RATIONALITY VS MORALITY: AN IN-DEPTH ANALYSIS OF THE WHISTLE EXPERIMENT FOR TAX CONTROL SYSTEMS

BEHAVIOURAL ECONOMICS

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INTRODUCTION

This report presents a detailed analysis of the results from the "Whistle Experiment" conducted in the laboratory LINEEX in Valencia on November 27th. The primary objective of this report is to identify, if possible, behaviour patterns by examining the resulting data. Such insights will allow us to make more informed decisions in the future regarding tax control.

We will go through the steps of the experiment and the game played by the participants, then we will formulate a prediction and a contrast of hypothesis based on our observations. With the theoretical base of the study, we will try to provide a clear explanation of the behaviour of the players and a solution if necessary.

To conduct this study, we have implemented software programs such as RStudio and Excel, and we have utilised various tools from different packages for the readers to visualise and comprehend the studies more easily.

OVERVIEW OF THE EXPERIMENT PROCESS

The initial steps taken in an experiment are essential for its validity since the resulting data sample must be unbiased and diverse. In this section we will navigate through the process and measures of the experiment in itself.

Registration

The registration process was through the web page of LINEEX where you have the options to register, reserve a spot in an experiment or read the beginner's guide. After you click 'register' you have to create a profile filling in your details. Afterwards, you have to activate your account by clicking 'Complete register' in an e-mail they send you so they can confirm that it is indeed your e-mail account.

Having already registered you can select a session where you can participate. However, participation is limited only to those who meet the requirements such as studies, gender or age criteria. Additionally, there are restrictions for individuals who have reached the maximum allowed partaking in experiments yearly, or those who have already participated in similar experiments. The aim of these constraints is to keep the samples diverse, for the resulting research to be valid.

Computer assignment

Computers were randomly assigned by drawing coloured balls from a basket that had the row and chair you would have to sit at written in. This extraction was done without repetition for obvious reasons. Additionally, the assignment of groups and roles were not only anonymous, which was achieved by having a wooden wall not allowing the participant to look over their neighbour's computer, but also random to have a fair environment. To ensure the unbiased judgement of the data, the participants stayed anonymous during the study via id numbers.

Execution

Once everyone had been assigned a spot, the experiment coordinators handed out and read out loud the instructions (you can read the instructions by clicking this link). Ensuring that everyone had understood the instructions, the experiment could start. We could write on our instructions sheet with a blue pen that was provided by the laboratory, and some drew the game to make a more informed decision. Nonetheless, everything considered for the study was exclusively extracted from the computers.

After the rounds were completed, we had to fill in a questionnaire to indicate our birthdate and gender. They also asked what we thought the probability of the buyer

evading was from 0 to 1 before and after the experiment.

Payment

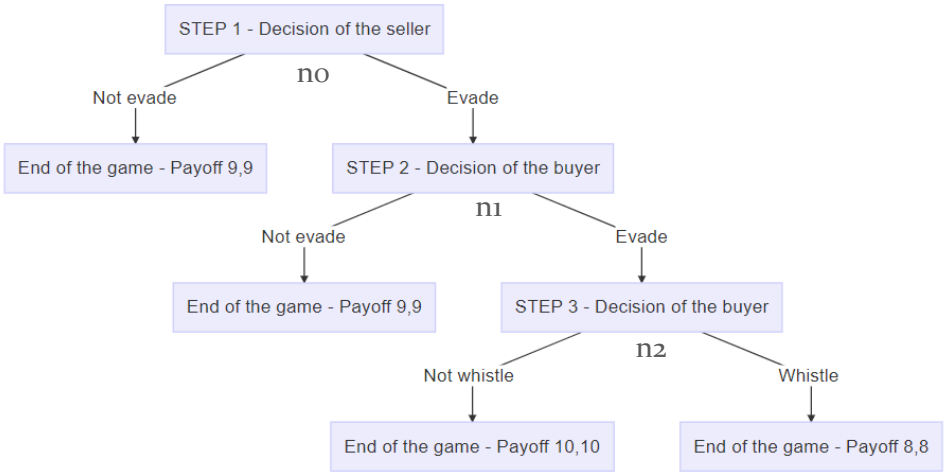
LINEEX stands out for its participant-friendly approach since they pay at least 5€ to those who engage in their experiments. The payment process used to be done by handing an envelope with cash, but after COVID they transitioned to a more convenient method: PayPal transfer, which is also safer.

