# ECON3997

## Behavioural Economics



Dr. Guy Mayraz
Department of Economics
University of Sydney

# Outline

# Introduction

# What these slides are about



- A brief tour of behavioural economics findings and theory
  - This is a selective tour, focusing on topics that are particularly likely to be relevant to behavioural interventions

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# How is this relevant



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1. Many (though not all) of the problems we seek to address through behavioural interventions are caused by behavioural biases
2. Behavioural interventions utilise behavioural biases to 'nudge' people towards better behaviour

# Temptation

# The Marshmallow Test

# The Marshmallow test





Link to video: http://youtu.be/Yo4WF3cSd9Q

# Original experiment

## The experiment

- Four year olds in a Stanford kindergarten
- Offered a food reward (whatever they prefer), which was either exposed or covered

## How self control was measured

Length of time until bell is pressed (to be able to eat the reward)

## Goal

- Original focus: techniques for self-control
- Later: correlation between childhood measures of self-control and later life outcomes

# Results

Self control measured in the condition in which the reward is exposed is strongly correlated with later life outcomes

- SAT verbal and (more so) quantitative
- Parental ratings of coping ability as adolescents

# Moffitt et al. study

# Background to the Moffitt study





- Recent study by Moffitt et al. [4]
- 1037 children in Dunedin, NZ.
- Self control measured by self reports, observations by researchers, and reports by teachers and parents.

# Results

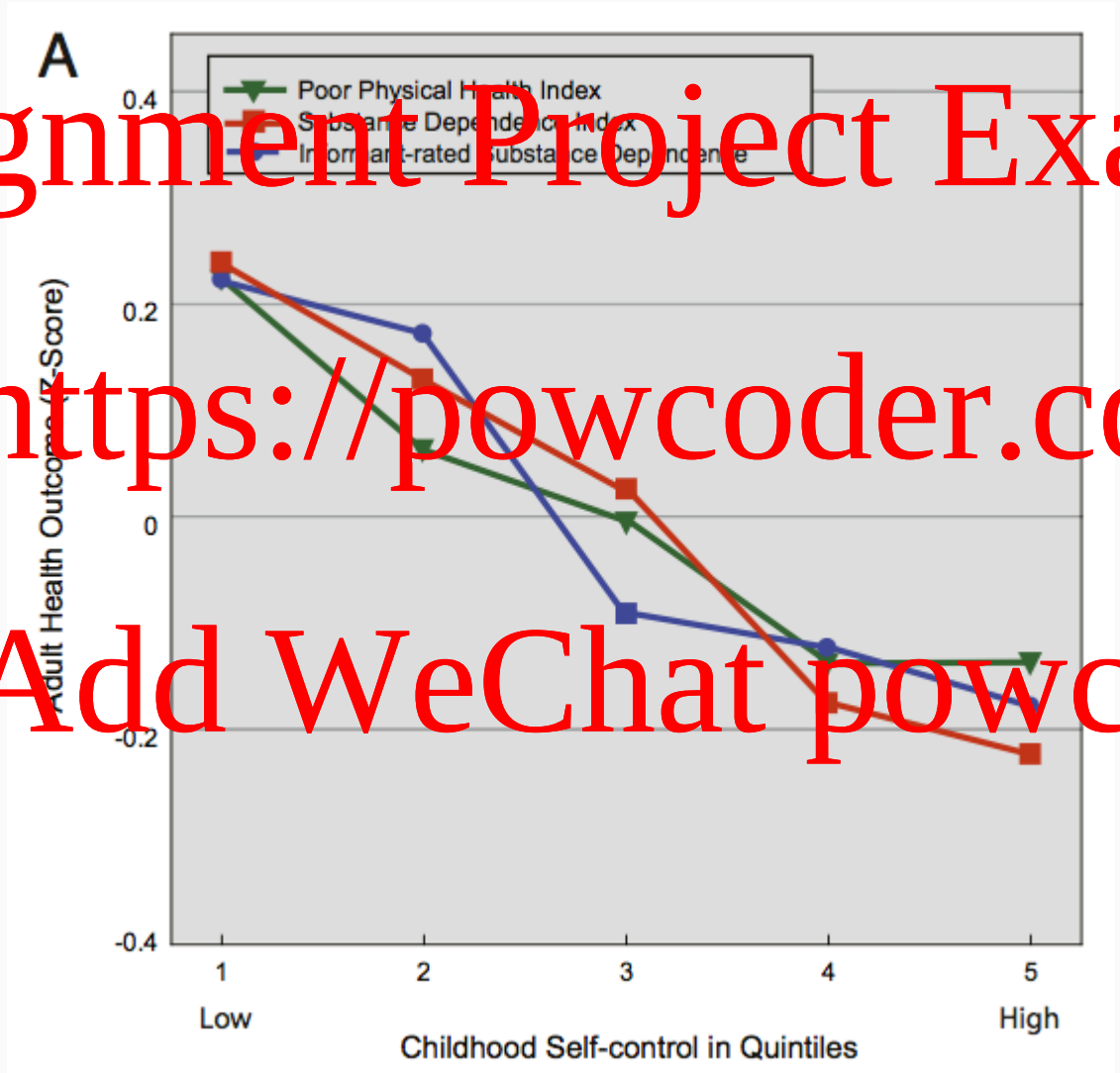




- Strong link with life outcomes:
  - Health
  - Material success
  - Being a single parent
  - Getting involved in crime
- Results remain when controlling for IQ.

