Econ 211

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More Evidence for Prospect Theory

Overview

- Loss aversion is one of the most well-supported theories from the field
- We already saw how it could explain behavior of cab drivers
- We will see two more famous examples today
  - One additional real-world example, this time of professional golfers
  - A laboratory experiment where reference points come from expectations

Why Golf?

- Pope and Schweitzer examine observational data from professional golfers playing on the PGA tour
- Golf suggests a natural reference point for score on each hole: par
  - Par is the number of strokes a professional golfer typically takes to complete the hole
  - Because object of game is *minimize* number of strokes, below par is the gain domain and above par is the loss domain
  - Terminology for going above or below par:
    - Eagle: two shots below par
    - Birdie: one shot below par
    - Bogey: one shot above par
    - Double bogey: two shots above par
- Stakes are very high: typical tournament pays out $5 million in prizes to the top finishers

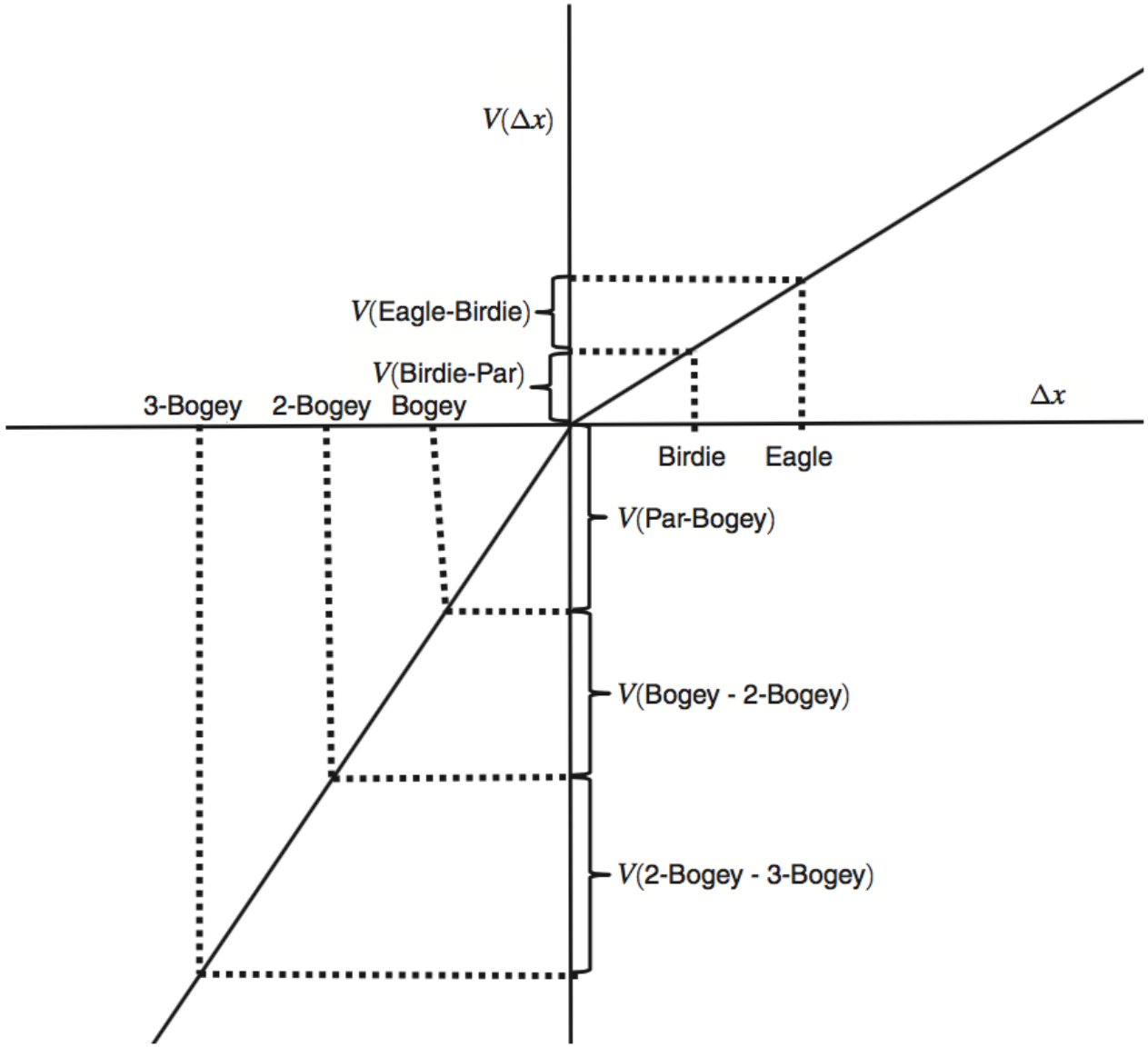
Connection to Prospect Theory

- Let Δx indicate the score relative to par
- Prospect theory value function (with no diminishing sensitivity):

