

# Decision by Sampling

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# Principles (I)

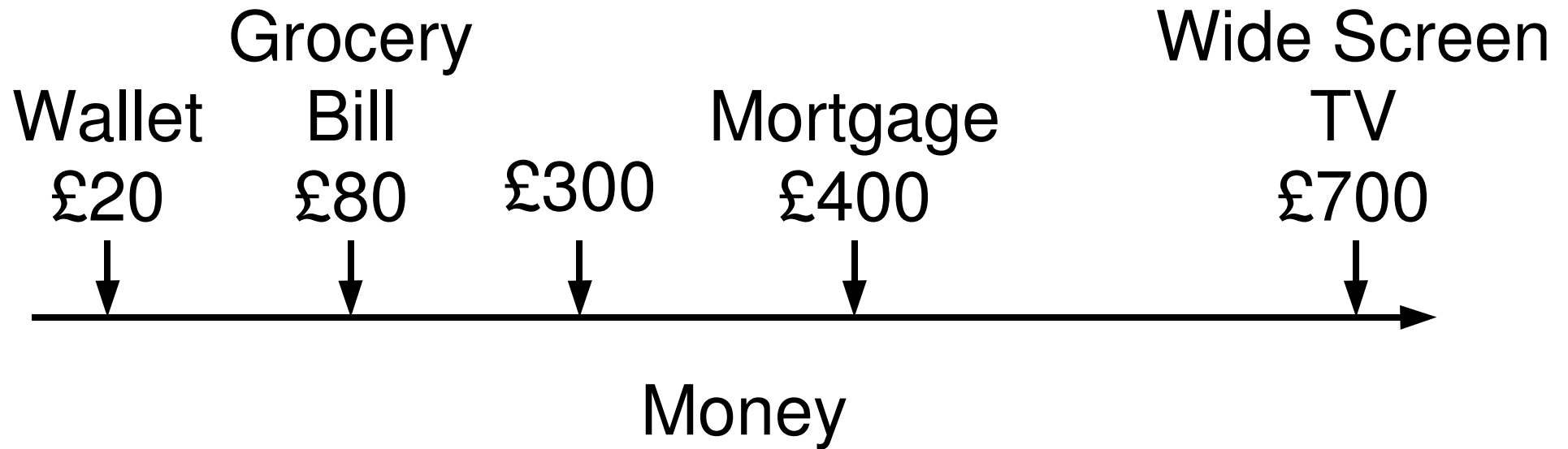
- There are no underlying psychoeconomic scales
  - no utility scale
  - no subjective probability scale
  - no time scale
- There are no relationships between scales
  - no trade-offs between scales

# Principles (II)

- Only ordinal judgments of attribute values
  - "less than", "equal to", and "greater than"
- Attribute values can be compared with a small sample of anchor values from memory
- All attributes are treated the same way
  - gains, losses, delay, probability, quality, length, etc
- Preferences are constructed (Slovic, 1995)

# Only Rank Matters

What is the utility of £300?



