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Income distribution in the Public Goods Game: An experimental analogue of corruption

Distribuição de rendimentos no Jogo dos Bens Públicos: Um análogo experimental do peculato

Distribución de ingresos en el juego de bienes públicos: un análogo experimental de malversación de fondos

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Abstract

Corruption has been the object of study in much research, but only recently have begun to investigate it experimentally. One way to study this phenomenon is to expose the participants in a Public Goods Game (PGG) in which they need to contribute to producing a particular public good, and then need to make decisions about how this good will be distributed among all the participants. A participant who makes distributions unequally for his own benefit shall behave in a manner analogous to that described in the crime of peculation. The aim of this study was to investigate how the participants distributed public resources in the PGG. Six participants were exposed to the game, in which they played two consecutives blocks of PGG. Each participant was informed that they were playing with in the same group, but in fact, he/she was plying alone, against non-real players. In the first block, they played the standard PGG version, contributing with de production of a public income. In the second block, each participant was elected in a false election to manage the income distribution. In this setting, five participants made unequal distributions, i.e., they allocated most of the resources to themselves (more than 17% of the resources) varying between 20% (like some P1 and P2 trials) and 80% (like some P4 and P6). From these results, it is suggested that changes in the contingencies that control the occurrence of this type of behaviour need to be in the center of any kind of discussions about corruption and its occurrence.

Keywords: Corruption; Behaviour Analysis; Game Theory; Public Goods Game.

Resumo

A corrupção tem sido objeto de estudo em diversas pesquisas, mas apenas recentemente tem sido investigada experimentalmente. Uma maneira de estudar tal fenómeno é expor os participantes a um Jogo dos Bens Públicos (JBP) no qual eles precisam contribuir para produzir um bem público específico, e então precisam tomar decisões sobre como tal bem seria distribuído entre os demais participantes. Um participante que fizer distribuições desiguais beneficiando a si estaría se comportando de maneira análoga ao que é descrito pelo crime de peculato. O objetivo do presente estudo foi investigar como os participantes distribuiram recursos públicos no JBP. Seis participantes foram expostos ao procedimento. Cinco deles fizeram distribuições desiguais, isto é, alocaram a maior parte dos recursos para si mesmo. A partir destes resultados, sugerimos mudanças nas contingencias que controlam a ocorrência deste tipo de comportamento.

Palavras–chave: Corrupção, Análise do Comportamento, Teoria dos Jogos, Jogo dos Bens Públicos.

Resumen

La corrupción ha sido objeto de estudio en varios estudios, pero solo recientemente se ha investigado experimentalmente. Una forma de estudiar un fenómeno de este tipo es exponer a los participantes a un Juego de bienes públicos (JBP) en el que deben contribuir a producir un bien público específico, y luego deben tomar decisiones sobre cómo se distribuiría entre los otros participantes. Un participante que realiza distribuciones desiguales beneficiándose a sí mismo se comportaría de manera similar a la descrita por el delito de malversación de fondos. El objetivo del presente estudio fue investigar cómo los participantes distribuyeron los recursos públicos en el JBP. Seis participantes fueron expuestos al procedimiento. Cinco de ellos hicieron distribuciones desiguales, es decir, asignaron la mayoría de los recursos para ellos. A partir de estos resultados, sugerimos cambios en las contingencias que controlan la ocurrencia de este tipo de comportamiento.

Palabras clave: corrupción, análisis de comportamiento, teoría de juegos, juego de bienes públicos.

Income distribution in the Public Goods Game: An experimental analogue of corruption

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Corruption has been the object of study in much research, but only recently have begun to investigate it experimentally. One way to study this phenomenon is to expose the participants in a Public Goods Game (PGG) in which they need to contribute to producing a particular public good, and then need to make decisions about how this good will be distributed among all the participants. A participant who makes distributions unequally for his own benefit shall behave in a manner analogous to that described in the crime of peculation. The aim of this study was to investigate how the participants distributed public resources in the PGG. Six participants were exposed to the game, in which they played two consecutives blocks of PGG. Each participant was informed that they were playing with in the same group, but in fact, he/she was plying alone, against non-real players. In the first block, they played the standard PGG version, contributing with de production of a public income. In the second block, each participant was elected in a false election to manage the income distribution. In this setting, five participants made unequal distributions, i.e., they allocated most of the resources to themselves (more than 17% of the resources) varying between 20% (like some P1 and P2 trials) and 80% (like some P4 and P6). From these results, it is suggested that changes in the contingencies that control the occurrence of this type of behaviour need to be in the center of any kind of discussions about corruption and its occurrence.

Keywords: Corruption; Behaviour Analysis; Game Theory; Public Goods Game.

The issue of corruption has come under the spotlight in Brazil due to the numerous cases that Federal Police operations have dismantled, such as Operation Car Wash (Lava-Jato), considered the second largest corruption case in history[1], affecting Brazil's position in the Corruption Perceptions Index, publicised by the NGO called Transparency International. In this ranking, countries receive points regarding their perceived levels of corruption determined by agents that deal with the government. The more honest the country, the more points it obtains on a scale from 0 to 100. In the last ranking, Brazil dropped its position compared to previous years, reaching the lowest position so far in 2019 (106th).

Although the issue of corruption is an age-old problem, of great social importance and is much discussed, its definition is far from a consensus, and can be observed by an almost infinite gradation (Brei 1996; Speck 2000). However, despite the difficulties in defining corruption, it has been systematically investigated by different authors (Heidenheimer, 1970; Power & Gonzalez, 2003; Speck, 2000), but only recently has it begun to be investigated experimentally. Frank and Schulze (2000) published the first experimental work on the subject, which aimed to investigate whether Economics students would accept more bribes than students from other areas.

[1] For more information, see: www.unmaskthecorrupt.org.

Since then, there have been advances over the years (Serra & Wantchekon, 2012). The behaviours of accepting and offering bribery were the dependent variables most investigated by the authors in this area (Abbink & Hennig-Schmidt, 2002, 2006; Armantier & Boly, 2008; Bilotkach, 2006; Lambsdorff & Frank, 2010; Schulze & Frank, 2003; Van Veldhuizen, 2013), having even produced comparative studies between the laboratory controlled environment and natural environments (Amantier & Boly, 2008).