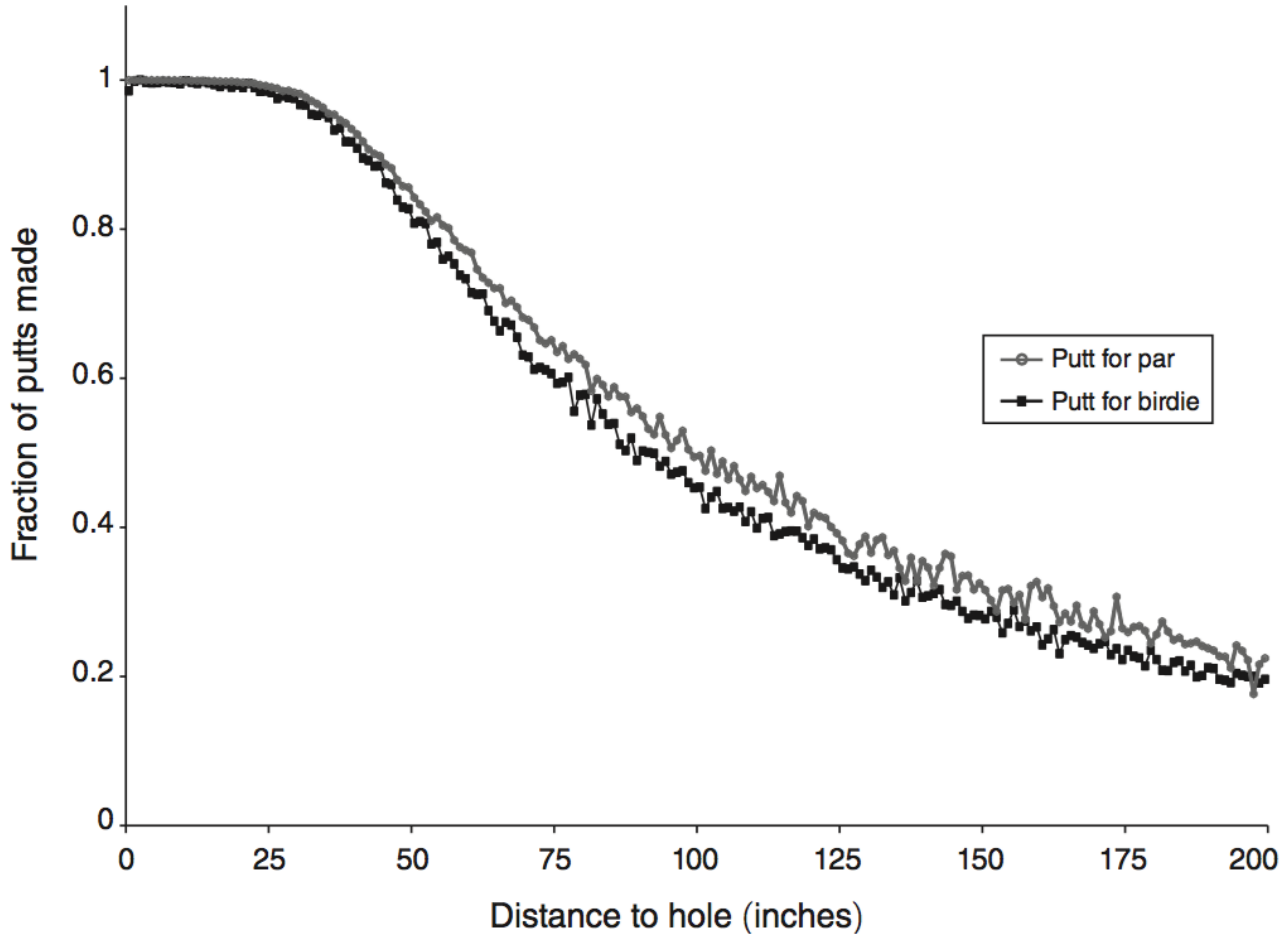
$$v(\Delta x) = \begin{cases} \Delta x & \Delta x \geq 0 \\ \lambda \Delta x & \Delta x < 0 \end{cases}$$