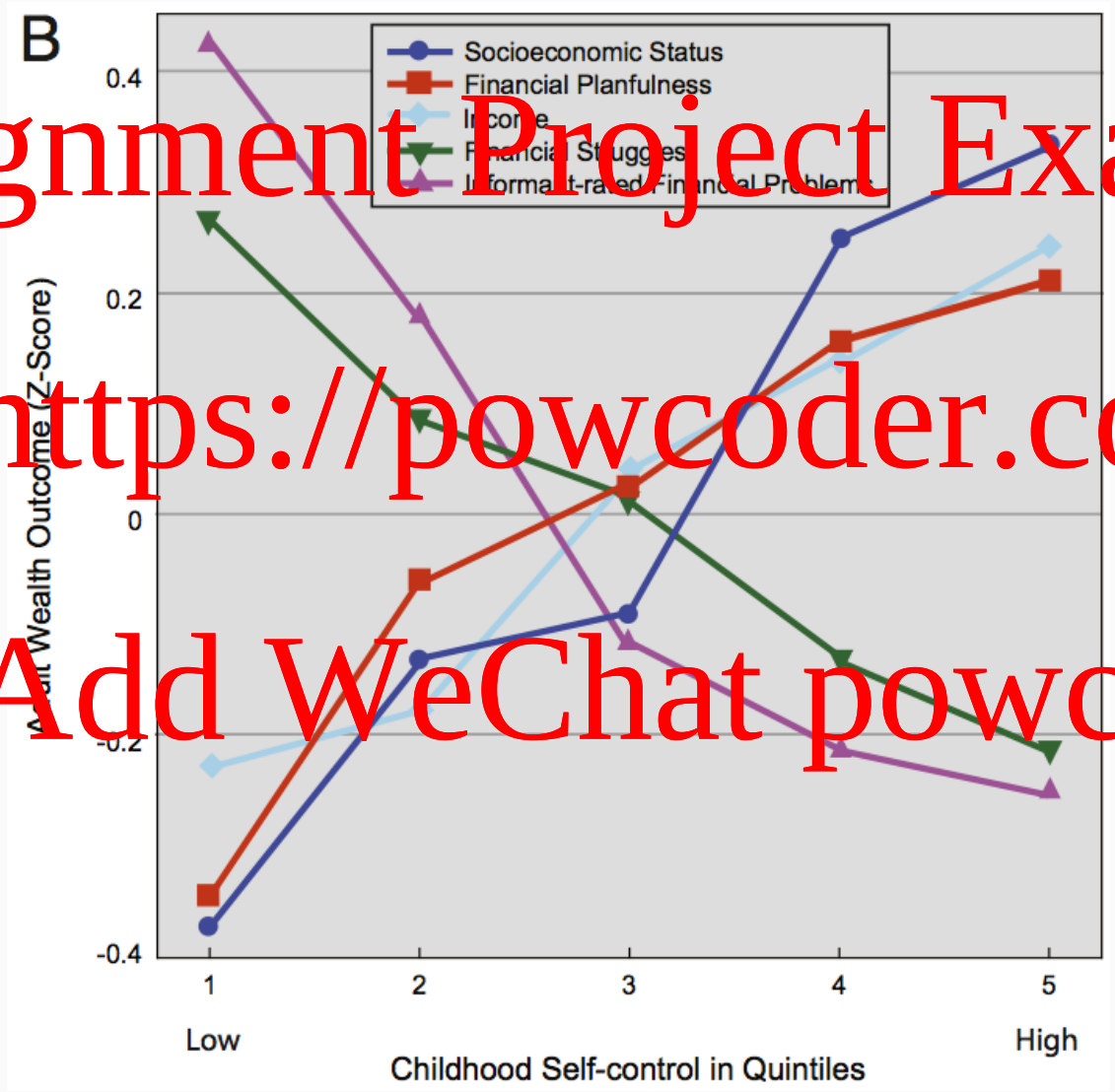
# Poor health





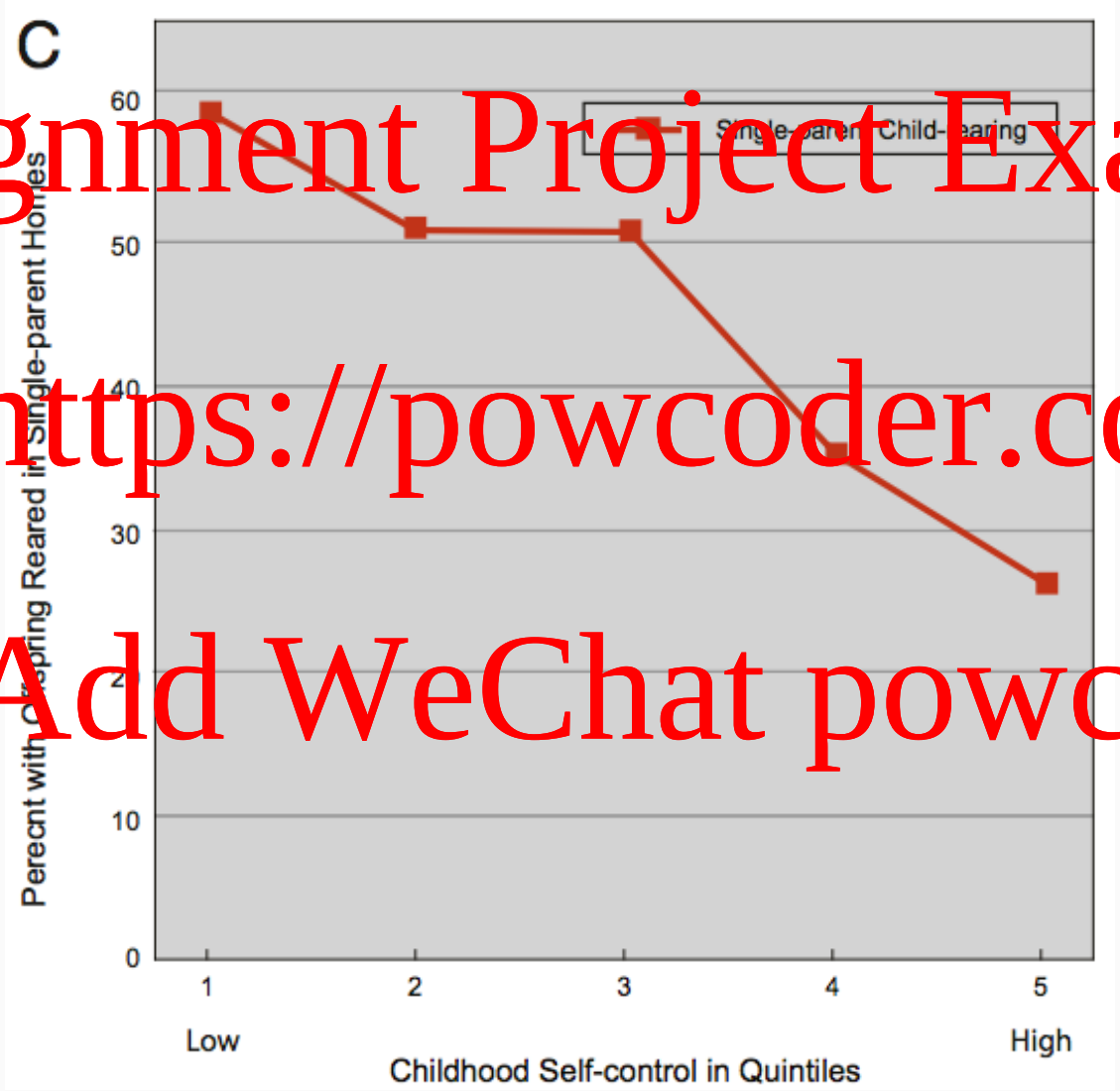
# Material success





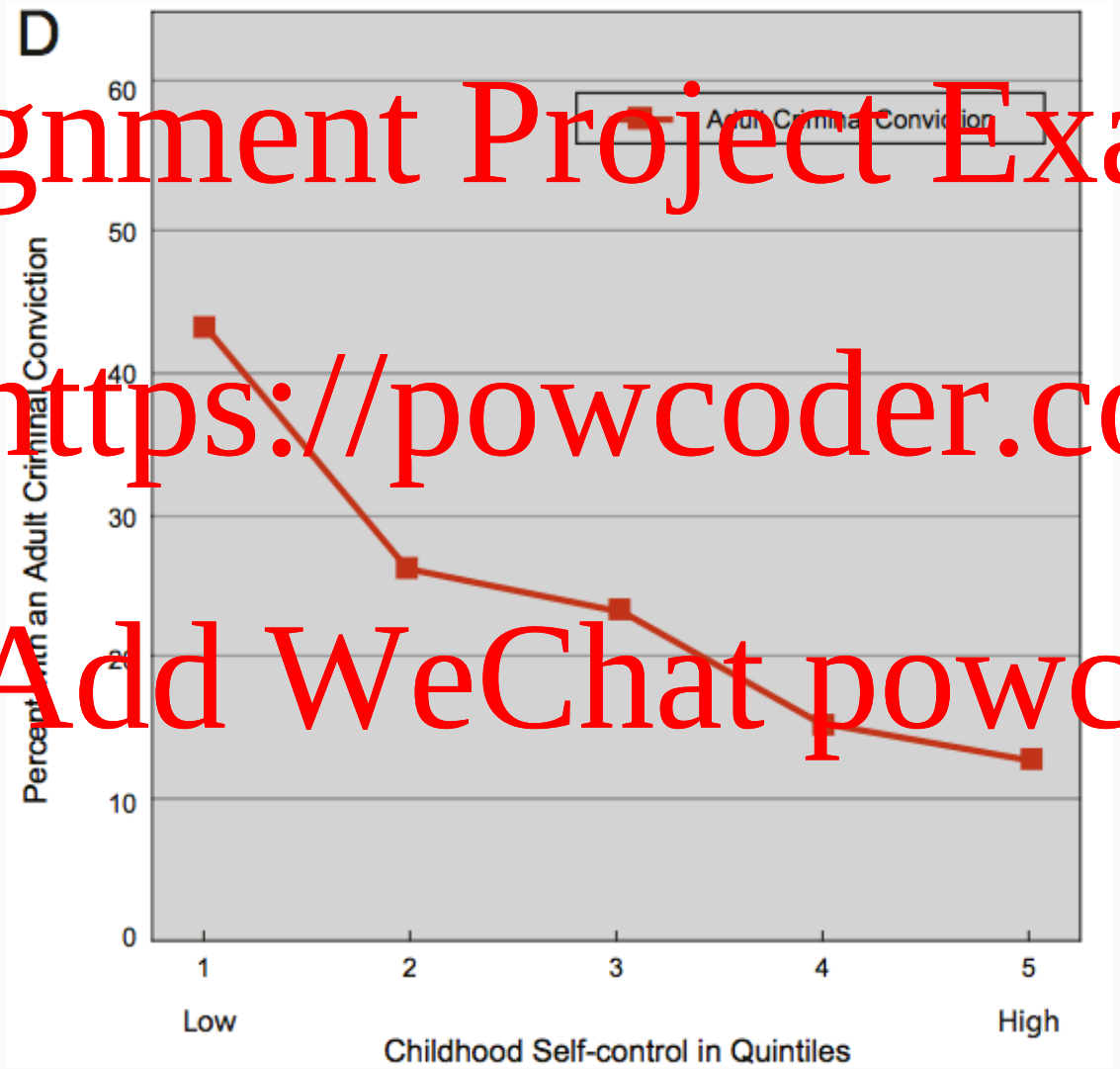
# Single parent





# Criminal conviction





# Modelling will-power

# Two systems

The most natural behavioural model uses two utility function

- A long-run utility that is unaffected by temptation
- A short-run utility that is a function only of temptation

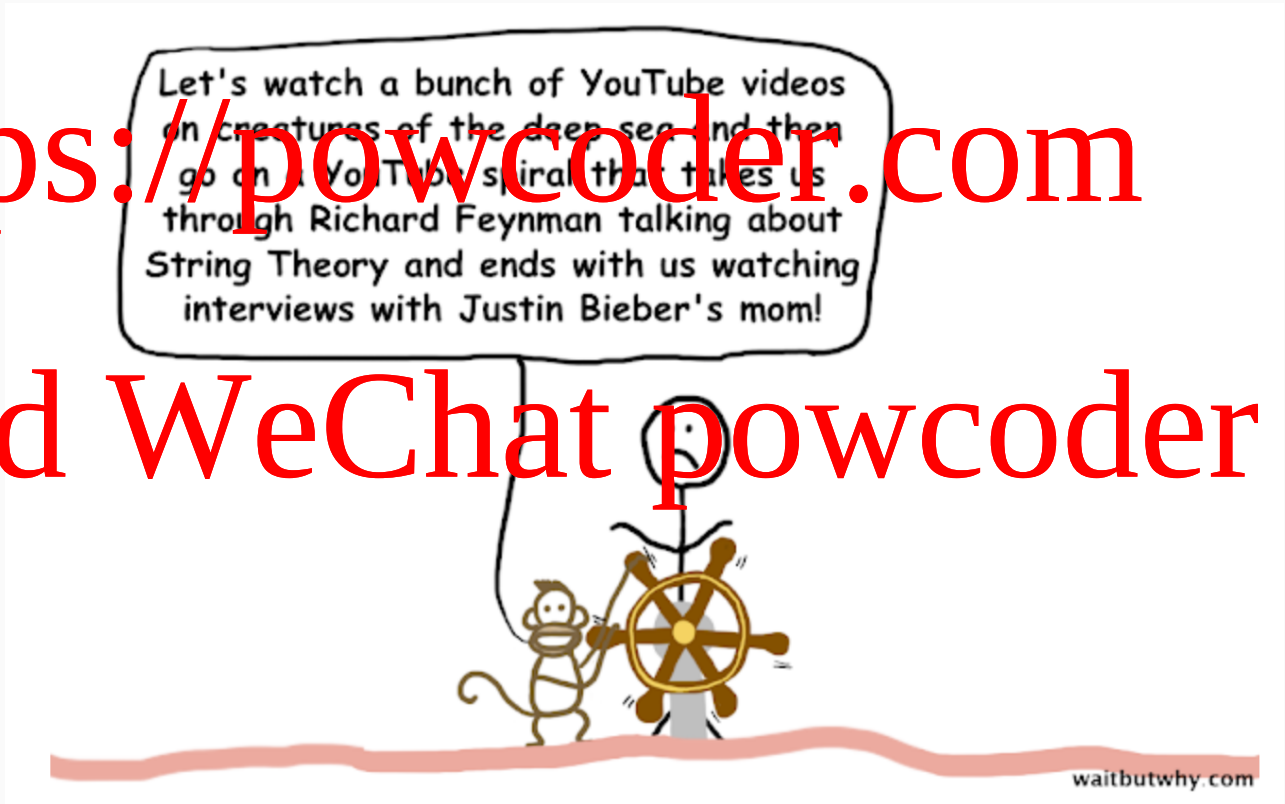
**Human and monkey metaphor**

# Human and monkey (cont.)



- "Rational" humans = monkey + uniquely human bit
- The monkey is still there



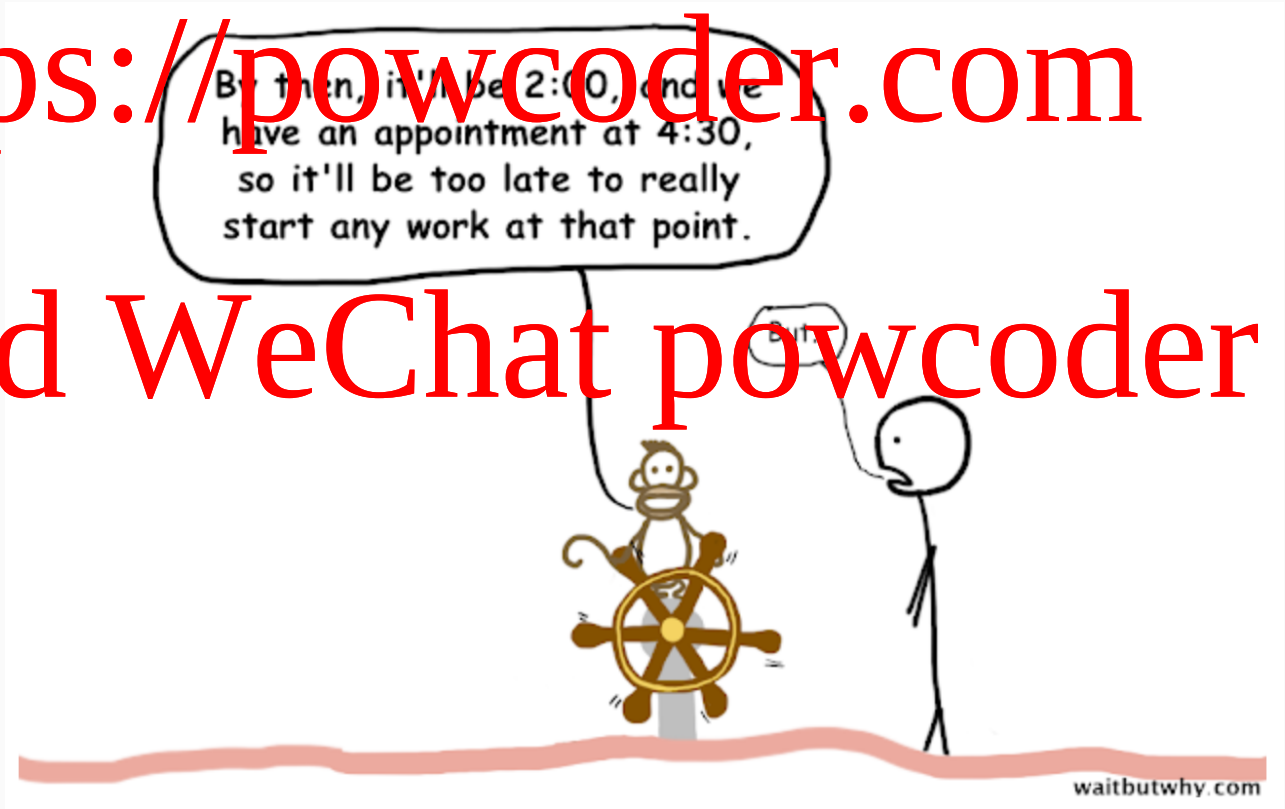


# Human and monkey (cont.)



- "Self-control" is the relative strength of the human vs. the monkey
- The monkey gets ekoted by attempting item (dessert) or an aversive item (work)





# Dessert example

- Long-run utility (human) rejects the dessert, because it makes you too full and causes weight gain
- Short-run utility (monkey) is excited by the taste of the dessert but only when it's there
- This results in time-inconsistent preferences:
  - Ahead of time, the person (human + monkey) prefers not to eat dessert
  - When the dessert is served, the person (human + monkey) eats the dessert



## Formal model

- Long-run utility: $u(\text{dessert}) = -1$
- Short-run utility: $v(\text{dessert}) = 2$
- Ahead of time: $u(\text{dessert}) < 0$
- Dessert served: $u(\text{dessert}) + v(\text{dessert}) > 0$

# Standard economic model





The standard economic model (exponential discounting) can model eating dessert (though this requires an absurdly low discount factor), but can never model time-inconsistent preferences



**Formal model**

- Eating dessert $= 2$
- Getting fat (later) $= -3$



- Eat dessert if discount factor $= \delta < 2/3$, since then $2 - 3\delta > 0$
- But then, ahead of time also prefer dessert: $2\delta - 3\delta^2 > 0$

# The $\beta - \delta$ model





- The $\beta - \delta$ model (hyperbolic discounting) is the best-known behavioural model of temptation
- It generalises the standard exponential discounting model
- Key idea: discount factor $\beta$ that weighs equally all future period
- It doesn't really generate additional insights to the human+monkey model

# Strengthening self-control



- Self-control changes with age
- It is not like a muscle. There is no evidence that people can increase their self-control (strengthen the human or weaken the monkey)

## What people can do

- What people can do is to create situations which require less self-control

## Commitment

# Eliminating options

The classical example is Odysseus and the Sirens





# Commitment





The human commits in advance to a course of action, so by the time the monkey wakes up, there is nothing it can do



**Odysseus and the sirens**

- When Odysseus was tempted by the sirens, he was unable to steer the ship towards them
- Odysseus' monkey was in control of Odysseus, but Odysseus was not in control of the ship

# Some examples



**Example (Casino black lists)**

- In several places in the world people put themselves on casino black lists, preventing themselves from gambling.



**Example (Alcohol addiction)**

- Some alcohol addicts take a drug which reacts to the presence of alcohol, and makes them sick if they drink



**Example (Self-imposed deadlines)**

- Some students choose self-imposed deadlines for assignments [2].
- Such students do better.

# More examples

**Example (Christmas clubs)**

- Christmas clubs are a traditional form of illiquid low interest saving to ensure money is available for Christmas.