Despite the advances in experimental literature (Serra & Wantchekon, 2012), there are some shortcomings, mainly when analysing the variables responsible for establishing and maintaining the behaviours in the participants´ repertoire. Not only in experimental literature, but also in the literature on corruption in general, some explanations of corrupt behaviour fall back on internalist variables. For example, Frank and Schulze (2000) conclude that "*economists tend to pursue their own interests more consequently than other people*" (p.110). Internalist explanations are wide ranging, such as personal inclinations (Cameron, Chadhuri, Nisvan & Gangadharan, 2009; Campos-Ortiz, 2011), moral cost and a sense of justice (Abbink, 2002), among others. The problem with resorting to this kind of explanation is that they are explanatory fiction (Skinner, 1953). It is in this sense that Behaviour Analysis can help analyse the environmental variables of which the behaviour observed in an experimental context is a function, describing the contingencies under which these repertoires are established.

An early contribution of Behaviour Analysis would be to provide an operational definition of what we call corruption. This implies leaving the term corruption aside, because it is a general label and a rather descriptive concept, and treats it as behaviours (or classes of behaviour). Behaviours can be described as corrupt given the functional relationships that are established between behaviours that the individual shows and the consequences he/she produces, more specifically, the illicit gain of reinforcers from public goods. When we say that corruption is on the rise, it means two things: an increase in the frequency with which certain individuals show corrupt behaviour over a given period of time (accepting and offering bribery and undue advantages, diverting public resources for private purposes, etc.) and the access we have to this information.

In Behaviour Analysis, some conceptual works have been published on the subject, demonstrating how the Behaviour Analysis framework can contribute to understanding corruption as a behavioural phenomenon, helping to analyse contingencies that can control these behaviours (Agbota, Sandaker, & Ree, 2015; Fernandes, Perallis & Pezzato, 2015; Goldstein & Pennypacker, 1998). However, much remains to be done, especially concerning experimental studies, a potential way to empirically study the contingencies responsible for shape corrupt behavioural patterns. Through experimental studies, analogous laboratory situations can be created in which people who show corrupt behaviour are exposed.

One of these possibilities is to expose individuals to a decision-making context in relation to public resources management, a context that is similar

to the one which politicians, civil servants and various managers are exposed to (trustees, union presidents and residents associations, etc).

The choices that an individual can make in this context are: to properly manage public resources, i.e., to distribute these resources in a way that legislation and other regulations foresee; or administer incorrectly, making distributions contrary to that foreseen in the legislation or regulation, privileging particular interests.

Making use of public goods for private purposes, in this case, distributing public resources in greater quantities for oneself or others, is characterized as a type of corrupt behaviour, more specifically, the crime of peculation, which is defined according to the Brazilian Penal Code in article 312 (Decree Law No. 2848, 1940) as "*The appropriation by a public official of money, chattel or valuables, no matter whether public or private, when he or she holds possession of them by using his or her office for his or her own benefit or for the benefit of a third party*."

One possibility of studying this type of context experimentally is by using the Public Goods Game (PGG). The PGG simulates a context of production and consumption of public goods using an investment fund that is maintained by the contribution of various players. Thus, the class of responses that the participants give is to contribute to the fund. Each player receives an equal amount of tokens at the beginning of the game, which can then be exchanged for cash. The contribution may vary among everyone, part or none of the amount available in a given trial. As a consequence, players receive an amount of tokens, calculated as follows: the fund calculates all the amounts contributed by the players and then an arbitrarily defined income factor is used (e.g. two) by multiplying the sum of the contributions. After applying this factor, the fund evenly divides the amount to all the players, regardless of the amount that each one contributed individually, that is, the player who contributed everything will receive the same amount as the one who contributed nothing. This means that a player's earnings depend more on the amount contributed by the others than on the amount he/she decided to contribute. Two relevant aspects in the game are that participation is anonymous and the contributions are confidential, i.e., none of the players know each other or know the amounts that the others have contributed.

The complexity of the contingencies programmed by the PGG is basically due to two aspects. The first one concerns the behavioural variability that participants may show, for example, if a participant has 10 tokens, there are 11 choices that he/she can make regarding the amount to be contributed, ranging from 0 to 10. The second aspect is related to the consequences to which a participant is exposed: for each choice he/she makes, the consequences can be reinforcing, i.e., maintaining the behaviour of contributing in the next trials, or punitive, that reduce the likelihood that the contributing behaviour will continue in subsequent trials. And this mainly depends on what the other participants do.

However, another more common possibility than the one described above occurs when a player reduces the amount contributed, even when the number of tokens obtained as a consequence is increasing. If a player has access to ever increasing gains, even when the amount he/she contributed remains stable, this indicates that the other players are contributing larger amounts. This allows the participant to reduce his/her contributions, under the control of three variables: decrease in the contribution cost; avoiding the probability of losing tokens and an increase in earnings. All the contributions have a cost for a player. When a participant has 30 tokens, contributes 10 and receives 20, his/her actual win is only 10 tokens. The lower the contribution, the lower the cost. Taking this into account, if a participant contributes with zero, and if the fund produces little or no income, he/she will not have lost any token, therefore in this respect, the behaviour of contributing zero would be reinforced negatively. However, if by contributing with zero, the participant has access to earnings from the contributions of others, then that pattern is likely to be reinforced.

It is in this sense that the problematic of the game resides, in the possibility of various players presenting the behaviour of contributing smaller amounts or nothing, as a kind of social parasite.[2] There are many real-life situations that resemble this one presented by the PGG, such as tax evasion, in which the evader does not contribute to the public good, but enjoys the benefits from other people´s tax payments. It is also possible to study experimentally the social interaction established between taxpayers and resource distributors using the PGG. This possibility is sustained by allowing one of the participants to make decisions about how the resources produced will be distributed among everyone. In this case, the behaviour of distributing resources replaces the behaviour of contributing as a dependent variable (Ledyard, 1995), constituting as an unprecedented modification when using the PGG. A participant who in this situation distributes income unequally between him/herself and the others (a greater amount of resources for him/herself than for the others) will behave in a manner analogous to that described when one commits the crime of peculation, by violating the rule of equal enjoyment of the public good.