- Focus on putting (usually last 1-2 shots of the hole)
  - Make the putt for score $\Delta x - 1$, or
  - Miss the putt for score Δx
- Prediction from prospect theory? Putts attempted for par, bogey, and double-bogey will be more accurate than putts attempted for birdie and eagle

Value Function Applied to Golf



Results



- 2-4 percentage points more likely to make putts for par from same distance as putt for birdie

Expectations as Reference Point

- So far, we have mostly thought of reference point as fixed number, independent of the choice at hand
- However, possible that reference point is based on *expected* outcome
  - For example, equal chances of getting \$10, \$40, or \$50
  - Getting \$10 feels like a loss, while getting \$40 or \$50 feels like a gain
  - So a reasonable reference points might be the expected value:

$$\frac{\$10 + \$40 + \$50}{3} = \$33.33$$

Setup: Effort Task

- Abeler, Falk, and Goette (2011) perform lab experiment where they manipulate expected payment for a task
- Task: count the number of zeros in an array of 150 randomly ordered ones and zeros
  - This is *really annoying* ▸ Example
- Subjects performed as many of these tasks as they wanted, for up to 60 minutes
- One of two possible payment schemes
  - 50% probability: paid 10 cents per correct answer (piece rate)
  - 50% probability: paid fixed amount (either 3 Euros in LOW treatment or 7 Euros in HIGH treatment)
- Do not know which payment scheme will be used under *after* they have decided to stop working

Expected Results

- Assume that reference point for earnings is average of what subject will earn if paid piece rate and what subject will earn if paid fixed amount
- Which treatment should have higher effort?
- Reference point should be higher for subjects in the HIGH treatment
- Earning less than the reference point feels like a loss, so subjects work harder to get to reference point
- Thus subjects in HIGH treatment are expected to work harder (ie complete more tasks) than subjects in LOW treatment

Formal Analysis

- Suppose if subject puts in effort e, they will finish e tasks
- Each task pays w (no fixed amount yet)
- Utility of money $4\sqrt{x}$
- Effort cost $c(e) = e$
- Thus utility is $u(e) = 4\sqrt{we} - e$
- Now introduce 50% chance of fixed payment F
- What is expected utility?

$$EU = \frac{1}{2}(4\sqrt{we} - e) + \frac{1}{2}(4\sqrt{F} - e) = 2\sqrt{we} + 2\sqrt{F} - e$$

- What level of e maximizes EU?
  - FOC of EU gives $e = w$
  - Note that effort does not change if F increases

Formal Analysis, cont

- Suppose reference point is expected payment
- What is formula for reference point as function of e? $\frac{1}{2}F + \frac{1}{2}we$
- What is prospect theory value as function of e?
  - Assume $\lambda = 2$
  - Assume reference point only affects money part of utility function, not effort cost part
  - Assume $F > we$ for all possible effort levels

$$PT = \frac{1}{2}(-2)\left(4\sqrt{\left|we - \left(\frac{1}{2}F + \frac{1}{2}we\right)\right|} - e\right)$$
$$+\frac{1}{2}\left(4\sqrt{\left|F - \left(\frac{1}{2}F + \frac{1}{2}we\right)\right|} - e\right)$$

- What level of e maximizes PT?
  - FOC of PT gives $e = \frac{F}{w} - \frac{1}{2}w$
  - Note that effort increases with F