**Example (Philippines saving study)**

- 28.4% choose a savings account with restricted access over one with open access in study in Philippines [3].
- They then save more (suggesting a benefit for commitment).

**Example (Obesity)**

- Some obese people undergo a stomach reduction (bariatric) surgery, which limits their capacity to eat

# Commitment and financial markets





Financial markets undermine commitment devices:

- Credit cards, zip and afterpay remove the control of limited cash
- Remortgaging eliminates the value of owning property as a commitment saving device
- In some places people can now borrow against restricted access accounts (e.g. superannuation), which again limits their value as a commitment device.

# Softer commitment

It may be sufficient to create a cost for yielding to temptation

**Social costs**

- you publicly promise your friends you will write the report
- this makes it more expensive to procrastinate on the report
- the potential embarrassment may also affect the monkey

**Helping people you hate**

- you make a credible promise to donate to a political enemy if you yield to temptation
- this disgusts the monkey, who may reluctantly agree to work

# Reducing temptation

# Reducing visibility





Something as simple as putting cookies in an opaque jar can have a big impact

- Out of sight—out of mind

# Changing order





The order of items in a menu can have a massive impact of choices:



- putting healthier choices first, dramatically increases consumption of healthy choices
- this works in written menus



- it also works visually in physical shops

# Erecting barriers





If people have to get up and walk over to get a cookie, they would eat fewer cookies than if they just need to reach out and grab a a cookie



**Small barriers matter**

General point: small barriers have a massive impact on choices



- if you want people to do more of something, eliminate all barriers
- if you want people to do less of something, erect barrier—even small ones can be surprisingly effective

# Temptations fluctuate





Because temptations fluctuate, it can be effective to let the monkey have what it wants, but with a bit of delay



- prepare to stop working, or to stop exercising—but in 5 or 10 minutes



Once 5 or 10 minutes pass, the monkey may be calmer, and will let you continue

## Self-awareness

# Sophistication





- Self-awareness or sophistication is essential for people to use self-control techniques
  - Without self-awareness, there would be no demand for commitment, or other methods of self-control

# Procrastination

Naivete is key to procrastination

## Report example

Suppose you need to write a report at some point during the term

- The monkey doesn't want to write it today – tomorrow is better
- The human gives up, believing that tomorrow the monkey would be calm
- Come tomorrow, the monkey again refuses to work
- In the end, the report is only written when it can no longer be postponed

# Report example (cont.)





If the human had correctly predicted this, he would have put up more of a fight:



- insisting on writing the report now
- creating artificial deadlines
- social commitments
- etc.

# Self-awareness





Increasing self-awareness can be effective at improving behaviour

# Risk

# Standard model

# Expected utility





The standard model in economics is expected utility

- People have a concave utility function over consumption, such as $u(c) = \sqrt{c}$, or $u(c) = \log c$.
- They evaluate an uncertain prospect by the expected utility of their total consumption



## Basic setup



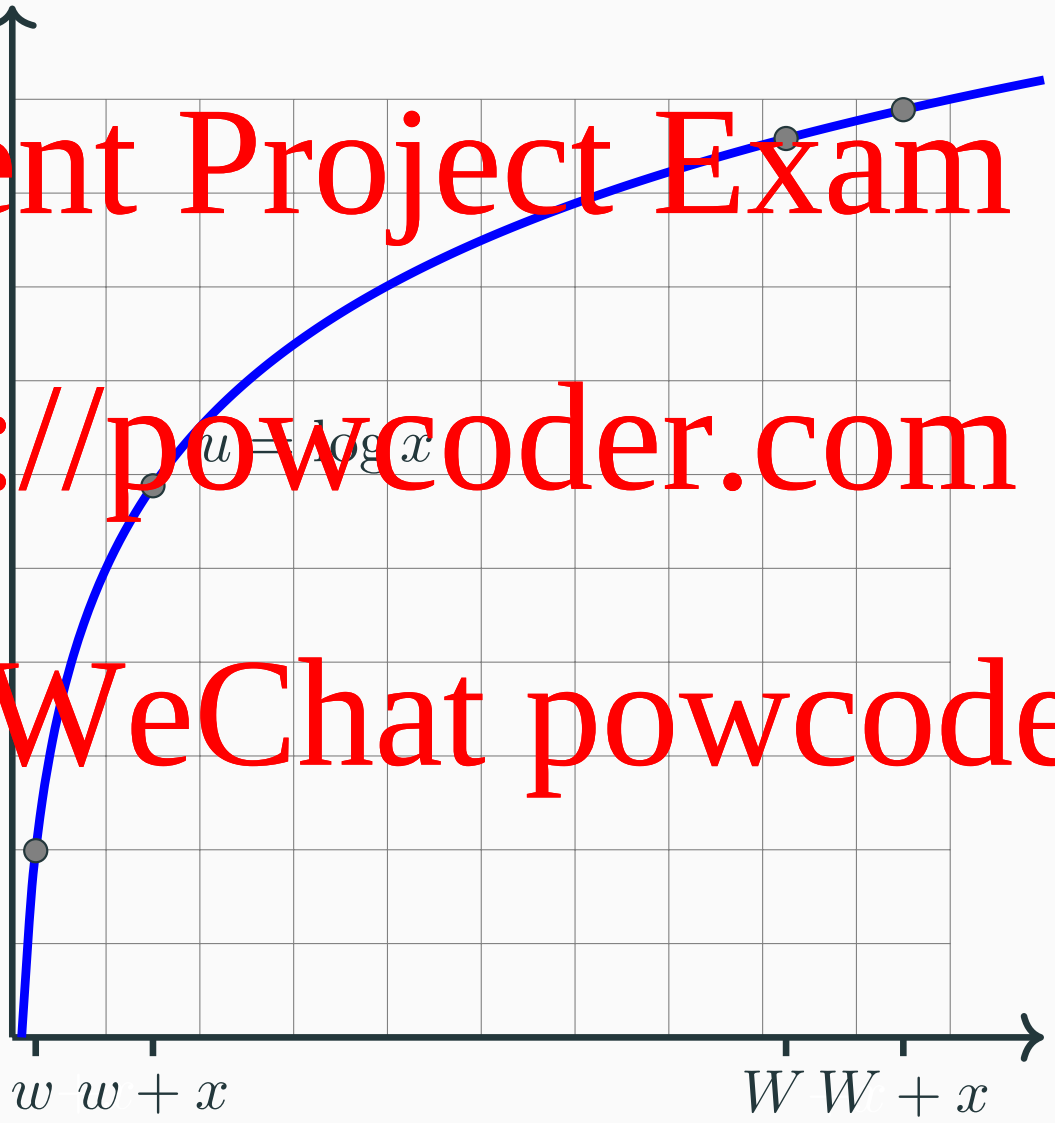
- A person has wealth $w$ and a chance $p$ of winning $x$
- Expected utility is given by

$$(1-p)u(w) + pu(w+x)$$

# Concave utility function







# Risk aversion





Since the utility function is concave, decision makers are always risk averse

But since utility is defined over final wealth, decision makers are effectively risk neutral over amounts smaller than their wealth

# Effective risk neutrality





An expected utility maximiser with $u(x) = \sqrt{x}$ has a wealth of $1,000,000

He has a 50% chance of winning some amount of money



| Amount | Certainty equivalent |
|---|---|
| 5000000 | 1974744.8714 |
| 500000 | 237372.4357 |
| 50000 | 24847.5383 |
| 5000 | 2498.4414 |
| 500 | 249.9844 |
| 50 | 24.9998 |

## Reality

# Risk aversion over small stakes





- People are (mostly) risk averse over small gain bets



**Example**

Many prefer a certain gain of $4 over a 50% chance of gaining $10

# Risk seeking over losses





People are (mostly) risk seeking over small loss bets

**Example**

Many prefer a 50% chance of losing $10 to a certain loss of $4

# Gains and losses

# Introduction





Prospect Theory (Kahneman and Tversky, 1979) is the main behavioural theory for choice under uncertainty



The key assumptions are that

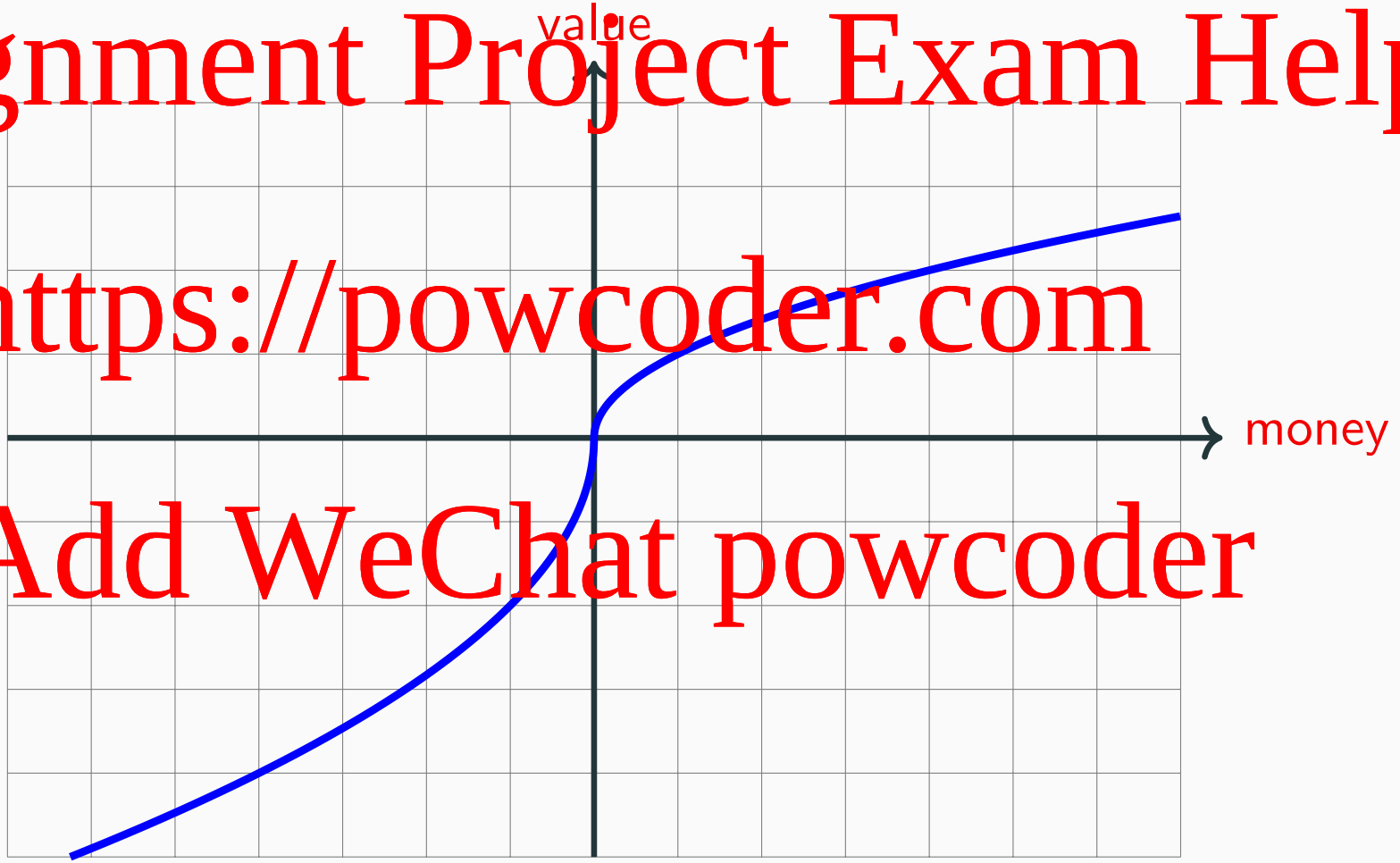


1. people evaluate risky prospects as gains and losses
2. a given difference carries more weight near zero than further away from zero

# Value function







# Intuition





This is consistent with psychological principles of perception and judgement

**Changes rather than absolute levels**

For example, people adapt to the overall light level, and focus on differences. We see objects as white or black even though a white objects indoors reflects less light than a black object outdoors





**Declining marginal value**

For example, the perceptual difference between 500 grams and 1 kilo is greater than the perceptual difference between 4.5kg and 5kg

# Implications





Consistent with evidence:

- Risk aversion over gains (including small ones)
- Risk seeking over losses

# Framing

# Gains and losses





- Some options can be presented either in terms of gains or in terms of losses
- Since people are risk seeking over losses, such framing can affect the choices people make

# The "Asian Disease" problem





**Asian disease: gain frame** ($N = 152$)

Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

- If program $A$ is adopted, 200 people will be saved (72%)
- If program $B$ is adopted, there is a one-third probability that 600 people will be saved and a two-third probability that no people will be saved (28%)

