# How to Make a Bad Graph
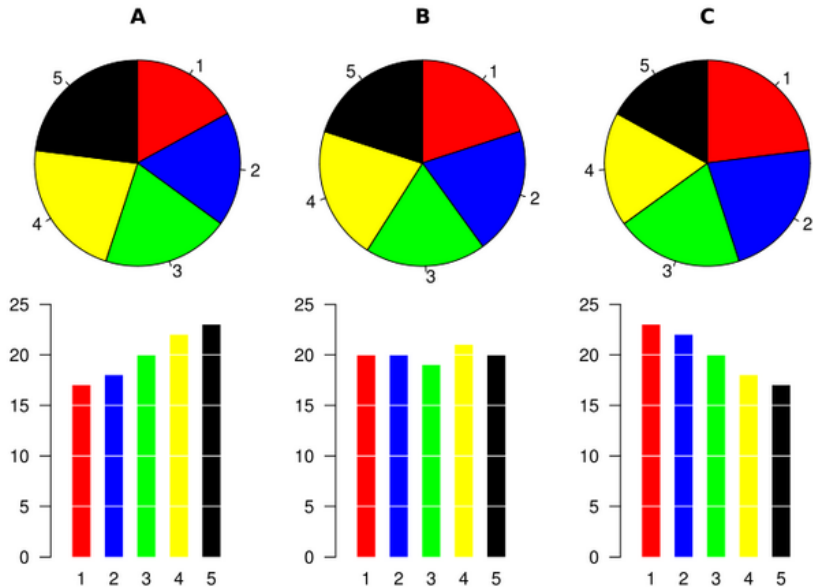
Alan R. Rogers

January 8, 2017

# Don't use pie charts

# Graphed Before the Challenger Disaster



Calculated Joint Temperature (°F)

This graph was made by engineers investigating the causes of O-ring failures during space shuttle flights.

Omits cases where no failure occurred—the engineers deemed these irrelevant.

Conclusion: temperature has no effect
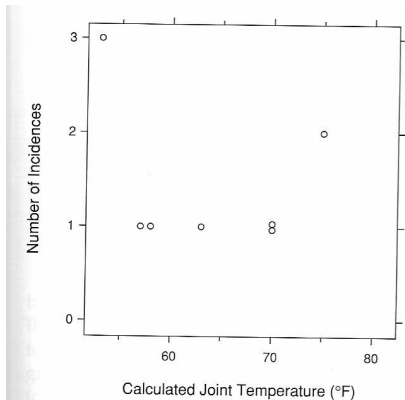
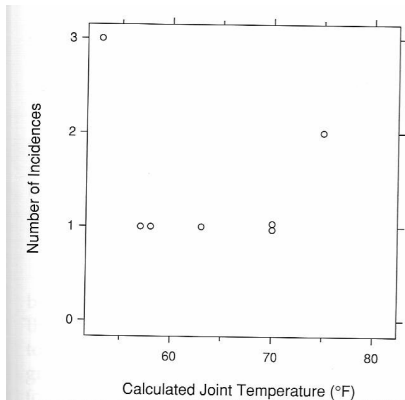# Graphed Before the Challenger Disaster



This graph was made by engineers investigating the causes of O-ring failures during space shuttle flights.

Omits cases where no failure occurred—the engineers deemed these irrelevant.

Conclusion: temperature has no effect

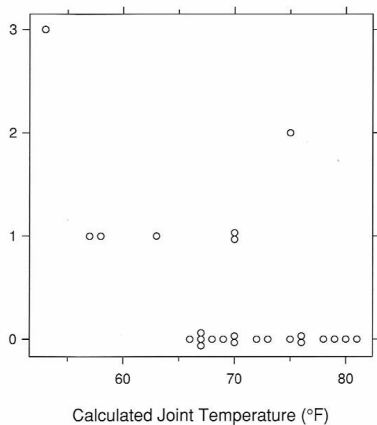# Graphed Before the Challenger Disaster



This graph was made by engineers investigating the causes of O-ring failures during space shuttle flights.

Omits cases where no failure occurred—the engineers deemed these irrelevant.

