Design Invariance in the Classical Consumer Problem: Part II

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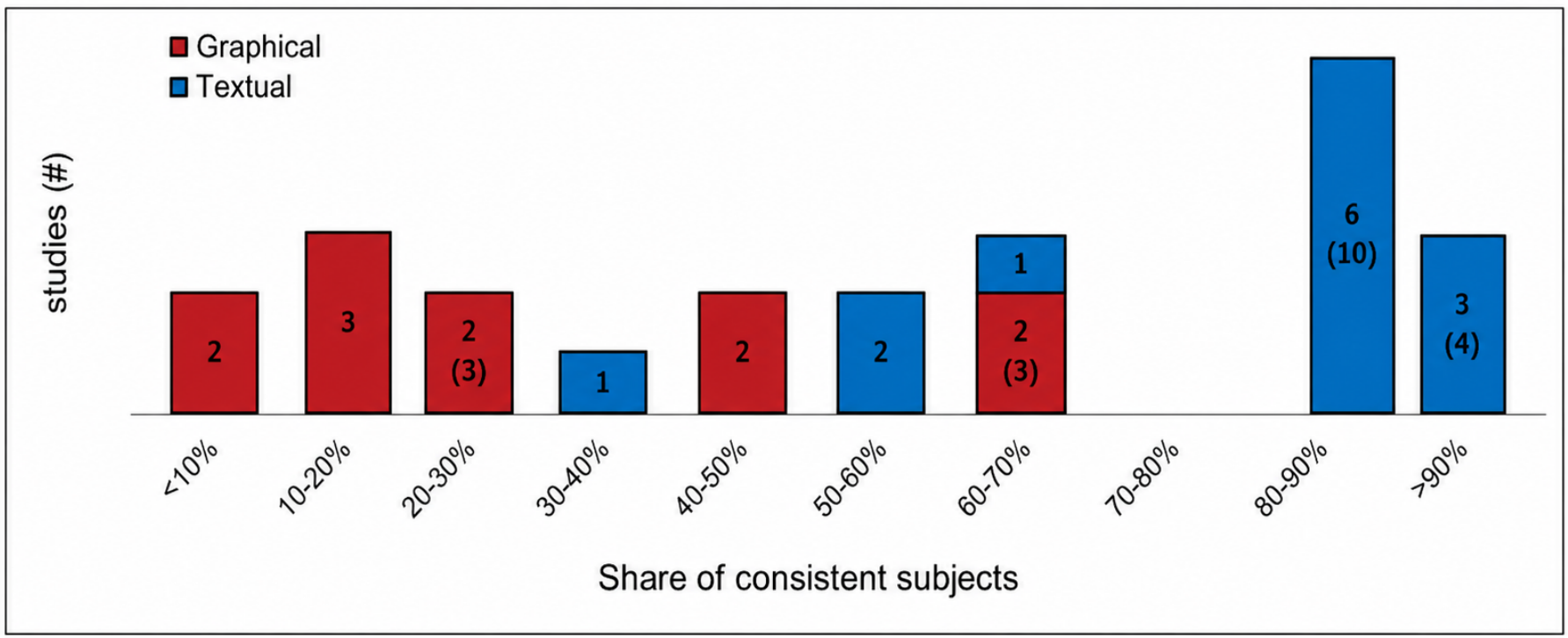
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The Puzzle

	Trials	*Price Ratios*	*No. of subjects*	*% of GARP satisfiers*	*Average Afriat index*
Fisman, Kariv and Markovits (AER 2007)*	50	Unbounded	76	10.5%	0.108
Andreoni and Miller (ECMT 2002)	8 (8 or 11)	T=3 (T=4)	142 (176)	90.8% (89.8%)	0.003 (0.002)

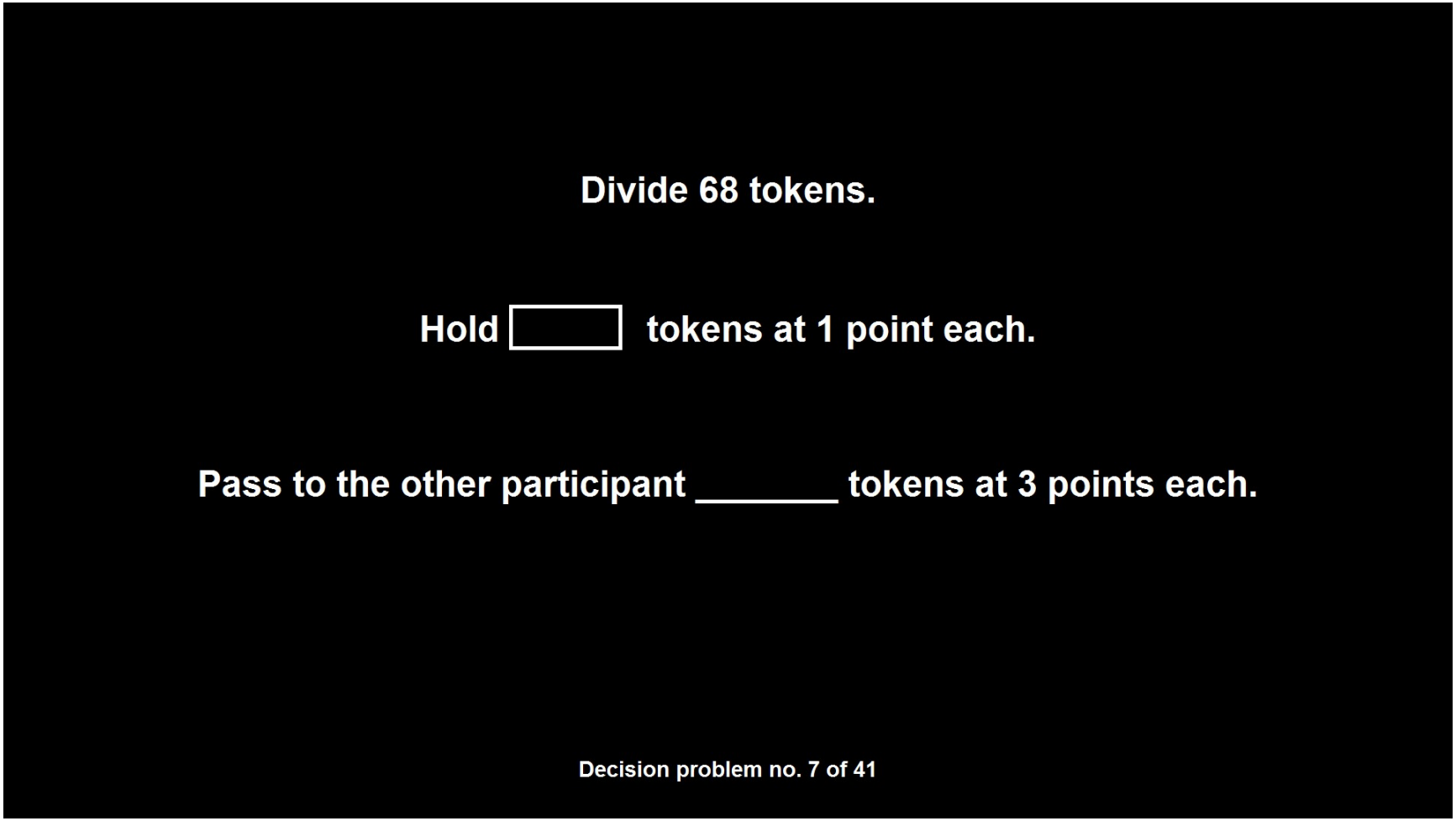
(*) only two-person treatment.