# Where do the anchors come from?

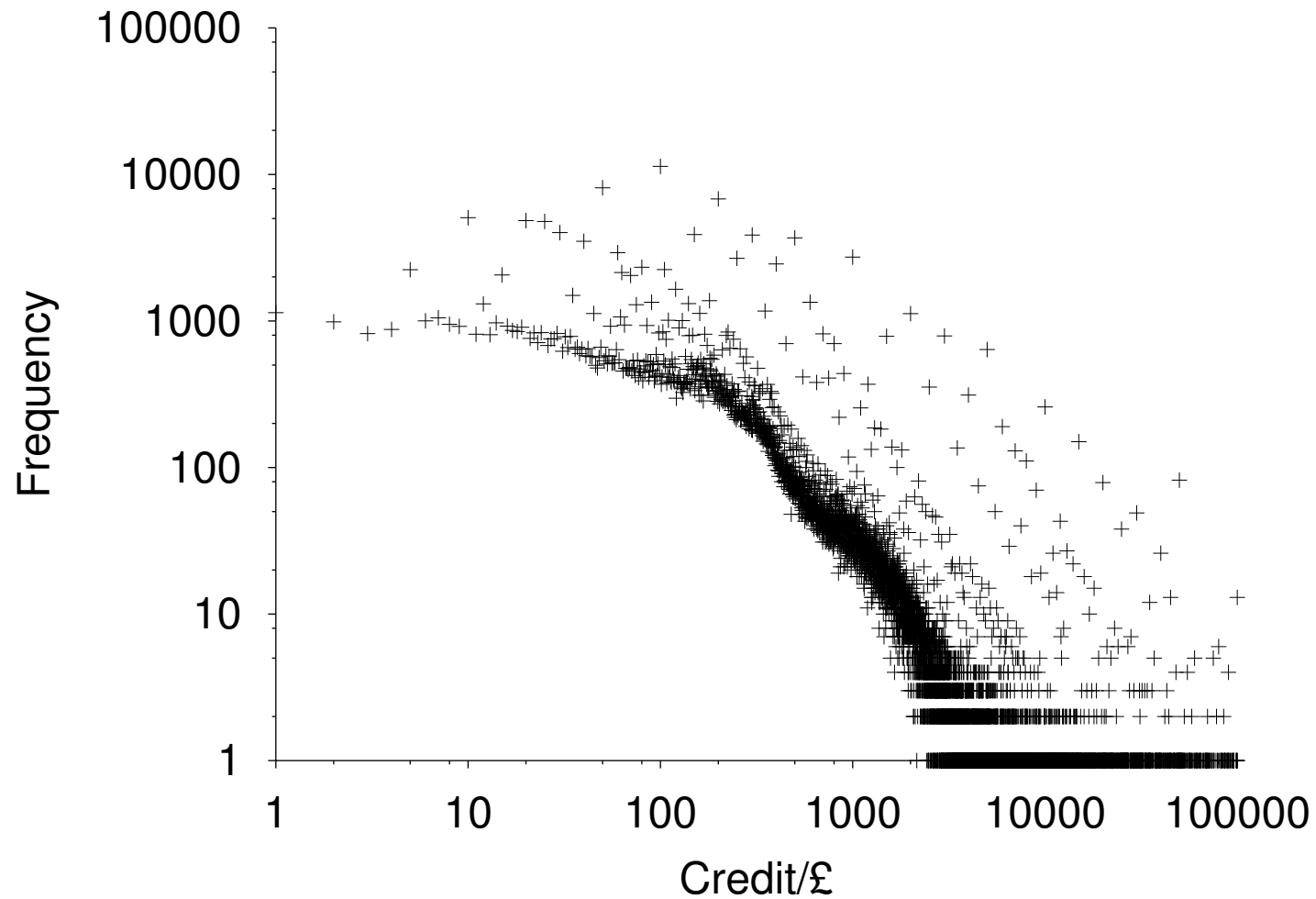
## Scale Invariance

- Statistical structure is invariant over scale (e.g., the coastline of Norway)
- Psychological processes are adapted to reflect the statistical structure of the environment (Anderson, 1990; Shepard, 1987)
- Scale invariant probability density functions
- An exemplar sampling model should directly reflect this structure

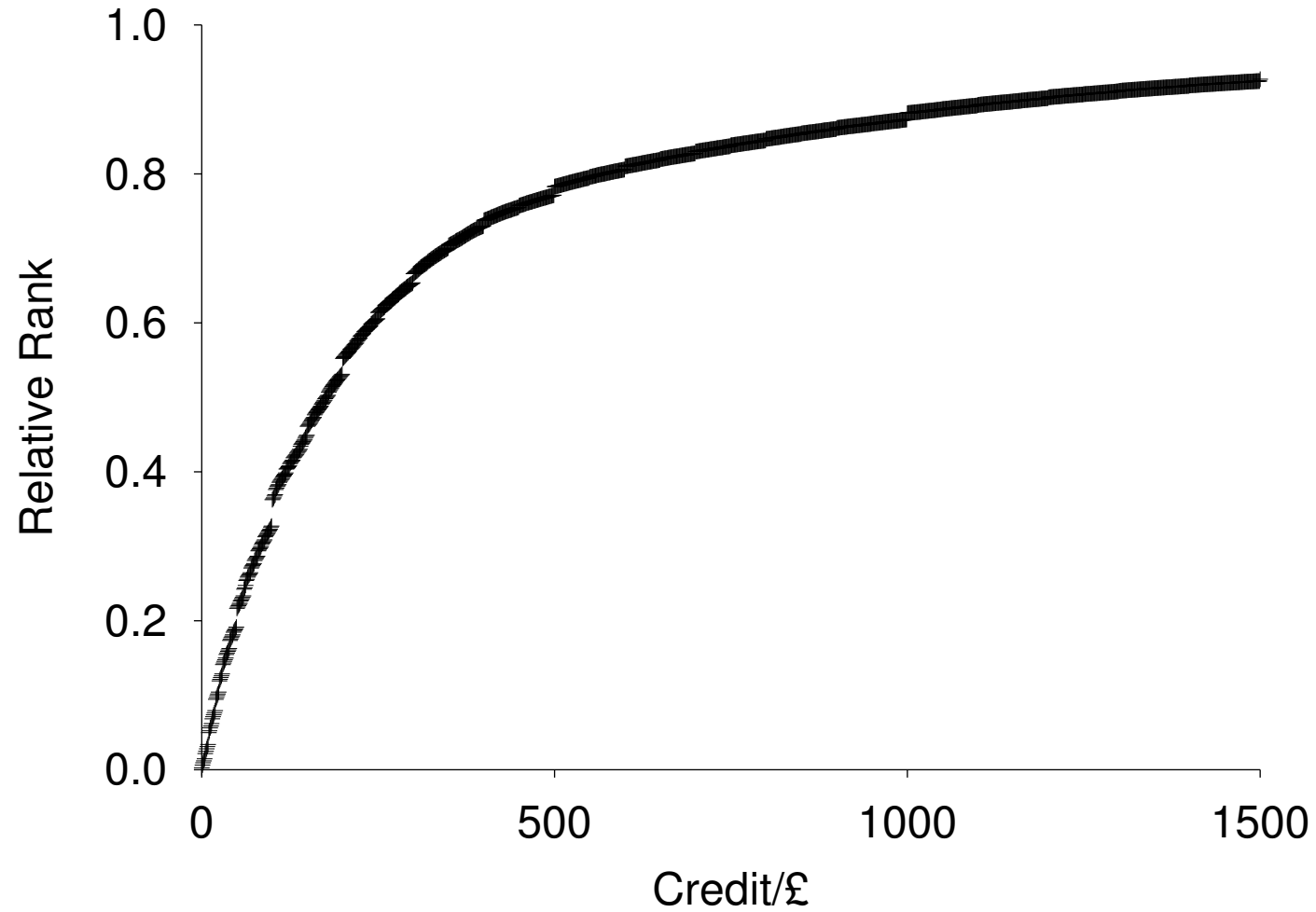
# Overview

- Today
  - Incremental wealth has diminishing utility
  - Losses loom larger than gains
  - Temporal discounting
  - Nonlinearity in decision weights
- Some other time maybe
  - Classic phenomena in decision under risk
  - Trade offs between attributes
  - Prospect relativity