The main objective of this study was to investigate the behaviour of distributing public resources in a context in which these resources were produced by the contribution of all the participants. The second objective was to verify if the participants who showed behaviours of contributing at a reduced or zero rate were those that presented a higher frequency of behaviour of unequal distributions.

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[2] The literature on the PGG (Andreoni, 1988; Ledyard, 1995) calls the participant who shows this pattern of behaviour the "Free-rider" because he/she "gets a free ride" on the contribution of others. We chose the term "social parasite" because it describes a greater number of social interactions in which an individual "takes" advantage of other individuals, not being restricted only to the situation described in the PGG.

Method

Participants

Six university students, aged between 18 and 24 yrs, both male and female, took part in this research: P1 (Female, Social Sciences); P2 (Female, Chemistry), P3 (Female, Social Sciences), P4 (Female, Bachelor of Arts), P5 (Female, Materials Engineering) and P6 (Male, Biological Sciences). The participants were recruited through a social network in a group of students from a university.

Potential participants sent an e-mail and received the Informed Consent Form (ICF) along as well as a preference assessment form. The aim of this form was to identify individual preference items that could be used as a consequence of participating in the research. The preference items selected were: credits for photocopying; pencil case with school supplies; 100g of chocolate and earphones. When at least three participants digitally signed the ICF, they were invited to take part in the experiment at a common time in the laboratory where the research was conducted.

Setting

Data collection took place in a Laboratory at the Department of Psychology of a public university in the interior of São Paulo State.

Material and Equipment

Four tables were used, measuring 90 cm x 70 cm x 90 cm (width x height x depth), with dividers between them on the sides measuring 60 cm x 90 cm (height x depth), in which participants sat avoiding eye contact and communication.

At each table there was a notebook or computer connected to the Internet that served as a terminal for the performance of the experimental task. There were also headphones. In addition to this equipment, the following was used: *Gmail* and Hangout to communicate between the experimenter and participant during the experiment so that the identification of the participants was anonymous; *Google Forms* for hosting the ICF; comprehension, socioeconomic, performance and preference assessment forms; *Excel* spreadsheets to record data and *Youtube* for hosting instructional videos.

A specific operating system user account was created on each of the terminals; all unnecessary icons were removed; operating system notifications were disabled; the Internet browser was open and maximized with the following tabs: *Gmail*; *Youtube* with instructional video (maximized); and the browser, Excel spreadsheet and "Player Record" (Figure 1) were open but minimized.

The experimenter's notebook was left with the browser open connected to the email created for the experimental task, as well as the Hangout and *Google* form chat boxes and Record worksheet (Figure 1).



Figure 1. Record Worksheets 1st Block: Player Record Worksheet on the left side and the Experimenter Record on the right side.

Procedure

When all the participants were seated, they signed the ICF and received the "preference list", according to the answers of the previously sent form. They were asked if they wished to change the order of the items and were instructed that obtaining the most preferred item was conditional on obtaining the highest number of tokens.

The participants were not informed about the exact amount of tokens, aiming to control possible effects of losing the reinforcement value of the tokens, for example, the possibility of the participant quickly obtaining the necessary number of tokens to obtain the most preferred item. Afterwards, the experimenter read out the general instructions to the participants, which were: "You are going to play a game called the Public Goods Game. The total number of participants is six. Two of them are in other rooms, waiting to begin."The other instructions were to turn off their cell phones and inform them that any communication between the participants was prohibited. Finally, the participants were asked to put on the headphones to watch the instructional video of the experimental task. At the end of the video, the participants removed their headphones and the email accounts were selected.

Slips of paper were put in a pot with the information: participant identification (for example "You are P2"), participant´s email address (for example, p2@gmail.com) and the password. One by one, the participants took a slip of paper from the pot and accessed the *Gmail* and *Google Hangout*. Then, they received the following message in the *Google Hangout*: "Please write "ok" to confirm that the chat box is open".

The participants received the socioeconomic assessment form and the first Procedure Comprehension Form on the Hangout to ensure that the participant had understood the experimental task. In case of errors in the answers, additional questions were sent. Participants then maximized the "Player Record" worksheet (Figure 1) to begin collecting data. Two blocks of 10 trials each were programmed. In each block, the participants started off with 10 tokens and accumulated these tokens throughout the trials. The remaining differences between the blocks will be specified below, but in general, the first block of trials was programmed to allow participants to understand the contingencies in the PGG, while the second block of trials was the main condition in the experiment where participants were exposed in the analogue of corruption as explained in the next session

1st block. As soon as the experimenter sent the message: "Make your first Contribution", the participant had to enter the amount of their contribution in the "Player Record worksheet in the "My Contribution" column and inform this amount to the experimenter via *Google Hangout*. The experimenter put the amounts contributed by the participants in the "Collection Worksheet" (Figure 1) and informed each participant of the amount of money he/she earned in that round.

The earnings of each participant per round was calculated by multiplying the income factor of 1.6 by the amount contributed by the participant, plus the amounts "contributed" by five other non-real players, who always contributed with all the amount of tokens they had available in that given attempt[3]. For example, if each non-real player had 10 tokens in his/her wallet, the contribution of each would be 10 tokens, making a total of a contribution of 50 tokens from non-real players. Adding to this amount the real player´s contribution, for example, five tokens, the spreadsheet would multiply 55 by 1.6 and divide the result equally for each player (five non-real and the participant).

Once the income of the round was informed, the participant had to put this information in the "My Earnings" column and click on the "Update Wallet" button so that the calculation of the final gain was done automatically, based on the formula:

(Initial Amount - Contribution) + Income = Final Gain

The next trial started when the experimenter sent the message "Make your second contribution". This procedure was repeated throughout the remaining trials of the first block. After ten trials, the end of the first block was indicated when the participants received the message "End of programmed rounds in the first block. Wait for further instructions. "

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[3] The experimental literature shows that in repeated games there is a high probability that contributions fall to zero (Andreoni, 1988). Putting participants to play with non-real players avoided this from happening, because no matter how much the participants contributed, the fund would never stop producing income as non-real players would always be making contributions.

