Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Effects of verbal/non-verbal correspondence in cooperative behavior with children

Aline Melina Vaz

alinemelinavaz@gmail.com

State University of Norte Fluminense

Júlio Cesar De Rose

Federal University of São Carlos

Research Article

Keywords: Cooperation, Public Goods Game, Verbal/nonverbal correspondence, Do-Say correspondence, Say-Do correspondence, Children

Posted Date: April 24th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9227087/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

The verbal/non-verbal correspondence paradigm was applied in a social context. The participants were 9 and 10-year-old children, who were invited to play several rounds of the Public Goods Game. During the game, each child received three coins and could choose to donate anonymously in a collective fund; which was then tripled and shared equally. The researcher asked each child if he or she donated the three coins to fund. Participants could answer "yes" or "no" to the researcher's question and would receive more coins as a consequence of the self-report depending on the experimental phase. Phases were: pro-cooperation (reinforcement for saying "yes"), anti-cooperation (reinforcement for saying "no"), and the baseline/control condition. In condition 1 each phase was applied for a group, and there were 11 sessions. In the second condition, the same group was submitted to all the phases, starting with baseline, followed by anti-cooperation, and then pro-cooperation; there were 16 sessions. The results of both conditions indicated that the group behaved according to the reinforced report. During the anti-cooperation phase, there were fewer donations of the coins, which did not differ statistically from the control group (condition 1), or from the baseline (condition 2). During the pro-cooperation phase, the participants increased their donations. In both conditions most of the self-reports of the donations were correspondent. This research presents an original experimental method to investigate honesty and cooperation. The data shows that the reinforcement of verbal behavior can modify social behavior, promoting cooperation (conditions 1 and 2).

Introduction

The field of verbal/non-verbal correspondence can be defined through the study of phenomena that link two behaviors occurring at distinct temporal intervals: one verbal, and thereby maintained in a mediated manner by a listener, and another non-verbal, which is directly maintained by the consequences it elicits in the environment (Lloyd, 2002; Perez, 2017). In correspondence research, verbal behavior is typically characterized as "saying," while non-verbal behavior is characterized as "doing."

When non-verbal behavior precedes its verbal description, this phenomenon is referred to as a sequence or chain of behaviors termed "doing-saying." A lack of correspondence between "doing" and "saying" in this sequence is generally referred to as lying. Conversely, when a specific non-verbal behavior occurs subsequent to its verbal description, this results in a behavioral chain known as "saying-doing." The absence of correspondence in the "saying-doing" sequence is typically termed a "broken promise." Research on correspondence is often categorized based on the behavioral chains being investigated, which may involve complex sequences with three components, such as doing-saying-doing (Beckert, 2005).

One of the earliest studies addressing correspondence investigates the "doing-saying-doing" sequence. Risley and Hart (1968) explored whether reinforcement of verbal reports concerning prior non-verbal behavior could influence subsequent non-verbal actions. They engaged preschool children in situations where they had to disclose whether they had played with specific preschool materials. In the initial

condition, the researchers reinforced the report of having used the materials, regardless of the child's actual engagement with them. In the second condition, they reinforced the corresponding reports, aligning the child's verbal account with actual usage. The findings indicated that both the reinforcement of the report and the reinforcement of correspondence significantly increased the likelihood of the child using the specified material in subsequent play sessions. The researchers repeated this procedure with the same children using different preschool materials, finding similar results: the children began using materials for which they received reinforcement for reporting their usage. The authors concluded that the reinforcement of verbal reporting led to increased non-verbal engagement and altered the probability of subsequent actions.

Reinforcement of verbal reporting also influenced the nature of the reports themselves. In 1989, Ribeiro investigated the correspondence between doing and saying in the self-reports of very young children about a play situation. There were six toys, and each child had the opportunity to play with them. After the play situation (the doing), the researcher showed a photo of the toys and asked if the child had played with those toys (the saying). Initial baseline results indicated a correspondence in the participants' reports. Subsequently, the author introduced a differential reinforcement scheme for reporting: each time the children claimed to have played with a toy—regardless of whether they had actually done so—the reporting behavior was reinforced. Under this new contingency, the frequency of reports claiming play with the toys increased, even when the participants had not engaged with them. In other words, the children began to lie about having played with a toy. The differential reinforcement of reporting that they had played (a specific topography of reporting) was what modified the participants' behavior. When the researcher began to differentially reinforce the correspondence between the report and the antecedent behavior (reinforcing telling the truth), the participants returned to their initial performance of corresponding reports. This research highlights how differential reinforcement of verbal reporting can undermine the correspondence between "doing" and "saying," indicating that certain forms of reinforcement can promote deceptive behavior.