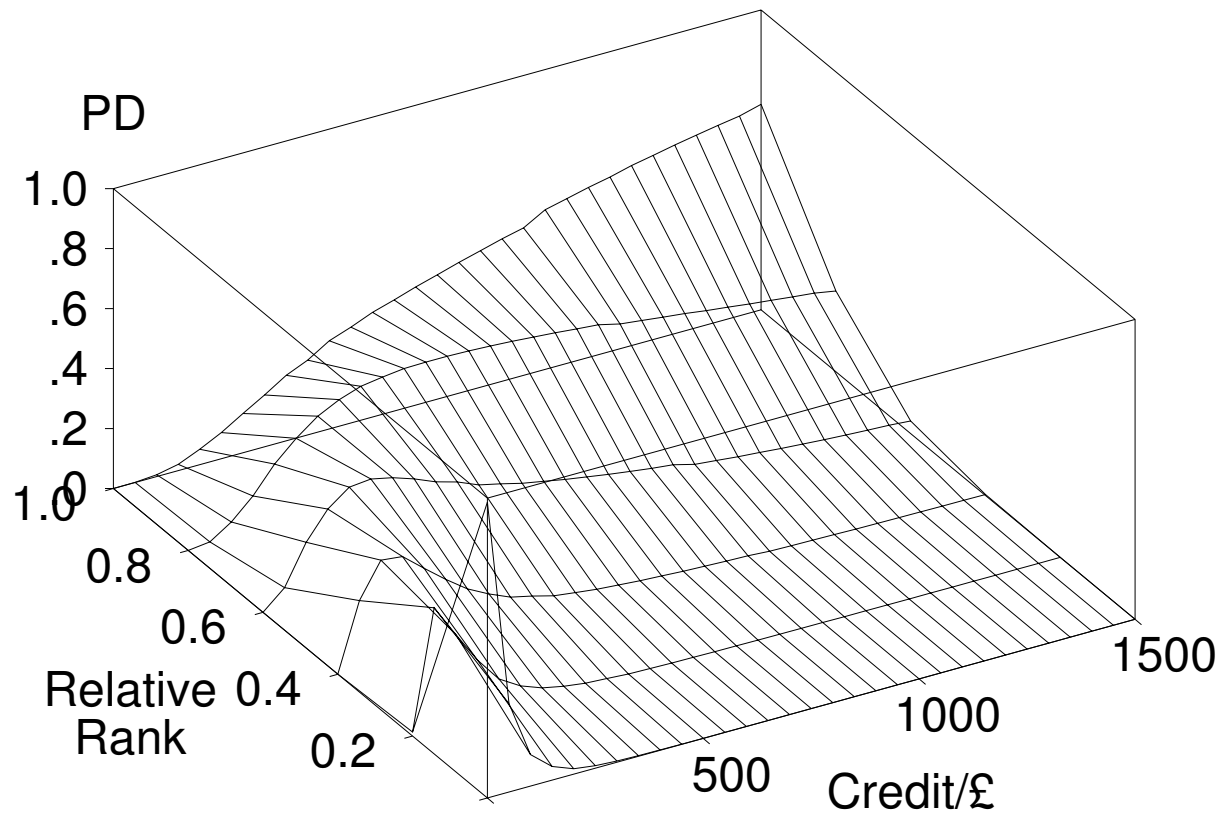
# The Distribution of Gains



# Full Sampling of Gains

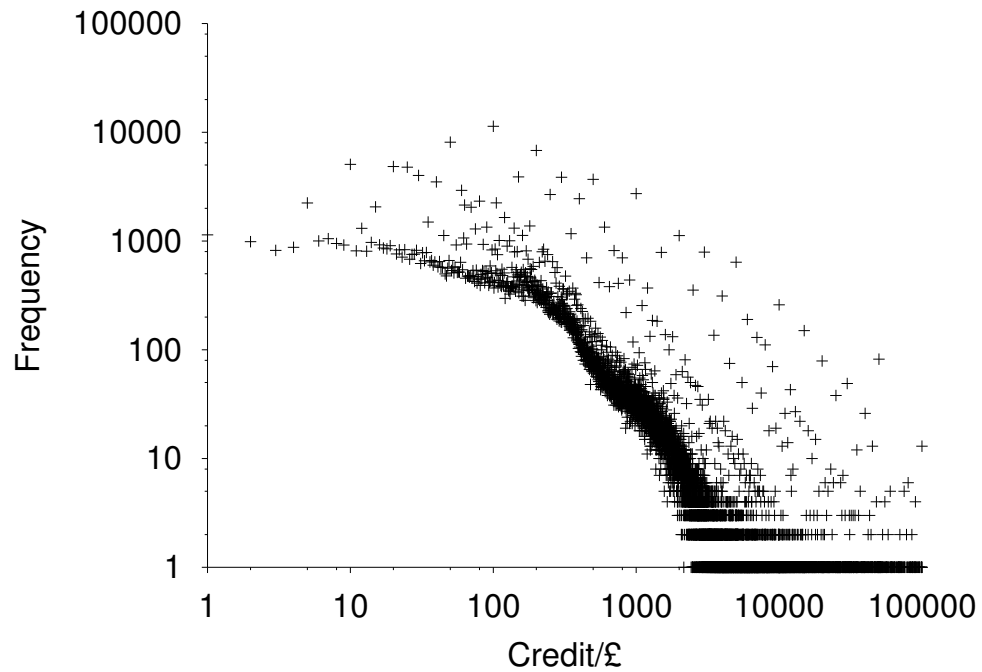


# Sampling of Gains (n=7)



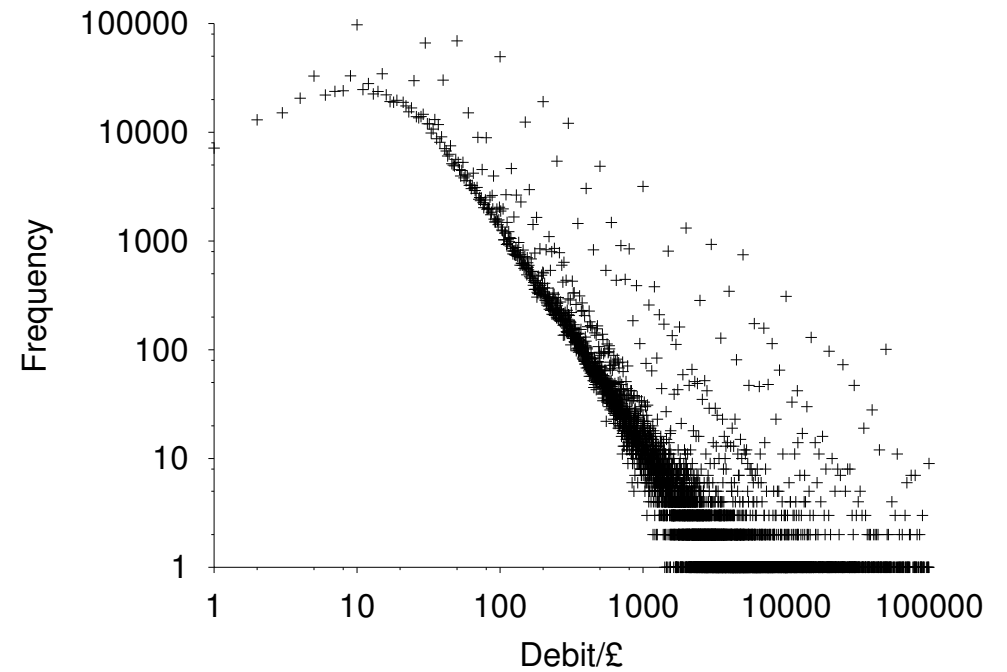
# Gains and Losses (I)