2nd Block. Before beginning the second block, the participants watched the instructional video about the 2nd block. After the video presentation, the participants answered a new comprehension form. In case of errors, the procedure already described was repeated.

In this block, the participants assumed the role of the Public Fund Administrator and had to decide how the income would be distributed between him/herself and the five non-real players. The fictitious selection for the position of administrator was carried out the same way as the e-mails were selected. After this selection, the experimenter sent the following message: "If you are the Administrator, say" yes ". If you are not, say "no". After all the participants replied "yes", the record worksheet for this block was maximized (Figure 2). It automatically calculated the income by multiplying the contributions by the three income factor[3] (defined in the pilot studies). Then, the experimental task began.

At the beginning of the second block, participants received the message "Make your first contribution" and the same sequence of responses described in the 1st block was requested, only this time the experimenter informed the participants of the amount rendered (e.g., 300) and they distributed this amount between themselves and the non-real players. The participant filled in a column called "Amount to Distribute" with the amount given informed by the experimenter, he/she put the amounts he/she wanted to distribute to the other players in the "Other Players" columns and sent the data to the experimenter. At the end, the participants answered a questionnaire about their strategies and received the preference item.

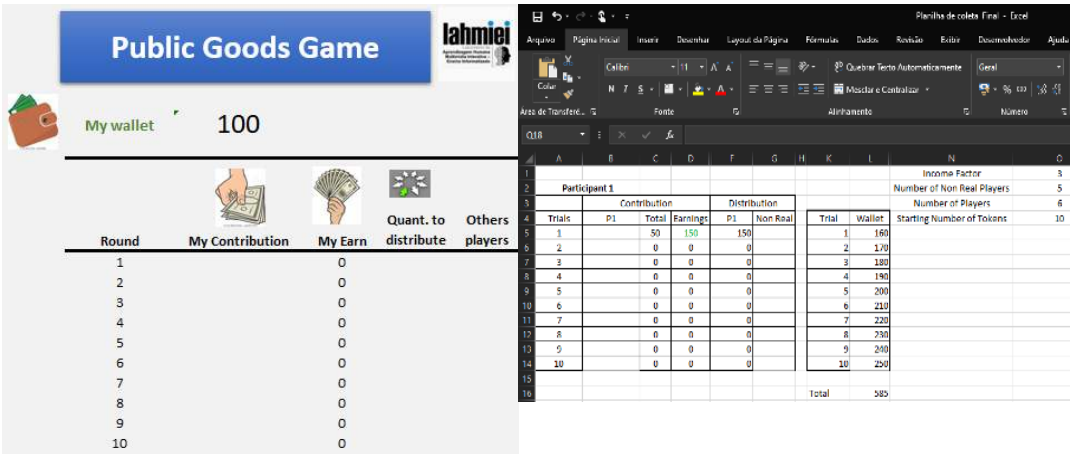

Figure 2. Record Worksheets 2nd Block of trials: Player Record Worksheet on the left side and the Experimenter Record on the right side. In the Player Record worksheet, the boxes with the formulas were blocked to prevent participants from changing it. The experimenter had a spreadsheet of these for each participant (P1, P2, P3 and P4).

[4] To make the resource distribution context close to those commonly observed in real contexts, a higher income factor was established than those commonly used in the PGG (between 0.4 and 2), because in this way the fund would produce large amounts of resources , giving the participant access to powerful reinforcers in large quantities to be freely distributed (Goldstein & Pennypacker, 1998).

Procedure for Recording and Data Analysis

In the first block, the behaviour of the participants' contribution was transformed into contribution percentages using the following calculation:

$$\frac{\text{Amount contributed by participant X 100}}{\text{Sum of all contributions made}}$$

For example, if the total contribution received was 55 (50 from the non-real players and five from the participant), the equation would result in the approximate value of 9.1%. That is, the participant contributed with 9.1% of the total collected in that round. The rate of 17% (with variations of 0.5% for more or less) was established as a parameter to analyse contributions. Each participant had to contribute at a rate of 17% to the fund to produce the public good equally (100% of the contribution made in a given attempt, divided by the number of players - in this case, six). Contributions above this rate showed a pattern of cooperative behaviour; contributions below showed a social parasite behavioural pattern.

The tokens that the player won in the first block were converted to a percentage increase in their earnings compared to their ten first tokens. This calculation was done using the following formula:

(Amount in the wallet at the end of the round – amount in the wallet at the beginning of the round) X 100

Amount available in the wallet at the beginning of the game

For example, if the participant got 22 tokens in the first attempt, then he/she would have increased the tokens he/she had by120%. This analysis showed the relation between contribution and gain throughout the trials.

In the second block, the gains per participant were converted into multiplication rates of gains. For example, if in one attempt the participant started with 100 tokens and at the end had 300, then the multiplication rate of gains was three.

The amount of tokens that the participant distributed to him/herself and the others were also converted into percentages calculated using the rule of three: Total amount of tokens to be distributed (100%); tokens that the participant distributed to him/herself (x).

The participants' responses were analysed by the experimenter and by an independent observer. The reliability calculation was obtained using the following formula: number of agreements between the two observers, divided by the number of agreements plus disagreements, multiplied by 100% (Hall, 1974). For a sample of 50% of participants (three), there was 98% agreement.

Results

There was a large variation in the amount of tokens that the participants achieved throughout the trials, resulting in different preference items being obtained. P1 and P2 were the ones that achieved the highest number of tokens (643,822 and 557,132, respectively), obtaining the first

item in the preference list. The others received the third item [P6 (72.674), P5 (40.342), P4 (12.230)].

In the first block, according to Figure 3, all the participants presented contributions below 17%: P2 showed this behaviour in four trials, P1 and P4 in six and P3, P5 and P6 in all of them. As explained above, the relationship between the amount contributed and the gain obtained in a given attempt are the two aspects that enable us to understand the acquisition of behavioural patterns. The increase in contribution rates, followed by the increase in gains can be observed in the data from P2, where during the trials the participant maintained similar rates of contributions until they were stabilised at the rate of 17%, showing that this pattern was reinforced throughout the trials. The increase in contribution rates, followed by gains at a smaller percentage than in previous trials, can be observed in trials three, seven and nine by P4, in attempt four by P5 and in attempt six by P6. Contributing with larger amounts and resulting in smaller amounts may have an aversive function, which is why the contribution rates of these participants were reduced in subsequent trials.