# The "Asian Disease" problem





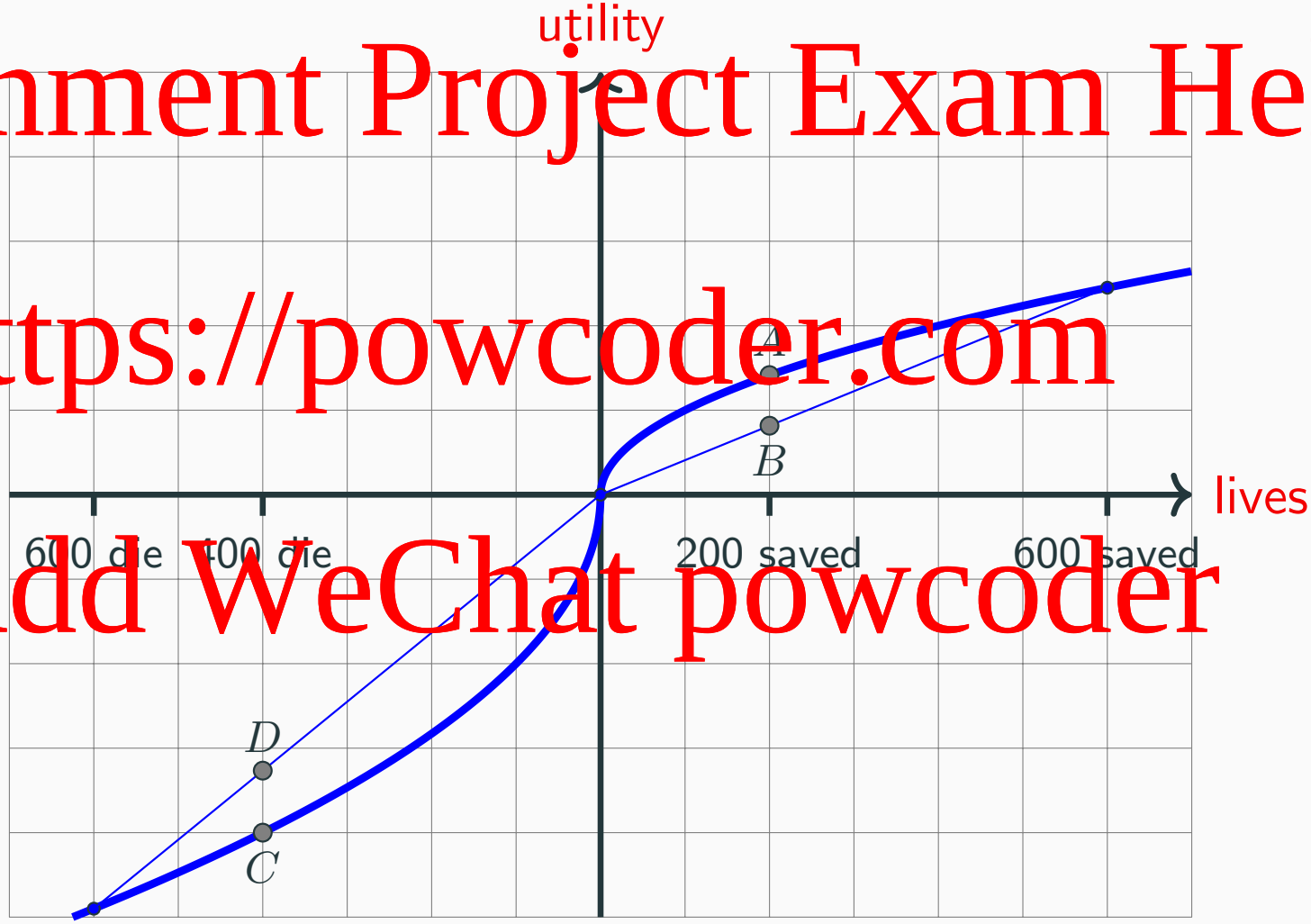
**Asian disease: loss frame** ($N = 155$)

Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

- If program $C$ is adopted, 400 people will die (22%)
- If program $D$ is adopted, there is a one-third probability that nobody will die and a two-third probability that 600 people will die (78%)

# The "Asian Disease" problem





# Framing affects experts





Experts are not immune to framing effects

**Medical doctors**

The following two frames lead to different choices by both doctors and patients:

- The operation has an 80% survival rate
- The operation has a 20% mortality rate

# The reference point



We talked about gains and losses, but didn't say what the reference-point is



In some cases, the reference-point is up for grabs:

- Current wealth level
- Expected wealth level (e.g. expected raise)
- Other people's wealth (social reference-point)
- Purchase price



By causing people to adopt a different reference-point, you may be able to change their choice

## Certainty

# Gains



- People love certain gains, over and above what would be predicted by risk aversion

- A certain gain of $990 is evaluated as much better than a 99% chance of gaining $1000

# Losses





- People hate certain losses, overand above what would be predicted by risk seeking

- A certain loss of $990 is evaluated as much worse than a 99% chance of losing $1000

# Dynamic implications



People cash out too soon when they are ahead

More importantly, they chase losses, hoping to get back to even.

# Bracketing

# Bracketing





- A key determinant of choices and feelings is how people bracket the risks that they face
- This is something people may be able to change, or is potentially changeable in an intervention



**Narrow bracketing**

Risks are perceived narrowly in both space and time



**Broad bracketing**

Risks are perceived broadly in both space and time

# Investment portfolio vs. individual stocks

## Entire portfolio

Thinking of an investment portfolio as a whole is an example of broad bracketing

- Investors still react to gains and losses, but are not bothered by gains and losses in individual shares
- If a stock is doing poorly, the investor can cut her losses without incurring a certain loss in her entire portfolio

## Individual stocks

Thinking of individual stocks is an example of narrow bracketing

- If a stock is doing poorly, cutting losses requires the investor to accept a certain loss
- This is hard, so the investor is less likely to act optimally

# Bracketing over time



## Daily portfolio check

- An investor who examines his investment returns daily is experiencing losses on an almost daily basis
- This is unpleasant, and can lead to suboptimal investment decisions
- It is an example of narrow bracketing

## Annual (or longer) portfolio check

- An investor who examines his investment returns annually is less likely to experience losses, and more likely to make optimal investment decisions
- It is an example of broad bracketing

# Incomplete preferences

# Standard economics

# Complete preferences



The most important assumption in standard economics is that people have **well-defined preferences** (always):

- $A \succ B$ ($A$ preferred to $B$),
- $B \succ A$ ($B$ preferred to $A$); or
- $A \sim B$ ($A$ and $B$ are valued exactly the same)

Equivalently, people have a **utility function**:

- $u(A) > u(B)$,
- $u(B) > u(A)$; or
- $u(A) = u(B)$

# Implication of complete preferences





- People know what they want (always)
- In particular, people know exactly how much they are willing to pay for anything
- Can non-paternalistically identify welfare with preference satisfaction
- More choice is always good (can only increase utility)

**Partial exception**

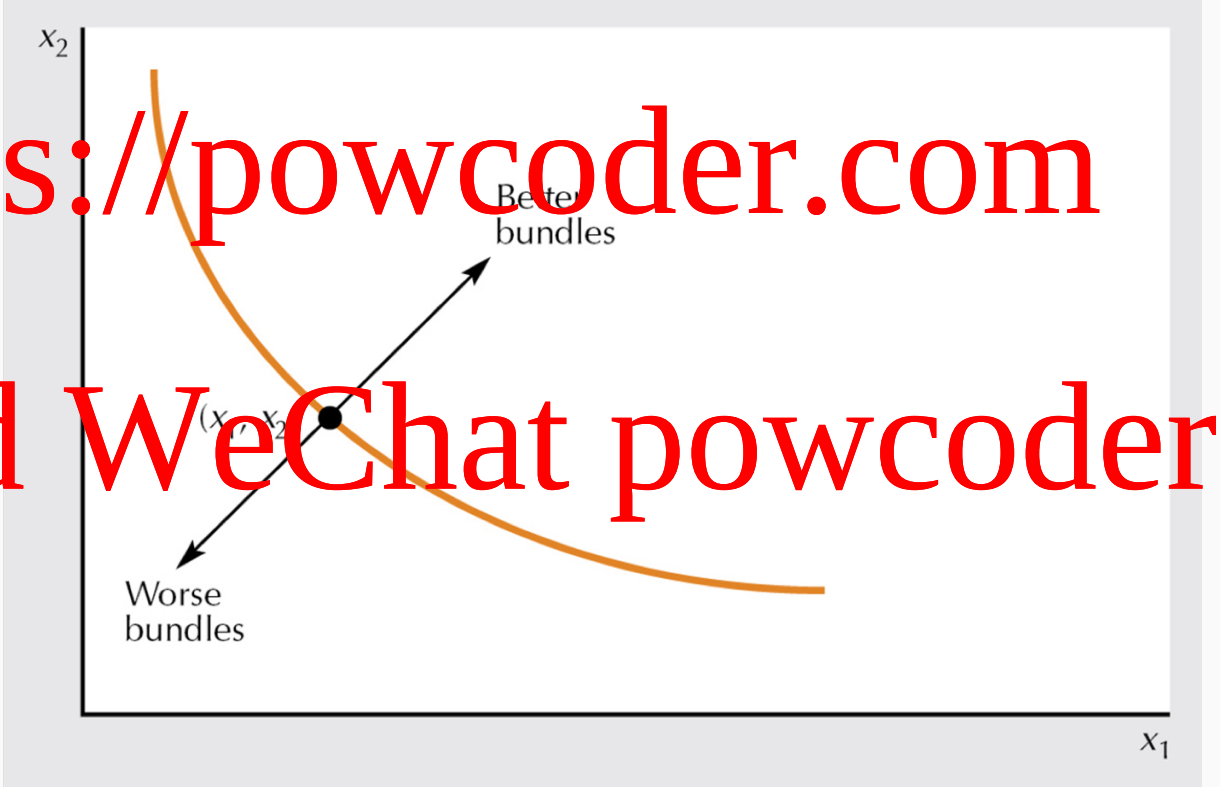
When people change their preferences (e.g. because of temptation), standard economics cannot tell us whose preference should count for welfare purposes

# Indifference



The trade-off between two desirable attributes is represented by indifference curves





# Indifference cont.





Since indifference curves have width zero, there is zero probability that two arbitrary bundles would be on the same indifference curve

**Conclusion**

The person would never be indifferent between two such bundles, always strictly preferring one bundle to the other

# Breaking indifference





Consider the following choice:

1. A week holiday in Paris
2. A week holiday in Rome

**What indifference means**

If you are truly indifferent between these two options, then throwing in an espresso (*un café* or *un caffè*) should break your indifference

# The anchoring effect

# Procedure



D. Ariely et al. "Coherent Arbitrariness: Stable Demand Curves Without Stable Preferences". In: *Quarterly Journal of Economics* 118.1 (2003), pp. 73–105

1. Write down last digits of own social security number
2. Report your reservation price for objects

# Results





AVERAGE STATED WILLINGNESS-TO-PAY SORTED BY QUINTILE OF THE SAMPLE'S SOCIAL SECURITY NUMBER DISTRIBUTION

| Quintile of SS# distribution | Cordless trackball | Cordless keyboard | Average wine | Rare wine | Design book | Belgian chocolates |
|---|---|---|---|---|---|---|
| 1 | $ 8.64 | $16.09 | $ 8.64 | $11.73 | $12.82 | $ 9.55 |
| 2 | $11.82 | $26.82 | $14.45 | $22.45 | $16.18 | $10.64 |
| 3 | $13.45 | $29.27 | $12.55 | $18.09 | $15.82 | $12.45 |
| 4 | $21.18 | $34.55 | $15.45 | $24.55 | $19.27 | $13.27 |
| 5 | $26.18 | $55.64 | $27.91 | $37.55 | $30.00 | $20.64 |
| Correlations | .415 | .516 | 0.328 | .328 | 0.319 | .419 |
| | $p = .0015$ | $p < .0001$ | $p = .014$ | $p = .0153$ | $p = .0172$ | $p = .0013$ |

The last row indicates the correlations between Social Security numbers and WTP (and their significance levels).