## Gains



power = -0.93

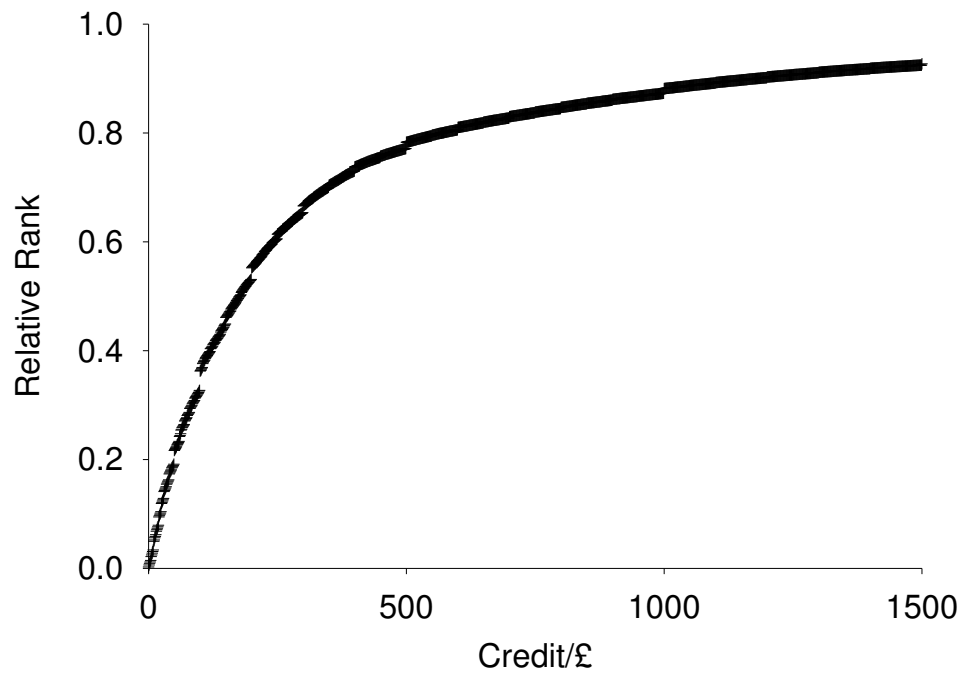
## Losses



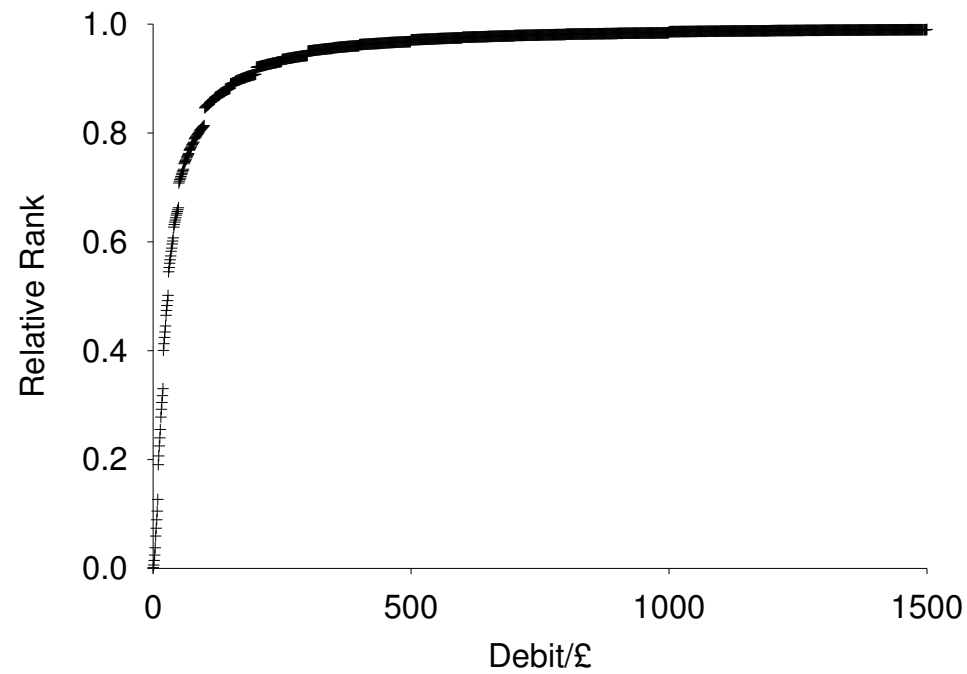
power = -0.96

# Gains and Losses (II)