Once you have finished the questionnaire, you have to write down the amount that you are entitled to, which varies depending on the experiment and what decisions you have made. In the context of this particular experiment they gave us 1€ for every 3 points of our final payoff, and you could gain up to a total payoff of (5 rounds x max payoff 10)=50, so the maximum money you could get was 50/3 = 16.77€, and the minimum was (5 rounds x min payoff 8)=40, 40/3=13.33€. To ensure a transparent process you receive an e-mail confirming your amount and PayPal account, and in the rare case of not having received it after 48h, you can reach out via e-mail or phone for further resolution.

THE GAME

This was a sequential game that had to be solved by backward induction. First, the seller chose whether to evade or not to evade, then, if he chose to evade, the buyer could also decide to evade or not, and finally, if he evaded, he could choose to whistle or not to whistle.

We have used the package “diagrammeR” in Rstudio to draw the game tree:



Actions

no: Seller (P1): {Not evade, Evade}

n1: Buyer (P2): {Not evade, Evade}

n2: Buyer (P2): {Not whistle, Whistle}

Strategies

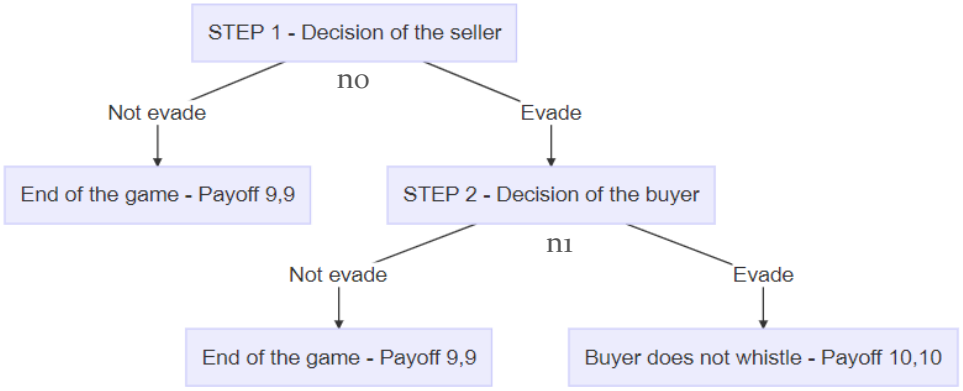
Ω_1={Not evade, Evade}

Ω_2={(Not evade), (Evade, Not whistle), (Evade, Whistle)}

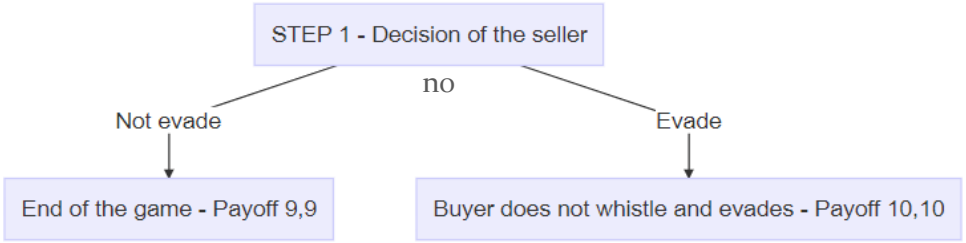
THEORETICAL PREDICTION COMPUTATION

Under the assumption of rationality, this is, the participants decide in order to maximise their own payoffs, ignoring the other's, we predict by backward induction.

