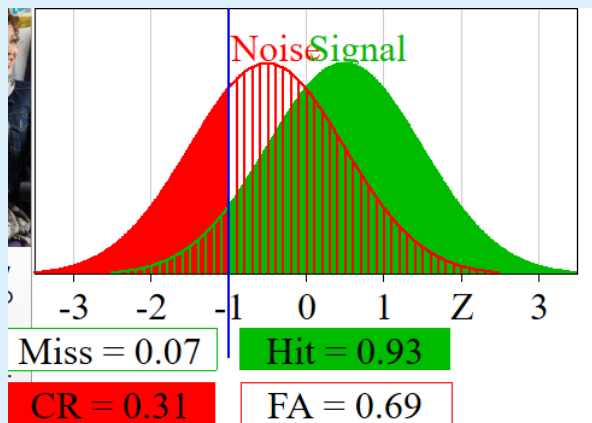d' is consider fixed for one experiment

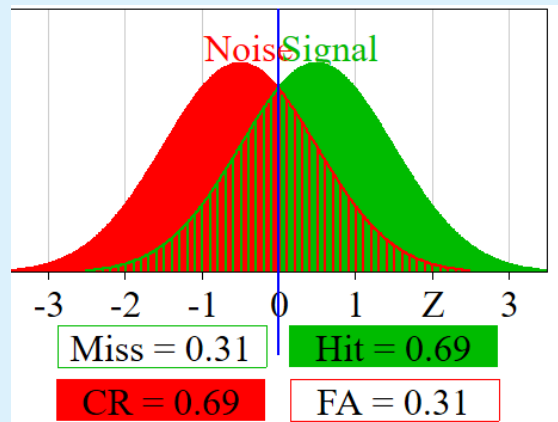Function of mind's ability to discriminate signal from noise

# Signal Detection Theory Threshold

Threshold set by observer

Threshold = -1      Unbiased threshold      Threshold = +2



| Threshold = -1 | Unbiased threshold | Threshold = +2 |
|---|---|---|
| Miss = 0.07   Hit = 0.93 | Miss = 0.31   Hit = 0.69 | Miss = 0.93   Hit = 0.07 |
| CR = 0.31   FA = 0.69 | CR = 0.69   FA = 0.31 | CR = 0.99   FA = 0.01 |
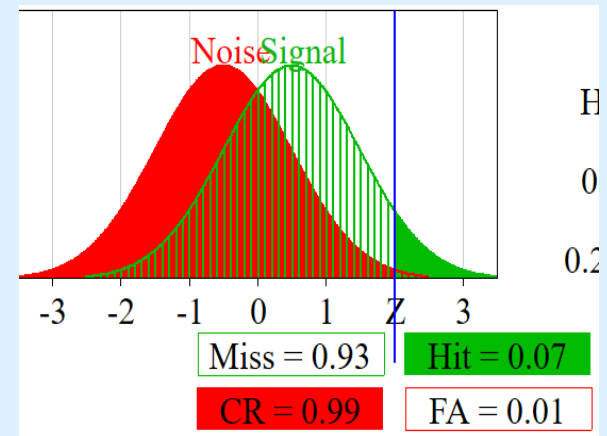
Why would observer change threshold?

      Costs

      Rewards

      Proportion of Signal Trials to Noise Trials

# Signal Detection Theory Lie Detection Exercise

Group 1

       Hits = 3 points

       Correct Rejections = 1 point

       Maximum Score = 80 points

Group 2

       Hits = 1 points

       Correct Rejections = 3 points

       Maximum Score = 80 points

# Signal Detection Theory
# Calculating D' and threshold Bias

Hits = 80%, FA = 30%
What is d' and threshold bias?

.80 hit rate puts
threshold at
-0.84 on signal distribution

.30 false alarm rate
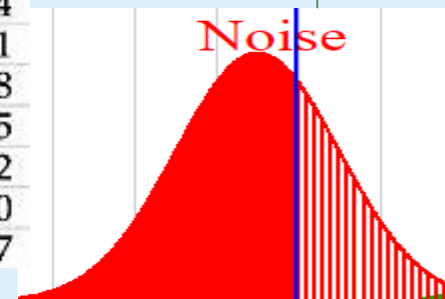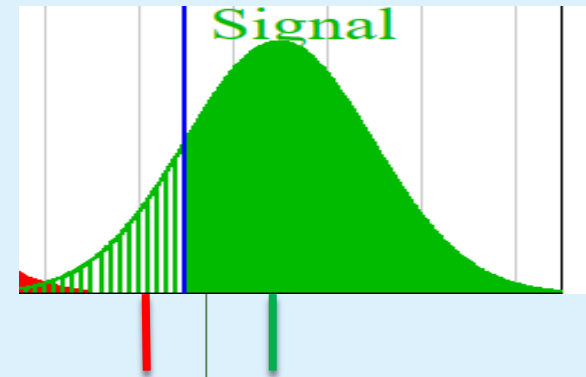puts threshold at
0.52 on signal distribution

| Area | Area Below z = | Area Above z = |
|------|------|------|
| 0.76 | 0.71 | −0.71 |
| 0.77 | 0.74 | −0.74 |
| 0.78 | 0.77 | −0.77 |
| 0.79 | 0.81 | −0.81 |
| 0.80 | 0.84 | −0.84 |
| 0.81 | 0.88 | −0.88 |
| 0.82 | 0.92 | −0.92 |
| 0.83 | 0.95 | −0.95 |
| 0.84 | 0.99 | −0.99 |

| Area | Area Below z = | Area Above z = |
|------|------|------|
| 0.26 | −0.64 | 0.64 |
| 0.27 | −0.61 | 0.61 |
| 0.28 | −0.58 | 0.58 |
| 0.29 | −0.55 | 0.55 |
| 0.30 | −0.52 | 0.52 |
| 0.31 | −0.50 | 0.50 |
| 0.32 | −0.47 | 0.47 |