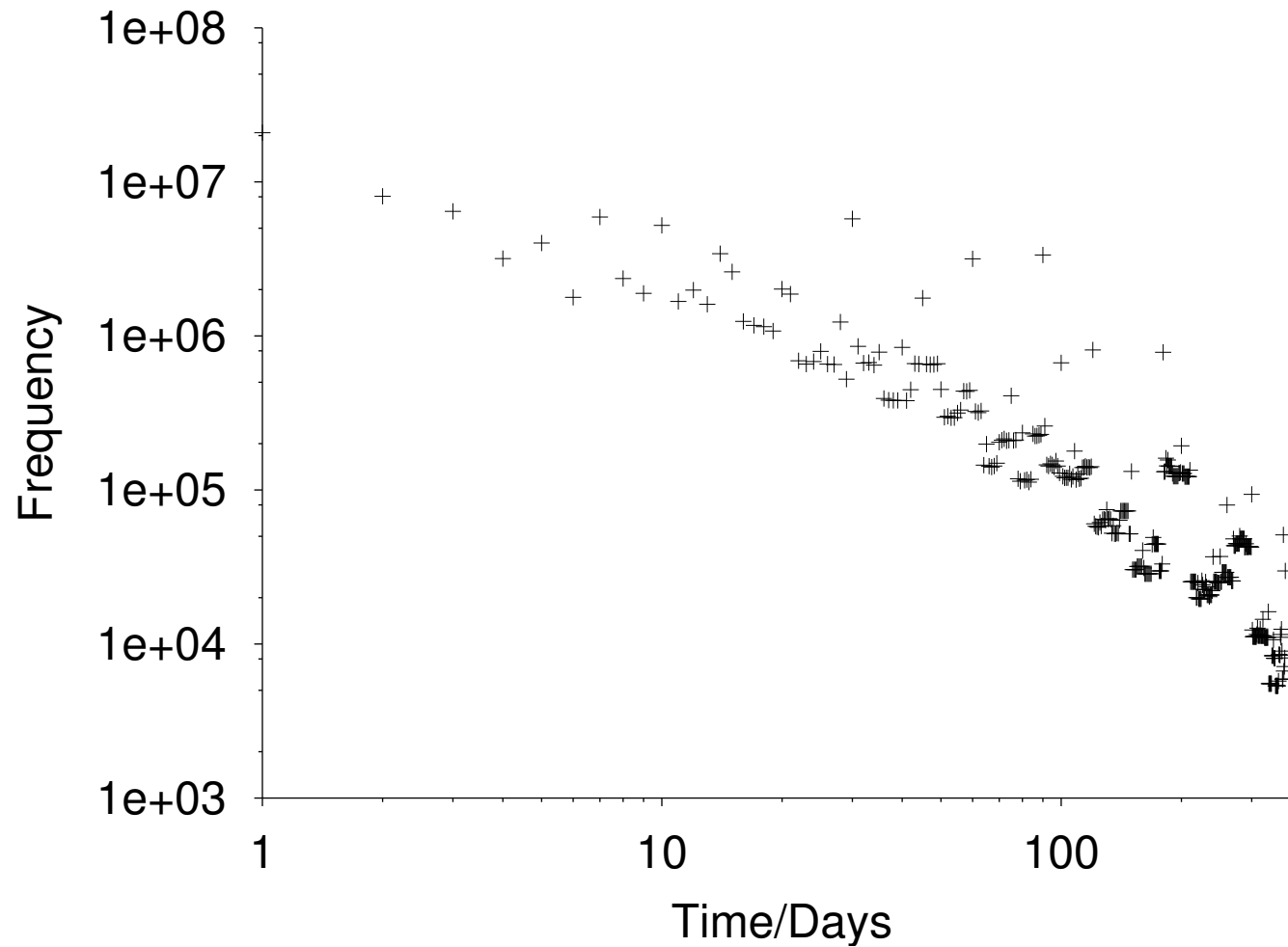
## Gains



## Losses



# The Distribution of Times (I)



power = -1.49

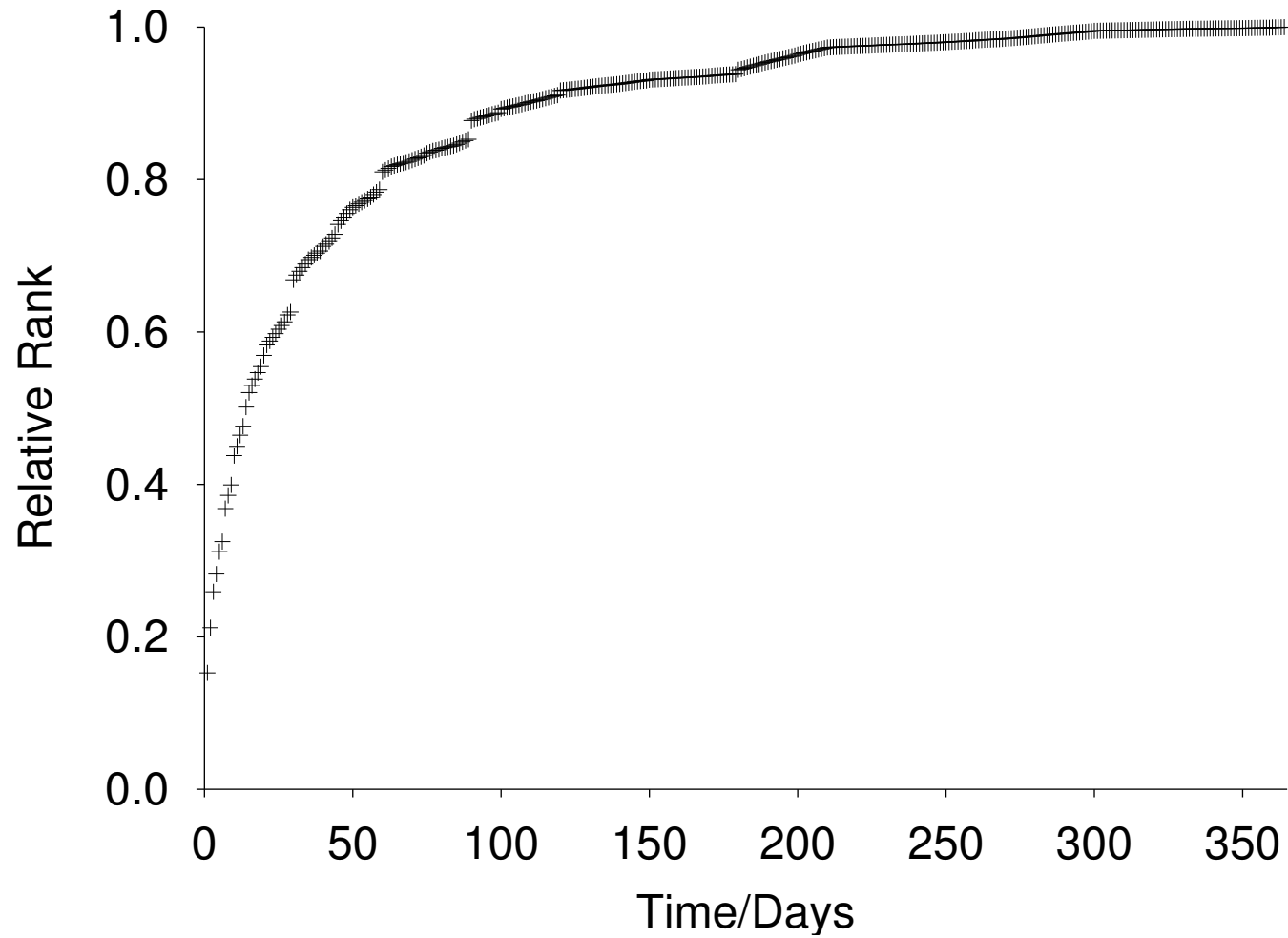
# The Distribution of Times (II)