# Conclusion

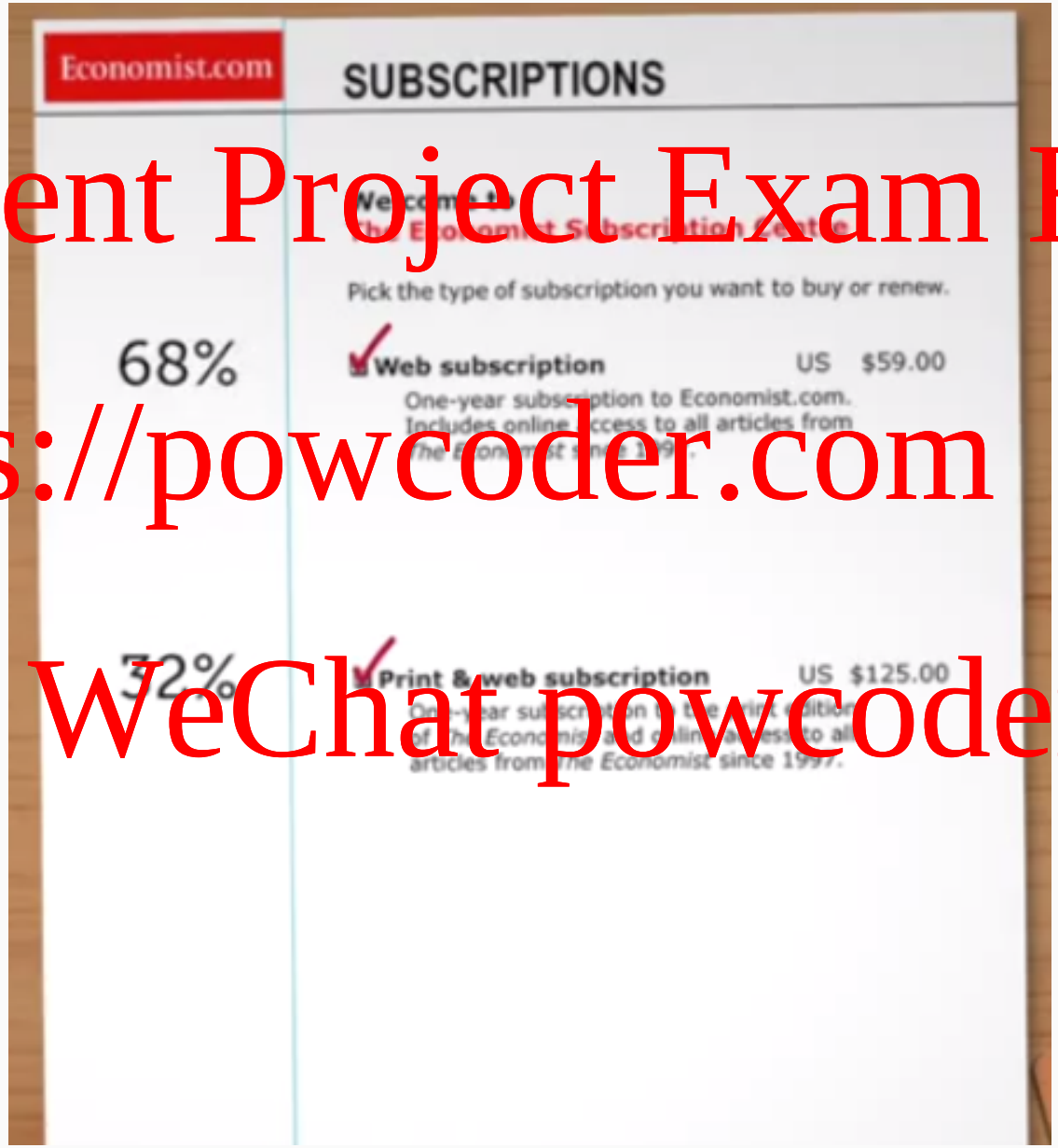




People do not have a well-defined monetary value for goods

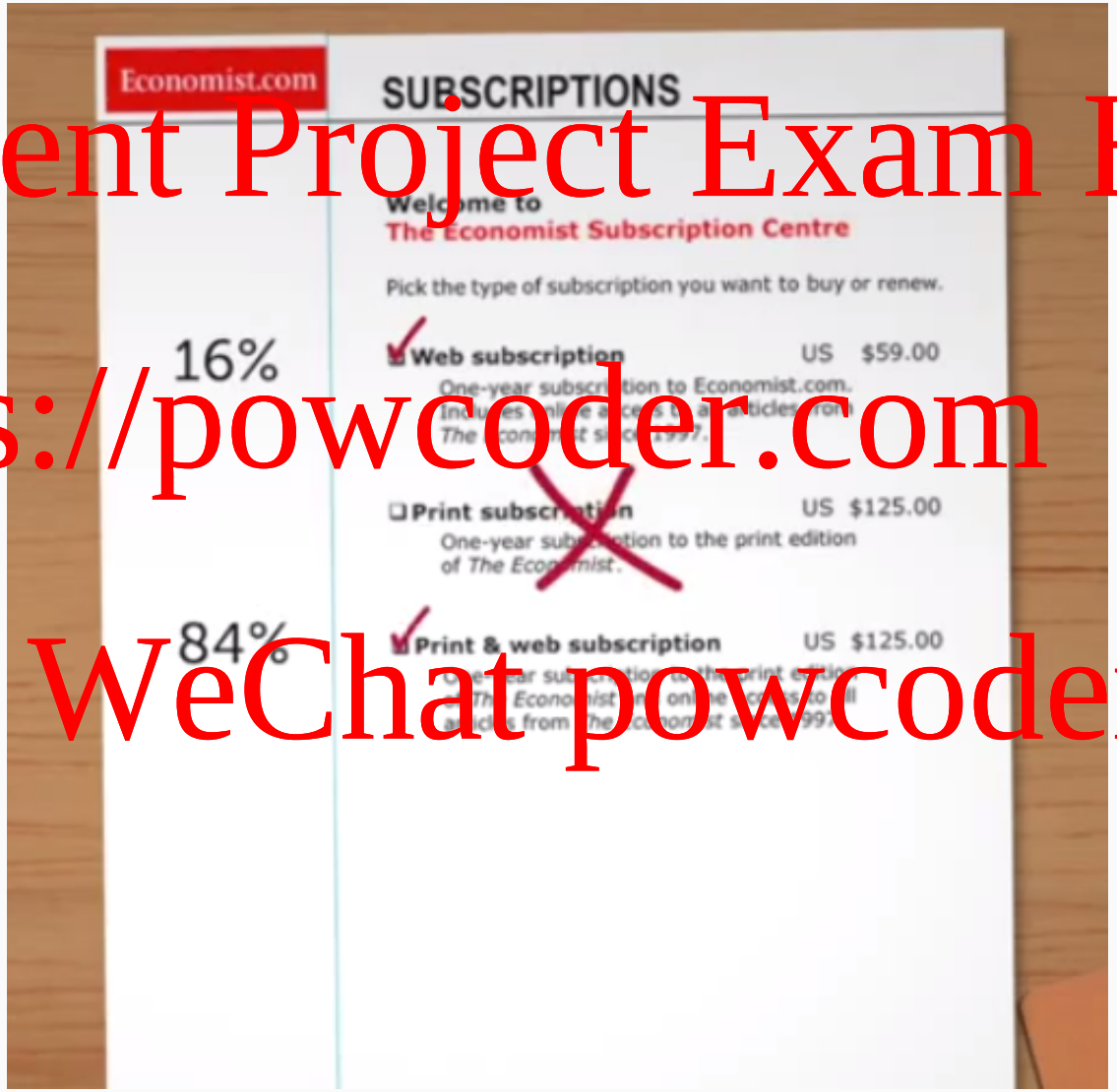
# The decoy effect

# Economist example (no decoy)



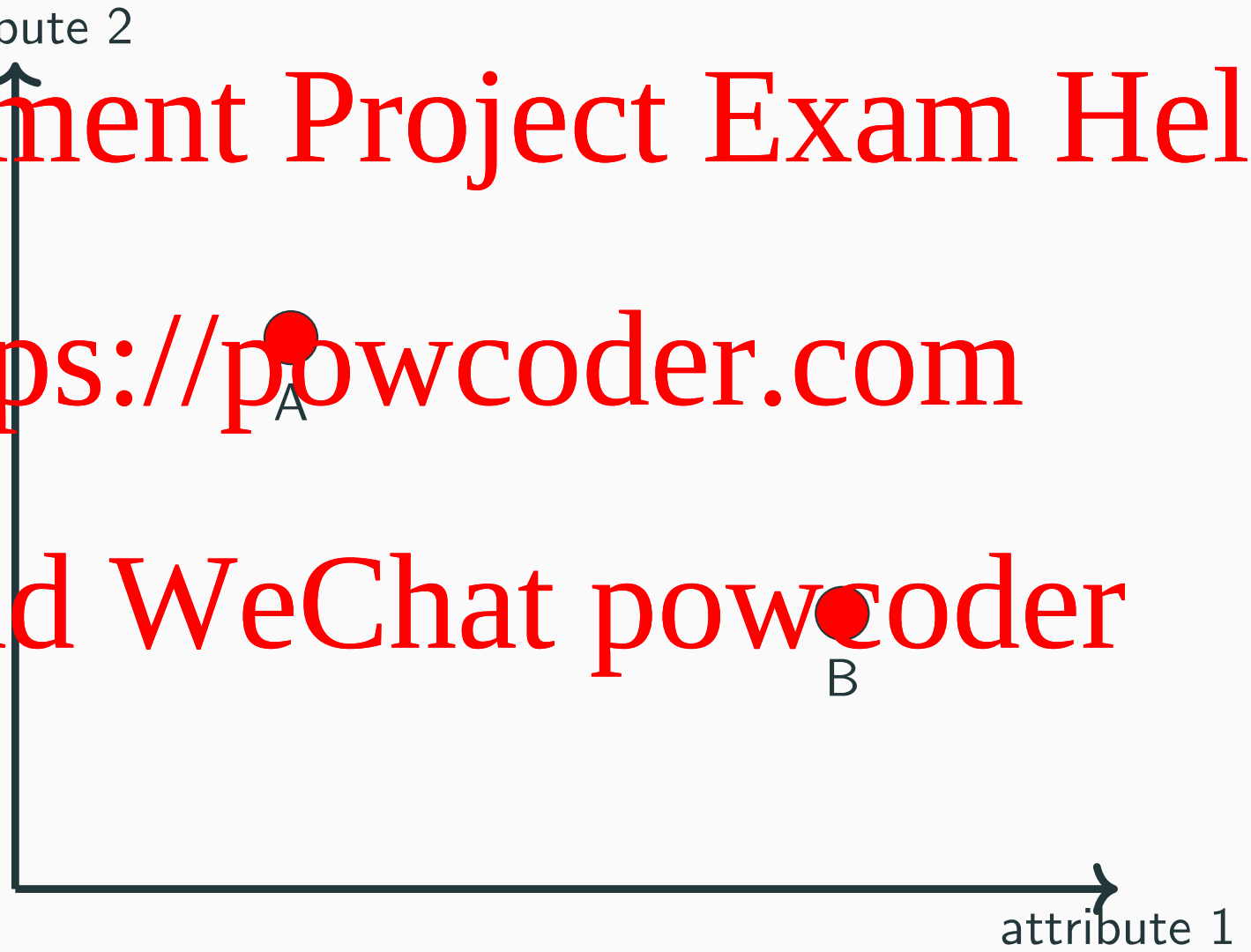
# Economist example (decoy)





# Decoy effect





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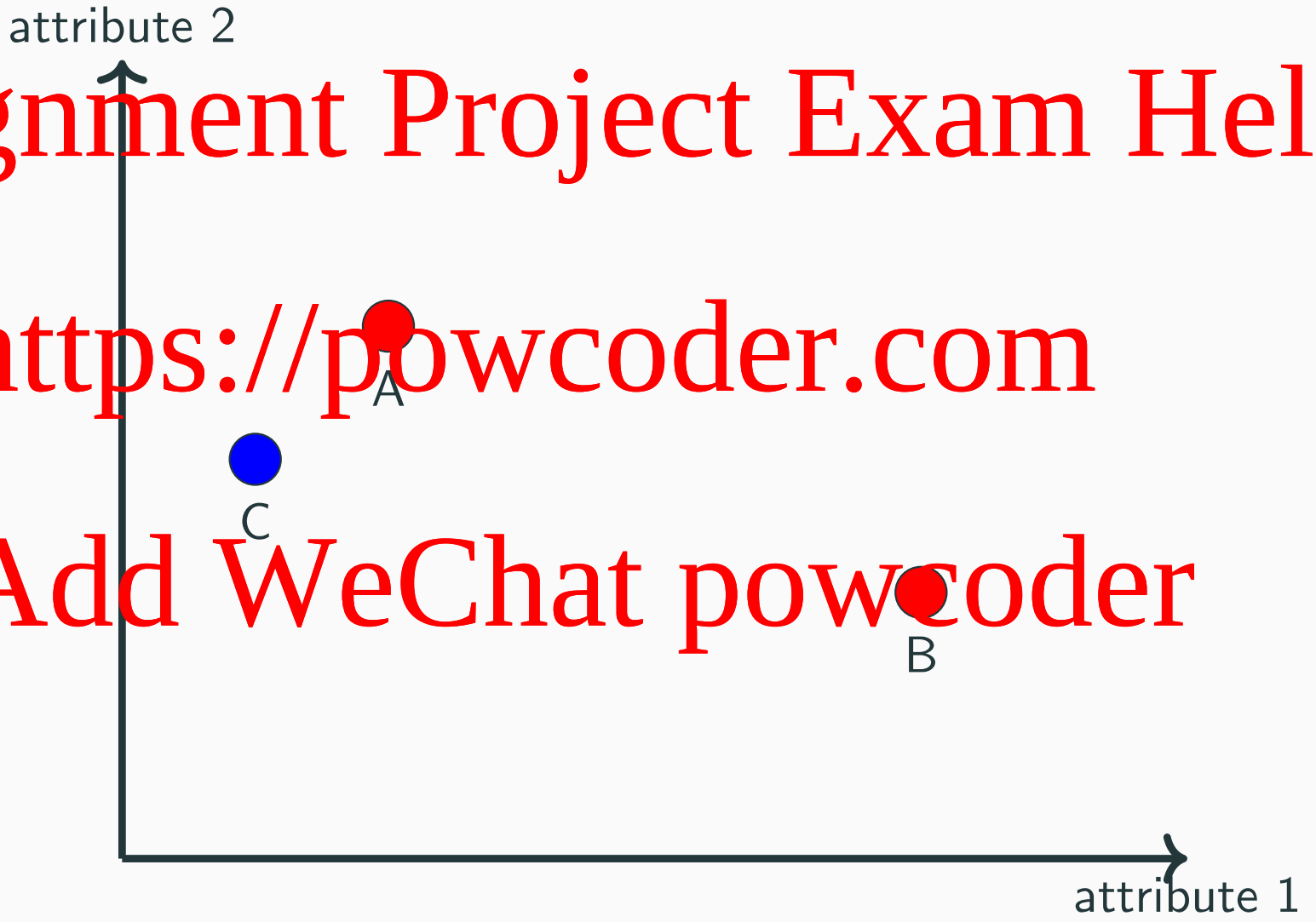