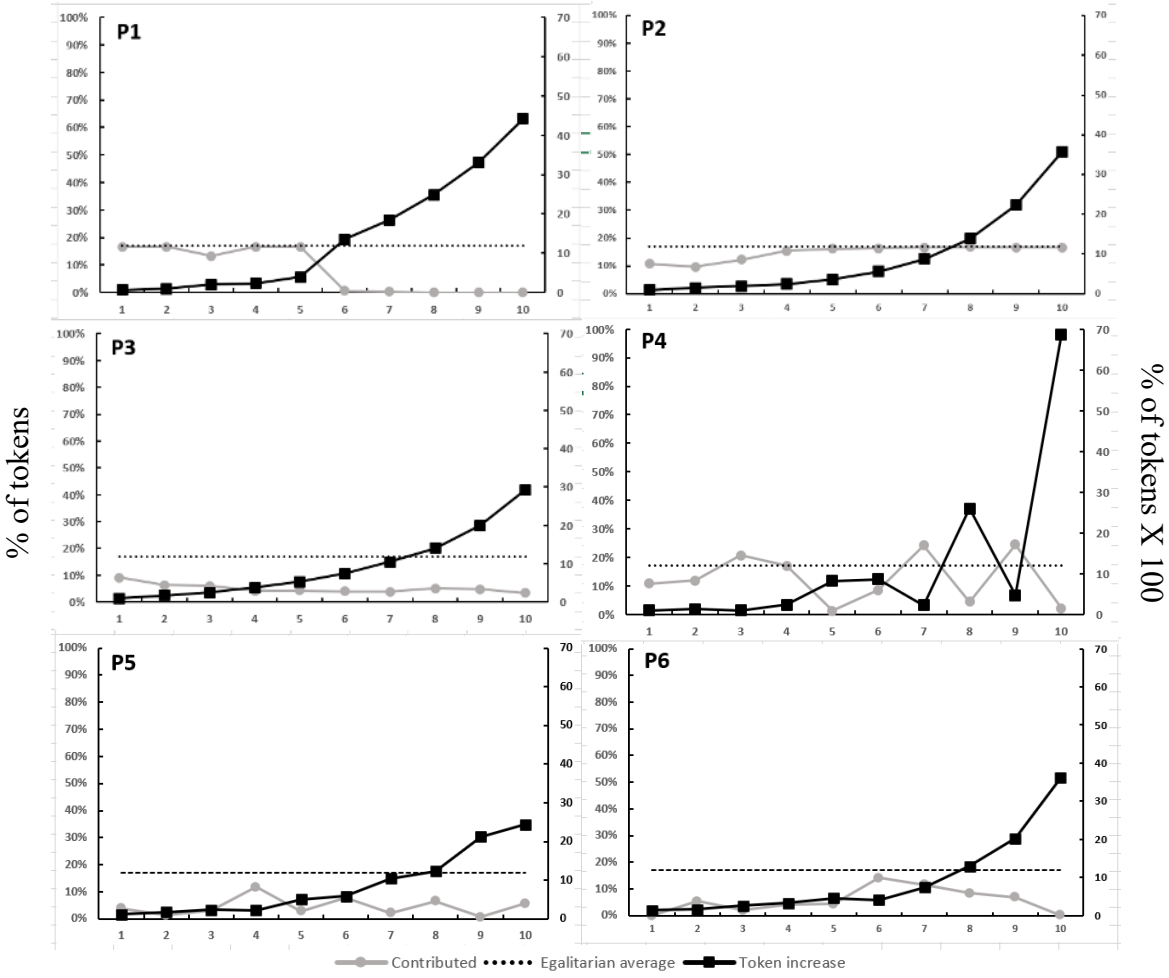

Figure 3. Contribution graph of the participants for the first block of attempts: The grey line shows the percentage of tokens contributed and the black line the percentage of increase of tokens throughout the attempts. The dashed line shows the contribution rate of 17%. Contribution rates below this line represent selfish contributions, close to the behaviour of the social parasite.

The contingencies that establish social parasite behaviour become clearer when analysing the data of P1. By the fifth attempt, the contributions from P1 were close to the average of 17%, however, in the following attempt, the participant contributed with only 0.6%, a decrease of 16.1% compared to the previous attempt. When P1 reduced his/her contribution rate and then had access to an increase in his/her gains, this consequence took on a reinforcement function and this pattern was maintained throughout the last few trials. This similar pattern can be observed in the data from P3, P5 and P6.

When analysing the progression of the participants' increase in tokens, P1, P2 and P3 presented a progressive increase of gains, i.e., a greater gain than in the previous attempt in all the trials; P5 and P6 in nine and P4 in six. The progression in the increase of tokens became significant after the fifth attempt, reinforcing the class of responses that the participants presented. This pattern can be observed in the data from five participants (P1, P2, P3, P5 and P6). This is due to the fact that after the initial trials, the non-real players had more tokens to make their contributions.

As they always contributed with all the tokens they received in the previous attempt, this allowed the fund to produce higher incomes, which meant higher gains for the participants. When the participants' contributions decreased, the curve of increase in gains became even more significant. This can be observed in the cases of P1 and P6. After both contributed with rates close to zero, their gains increased markedly, going from an average of 198% (P1) and 270% (P6) in the first five trials, to 2682% (P1) and 1618% (P6) in the last five trials. The data showing the increase in gains for P4 presented less stability during the trials. The contribution pattern that P4 presented until the fourth attempt had little variability, however in the following trials when she reduced her contribution rate in attempt five, she had access to a gain of greater magnitude; when it increased, the gain which she had access to decreased.

Regarding the second block, the contribution rates presented by some of the participants differed from those presented in the first block in Figure 3. P6 only made a contribution below the rate of 17% in the second block and in all in the first block; P1 made three and six in the first block; P2 made five and six; P4 made eight and six; P5 in eight, and all in the first block. P3 showed a similar performance in both blocks, which is why this participant was the one that obtained a lower number of tokens at the end of the game. This change in the contribution rate from the first to the second block can be attributed to the change in contingencies produced by two variables: access to the distribution of the tokens and the increase in the income factor.