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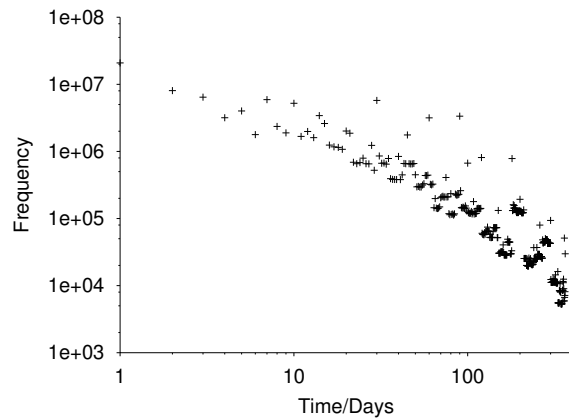
Source	Range	Power
Telegraph	30 days	-1.7
Google hits	1 year	-1.5
Frankfurter Allgemeine Zeitung NRC/Handelsblad International Herald Tribune (Pollmann & Baayen, 2001)	500 years	-1.4

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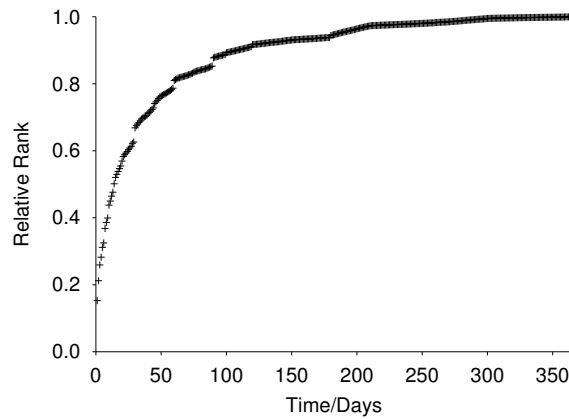
# Full Sampling of Times



# Predicted Discounting Function (I)



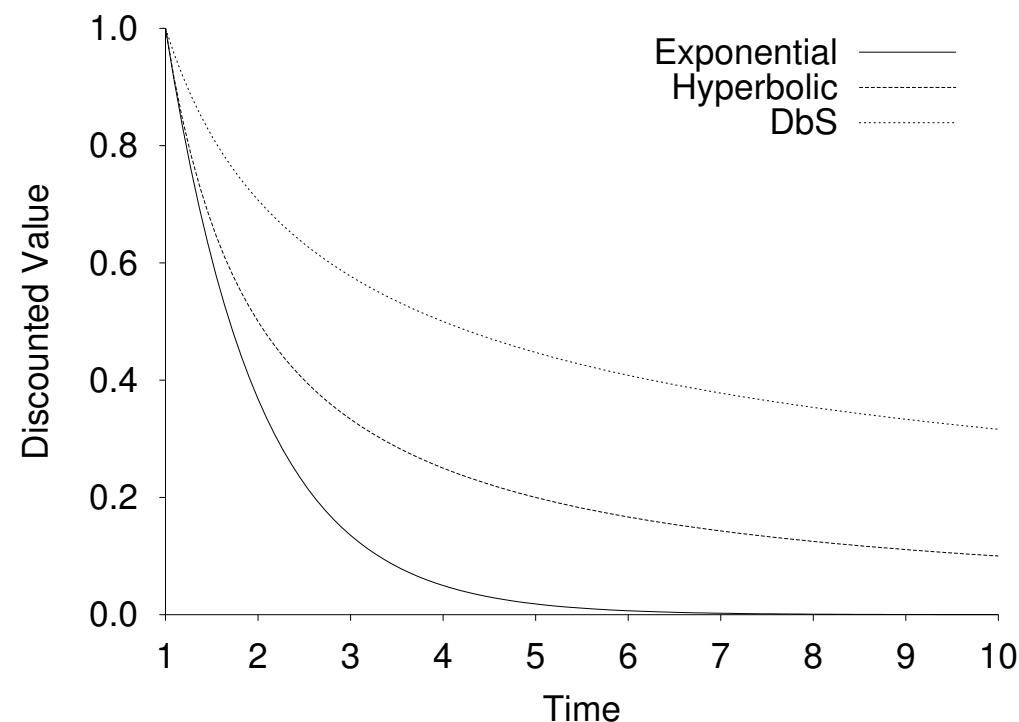
$$f(t) = \frac{1}{2t^{3/2}}$$



$$F(t) = 1 - \frac{1}{\sqrt{t}}$$

# Predicted Discounting Function (II)

People don't discount long delays as much as is predicted by either exponential or hyperbolic functions (Myerson & Green, 1995; Simpson & Vuchinich, 2000)