# Decoy effect (cont.)





- C is called a *decoy option*
- Nobody chooses C
- Nevertheless, its presence affects choices, making it more likely that people choose A

# Explanation

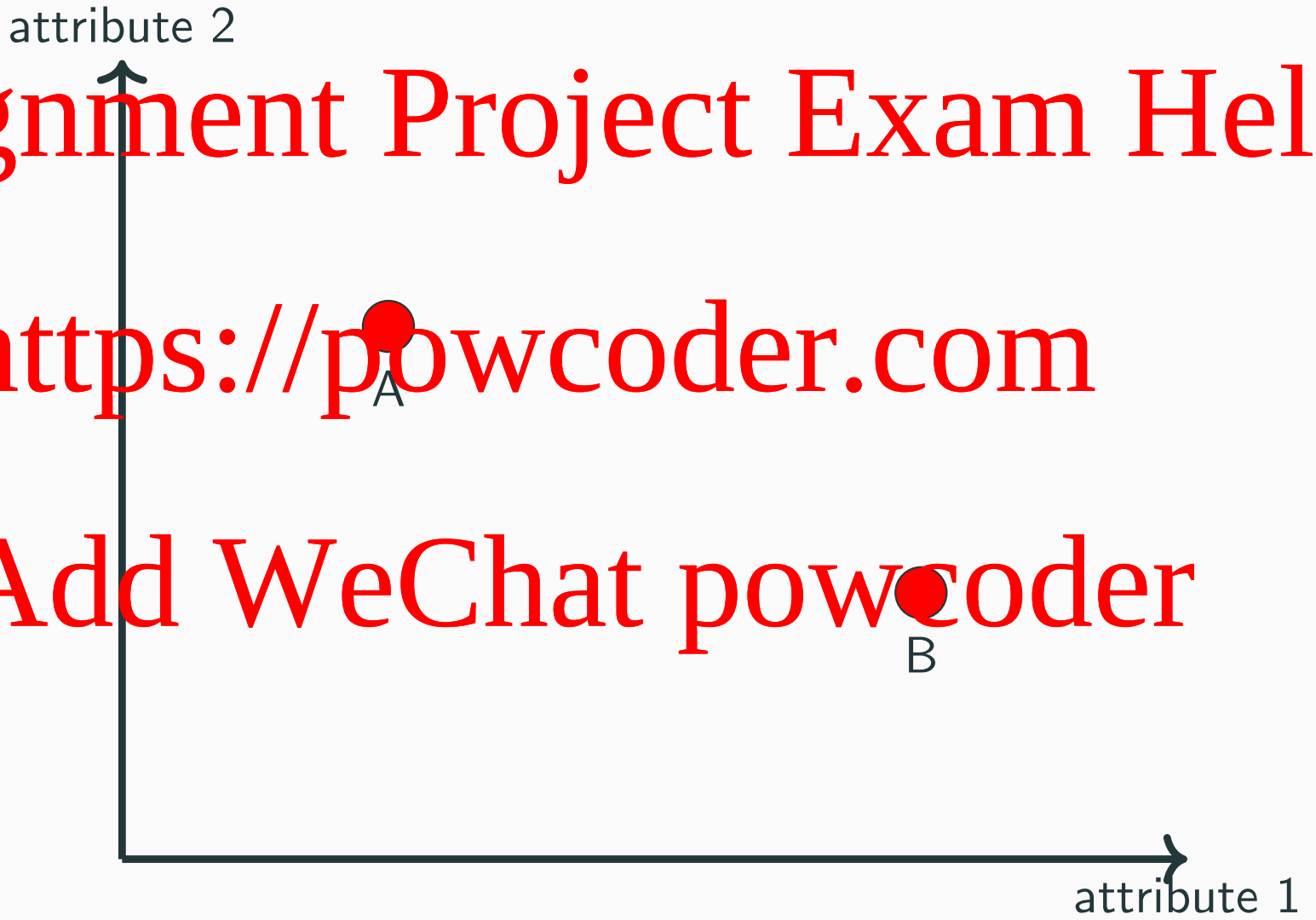


- Some people have no preference between A and B
- They look for a reason to choose one or the other
- A (but not B) is clearly better than C
- Therefore, C offers a reason to choose A, but does not offer a reason to choose B

# The compromise effect

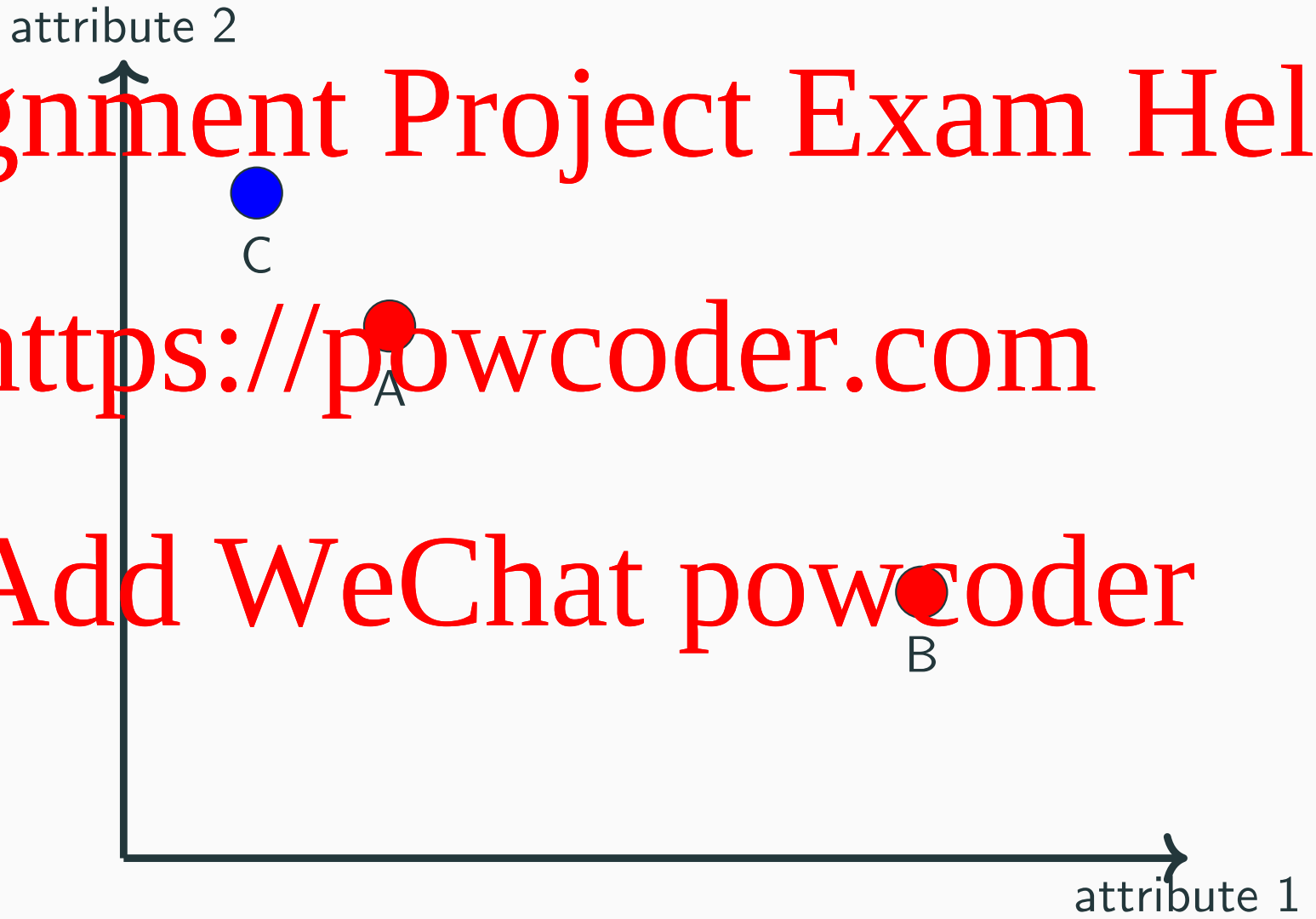
# Compromise effect





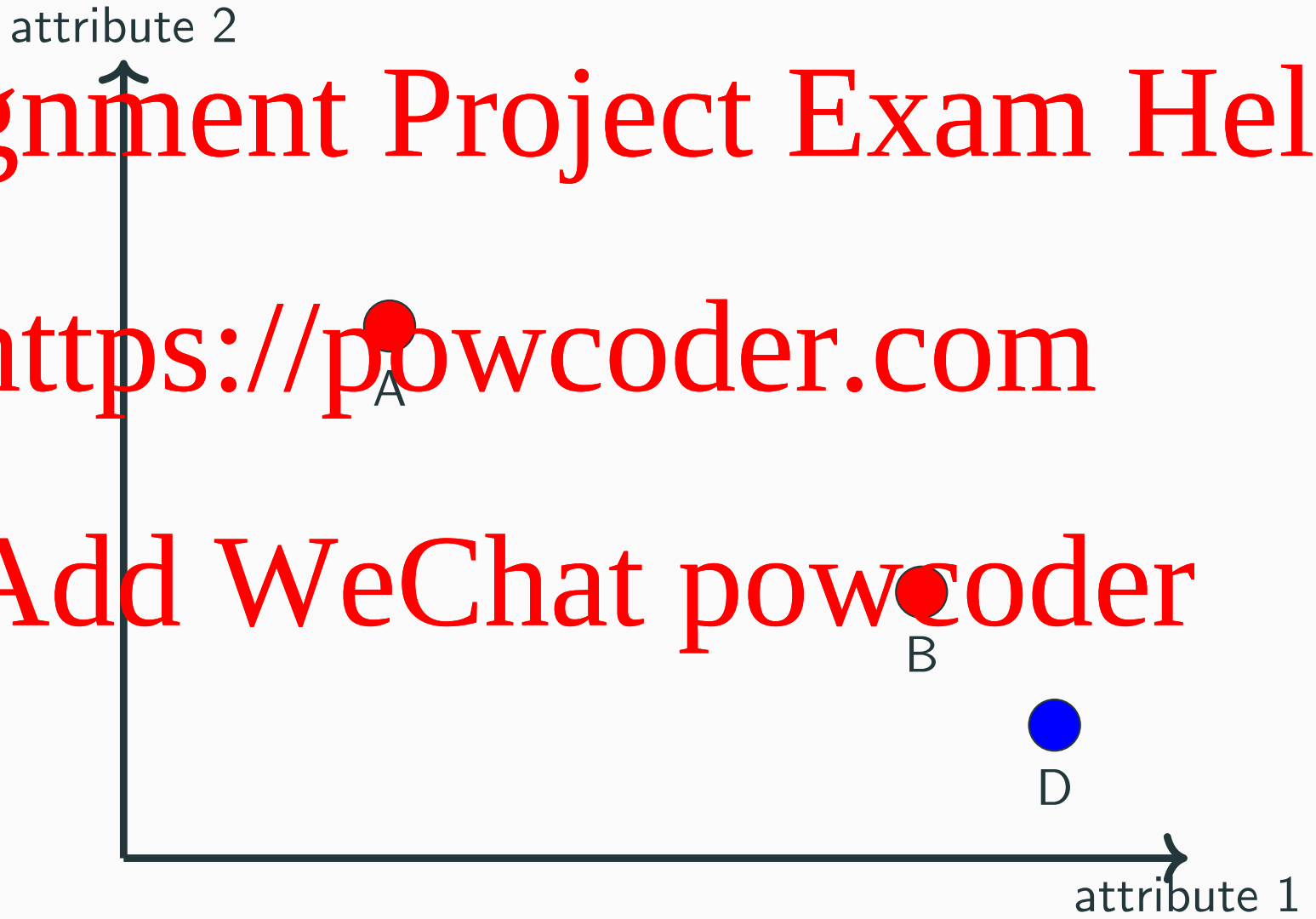
# Compromise effect





# Compromise effect





# Compromise effect



- C and D are extreme options
  - Few people choose C or D
  - However, their presence affects choices
    - With C present, A is more likely to be chosen
    - With D present, B is more likely to be chosen



**Explanation**



- Choosing the middle option is a reasonable decision rule (when you have no preferences)
- It also feels safer

# Marketing





- Stores will often stock highly expensive items that few people buy, and avoid stocking very cheap items
- One reason is to make fairly expensive items look like a safe middle option

# The default effect

# The default effect





**Normal (forced) choice**

- $A$ or $B$?
- Must choose one or the other



**Default**

- Some option is the default
- Can freely choose some other option



- But can also make no choice, in which case end up with the default

# Standard economic analysis





**Defaults should not matter**

- Choose preferred option whether or not it's the default

**Exception**

- Stakes are low
- Making an active choice is costly, so not worth it

# Saving for pension

## Research question

Does the default option affect outcomes even when

- the stakes are very high
- it's really easy to change

## Method

Study saving for pensions in an environment with

- different defaults
- easy switching (phone or fill in a form)

## Rational choice

Save (and save a lot):

- necessary for decent retirement
- company matching employee saving

# Saving for pension



**Default**

- no saving
- participate at 3% level in money market fund



**Choices**

Participation rate a year after joining company:

- 49% in group with no participation default
- 86% in group with participation default.