One of the main changes in the contingencies that the possibility of the participant distributing resources shows is that in this context the access to the reinforcer becomes more immediate and probable, through a low cost response, since the gain of tokens to which a participant has access to is manipulated by him. In this context of resource distribution,

the participant had three alternatives in each attempt: to make an equal distribution around 17% for each one; make an unequal distribution receiving less than the other participants (below 17% for him/herself); or make an unequal distribution by assigning to him an amount greater than 17%. According to Figure 4, only P3 did not distribute to herself an amount higher than 17%. The other participants made unequal distributions: P1 in one attempt (90.26%, mean of 22.15% among all trials); P2 in three (ranging from 19.35% to 33.33%, mean of 15.83%); P4 in 8 (29.82% - 80.91%, mean of 51.77%) and P5 and P6 in all (31.55% - 62.12%, mean of 45.43% and 33.33% - 75.08%, mean of 65.72%, respectively).

In Figure 5, the choices that the participants made regarding the division of resources can be observed among the three possibilities of choices mentioned, where it can be clearly seen that P4, P5 and P6 were the participants who made the greatest number of choices for unequal distributions for themselves (8, 10, and 10 respectively).

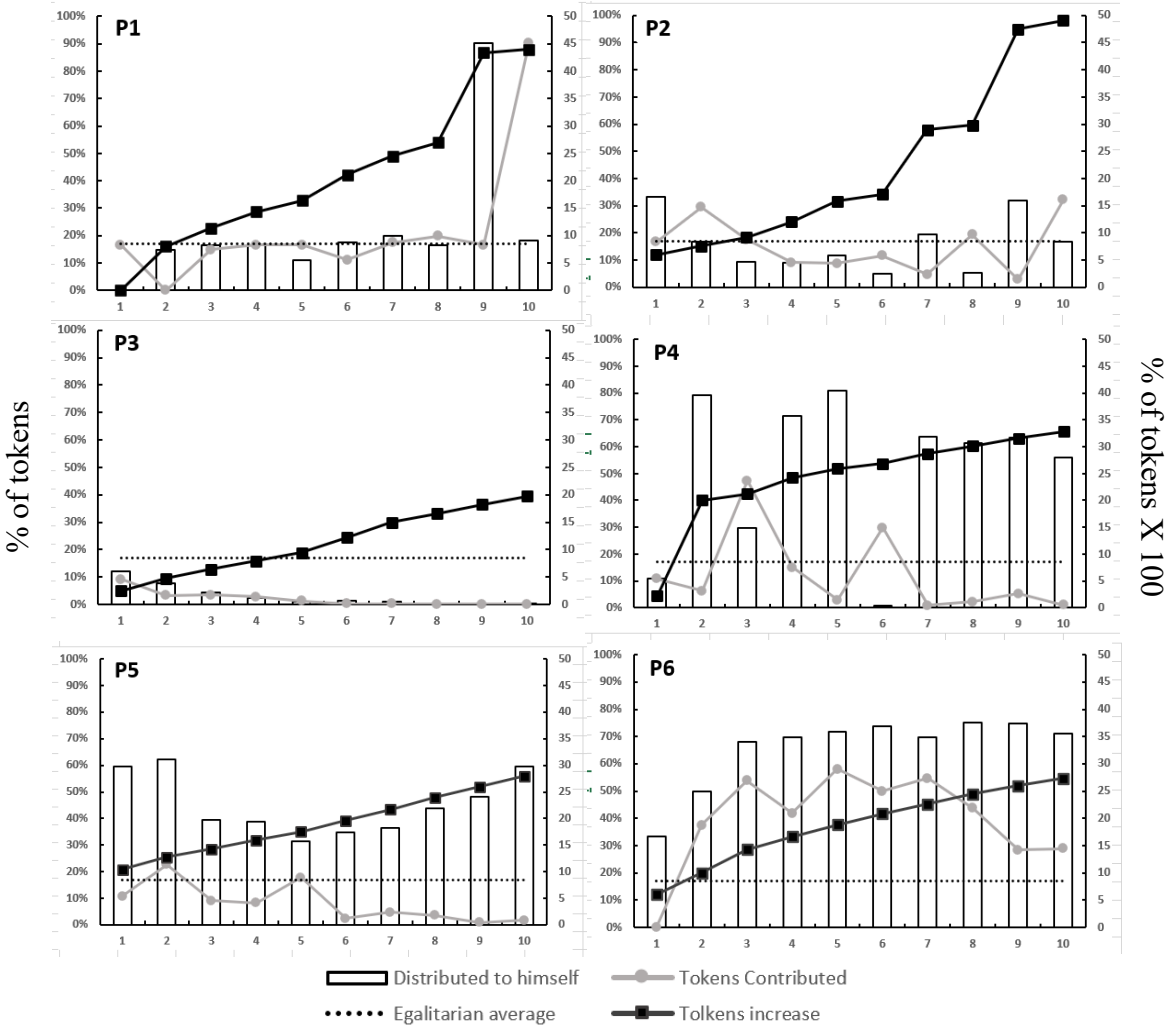

Figure 4. Distribution graph of the participants regarding the second block of trials: The bars represent the percentage of tokens that the participant distributed to him/herself; The grey line shows the percentage of tokens contributed and the black line shows the multiplication rate of tokens.

When the increase in the income factor is three, there is a greater amount of tokens being produced, and in this case, even if the participant makes an unequal distribution, there is a high probability that the amount obtained by the other players is always greater than that contributed, which makes it more likely for the real participant to make unequal distributions without there being any possibility of the other players reducing their contribution rates, since they would be reinforced by obtaining tokens in larger amounts in each attempt. For example, in the fifth attempt of the first block, non-real participants had access to a gain of an average of 90 tokens; whereas in the second, in some cases, they reached 2,500 tokens. Taking this into account, it is possible that unequal distributions occur without affecting the gains that the real participant has access to, since this would show him that the other players would be more likely to maintain their contribution rates.