First, we compare the payoff of whistle (8) and not whistle (10) only for the buyer because he is the one deciding in the last step (n2). Since 10>8 we can reduce the tree to the following:



Then, we compare the payoff of evade (10) and not evade (9) only for the buyer because he is still the one deciding (n1). Since 10>9 we can reduce the tree to this one:



And finally, from this tree, we can compare the payoff of the seller evading (10) and not evading (9). Since 10>9, we can predict the following:

Best-responses of buyer: (Evade, Evade, Not whistle)

Best-responses of seller: (Evade, Evade, Not whistle)

Perfect equilibrium = {Evade, Evade, Not whistle} with payoffs (10,10)

Equilibrium Path = (Evade, Evade, Not whistle)

It is important to take into account that even though we have supposed rationality, society is not always moved by rational thinking. This is why, although this game may look very simple, its moral component is very interesting. In this sense, it can reveal how our society thinks of the tax collector and distributor: the Government. If we live in a State of Welfare and we trust the government, we will more likely not evade since we know that our money has a fair common use, but if we live under a corrupted State, we will most likely not trust the government with our taxes.

Nonetheless, we cannot assure causality between evading and not trusting the state without a more in-depth analysis.

HYPOTHESIS DESCRIPTION

Null hypothesis (H0): we are primarily influenced by moral values which would make us deviate from rational behaviour patterns.

Alternative hypothesis (H1): we are significantly influenced by individual rational economic considerations, such as maximising our profits.

In a statistical test, we start with the null hypothesis (we are driven by social norms) and use data to find out if we have enough evidence to reject it in favour of the alternative hypothesis (we are driven by our own monetary interests). It is important to understand that if there is not enough evidence, we cannot reject H0, but this does not necessarily mean that we accept it, it just means that now and with this data sample (which is always limited) we do not have enough evidence to support the alternative hypothesis. We will perform the test later on.

DATA SUMMARY

Now, we can study the data of the experiment using Rstudio. After importing the necessary libraries (we used “readxl” for data import, “dplyr” for data management, and “ggplot” for visualization) we can start the preprocess of the data.

Some of the numeric variables are of character type, so we convert them to numeric with the instruction as.numeric(). Moreover, the variables ‘player.role’, ‘player.whistle’,

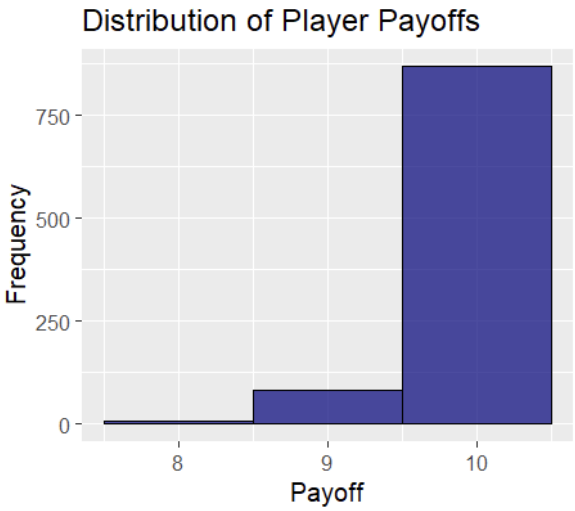
'player.cluster' and 'player.evade', could be represented as factors since their values are levels and do not have a numeric meaning, so we transform them too with the instruction as.factor().

After having pre-processed the data, we use summary() to get a wrap-up of those variables that we are interested in. The outputs and their interpretation are:

Payoff

Min. 1st Qu. Median Mean 3rd Qu. Max.
8.000 10.000 10.000 9.896 10.000 10.000

The data suggests that most of the players received a maximum payoff of 10 since all the quartiles, including the median, are 10, with a mean value slightly below the max. This indicates that participants mostly decided to evade since that is the only way that we could have gotten a payoff of 10.



Whistle

0 (not whistle)	1 (whistle)
956	4

Most of the players, 956, chose not to whistle, while only a small fraction, 4, opted to whistle. This makes sense from a rational perspective, since the buyer chooses the last two steps in a row, and he can only choose to whistle or not if he has evaded. This means that he is already acting in an immoral way so it would be strange for him to abruptly shift and behave in an etic way and choose an action that gives him the lowest payoff of all.

Evasion

0 (not evade)	1 (evade)
74	886

This summary indicates that 74 players did not evade while 886 players did choose to evade during the experiment. Therefore, the percentage of people evading out of all the players was a 92.29167%.