**Conclusion**

Default options matter greatly in high-stakes real-life situations

# Choosing investment funds



- Sweden privatised social security in 2000
- 456 plans on offer
- Standard theory prediction: 1/456 should choose the default
- Effort to encourage individual choice
- Nevertheless, 43.3% chose the default, later increasing to 91.6%

# Medicare Part D



## Introduction

Medical Part D is a 2003 law offering seniors coverage for drug purchase



## The Bush plan

- President's Bush plan gave seniors dozens of choices in each state



- The default was non-enrolment in most cases, and random in others

# Medicare Part D



*"The reason why we felt it was necessary to provide choices is because we want the system to meet the needs of the consumer. The more choices you have, the more likely it is you'll be able to find a program that suits your specific needs. In other words, one-size-fits-all is not a consumer-friendly program. And I believe in consumers, I believe in trusting people." (President Bush)*

# Results



- 73% of seniors 90% of doctors and pharmacists said part D was "too complicated."
- More than 22% stopped taking medications because of problems in managing their new plan
- 4 million seniors ended up with no cover whatsoever (when no cover was the default)
- Many others ended up with a random default, paying an average of $700 over an optimally chosen option

# Postmortem

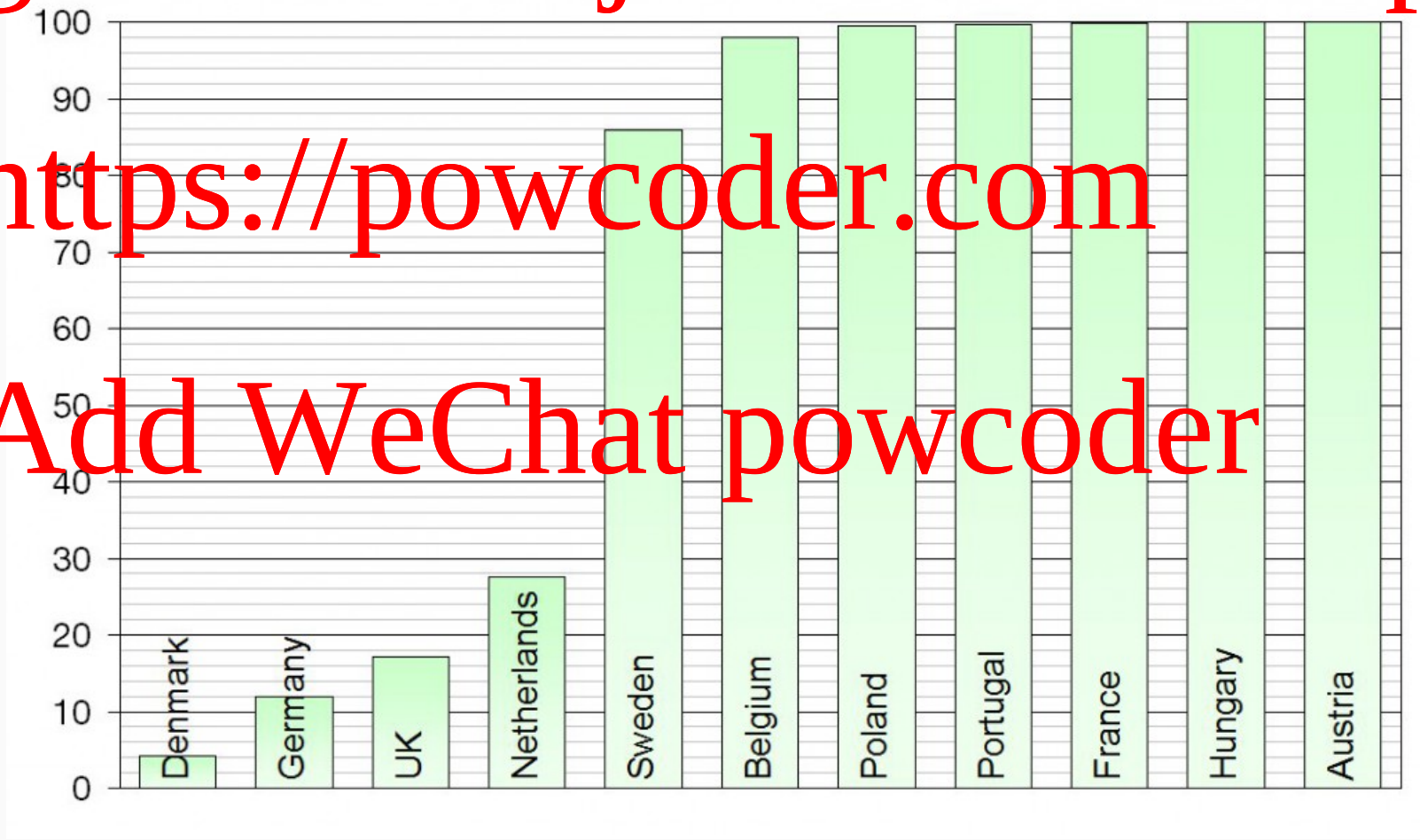


*"I knew that when we. . . laid out the idea of giving seniors choices, it would create a little confusion for some. I mean, after all, up to now there hadn't been. . . many choices in the system, and all of a sudden [for] a senior who feels pretty good about things [here comes] old George W. . . and all of a sudden forty-six choices pop up." (President Bush)*

# Organ donations

- Chart shows % who agree to organ donations
- Countries with high numbers have enrolment as the default





# Explaining the default effect





## Incomplete preferences

- Sticking with the default is an attractive rule when you don't know what to choose
- The more choices, the more likely it is that people stick with the default (the opposite of what would be expected in a standard model)
- Harder choices also make it more likely that people stick with the default

## Loss aversion

- People compare alternatives to the default, putting extra weight on attributes in which the alternative is worse

# Bounded rationality

# Introduction

# Bounded rationality





Bounded rationality is about situations where

- the goal is clear (preferences are complete), but
- it's not obvious how to get there
- Particular focus on strategic interaction

**Chess example**

- The goal is clear (winning)
- It is a game of complete information
- It is theoretically possible to analyse it, and find a solution

# Chess (cont.)





**Game theoretic analysis**

In every chess game, one of the following must be true:

- White can force a win
- Black can force a win
- Both sides can force a draw



**Implication (with unbounded rationality)**

Chess is not an interesting game!



- The outcome of every game would be the same: the Nash Equilibrium of the game

# Chess (cont.)





**Reality**

- The number of configurations in a complete analysis of chess is more than the number of atoms in the universe
- No human (or machine) can fully analyse chess
- Chess remains an interesting game

# Level-k

# Nomenclature



Largely synonymous terms:

- Cognitive hierarchy
- Limited depth of reasoning
- Level-k

# Level-k idea

**Players are classified into levels of reasoning**

- L0 do not reason at all, choosing randomly or instinctively (e.g. a focal action)
- L1 best respond to L0
- L2 best respond to L1
- L3 best respond to L2
- etc

**Typical finding**

- Most people are L1 or L2
- Some are L0
- L3 and above are rare

# What is optimal?



- You want to predict how others would play
  - Overestimating their rationality may be as much of a mistake as underestimating it
- You want to be exactly one step ahead

# Beauty contest game

# Introduction

## Name

Also known as the guessing game

## Goal

Demonstrate level-k like behaviour in a setting in which Nash Equilibrium is easy to see and very different from level-k

## Rules

- Each player chooses a number from 0 to 100
- The winner is the player whose guess is closest to $2/3$ of the mean of all guesses

## Nash equilibrium

- Everyone guesses 0

# Level-k analysis



- L0 chooses $50$ on average
- L1 chooses $(2/3) \times 50 \approx 33$
- L2 chooses $(2/3)^2 \times 50 \approx 22$
- L3 chooses $(2/3)^3 \times 50 \approx 15$