MDG: The Setting

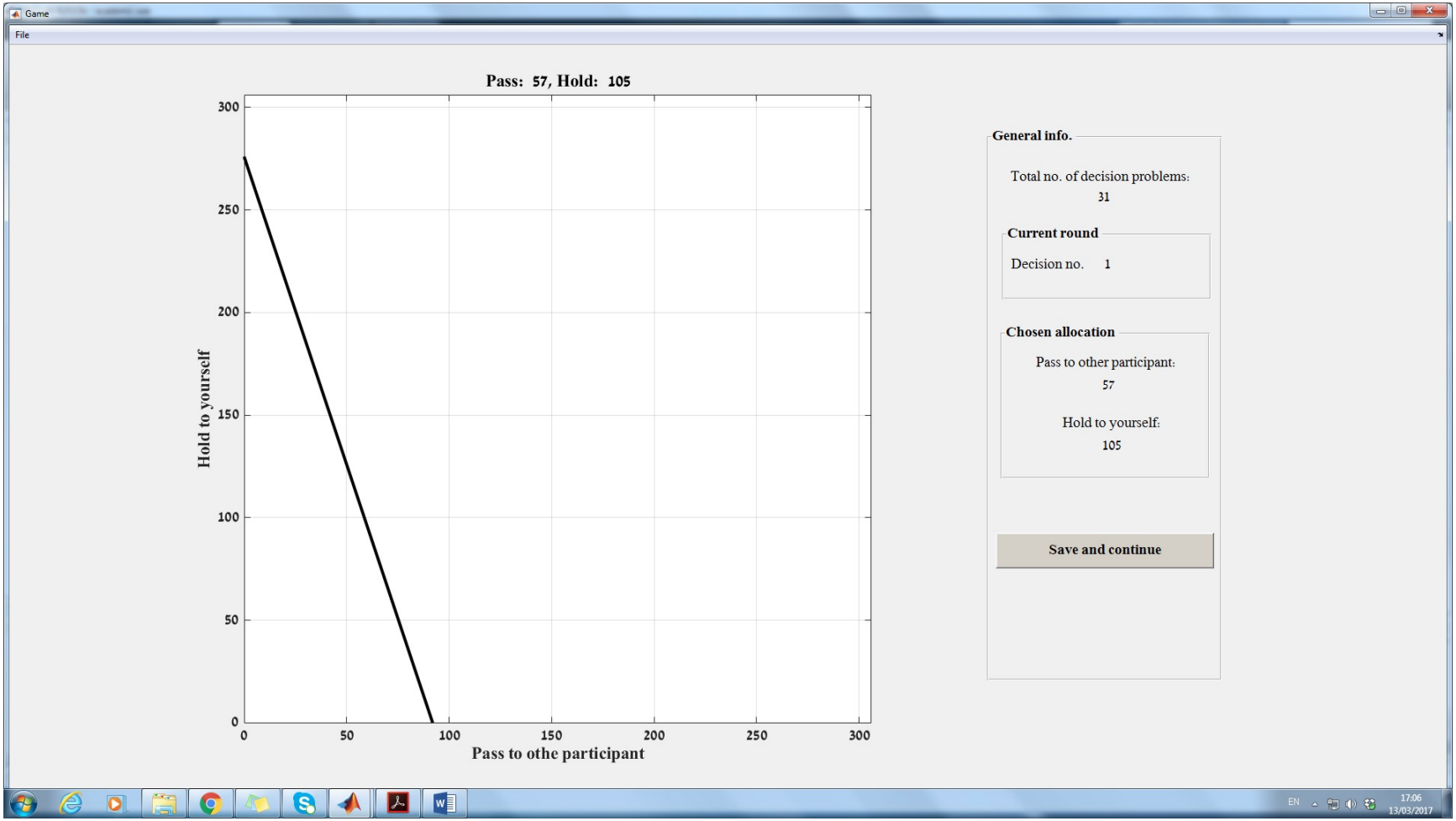
- In each decision problem, the subject allocates tokens between herself and an anonymous other subject.
- Each token allocated to herself is multiplied by α points; each token allocated to the other is worth β points.
- Subjects face a series of 10–50 problems that differ in α, β, and the number of tokens to allocate.

MDG: Textual Interface



◂ Hebrew ◂ Original

MDG: Graphical Interface



◂ Hebrew ◂ Original

Implementation

- Sessions were run either entirely in the textual interface or entirely in the graphical interface (between subject design).
- At the beginning of the experiment, each subject was randomly assigned to:
  - A number of trials (between 10 and 50).
  - An upper bound on the price ratio T (integer between 3 and 12).
- In each trial the subject was randomly assigned with:
  - Price ratio (in $\{\frac{1}{T}, \frac{1}{T-1}, \ldots, 1, \ldots, T-1, T\}$).
  - Tokens endowment (integer between 40 and 100).
- 272 subjects: undergrads from TAU and BGU.