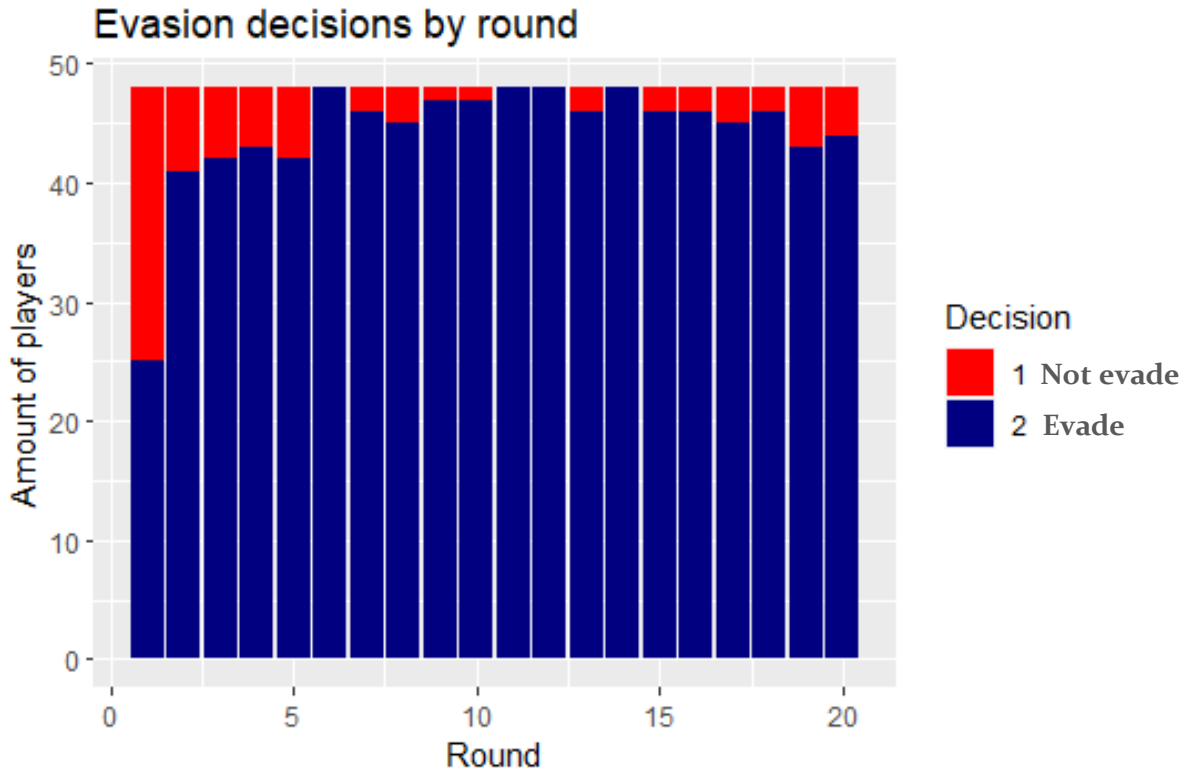
It is worth noting that we have realised looking at the data in Excel that some players did not choose to not evade while the data says that they did. This is because, in the case that the seller had decided not to evade (0), then the game would end and the buyer would not be able to make a decision, but the data would still classify it as non-

evasion (0). This insight has a remarkably interesting undertone: the seller is the one that allows the possibility for the buyer to evade, only if he has evaded first.

So, with even more reason, the difference between evading and not evading is very notable, but we still do not know if this difference in proportion is significant, that is why we must look at it in the econometric study later on.

Evasion throughout the rounds

An interesting approach is to see how some of the variables interact with the others. We used a temporal graph to show how the behaviour of the players changed throughout the rounds. In this case we looked at the interaction between the decision of evading (2) or not (1) and the rounds.



Clearly, there was a decline in the number of players choosing not to evade as the experiment progressed, especially in the beginning. This shift can be associated to a lot of factors. From a technical point of view, participants may have started to comprehend the game dynamic as they advanced, having already experienced some of the possible outcomes. In a social level and strictly looking at the experiment, this could be linked to a slop of sense of guilt after some time seeing that a lot of other players were evading, particularly for the buyers because they can only evade if the other has already evaded. Additionally, an awareness of the fact that their actions equally affected the other player of the round could have made them gain a sense of responsibility and fellowship which could have made them shift to evade.