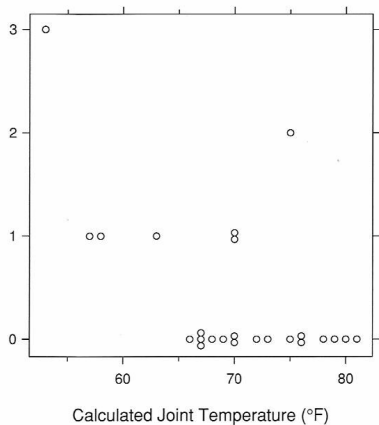Conclusion: temperature has no effect

# Graphed After the Challenger Disaster



Calculated Joint Temperature (°F)

Includes cases where no failure occurred.

Effect of temperature is obvious.
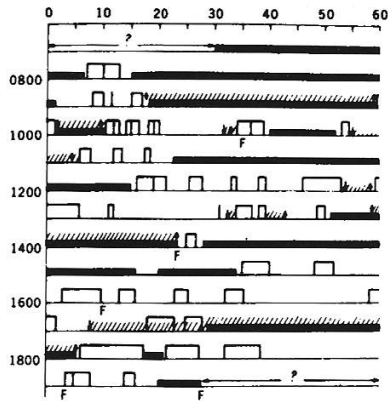
# Graphed After the Challenger Disaster



Calculated Joint Temperature (°F)

Includes cases where no failure occurred.

Effect of temperature is obvious.

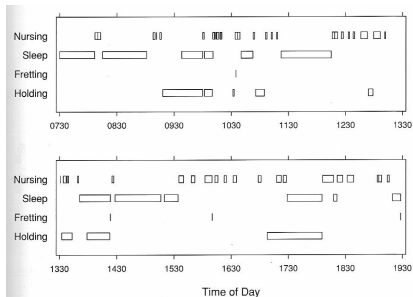# !Kung Mothers and Babies (Konner and Worthman)



Interaction of one mother and infant during 1 day.

Complex code: open bars and vertical lines are nursing times; closed bars show sleeping; F means fretting; slashed lines are intervals when baby is held by mom, w/ arrows for picking up and setting down.
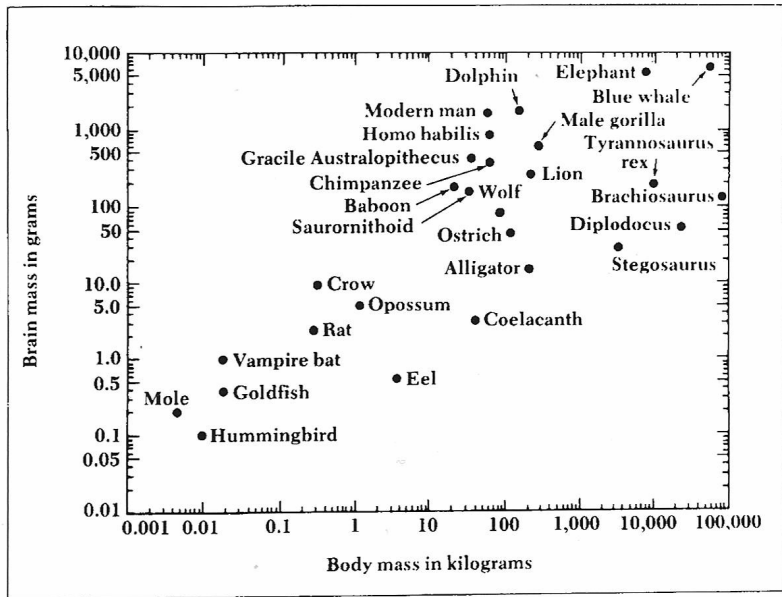
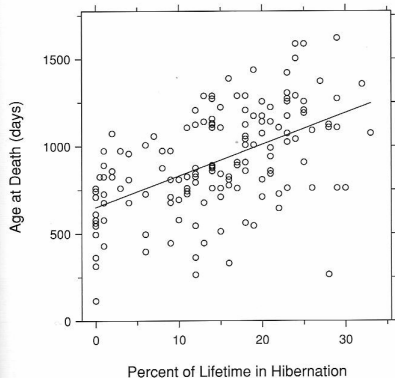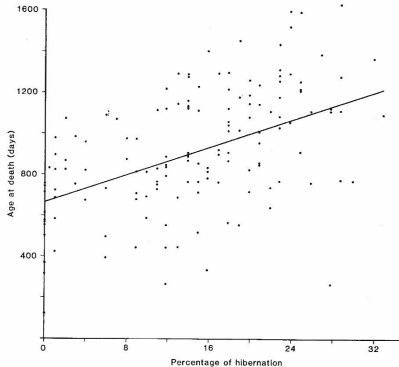This graph is hard to decode.
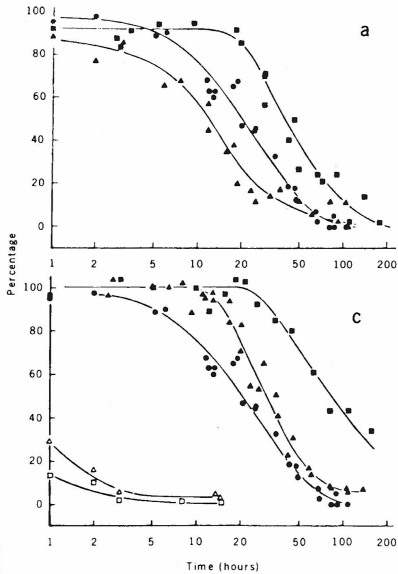
# !Kung Mothers and Babies Re-graphed