In a related study examining "doing-saying" correspondence, Brino and de Rose (2006) investigated the effects of correspondence training in children with a history of academic failure. In this study, a computer displayed a word, and the child was supposed to read it aloud (doing). Then, the computer played the correct pronunciation of that same word, and the child, upon hearing the correct sound, was supposed to report whether they had read it correctly or not (saying). Participants experienced two conditions of differential reinforcement: in the first condition, reporting correct readings was reinforced, aligning with standard educational practices of rewarding correctness. In the second experimental condition, the correspondence between "doing" (reading) and "saying" (reporting corrections or errors) was reinforced. Reporting of errors is particularly challenging for this population, as the authors noted in the first condition, the children's reports often seemed to be influenced by a history of punishment for errors, leading them to misreport inaccuracies as correct. The authors observed that correspondence training resulted in an increase of accurate reports. Furthermore, the authors manipulated the presence or absence of the researcher during the reporting phase, finding that a greater correspondence between

"doing" and "saying" occurred in the researcher's presence, suggesting that social variables impact reporting beyond differential reinforcement.

Alves (2018) examined "doing-saying" correspondence among adults, seeking to assess the role of the audience in the accuracy of reports. Participants were invited to engage in a virtual role-playing game (RPG). In this game, individuals assumed the role of the protagonist in an adventure (inspired by "Prince of Persia") and were instructed to collect magical orbs, specifically green and red ones. Within the narrative context, red orbs were prohibited but yielded greater points for players. Throughout the adventure, players encountered various characters to whom they reported whether they had taken the red orbs. Three types of characters were defined by the consequences they communicated to the players: a punitive audience, a reinforcing audience, and an ambiguous audience (oscillating between punishment and reinforcement). Results indicated that the highest frequency of inaccurate reports occurred in interactions with the punitive and ambiguous audiences, underscoring the significant role of the audience in shaping report accuracy. It could be inferred that reinforcing audiences foster truthful reporting, providing further evidence of how social variables modulate verbal behavior.

While social variables play a crucial role in modulating verbal behavior, the existing literature on correspondence has primarily focused on behaviors emitted by participants in isolation. Investigations into the influence of social variables on verbal reporting can be found in studies where a participant reports in the presence of others (Oliveira, Cortez & de Rose, 2016; Ribeiro, 1989); however, the impact of verbal reinforcement on non-verbal behavior, particularly in social contexts, remains largely unexplored. The "doing" referenced in the aforementioned studies pertains to behaviors executed in individual contexts, without consideration for situations where such "doing" may transpire in environments where one individual's behavior could be contingent upon another's actions or produce consequences for another individual, particularly in cooperative contexts.

Cooperation and other prosocial behaviors can be understood from an evolutionary standpoint as providing adaptive advantages not merely for the individual but for the group to which they belong, particularly among social species (Yamamotto, 2019). Skinner (1953/2003) asserted that the reinforcing effects are amplified within groups: "The reinforcing consequences generated by the group easily exceed the totals of the consequences that could be achieved by the members acting separately. The total reinforcing effect is greatly increased" (Skinner, 1953/2003, p. 341). Humans are among the most cooperative species observed in nature (Boyd & Richerson, 2009). Evidence supporting the notion that such behavior has been selected in the human species is that very young infants engage in cooperative interactions (Warneken & Tomasello, 2008).

Despite the evolutionary selection of cooperation, the tension between individual and collective gains complicates the maintenance of cooperative environments. Daily social interactions often present similar dilemmas: equitable distribution of resources, determining whom to trust, deciding how to act justly, and evaluating when it is more prudent to prioritize individual interests versus group interests.

Many of these scenarios have been analyzed within the framework of social dilemmas proposed by Game Theory (Ostrom, 1990).