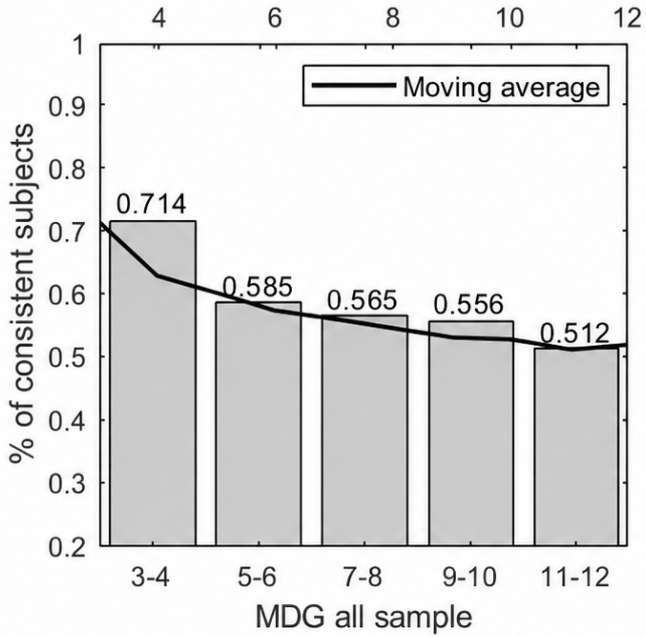
Consistency

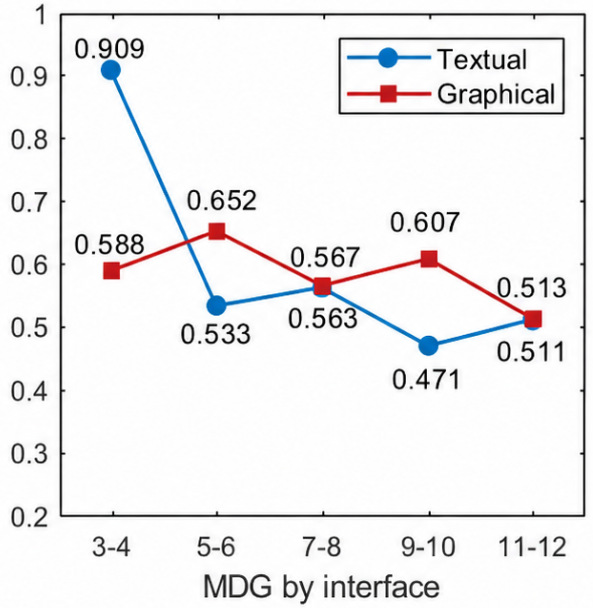
Interface	Consistent	
	subjects (#)	%
Textual	75	55.6%
Graphical	79	57.7%
Total	154	56.6%

Result

When the design controls for the number of trials and for the range of slopes, the effect of the interface on consistency vanishes and maybe even reverses.

The Range of Price Ratios





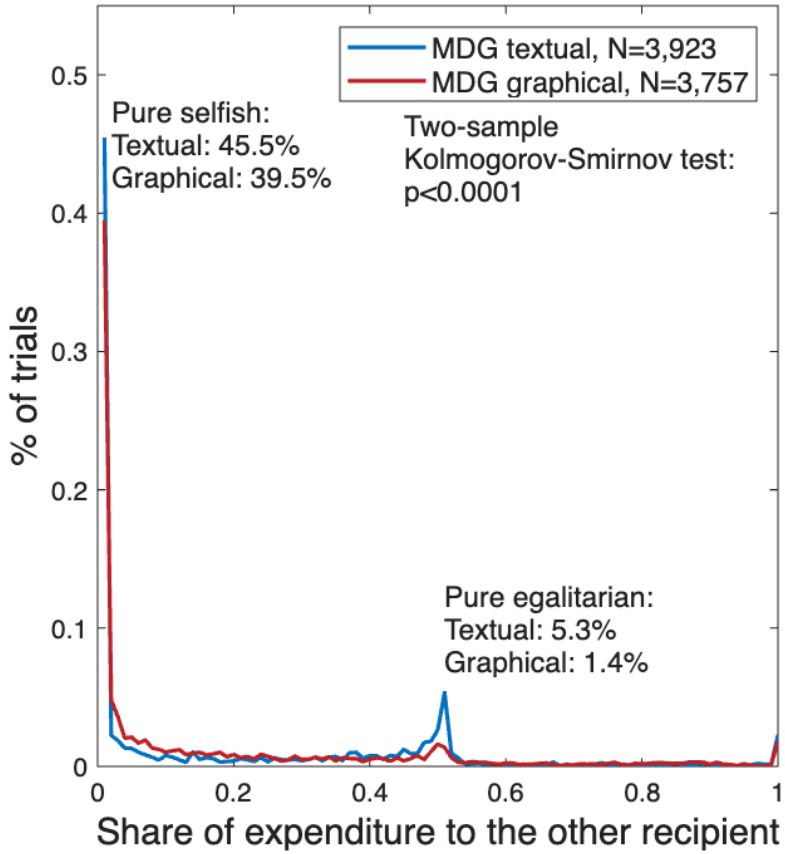
Result

An increase in the maximal slope assigned to the subject leads to heterogeneous effects across interfaces.

Does the Format Affect Behavior?

- If the interfaces differ only in ease of use (user-friendliness), then subjects should behave similarly across interfaces, after accounting for mistakes.
- Consistency analysis is not adequate to answer this question.
- Such analysis requires exploring actual choices rather than their internal consistency.

Focal Bundles



Result

50-50 and Selfish allocations are chosen more often in the textual treatment.

Parametric Recovery of Preferences

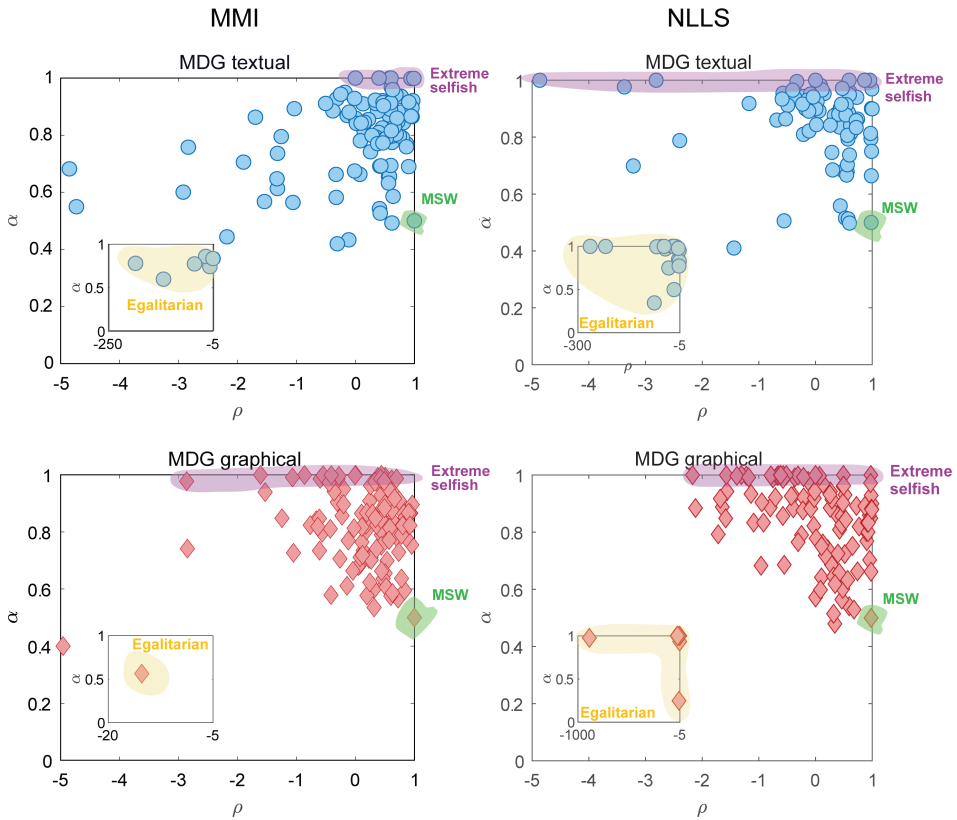
In MDG, preferences are usually recovered using the Constant Elasticity of Substitution (CES) utility function

$$u(x,y) = [\alpha \times x^{\rho} + (1-\alpha) \times y^{\rho}]^{\frac{1}{\rho}}$$

where x is the monetary allocation for Self and y is the monetary allocation for Other. $\alpha \in [0,1]$ is the relative weight on payoff to Self, and $1/(\rho - 1)$ is the elasticity of substitution between Self and Other ($\rho \in (-\infty, 1]$).