Now it is easy to see what went on between this mother and infant.

# This graph is too busy; it is hard to see pattern



A scatter plot of "Brain mass in grams" (y-axis, logarithmic from 0.01 to 10,000) versus "Body mass in kilograms" (x-axis, logarithmic from 0.001 to 100,000). Labeled data points include: Dolphin, Elephant, Blue whale, Modern man, Homo habilis, Male gorilla, Gracile Australopithecus, Tyrannosaurus rex, Chimpanzee, Lion, Wolf, Baboon, Brachiosaurus, Saurornithoid, Ostrich, Diplodocus, Alligator, Stegosaurus, Crow, Opossum, Coelacanth, Rat, Vampire bat, Eel, Mole, Goldfish, Hummingbird.
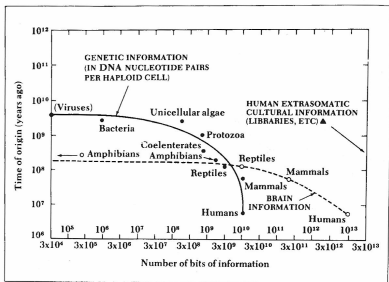
# Don't let the axes hide points

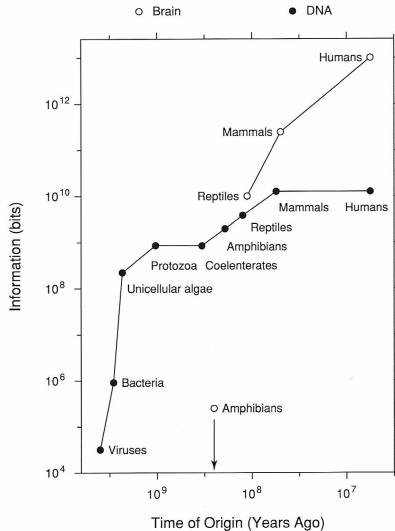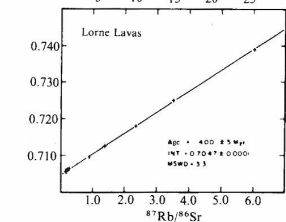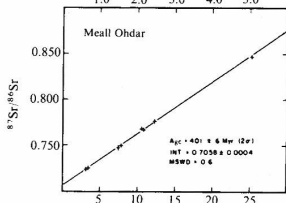Another graph with axes obscuring data.
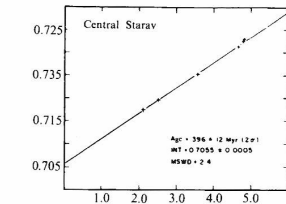