Results

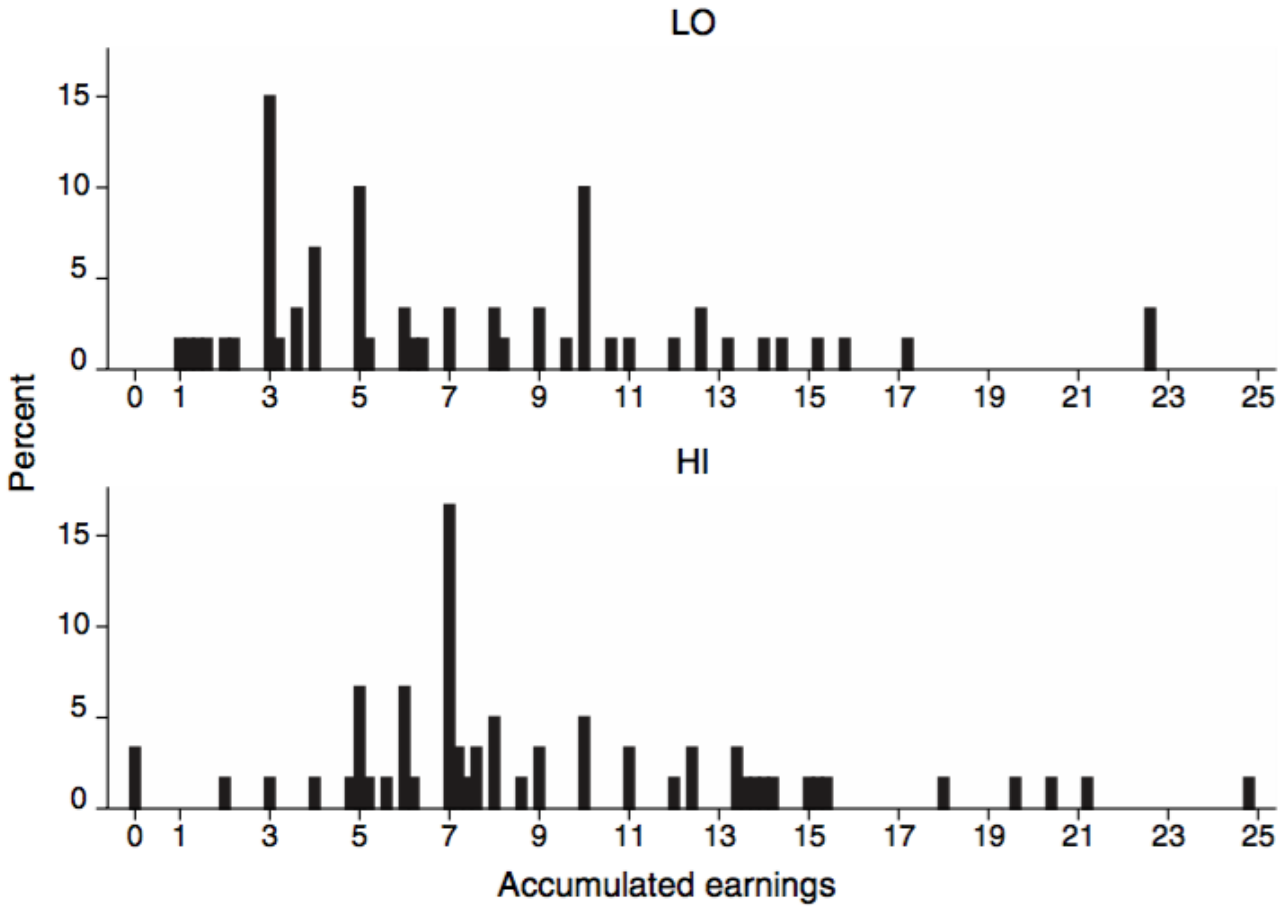


FIGURE 1. HISTOGRAM OF ACCUMULATED EARNINGS (IN EUROS) AT WHICH A SUBJECT STOPPED

- Averages:
  - LOW: 7.27 Euro
  - HIGH: 9.22 Euro

Formation of Risk Preferences

Motivation

- Standard theory
  - You are born knowing exactly how you will respond to risk
  - Risk preferences are stable over your entire lifetime
  - Your risk preferences do not depend on outside factors or information
- However, it is clear intuitively that your experiences can shape your tolerance for risk

Setup

- Malmendier and Nagel (2011) examine this question with observational data
  - Data from the Survey of Consumer Finances, 1960-2007
  - Respondents report own risk tolerance, as well as their stock and bond holdings
  - Authors also collect data on annual average returns for stock market
- Hypothesis: individuals who have experienced higher returns on the stock market during their lifetime are more likely to take risks and invest in stocks

Results

- Individuals who experienced better-performing stock markets . . .
  - more likely to categorize themselves as financial risk-takers
    - Risk tolerance self-assessed on 4-point scale
    - Going from 10th to 90th percentile of returns experienced makes 10 percentage points less likely to be in lowest-risk-tolerance group
  - more likely to participate in financial markets at all
    - Participation as many as 7 percentage points lower than expected for some cohorts
  - hold more of their risky assets as stocks (as opposed to bonds)
    - Going from 10th to 90th percentile of returns experienced predicts 7.9 percentage points more assets as stocks