- Extreme Altruism: $\alpha = 0$.
- Extreme Selfishness: $\alpha = 1$.
- Egalitarianism: $\rho \to -\infty$.
- Maximal Social Welfare: $\alpha = 0.5$ and $\rho = 1$.
- (Cobb-Douglas with Parameter α: $\rho \to 0$.)

Results



Result

The majority of non-selfish subjects cannot be classified into standard behaviors based on parametric preference elicitation.

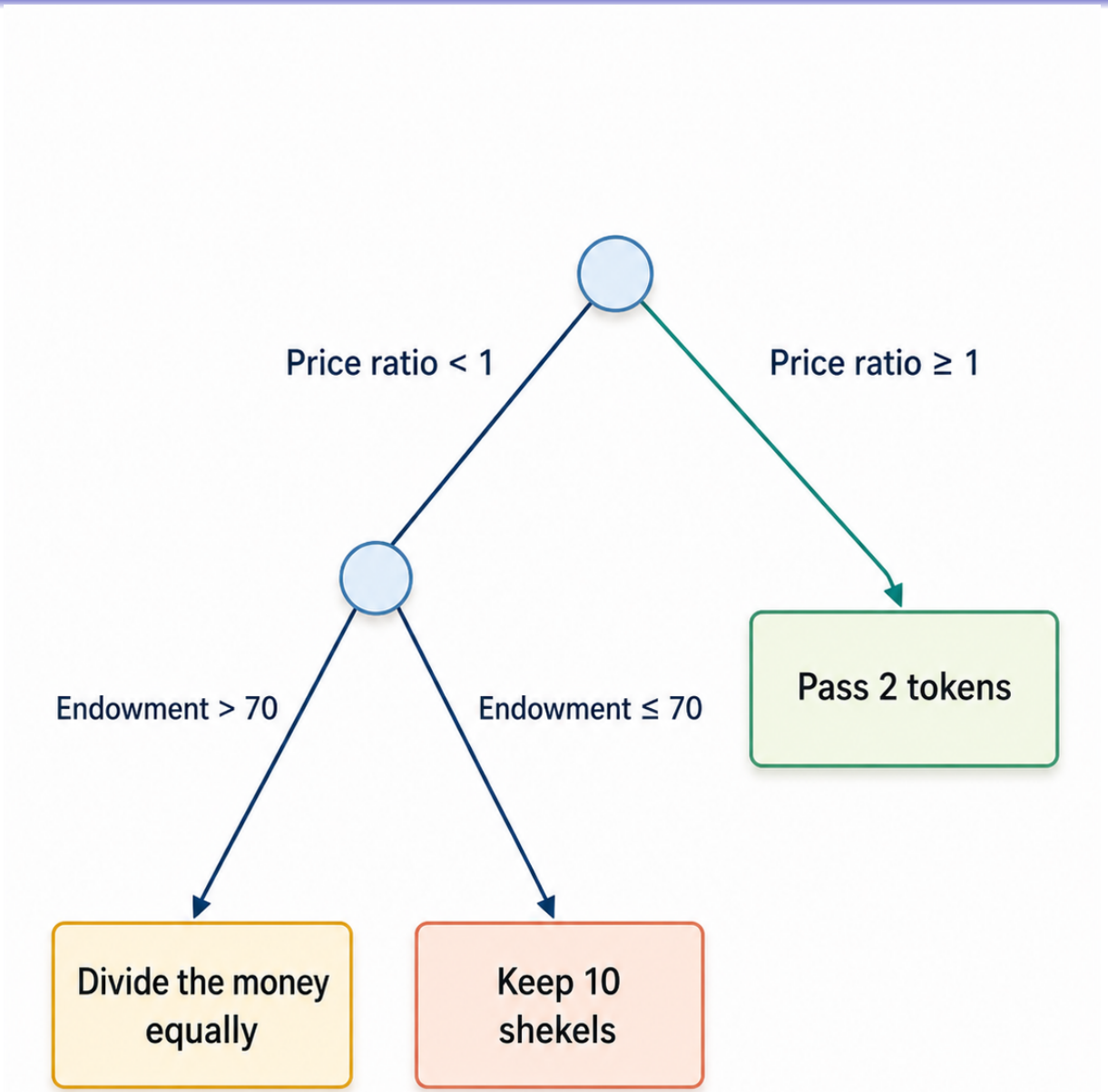
A different approach: Procedures

- Utility maximization is an AS-IF approach.
- Can we use a direct approach and identify the decision rules of the subjects?
- First step: Ask an RA to “eyeball” the choices and classify the subject’s behavior.
- Second step: Supervised learning. A classification algorithm.
- Third step: Ask your favorite AI agent to “eyeball” the choices and classify the subject’s behavior.

What Are Procedures?

- Two parameters change across trials:
  - Price ratio (flat/steep slope).
  - Endowment (inward/outward parallel shift).
  - (Trial number)
- We study procedures where the set of trials is partitioned by these parameters and each subset is assigned with a "simple rule".

Example


Price ratio < 1
Price ratio ≥ 1
Endowment > 70
Endowment ≤ 70
Pass 2 tokens
Divide the money equally
Keep 10 shekels

The Procedures We Study

- Partitions are implemented by cutoffs:
  - Either by price ratio, endowment or observation number.
  - We allow multiple and mixed cutoffs.
  - Up to 4 cutoffs with up to 2 types.
- Simple decision rules:
  - Give self or the other participant a fixed amount or a constant ratio.
  - Tokens, points or money.
  - On top of that: Rounding (Breitmoser (2021)).

The Algorithm: Intuitive Description

For each subject:

- Generate all possible procedures with up to 4 cutoffs.
- Each one is scored relative to the real data (we implement various scoring rules).
- Find the best procedure for every number of cutoffs.
- Penalize additional cutoffs (p is the penalty parameter).
- The output is a winner for each penalty parameter p.
- Note: the number of cutoffs in the winning procedure weakly decreases with p.

Sample

- The sample includes 240 subjects.
- Procedure computations are not yet completed: 32 of 272 subjects remain to be processed (11.8%).