# Ticks can also interfere with data
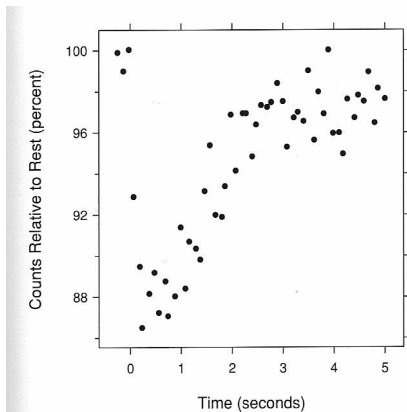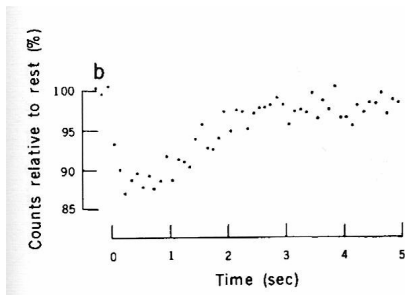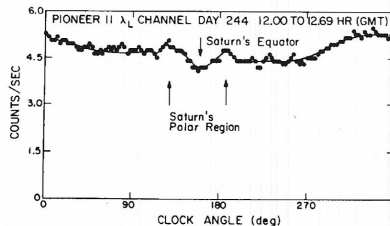
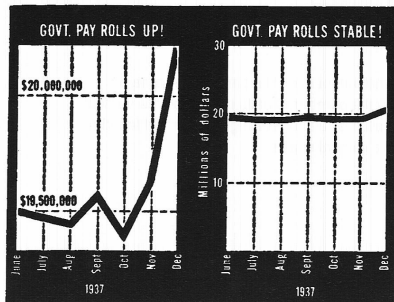# Too many ticks and tick labels
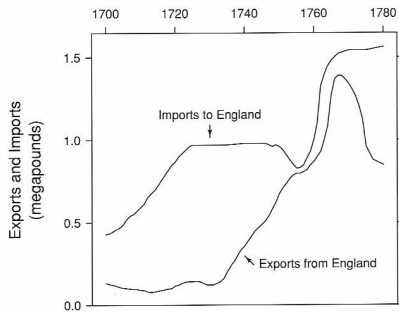


Original

Improved

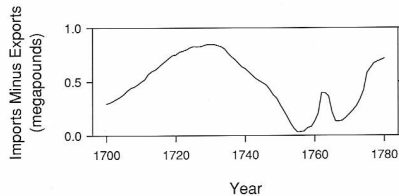Small symbols make graphs hard to read.
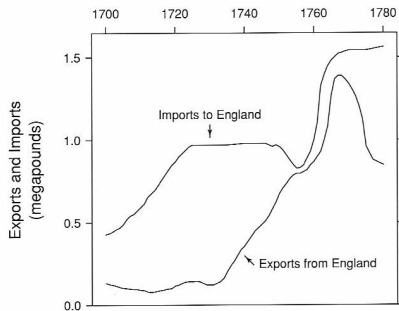
# Should axes always include zero?

Upper graph (Playfair, 1786) shows imports and exports.

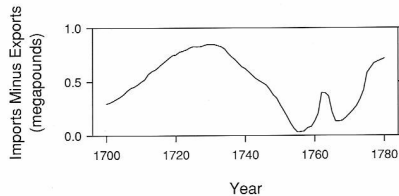Suggests these differed little around 1770.

Hides spike seen in lower graph.

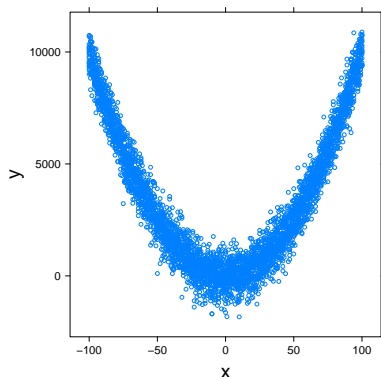Upper graph (Playfair, 1786) shows imports and exports.

Suggests these differed little around 1770.

Hides spike seen in lower graph.

# Michael Lewis's illustration of Playfair's problem

```
1   x <- rep(-100:100, 20)
2   y = x**2 +
3      rnorm(n=length(x),
4      sd=600)
5   xyplot(y~x)
```



Vertical width of the necklace doesn't change.

# Banking to 45 degrees