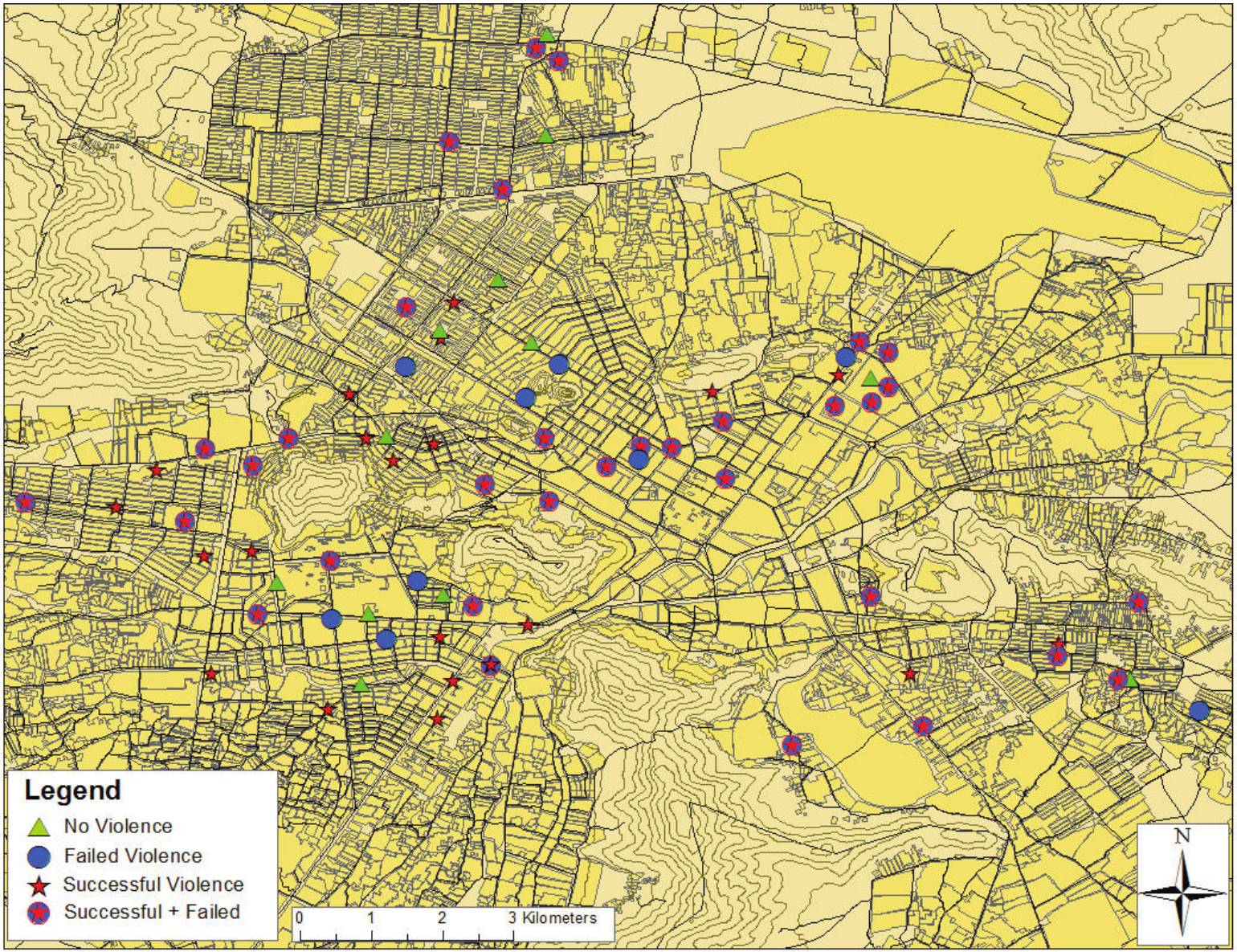
Subject Population

- Callen et al (2014) conducted field experiment in Afghanistan in December 2010
- Subjects were asked questions about their risk preferences, and some were also given a psychological prime
- Conducted near polling centers, three months after major election in September of that year
- Surveys conducted in homes
  - Hypothetical risk elicitations used for safety issues
- 1127 respondents in 12 provinces
  - Major attrition issues