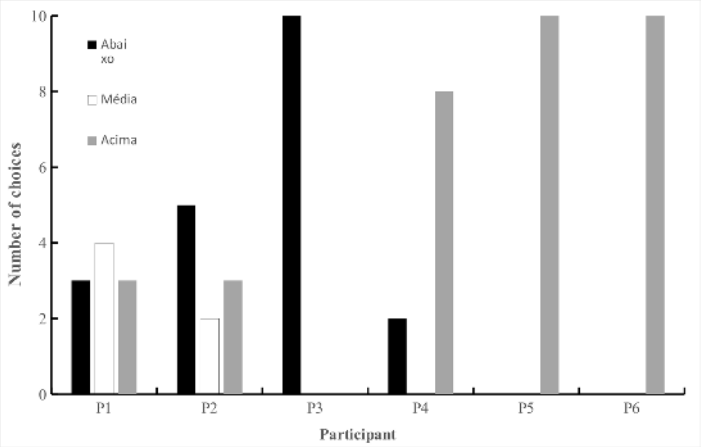

Figure 5. Choices of resource divisions made by participants in the second block of trials: The bars represent the number of choices for a given type of resource distribution made by the participants.

Concerning the performance of the participants, P1 performed best among the participants because he/she presented a higher frequency of distributions and equal contributions, i.e., when analysing the data of the second block, it could be observed that the distribution and contribution pattern of P1 was in practically all trials close or exactly at the rate of 17%. When making equal contributions and distributions, these behaviours are reinforced by the increase in income and, therefore, in the gains to which he/she had access. When a participant makes equal contributions and distributions, this increases the amount of tokens that other players have access to, which therefore allows for the contributions of these players to be greater. Larger contributions produce higher incomes, making the gains of the participant larger than those in contexts of unequal distributions.

Regarding the existence of negative correlation between social parasite patterns in the first block and of unequal distribution in the second, i.e., the lower the first, the higher the second for four participants (P4, P5, P6

and P1, to a lesser extent), there seems to be this correlation, as shown in Figure 6.

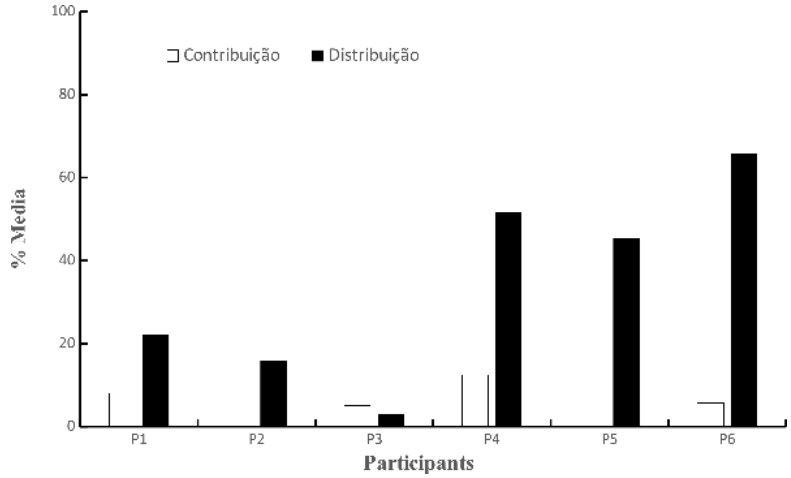

Figure 6. Average percentage of contribution and distribution: The bars represent the average percentage of tokens that the participants contributed and distributed to him/herself in all the trials.

P1 contributed with an average of 8.1% in the first block, and distributed to him/herself 22.15% in the second; P2, 14.7% and 15.83%; P3, 5.1% and 3.03%; P4, 12.5% and 51.77%; P5, 4.6% and 45.43%; and P6 5.7% and 65.72%. The data for P4, P5 and P6 show that when the contribution rates were low in the first block, the distribution rates for themselves were significantly high in the second; for P1, this correlation seems to be less evident; for P2, the difference is practically non-existent and for P3 there is a reversal in correlation, however with little difference.

The data show the independence of the performances obtained in both blocks. Among the possible reasons for this observation are the previous aspects mentioned about the changes in the contingencies from one block to the other, such as the presence of the dependent variable "Distribution" in the 2nd block and the change in the income factor for three.

Discussion

Overall, these data suggest that the manipulation of environmental variables, such as the income factor and unrestricted access to tokens, played a decisive role in establishing behavioural patterns of unequal contributions and distributions throughout the trials, mainly when behavior patterns of P5 and P6 were analyzed in the second block of trials. In fact, because of conditioned reinforcement value of the tokens, most participants showed a selfish behavior, and that can be an evidence to justify that we've been looking to the "wrong side" when we analyses corruption cases, as we discussed below.

When the Public Fund produced steady incomes and no unlikely and/or unrecognized aversive contingencies (such as possible censorship from the experimenter (Bolton, Katok, & Zwick, 1998)) was manipulated, the

Administrator was more likely to make unequal distributions, demonstrating that access to the tokens in larger quantities was established as a reinforcement consequence. The literature on the Public Goods Game (Andreoni, 1988; Ledyard, 1995) shows that there is more likelihood that unequal contributions will occur, which indicates that the contingencies programmed by this Game shape these repertoires. In addition, the use of the word "Game" has been pointed out as a variable that increases the likelihood of the participants to show competitive behaviours (Kennelly & Fantino, 2007).

An important aspect of this study is that the participant deals with resources produced by his/her own behaviour. The literature on behavioural games has shown that participants present a higher frequency of behaviours characterized as selfish and competitive when the resources they produce are at stake (Cherry, Frykblom, & Shogren, 2002). The data of the present study taken as a whole corroborate this finding, considering that most of the subjects made contributions below the rate of 17% or distributions above 17%. Other important aspect was that condition in which participants can use his/her private resources produced by gains in the past trials are very similar with real life situations, when individuals in fact contributed to produce a public good with his/her own resources, like when a citizen pay taxes and can provide, for example, a lamppost in streets. This is another aspect that can justified this experiment as an analogue.

These data enable us to look at the real world and propose a shift in focus concerning individuals who behave according to the context in which the behaviour occurs. The following commonly asked question "Would it be possible for anyone to behave in a corrupt way?" should be replaced by this: "Under what conditions can people behave in a corrupt way?".