Extreme Selfish

- 42 subjects (17.5%) are unambiguously identified as extreme-selfish.
  - 24/117 textual subjects (20.5%) vs. 18/123 graphical subjects (14.6%). The difference is not significant.
- Assigned T has a negative effect only within the textual interface.
  - Increasing T by 1 lowers the probability of being extreme selfish by about 2.8 percentage points.
- This inference could have been obtained from the parametric elicitation as well.
- These subjects are not included in the following analysis.

NLLS vs Simple Rules + Rounding: The Exercise

- Loss = the sum of Euclidean distances between the predicted choices and the actual choices in the money space.
- We compare:
  - Best-fitting CES function (α and ρ) estimated by NLLS.
  - Winning procedures identified by the algorithm.

NLLS vs Simple Rules + Rounding: Misspecification

- Specification test: CES vs. simple rules + rounding and no cutoff.
- For at least 102 subjects (51.5%) the simple rules + rounding did at least as well as CES.
- The success rate for the textual treatment was 68.8%, and only 36.2% for the graphical treatment.

Result

1. *Textual treatment: Misspecification is higher with CES.*
2. *Graphical treatment: Misspecification is higher with simple rules + rounding.*

NLLS vs Simple Rules + Rounding: Cutoffs

- Focus on the 96 subjects for whom CES "won" when no cutoffs were applied.
- Compare CES to the winners in the one cutoff optimization.
- For at least 73 subjects (76.0%), the simple rules + rounding + one cutoff did at least as well as CES.
- The success rate was 82.8% for the textual treatment and 73.1% for the graphical treatment.

Result

The CES specification fits worse than simple rules + rounding + one cutoff.

- 19 out of the 23 remaining subjects require only one additional cutoff to exhibit better performance than CES.

Example: Subject 1220613



Which Cutoffs Appear in Optimal Procedures?

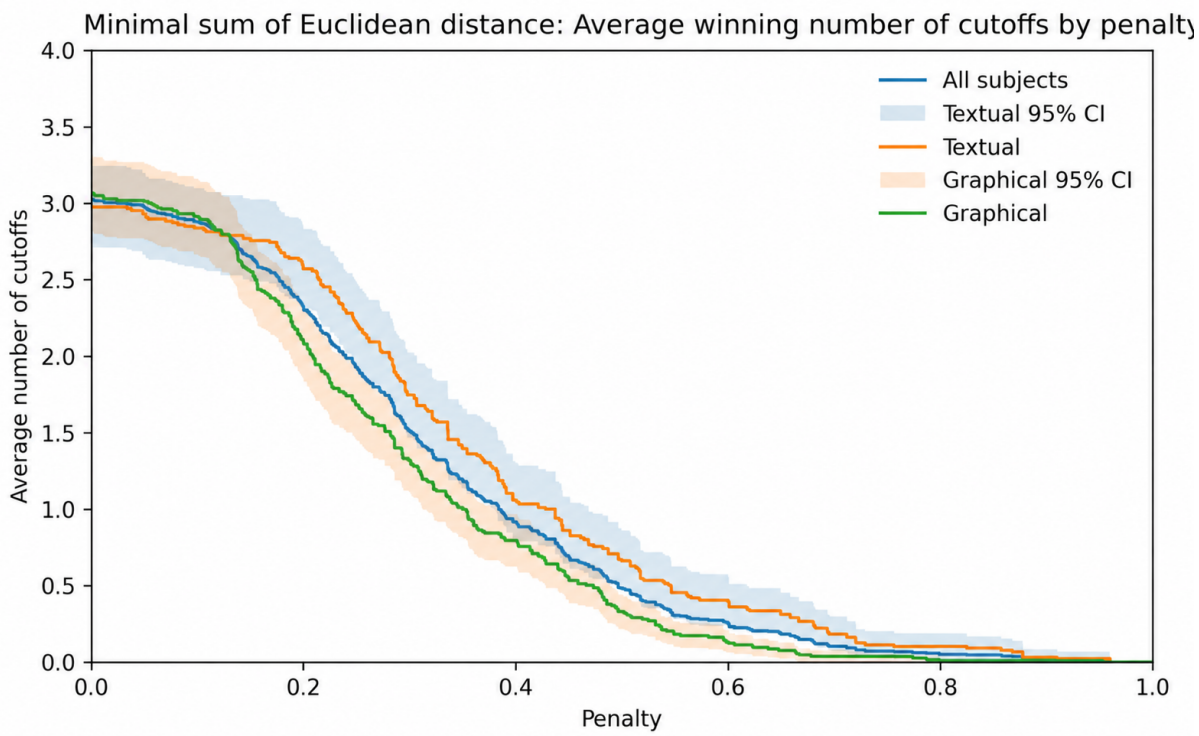
- The distribution of cutoff types within winning procedures with one cutoff:

Sample	Price Ratios	Endowments	Observation Number
All Subjects	47.5%	19.8%	32.7%
Textual	50.0%	13.2%	36.8%
Graphical	46.0%	23.8%	30.2%

- For two cutoffs or more we allow for partitions that include more than one type.

Cutoffs	Price Ratios	Endowments	Observation Number
2	64.9%	44.7%	62.3%
3	58.4%	55.4%	80.2%
4	67.3%	47.5%	82.2%

Number of Cutoffs



Result

Over penalties from 0.2 to 0.8, the textual curve is on average about 0.31 cutoffs higher than the graphical curve.

◂ No Observation Number

What Simple Rules Are Used? No Cutoffs

- Sample: 198 subjects who were computed and are not unambiguously extreme selfish.
- For 14 subjects, the no-cutoff rule won for each penalty:
  - 11 subjects are selfish with minor noise (8 in the graphical).
  - 3 subjects, all textual, divide the money equally (egalitarian).
- For 77 of the other 184 subjects the no-cutoff rule wins for every penalty greater than 0.4:
  - 18 are almost selfish (11 graphical).
  - 7 are egalitarian (5 textual).
  - Textual subjects tend to use fixed-sum rules and fixed-ratio rules with similar frequency while graphical subjects use ratio rules in 75% of the cases.

What Simple Rules Are Used? Cutoffs

- For 174 subjects, at least one procedure with a cutoff wins for some penalty greater than 0.2:
  - More fixed sum rules are elicited compared to the no cutoff procedures on both interfaces.
  - 22% of the rules are selfish.
  - 8.5% of the textual rules are egalitarian compared to only 3.4% among graphical (statistically significant difference).
  - 11 subjects have procedures that include both selfish and egalitarian rules.

Concluding Remarks: AS IF

- Simon (1976): ... notions of substantive rationality ... make no concessions to computational difficulties ... [Decision makers] use selective heuristics ... to explore a small number of promising alternatives.
- Elicitation using CES seems less useful than elicitation using simple rules, rounding and cutoffs both in prediction and in understanding human behavior.