Violence Data

- Afghanistan has experienced widespread violence for last 30+ years
- Focus on 2002-2010, ie leading up to election in 2010
- Geo-coded data on violence incidents during this time
  - Successful attacks: direct fire, explosions
  - Unsuccessful attacks: explosive devises found and cleared, hoaxes
- Main variable used: whether there were any successful attacks within one kilometer of polling station
- Placebo test: use failed attacks as main indicator instead
  - If assume success/failure is random, this allows us to tell whether it is threat or violence or actual violent outcomes that affect behavior

Polling Centers in Kabul



Risk Elicitation Task: Monetary Payoffs

$\in$	Option B	Option A
Task 1		
q'		
[0, 0.1]	10% chance of 450 Afs, 90% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.1, 0.2]	20% chance of 450 Afs, 80% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.2, 0.3]	30% chance of 450 Afs, 70% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.3, 0.4]	40% chance of 450 Afs, 60% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.4, 0.5]	50% chance of 450 Afs, 50% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.5, 0.6]	60% chance of 450 Afs, 40% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.6, 0.7]	70% chance of 450 Afs, 30% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.7, 0.8]	80% chance of 450 Afs, 20% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.8, 0.9]	90% chance of 450 Afs, 10% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.9, 1]	100% chance of 450 Afs, 0% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
$\in$		
Task 2		
q		
[0, 0.1]	10% chance of 450 Afs, 90% chance of 0 Afs	150 Afghanis
[0.1, 0.2]	20% chance of 450 Afs, 80% chance of 0 Afs	150 Afghanis
[0.2, 0.3]	30% chance of 450 Afs, 70% chance of 0 Afs	150 Afghanis
[0.3, 0.4]	40% chance of 450 Afs, 60% chance of 0 Afs	150 Afghanis
[0.4, 0.5]	50% chance of 450 Afs, 50% chance of 0 Afs	150 Afghanis
[0.5, 0.6]	60% chance of 450 Afs, 40% chance of 0 Afs	150 Afghanis
[0.6, 0.7]	70% chance of 450 Afs, 30% chance of 0 Afs	150 Afghanis
[0.7, 0.8]	80% chance of 450 Afs, 20% chance of 0 Afs	150 Afghanis
[0.8, 0.9]	90% chance of 450 Afs, 10% chance of 0 Afs	150 Afghanis
[0.9, 1]	100% chance of 450 Afs, 0% chance of 0 Afs	150 Afghanis

Note: 150 Afghanis equivalent to about 1 day's wage. Recall that stakes are hypothetical.

Theoretical Predictions

- Consider Task 1
  - EU decision-makers should switch from A to B at q' such that

$$\underbrace{q' \cdot v(450) + (1 - q') \cdot v(0)}_{\text{option B}} = \underbrace{0.5 \cdot v(450) + 0.5 \cdot v(150)}_{\text{option A}}$$

  - We can choose scale of $v(\cdot)$ so that $v(0) = 0$ and $v(450) = 1$
  - Solve to find

$$v(150) = \frac{q' - 0.5}{0.5}$$

- Now consider Task 2
  - EU decision-makers should switch from A to B at q' such that s

$$\underbrace{q \cdot v(450) + (1 - q) \cdot v(0)}_{\text{option B}} = \underbrace{v(150)}_{\text{option A}}$$

  - Solve to find

$$v(150) = q$$

Theoretical Predictions, cont

- So expected utility theory says there should be a connection between Task 1 switch point q' and Task 2 switch point q:

$$q = \frac{q' - 0.5}{0.5}$$

- For example, if you switch at row 8 of Task 1, ie $q' \in [0.7, 0.8]$, you should switch at row 5 or 6 of Task 2, ie $q \in [0.4, 0.6]$
- If you switch earlier or later than this in Task 2, we can take this as evidence against Expected Utility, and in favor of Prospect Theory