# Distortion of Decision Weights

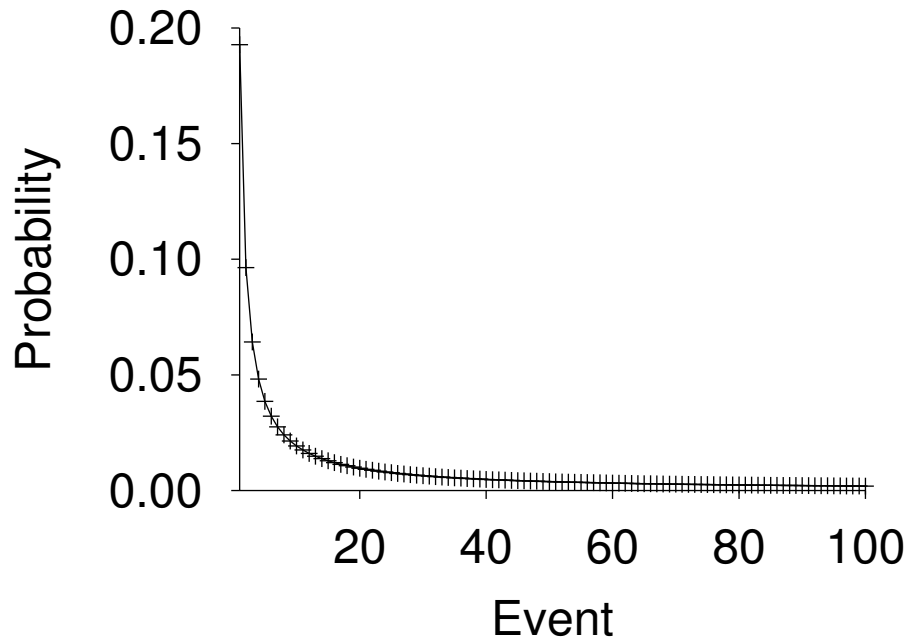
Overestimation of small probabilities and  
underestimation of large probabilities

(Camerer & Ho, 1994; Tversky &  
Kahneman, 1992; Wu & Gonzalez, 1996)

# Distortion of Decision Weights

- There are many more small and large probabilities than mid-range probabilities
- Amplification by hindsight bias (Fischhoff, 1982)
- Sampling of events
- Experimental design

# Sampling of Events (I)



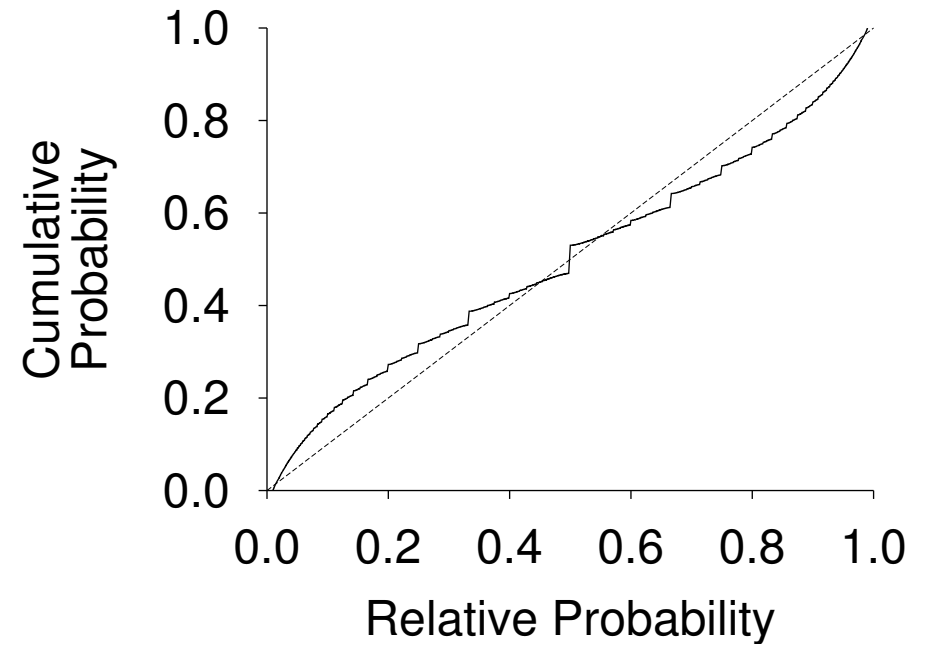
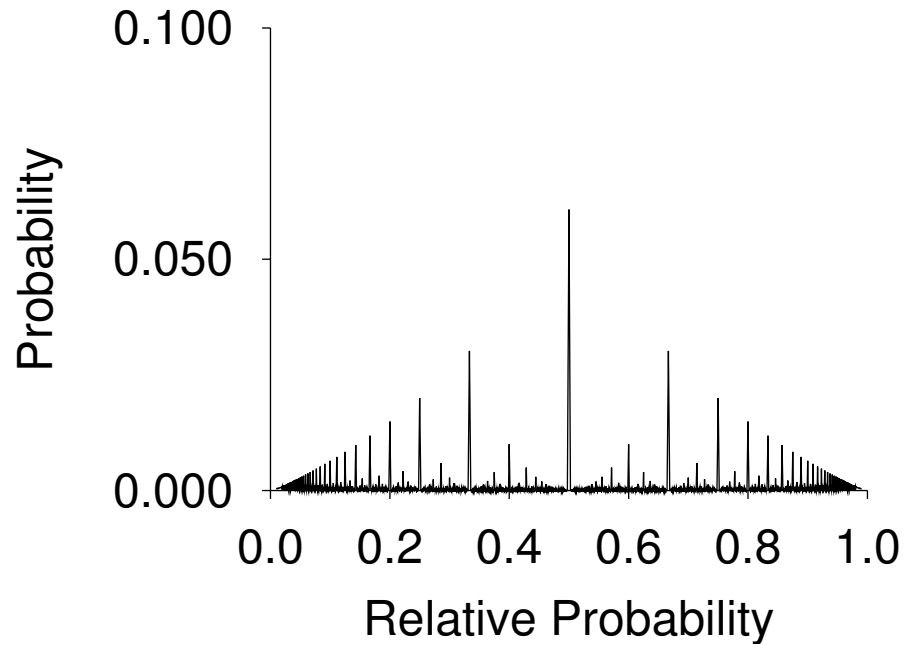
Sample a pair of events  
 $E_1$  and  $E_2$