Z = -0.84

Signal

Noise

Z = 0.52

d' = 0.52 + 0.84 = 1.36
Unbiased threshold = 1.36/2 = 0.68 on noise
Actual threshold = 0.52 – 0.68 = -0.16 (or 0.16 below unbiased)

Signal Detection Theory
Calculating D' and threshold Bias

Noise  Signal

-3  -2  -1  0  1  Z  3

Miss = 0.2    Hit = 0.8
CR = 0.7    FA = 0.3
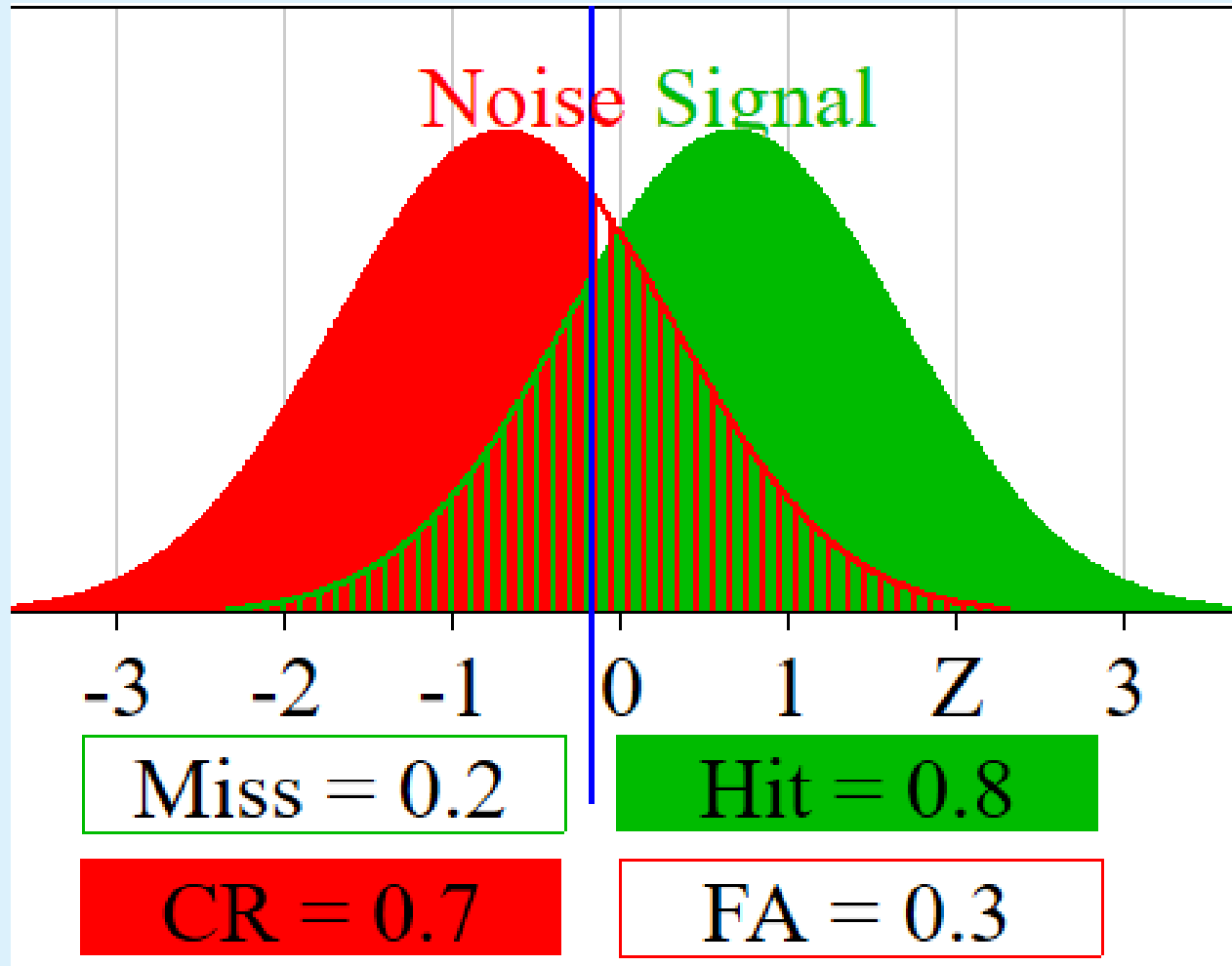
# **Signal Detection Theory**
## ROC CURVE

Shows all possible performances for a given d'

Use online application at

http://www.thebeststatistics.info/psych/calculators/plotters/signaldetect_main.html