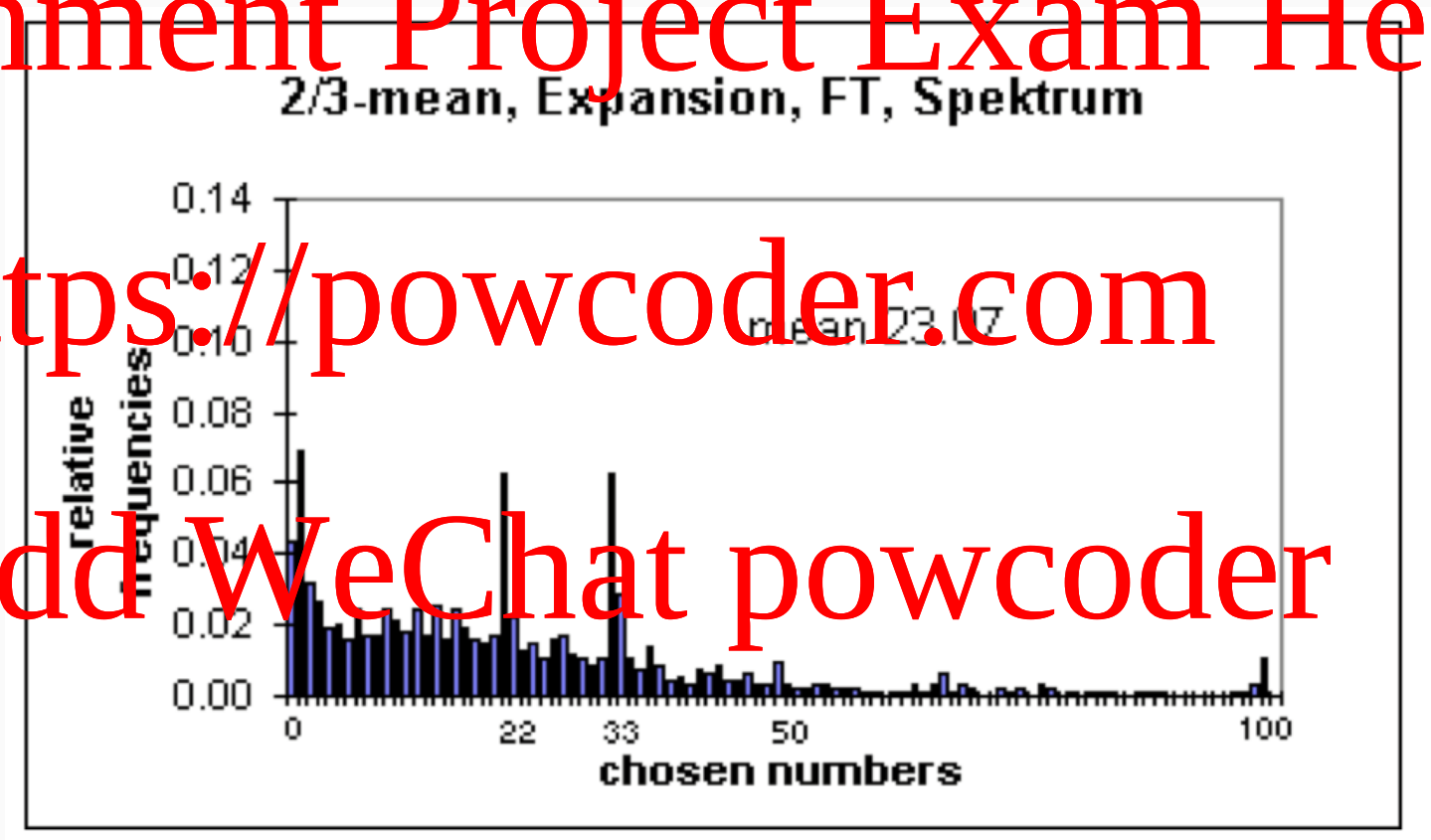
**Nash Equilibrium**

- Everyone chooses 0

# Financial Times readers



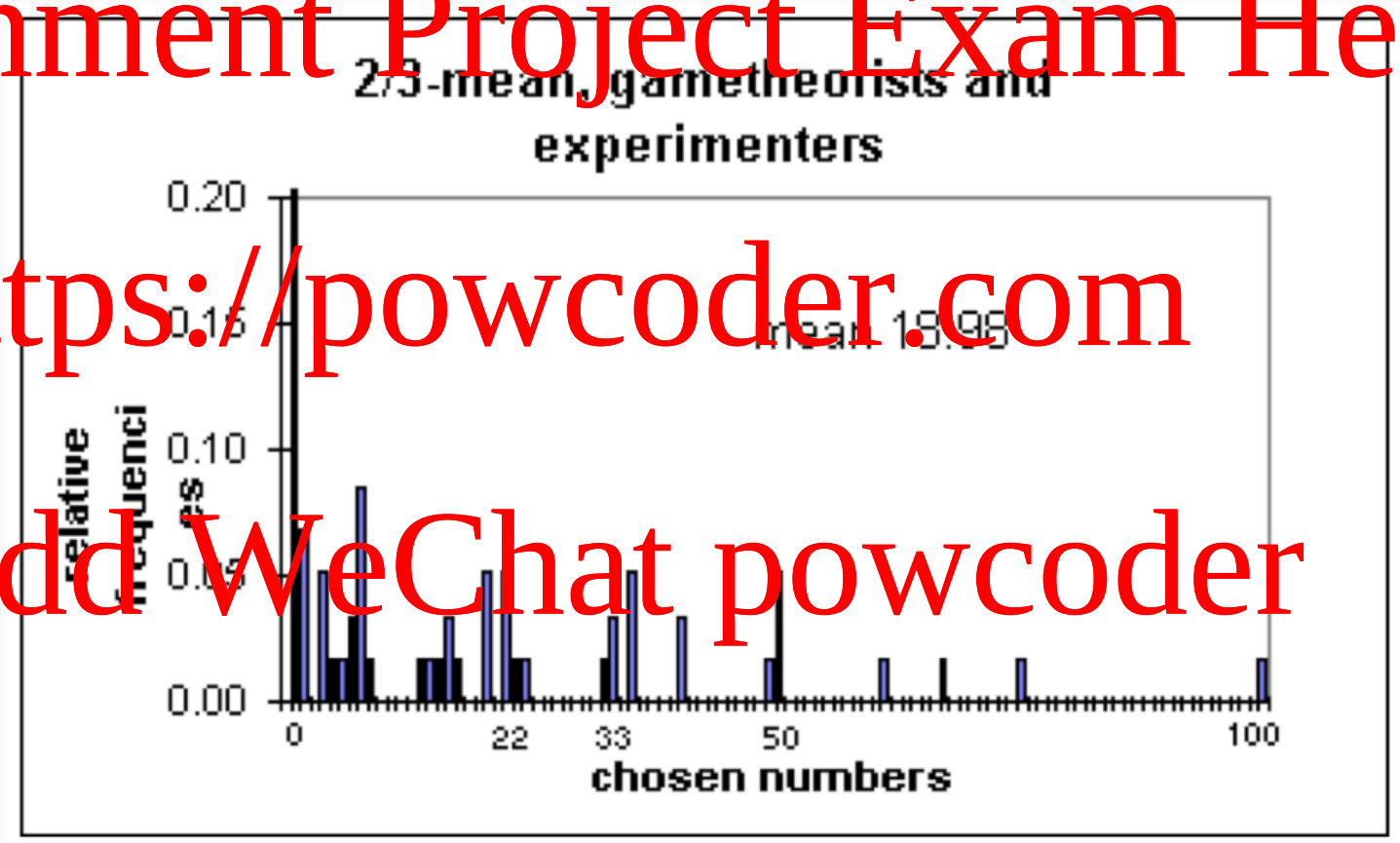




# Game theorists and experimenters







# Comparative statics (one round game)

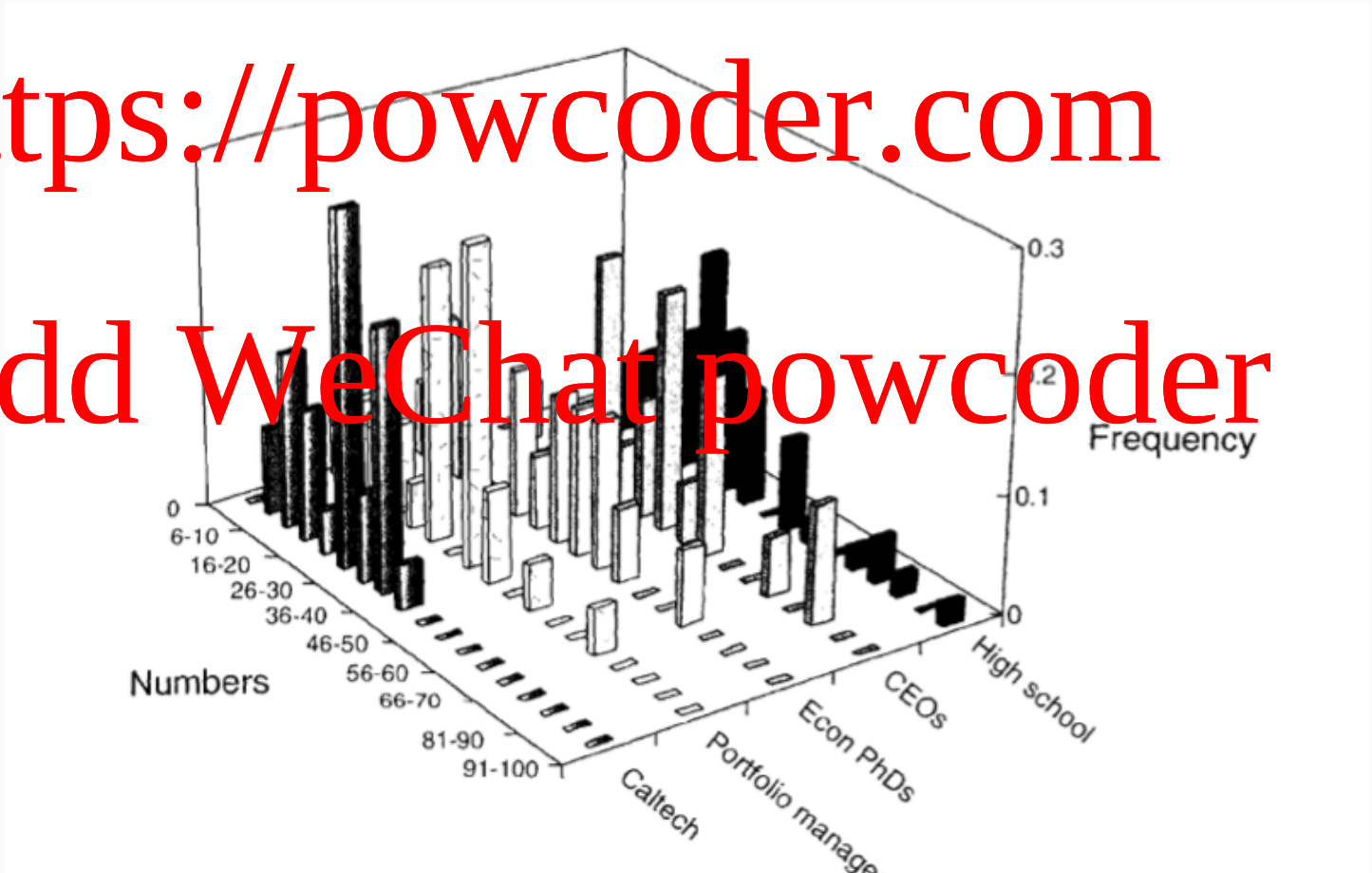
## Stakes

Not much difference

## Population

No massive difference





# Two player beauty contest



**Best response**

If $p < 1$, guessing zero is a weakly dominant strategy

**Actual play**

Only a minority realises this

# Learning





When the game is played in multiple rounds, people learn

- Roughly speaking, people best-respond to the typical choices in the previous round

# Conclusion

# Conclusion



## One-shot games

- Common knowledge of rationality reasoning does not work in practice
- Level-k reasoning is a much better model



## Repeated games

- When people repeat an interaction many times, they best-respond to the previous round's behaviour
- In some cases, behaviour eventually converges to Nash-equilibrium

# Individual behaviour

# The profit maximising firm



## Theory

- In intermediate-micro, we model firms as choosing supply and prices to maximise profit
- Firms know what market demand is, and solve profit maximisation equations



## Reality



- Firms do not know what market demand is
- Nobody solves profit maximisation equations
- Firms use rules-of-thumb, such as cost plus pricing (charge 20% more than production cost)

# Competitive pressures





- In highly competitive markets (and not all markets are competitive!), closer to optimal behaviour will drive out less optimal behaviour
- Over time, firms will come closer to optimal behaviour
- Analogy with repeated interaction in games

# Social

# Standard economics

# Selfishness





- People are assumed to be selfish
- Care only about their own consumption
- Do not care about others at all

# Other-regarding preferences

# Preferences over distribution

**Selfish**

- Don't care about others at all
- Uncommon

**Competitive**

- Want others to have less
- Uncommon

**Pro-social**

- Want others to have more
- Common

**Equality**

- Want others to have more, but not more than themselves
- Most common?

# Warm glow



- People often enjoy directly helping others
- They get a warm glow from it
- Prefer this to more effective help
- Relatively few people care only about outcomes

# Temptation to help

## Beggars

- Many people will donate to a beggar
- But if they see the beggar in advance, they will cross the street to avoid the beggar

## Charity

- Many people will donate to charity if they knock on their door
- But if informed in advance when the charity will come to solicit donations, they will not open the door

## Helping as a temptation

- Helping, for these people, is something they cannot help doing, but prefer not to

# Reciprocity





- Many people like to reward nice people
- Will often pay a cost to punish bad people

# Conformity

# Conformity





People will often conform with how other people around them behave



**Moral behaviour**

- If other people are good, they will also be good
- If other people are bad, they will also be bad



- It takes an unusual personality to defy social norms

# Conformity and energy preservation



- If you tell people that they use up more energy than their neighbours, many will cut down on their use
- If you tell people that they use up less energy than their neighbours, many will increase their use
- social comparisons can change behaviour in both directions

# Social norms

# Social norms





Social norms are often very strong, and people are well aware of them

# Ultimatum game





## The game

- The Proposer offers to split an amount of money with the Recipient
- The Recipient can accept or reject the offer



## Standard economic analysis

- The Proposer will offer as little as possible, and the Recipient will accept



## Actual results

- Recipients reject many offers below 40%
- Most Proposers offer at least 1/3 to the Recipient, and usually 40-50%

# Ultimatum game



## Summary

- There is a social norm to reject low offers
- Recipients follow this norm
- Proposers anticipate this

# Beliefs

# Anchoring effect

# Anchoring in beliefs





**Example (Number of countries in Africa)**

- Write down the last two digits of your phone number
- Is the number of countries Africa greater or smaller?
- What's your best guess for the number of countries in Africa?



**Results**



| Anchor | Median estimate for # countries |
|---|---|
| 10 | 25 |
| 65 | 45 |

**Conclusion**

Beliefs can often be manipulated

# Confirmation bias

# Beliefs are hard to shake





Once people come to believe something, they are biased to interpret evidence as confirming their existing beliefs

- Confirming evidence will be accepted without question
- Disconfirming evidence will be questioned, and will often be rejected

# Polarisation

## Corollary of confirmation bias

If two groups believe opposite things, mixed evidence will drive their beliefs further apart

## Explanation

- Each side will unquestionably accept the evidence that supports their position
- Each side will reject much of the evidence that contradicts their position

## Exception

- Evidence not open to interpretation
- Example: colour of balls drawn from an urn
- Such cases are rare in practice

# Overcoming confirmation bias



**Delay forming beliefs**

Whenever possible, gather all the evidence first, and only then form your beliefs



**Formal testing**

- Act like a scientist, writing down testable predictions, and checking whether the data is consistent with them



- This is very different from an informal evaluation of the evidence after the fact

## Wishful thinking

# Believing what you want to be true





People are biased to believe what they want to be true

# Conflict situations



The two sides believe justice is on their side, and they are going to win



- Fouls in sports games
- War
- Etc.



**Results**

- Failure to reach efficient agreement
- Negative-sum games

# Social conformity

# Following others



- If everyone else states that $x$ is true, people conclude $x$ really is true



- This can be rational (if everyone has independent evidence), but people may also irrationally ignore their own information

**Implication for group decision making**



- Better to ask everyone to write down their views before they hear what other people think
- Otherwise, the order of speakers will affect the result
- People in authority should be particularly careful not to reveal their view too early

# Base-rate neglect

# Breast cancer screening



## The test

- Breast cancer screening has 75% sensitivity and 88% specificity
  - 75% of women with cancer test positive
  - 88% of women without cancer test negative



## Case

A young woman tests positive for breast cancer



- How likely is she to have breast cancer?

## Answer

- Less than 1%

# What's going on?

## Base-rate

The base-rate in this population is extremely low

- Despite the high sensitivity and specificity of the test, a positive test is much more likely to be a false positive than a true positive



## Base-rate neglect

- People don't think like that
- It's easy to think of the causal link between an individual woman and her test result (Probability of positive test given disease)
- It's hard to think of the non-causal inverse-probability (Probability of disease given positive test)

## Availability

# Shark attacks



- People often assess the likelihood of events by how easy it is to recall events like that
- Shark attacks are assessed as common, because people remember reading about a shark attack
- Recent news have a disproportionate effect on probability evaluation

# Representativeness

# Independent events





People feel that a sequence of random draws should be representative:



- TFTTFTFFT etc.



**Gambler's fallacy**

If they see several T T T in a row, they think F is 'due'

# Probabilities

# Limited understanding of uncertainty

Most people have a very limited understanding of uncertainty:

- Certain to happen
- Certain not to happen
- Uncertain



**2016 U.S. election**

- The final forecast of the 538 website was a 2/3 probability for a Clinton victory
- After Trump won, many people just said they were wrong
- What's worse, they did not distinguish between this prediction, and that of people who said Clinton is certain to win

# Expressing uncertainty





Most people (including university students) are hopeless at expressing their uncertainty in probability terms