Concluding Remarks: Design Invariance

- Textual interface vs Graphical interface:
  1. Encourages integers.
  2. Encourages giving (egalitarianism, maximizing social welfare, less selfish with high T).
  3. Encourages more partitioning (higher complexity?).
- Different interfaces operate different cognitive systems, leading subjects to different choice procedures

Thanks


THANK
YOU
GRACIAS
ARIGATO
SHUKURIA
DANKSCHEEN
JUSPAXAR
GOZAIMASHITA
EFCHARISTO
KOMAPSUMNIDA
MAAKE
GRAZIE
MEHRBANI
SUKSAMA
EKHMET
TASHAKKUR ATU
YAQHANYELAY
BOLZÏN
MERCI
BÏYAN
SHUKRIA
TINGKI
SPASSIBO
SNACHALHUYA
NUHUN
CHALTU
WABEEJA
MAITEKA
SPASIBO
DENKAUJA
NENACHALHYA
SIKOMO
MERASTAWHY
GAEJTHO
TAVTAPUCH
MEDAWAGSE
AGUYJE
FAKAAUE
LAH
PALDIES
MINMONCHAR
MAKETAI

Textual Methodology - Hebrew

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חלק/י 60 אסימונים.

שמור/שמרי לעצמך ☐ אסימונים
בערך של 1 נקודות לאסימון.

העבר/העבירי למשתתף/ת השני/ה _____ אסימונים
בערך של 2 נקודות לאסימון.

בעית החלטה מספר 33
מתוך 34

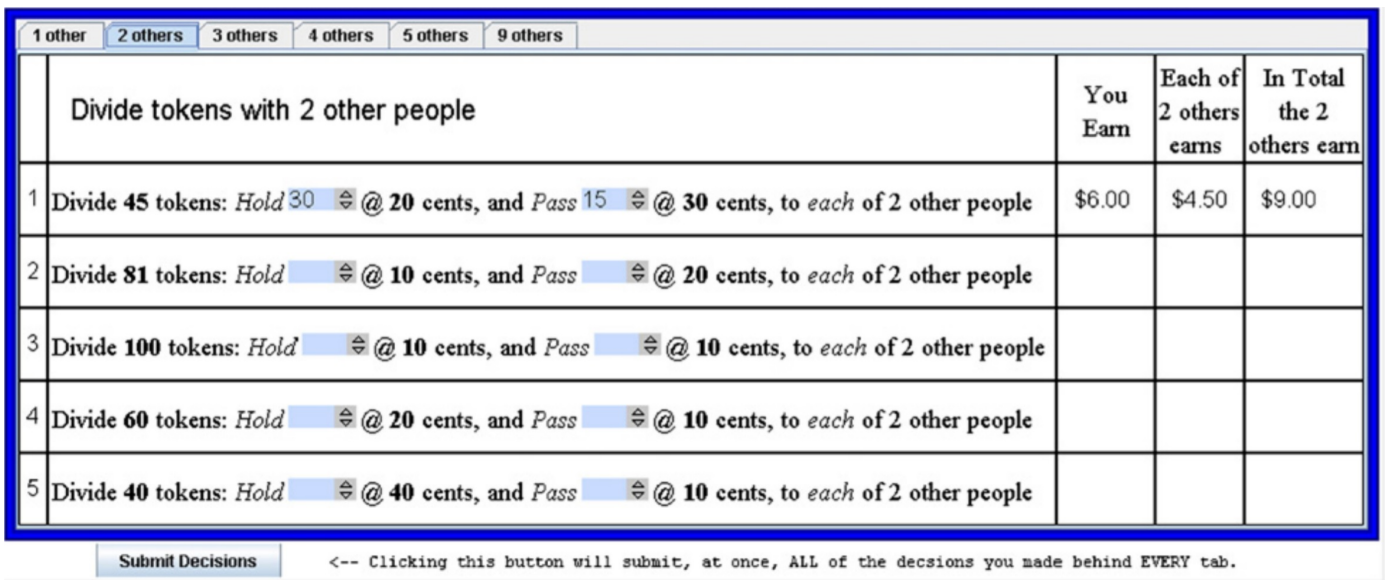
Textual Methodology - Hebrew

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Textual Methodology - Original

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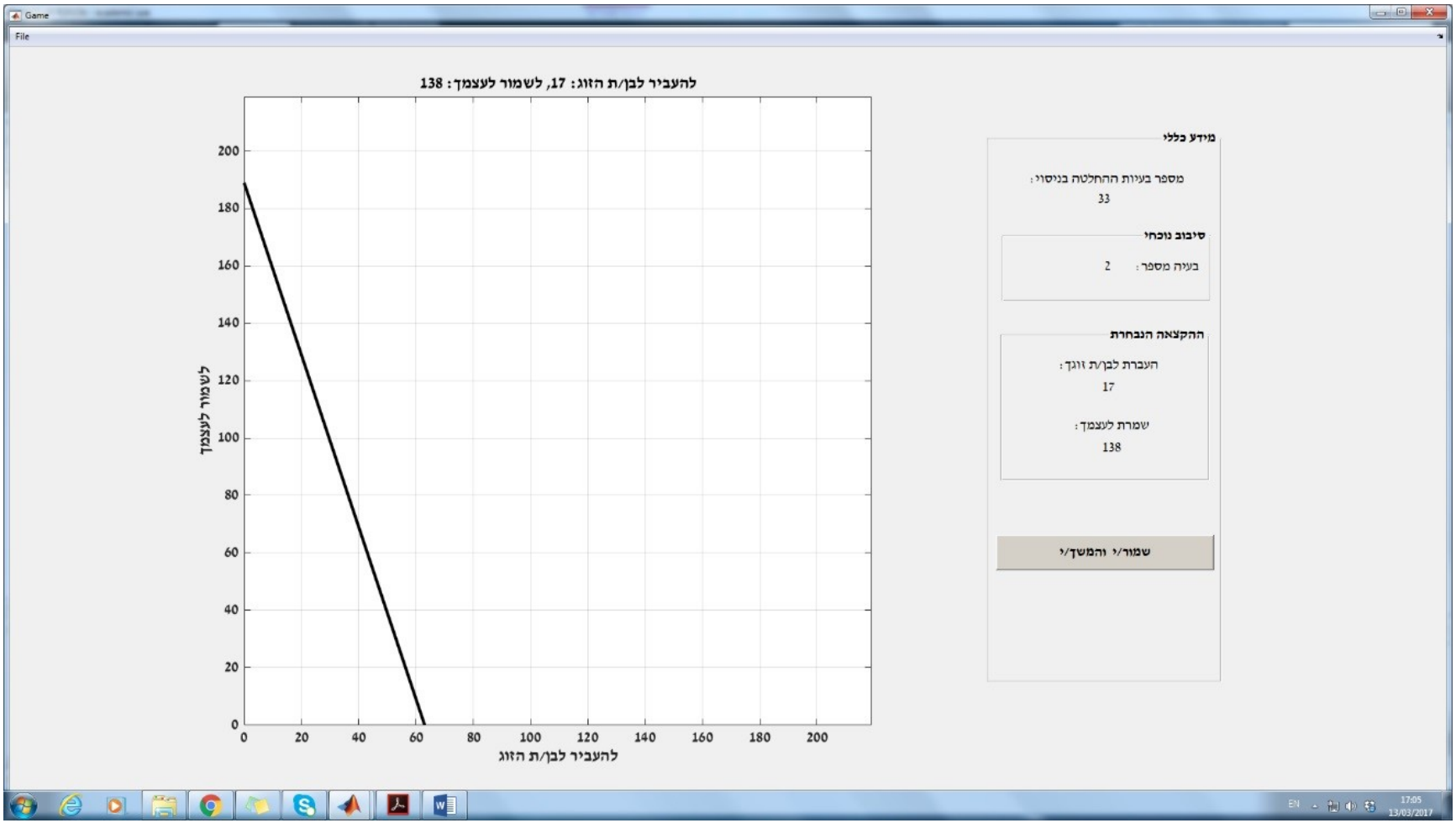
1 other | 2 others | 3 others | 4 others | 5 others | 9 others