Pair probability =  $p_1 p_2$

Relative probability of  $E_1 =$

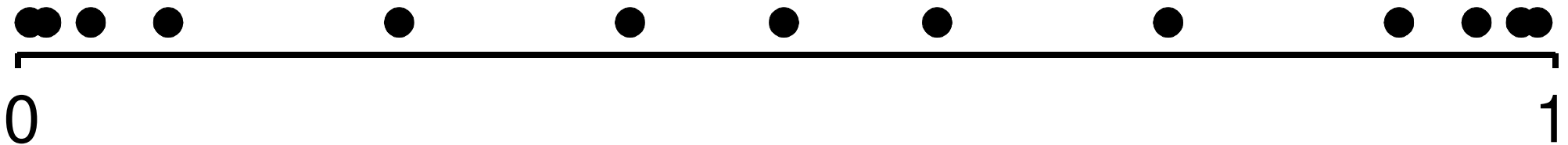
$$\frac{p_1}{p_1 + p_2}$$

# Sampling of Events (II)

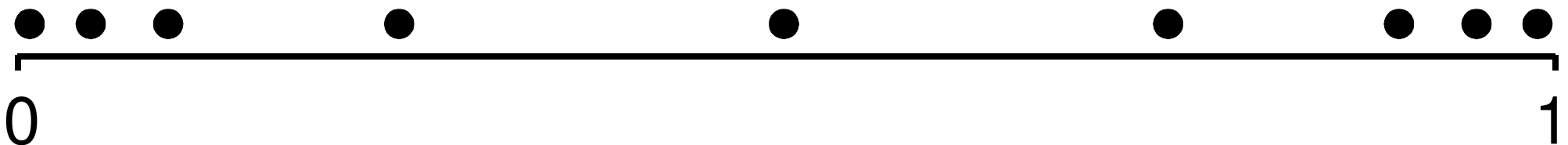


# The Distribution of Probabilities

Gonzalez and Wu (1999)

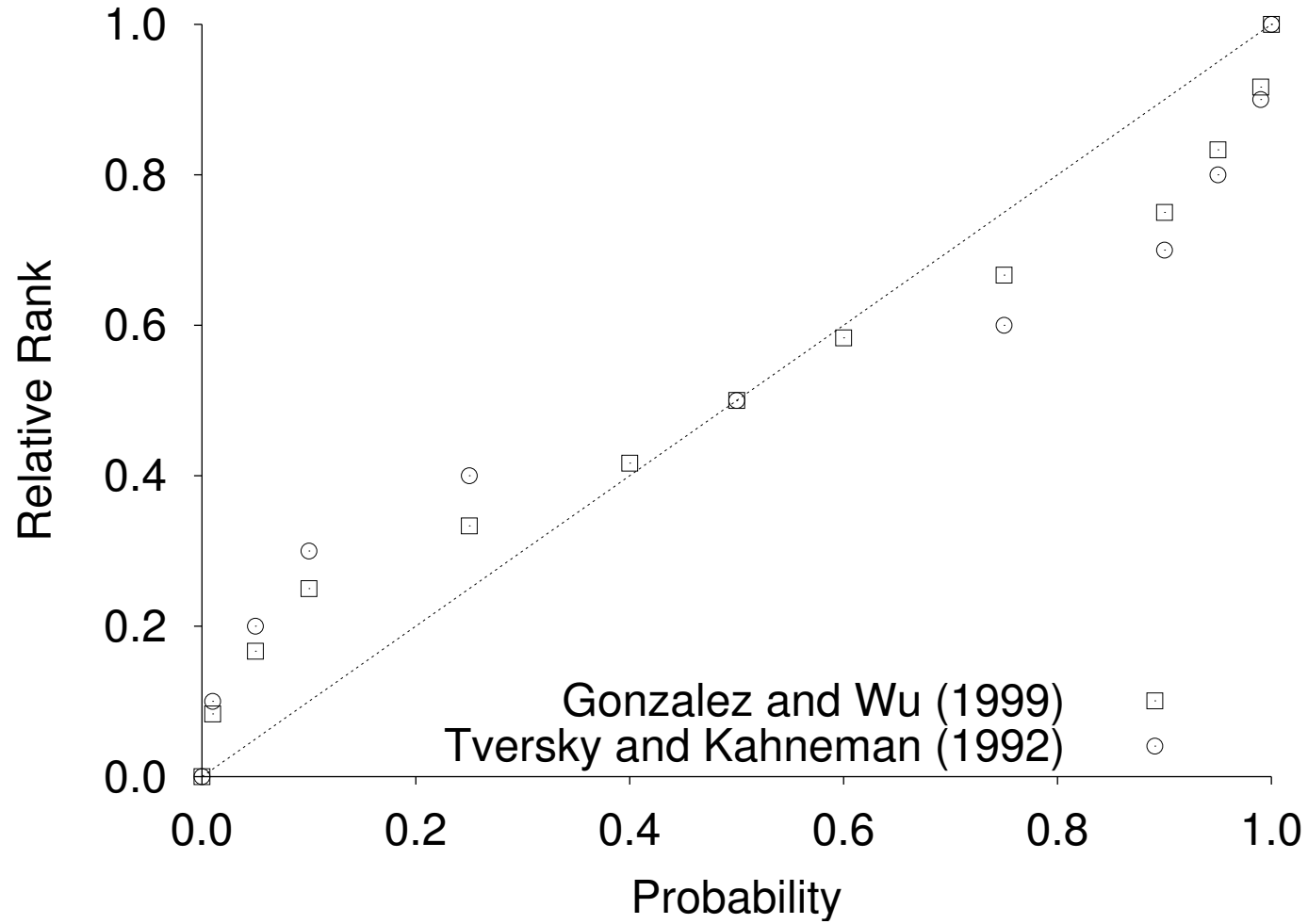


Tversky and Kahneman (1992)



Qian and Brown (in prep)

# Sampling of Probabilities



# Conclusion

- Why does incremental wealth have decreasing utility?
- Why do losses loom larger than gains?
- Why do people discount less than hyperbolically?
- Why are decision weights distorted?
  
- No psychoeconomic scales
- Instead, only ordinal judgments
- Comparison with small real-world samples