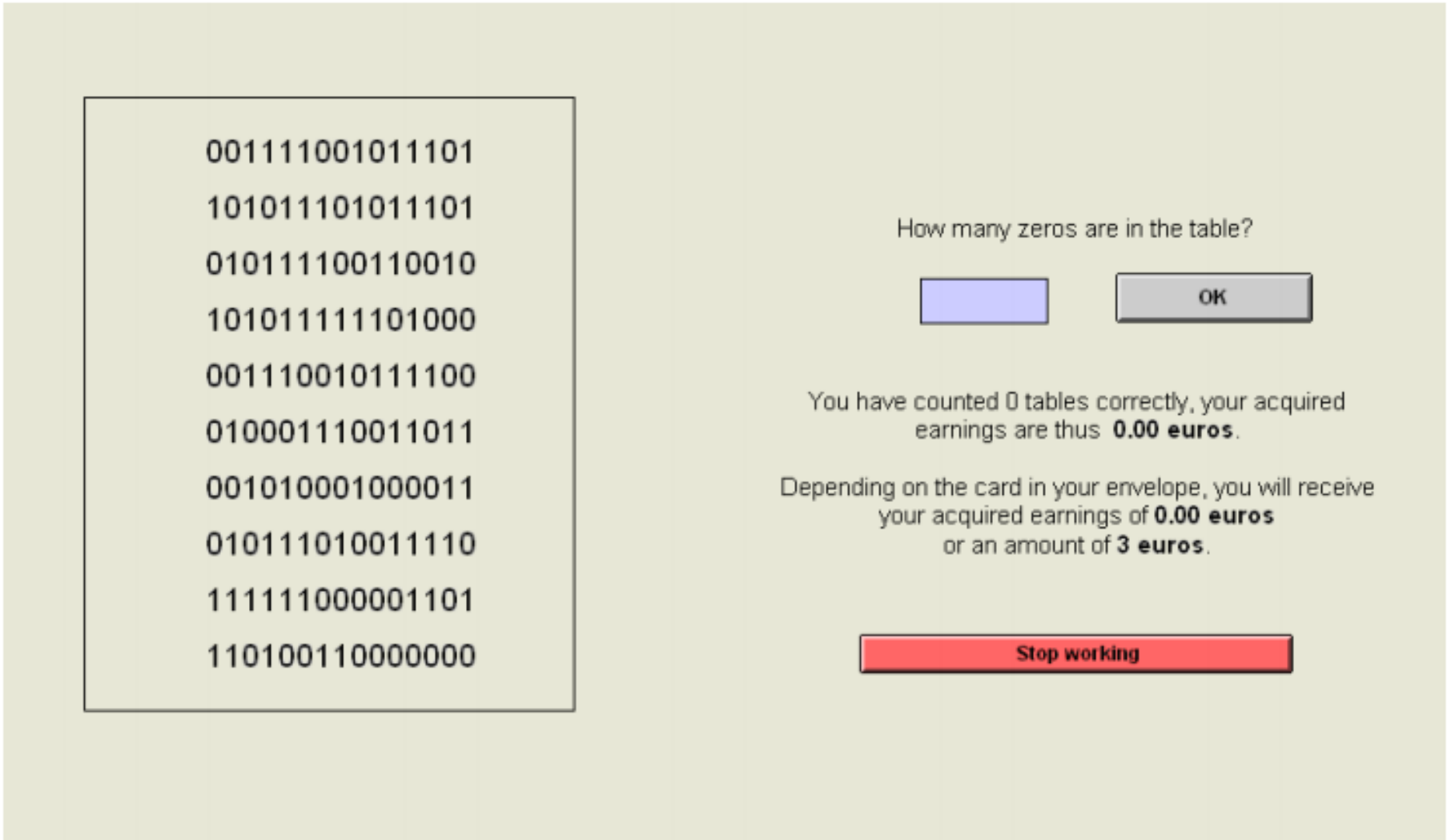
Psychological Prime

- Prior to risk elicitations, subjects are asked one of three (randomly selected) questions:
  - "We are interested in understanding your daily experiences that may make you fearful or anxious. This could be anything, for example getting sick, experiencing violence, losing a job, etc. Could you describe one event in the past year that caused you fear or anxiety?" (FEAR)
  - "We are interested in understanding your daily experi- ences that make you happy or joyous. This could be anything, for example birth of child, marriage of a relative, or success in your job. Could you describe an event in the past year that caused you happiness?" (HAPPY)
  - "We are interested in understanding your general daily experiences. This could be anything. Could you describe an event from the past year" (NEUTRAL)
- Prior evidence that being primed for fear makes individuals think bad events are more likely (Lerner et al 2003)

Results

- Evidence of strong violations of EU predictions among subjects who received FEAR prime and had violence near their polling center
  - Placebo test indicates that is it successful attacks, and not intended violence, that causes response
- All other groups consistent with EU predictions

Example of Counting Zeros Task



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