ECONOMETRIC STUDY

Considering that the variable is binary, the appropriate test to contrast the previous hypothesis is a binomial test. This test consists of *n* identical trials, and each trial results in success or failure. The probability of success, denoted by *p*, is the same in every trial. In our experiment, a trial is a decision, successes are found when *evade=1* and failures when *evade=0*. This way, we can calculate the probability of success (evade=1 which is to decide to evade).

To perform the test, we have translated the original Ho and H1 to values suitable for the Wilcoxon test:

Ho= the probability of success or evasion, *p*, is equal to 50%.
H1 = the probability of success or evasion, *p*, is greater than a 50%.

We have chosen *p*=50% in the hypothesis because we would consider more that a half of the individuals evading are enough to say that we are driven by our own monetary interests.

We perform the test with the following codes:

```
successes <- sum(datos$player.evade==1)  # Number of successes
trials <- length(datos$player.evade)  # Total number of trials
binom.test(successes, trials, p = 0.5, alternative = "greater")
```

The output is the following:

```
Exact binomial test
data:  successes and trials
number of successes = 886, number of trials = 960, p-value <
2.2e-16
alternative hypothesis: true probability of success is greater than 0.5
95 percent confidence interval:
 0.907248 1.000000
sample estimates:
probability of success
            0.9229167
```

Looking at the result, the p-value is extremely close to 0, so we can conclude that, for any significance level, we can reject the null hypothesis (the probability of evading is 50% or that we are driven by moral compasses) because we have enough evidence to accept the alternative (the probability of evasion is greater than 50% or that we are driven by our own monetary interests).

In fact, this test gives the 95 percent confidence interval which gives a range of values for the true probability of success (0.907248, 1.000000). This means that we can be 95% confident that the true probability of evading is in that range, and the lower limit (90,7248%) indicates a very high probability of evading.

It also gives the probability of success from the data (successes/trials), which is roughly 92,3% of times that participants have decided to evade in this sample.

To sum up, the contrast gave enough evidence to reject the null hypothesis that the true probability of evading is 0.5 or less. And the 95% confidence interval indicated that the observed probability of evading is even greater, between approximately 91% and 100%. Therefore, there is a notable tendency for participants to choose to evade, which can be translated to tax aversion.

BEHAVIOURAL EXPLANATION

As we have seen throughout the study, there is a clear and significative tax aversion. Tax aversion can be caused by several reasons, but we propose that a significant portion of it can be explained by two psychological believes of the tax system.

First, tax people tend to separate tax payments from the public goods received in exchange. This disconnection leads taxpayers to stop feel like it is not their responsibility but the Government's. This can happen specially in people that can pay for private schooling or health insurance because they already have their needs covered.

Second, the taxpayer frustration comes from the lack of sense of influence over tax spending, the fact that their part over the total is so insignificant while the same money makes a great contrast in one's own private spending. Therefore, people start feeling that they are losing control over their private monetary property for nothing.

POSSIBLE SOLUTIONS

Addressing tax aversion is a complex challenge that requires very thoughtful strategies. It is important to consider that there is never a way to completely change how people behave, but the approaches we propose are the following:

-Transparent Policies: Governments should be transparent and clear when communicating how tax revenues are being used. This would imply a user-friendly platform that any civilian may freely enter that would inform of the projects powered by our taxes and straightforward statistics of tax usage in real time.

-Awareness Campaigns: since one of the biggest issues in this matter is taxpayers separating public goods and their tax payment, Governments should make public awareness campaigns reminding people of how much of an impact they are making in order to live in a Welfare State.

Both approaches would mean a cost for the Government, but we consider that the problem of tax aversion is only getting worse, and we should address it as soon as possible.

CONCLUSION

The Whistle Experiment gave us a lot of helpful insights into the interaction between a taxpayer and the decision of evading or not. Not only the data but also the econometric study suggested that we acted rational and only thought of our own selfish interests over the common goods. The behavioural explanation to this tax aversion tendency could be the fact that we tend to separate taxes and the public goods associated to them, and that we think that our impact is not that important compared to the whole. Overall, solutions are that Governments remind civilians the benefits taxes create and the importance of everyone's participation.

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