Looking at the environment (the “right side”) rather than looking for individual characteristics (“wrong side”) allows interventions to be problematized to deal with the occurrence of corrupt behaviour. If the problem is in individuals who behave, the only viable alternative to deal with the problem of corruption would be to remove all those the environment who show these behaviours from. The mistake of this view is to believe that changing the "pieces of the game" will change the game itself. But if the problem lies in the contingencies to which the subjects are exposed, an intervention must necessarily be attentive to changes in this environment, as Skinner (1978) pointed out:

> The appeal to cognitive states and processes is a diversion which could well be responsible for much of our failure to solve our problems. We need to change our behaviour and we can do so only by changing our physical and social environments. We choose the wrong path at the very start when we suppose that our goal is to change 'the minds and hearts of men and women' rather than the world in which they live (p. 112).

An environmental variable that was pointed out by the literature in criminal law and economic crime theory as being the most significant to control the occurrence of criminal behaviour is the probability of punishment followed by its magnitude. Currently in Brazil there is a widespread popular belief in the impunity of those who show corrupt behaviour. Interested in investigating this scenario, Alencar & Jr. Gico (2011) conducted a study to verify the effectiveness of the legal system in punishing the behaviour of civil servants who had engaged in some kind of corrupt behaviour. The authors reviewed the Official Gazettes from 1993 to 2005 to locate civil servants who were exonerated for corrupt practices. In general terms, the authors found that only 3% of the cases that were actually judged materialized in some type of punishment, not necessarily severe, since according to the authors "*It should be remembered that even this very low performance in law enforcement does not necessarily represent time of incarceration, since the prison regime can be converted into other types of punishment depending on the time of imprisonment imposed*" (p.88).

According to Behaviour Analysis, the central points of any intervention should prioritize the probability and contiguity of the punishment, since unlikely and non-contingent consequences may not exercise the foreseen control. However, due to the high cost that the speed in the processes can cause (Alencar & Jr. Gico, 2011) which could make implementation feasible and difficult, there is a need to take into account alternatives, especially regarding applied cases to public agents who occupy their positions through electoral processes, who are often at the centre of corruption scandals most damaging to society, such as those dismantled by Operation Car Wash (*Lava-Jato*).

Taking this into account, a possibility for establishing more probable and immediate contingencies of control would be to make a change in the representative system through the recall election system (Santana, 2004). Recall election is the possibility of the representative losing his mandate through a popular vote (Cronin, 1999). Traditionally, the control that the population exerts on politicians´ behaviour is restricted to the election period. During the election, there is a motivating operation (Michael, 1982) that establishes how reinforcing the approval of the electorate is and evokes all the behaviours that in the past were followed by this reinforcer.

For this reason, it is common at this time for politicians to show behaviours where they approach the population, make promises, visit poor neighbourhoods, inaugurate works, etc. In a survey conducted by the UOL website (Rodrigues, 2016), it was observed that in 2016, the five mayors of the five largest cities in Brazil increased the rate of inaugurating works from 138% to 1600%, compared to the same period of the previous year.

At the end of the elections, the reinforcement value that maintains all these behaviours decreases, and the now-elected candidate is exposed to conflicting contingencies with those that were in force during the electoral period (Goldstein & Pennypacker, 1998). The recall election system allows the same motivating operation in force during the elections is also in force

during the candidate's mandate, allowing the voter to control the behaviour of the candidate he/she elected, not having to wait for the next election or judgements from the legal system that may have late consequences for these behaviours.

Nowadays, the question of improving transparency, which allows access to politicians' behaviours, would increase the possibility of them losing votes received during the election, and depending on the number of votes lost, the mandate and political rights. In this context, there is the establishment of direct and immediate control for any behaviour presented by the politician, among them, corrupt behaviour, so as to deal with this temporal gap between behaviour and consequence. An important research gap to investigate this and other potential interventions that aim at controlling corrupt behaviour arises and, is therefore, still an unexplored area.

Final Considerations

This research has produced results that confirm the viability of this experimental model to study the behaviour of peculation, and this is one of its main contributions. However, there are several aspects that should be considered in future research in order to deal with various gaps related to the experimental control of the present study. Firstly, in order to increase experimental control and to more directly demonstrate the effect of environmental variables on the observed behaviours, reversal design should be used.

A second aspect would be related to the behavioural variability that the participants presented, which proved to be difficult to control. As the participants were able to contribute/ distribute very different amounts, many different performances were obtained throughout the 10 trials. Future research can control this aspect by limiting the range of contributions a participant could make. One possibility would be to provide in each attempt the same token amount for the participants, and the contributions would be made by them, rather than being made with the amount accumulated by the participant throughout the trials. This not only reduces the variability, but would also allow participants to deal with smaller amounts of tokens. Along the same lines, the income factors could be equal in both blocks, which would make the number of tokens similar that the participants have access to.

Secondly, future research should consider the possibility of establishing stability criteria of the data for completing a block. In the present research, both blocks were structured with only 10 trials, however it is possible that the presented patterns could undergo changes during the trials and that the control variables become clearer after stabilising the data.

Despite the attempt of the present study to be characterized as an experimental analogue, we did not claim to account for all the complexity existing in real contexts in which corrupt behaviours occur as one of the main characteristics of these behaviours is their obscurity, i.e., the difficulty

in detecting the problem behaviour occurring in real time. In fact, corruption crimes that come to the forefront are those that went wrong. However, some similarities of the present study with real life have allowed for an approximation in aspects relevant to experimental studies on this phenomenon, such as the fact that the Fund Manager remains a contributor. This happens in natural contexts, since for example, a politician does not refrain from making contributions with the public good. When he/she buys a new car, goes to the supermarket, buys clothes, etc., he/she is invariably contributing to the Public Good, as the prices of these products are taxed.

The present study is a starting point for experimental research on corruption within Behaviour Analysis, contributing to the still incipient production in the area, which can initiate an interdisciplinary dialogue that can help strengthen Behaviour Analysis, broadening into other areas.

Finally, the data presented can help with discussions in real contexts on anti-corruption measures, by providing evidence that looking at the environment may be a more pragmatic way of attempting to address this problem.

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