	Divide tokens with 2 other people	You Earn	Each of 2 others earns	In Total the 2 others earn
1	Divide **45** tokens: *Hold* 30 @ **20** cents, and *Pass* 15 @ **30** cents, to *each* of 2 other people	$6.00	$4.50	$9.00
2	Divide **81** tokens: *Hold* @ **10** cents, and *Pass* @ **20** cents, to *each* of 2 other people			
3	Divide **100** tokens: *Hold* @ **10** cents, and *Pass* @ **10** cents, to *each* of 2 other people			
4	Divide **60** tokens: *Hold* @ **20** cents, and *Pass* @ **10** cents, to *each* of 2 other people			
5	Divide **40** tokens: *Hold* @ **40** cents, and *Pass* @ **10** cents, to *each* of 2 other people			

Submit Decisions <-- Clicking this button will submit, at once, ALL of the decsions you made behind EVERY tab.

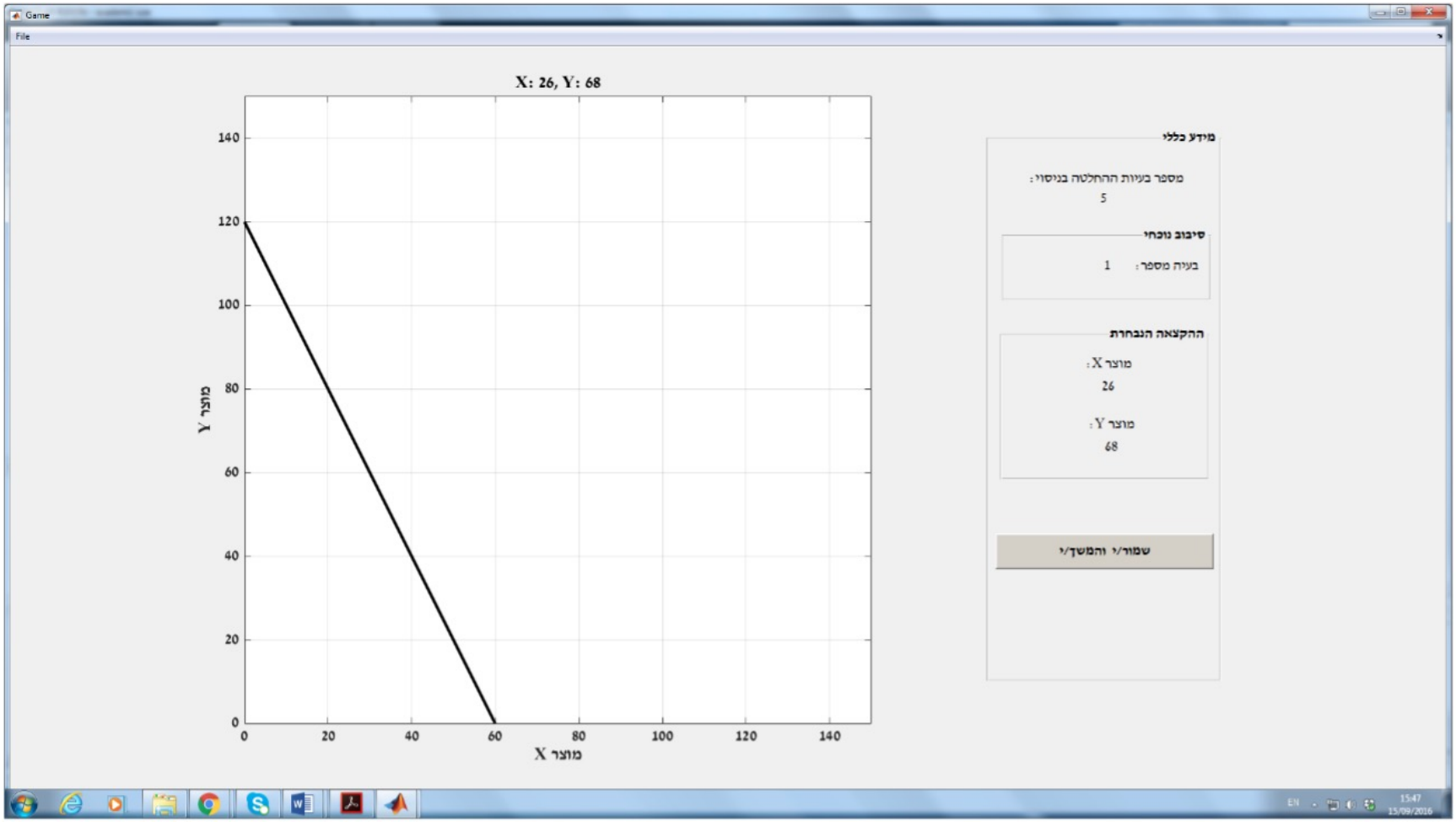
Graphical Methodology - Hebrew

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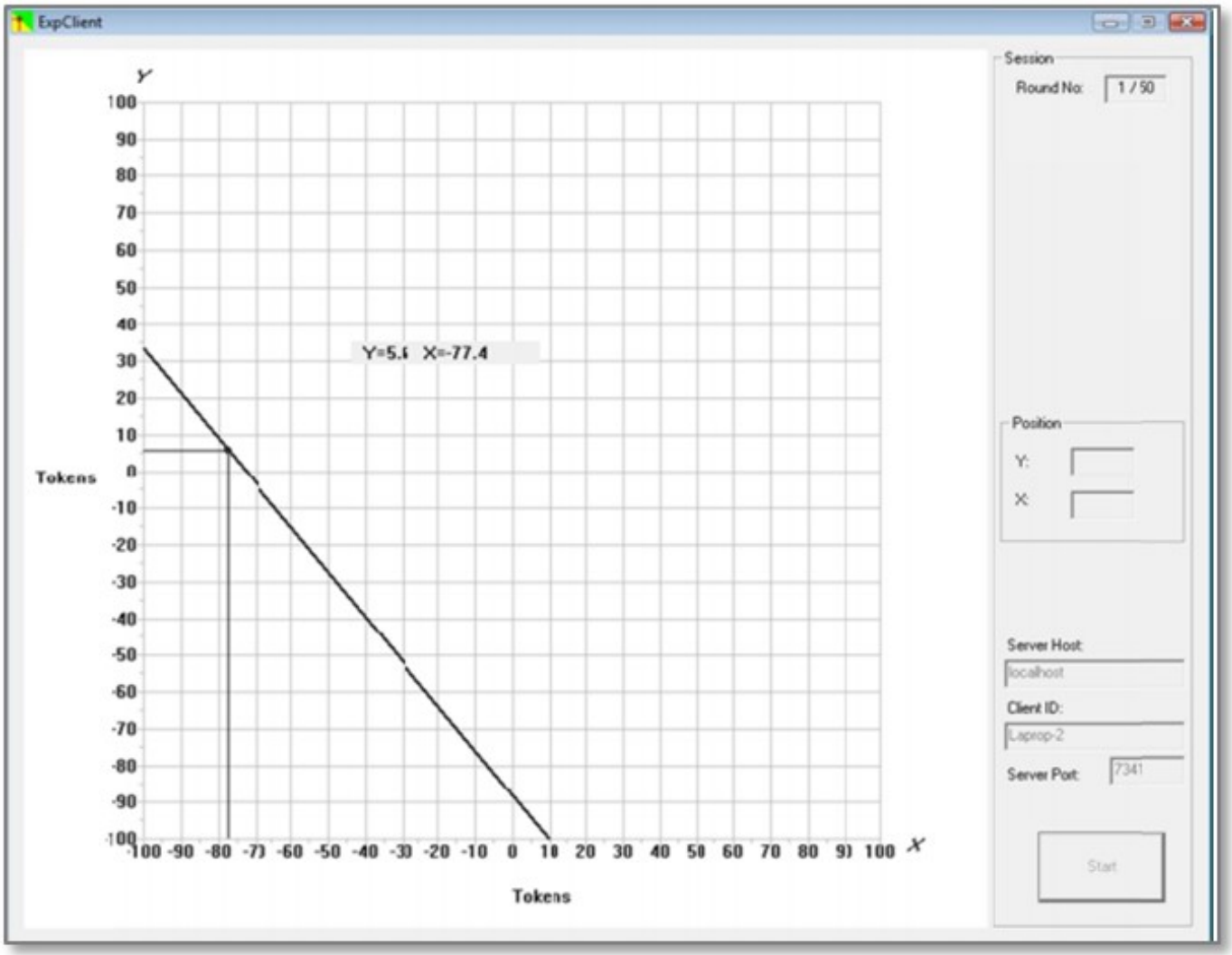
Graphical Methodology - Hebrew

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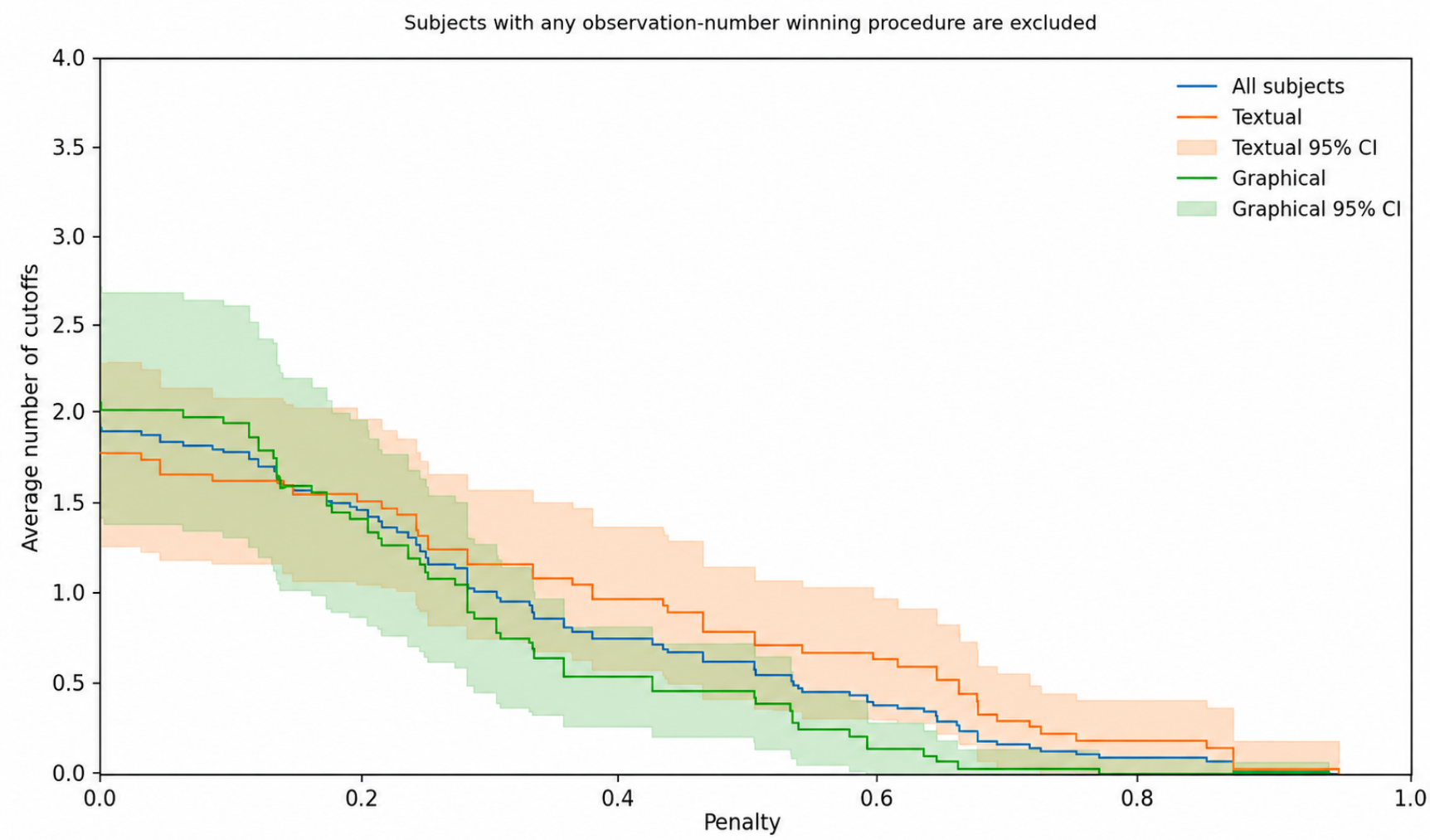


Graphical Methodology - Original

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Number of Cutoffs (No Observation Number Cutoffs)



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