In a review of social dilemmas, Kollock (1998) characterizes them as "situations in which individual rationality leads to collective irrationality" (p.183), wherein individual interests clash with collective interests. Alencar and Yamamoto (2008), in an article discussing game theory and scientific methodology, demonstrate how social dilemmas can serve as methodological strategies for investigating scenarios in which individuals must consider the behaviors of others. The authors argue that this type of investigation is relevant across various disciplines, including Political Science, Social Sciences, Biological Sciences, and Psychology, and they contend that social dilemmas can be effectively applied to the study of cooperative behaviors. They identify three of the most recognized games: the Prisoner's Dilemma, the Commons Dilemma, and the Public Goods Dilemma, with the latter being particularly pertinent to the present research.

The Public Goods Dilemma, or Public Goods Game, can be characterized among social dilemmas as a multi-person dilemma (unlike the Prisoner's Dilemma, which involves only two individuals). It is based on the premise that all individuals must invest some resources so that the entire group can achieve a greater return from this investment. This greater return, the public good, is distributed or made equally accessible to everyone in the group. The dilemma lies in the fact that some individuals may choose not to invest; however, if everyone acts in this way, the group can not achieve the greater benefit (Alencar & Yamamoto, 2008; Guerin, 2004). The public good is understood as a resource from which everyone benefits, but not everyone necessarily contributed (or contributed equally) to receive it. Precisely because it is a public good, one individual's use of the resource does not diminish its availability for others, meaning there is no rivalry, and everyone can benefit equally—hence the temptation to simply enjoy the good without having contributed to it (Kollock, 1998).

In a behavioral review of the Public Goods Game, Ferreira (2018) presents an analysis of the complexity of the contingencies involved in the game. Among the antecedents are: the amount available to contribute, the amount gained in the previous round, instructions about how the game works (anonymity, confidentiality, etc.), the contributions of other participants, and whether the items obtained can or cannot be exchanged for reinforcers at the end of the game. The complexity increases further when considering the consequences of contributing, which can be either reinforcing or punitive. Contributing is positively reinforced with delay and immediately punished by the risk of losing the invested items, while the behavior of not contributing is reinforced both positively (gaining more items) and negatively (avoiding the punishment of loss), making it more likely to occur (Ferreira, 2017).

Considering all this, the present research aimed to investigate the relationship between correspondence and cooperation in an experimental study. As in correspondence research, there is a task that characterizes the "doing" and the "saying". In the studies presented below, the "doing" involved participating in a Public Goods Dilemma activity. The "doing" was operationalized as the behavior of donating/investing coins in a collective fund. The "saying" referred to the report about the donation of

coins to the collective fund. There was also differential reinforcement of a specific topography (pro-cooperative or anti-cooperative) of the report, as well as reinforcement of the correspondence between doing and saying.

In summary, the present research on correspondence used the Public Goods Dilemma as an experimental strategy to create a social context in which the "doing" was a behavior whose consequences depended on the behavior of other individuals, thus constituting a social doing. The participating children had their reports differentially reinforced according to the experimental condition in effect. Some questions involved the manipulations made in each experimental condition. Can reinforcing the report of a cooperative behavior (regardless of whether it is correspondent or not) increase the frequency of cooperative behaviors? Can reinforcing the report of a non-cooperative behavior (regardless of whether it is correspondent or not) increase the frequency of non-cooperative behaviors? Finally, can reinforcing the correspondence between doing and saying increase the frequency of cooperative behavior? The objective was to verify the effect of manipulating verbal behavior on: a) non-verbal cooperative behavior (operationalized as the behavior of donating coins to the collective fund); and b) verbal behavior itself (reporting about the donation). Two conditions were conducted, using an inter-group (Condition 1) and intra-group (Condition 2) experimental design.

Materials and Methods

1. Participants

The studies presented below were conducted with typically developing children aged 9 and 10. Children of this age already possess sufficient social and verbal skills to understand the similarities and differences between their own perspective and that of their interlocutor—that is, they are already capable of lying, as this ability develops around the age of 4 (Ding, Wellman, Wang, Fu, & Lee, 2015). This is also a population that has been little studied in terms of cooperation research (Yamamoto, 2019), especially from a behavioral analysis perspective (Suarez et al., 2018).

Condition 1: Sixty nine aged 10 years from three regular classes in a public school located in São Paulo, Brazil participated in this study. Each class was assigned to a different experimental groups:

- Pro-cooperation group (n=27; 16 girls; mean age: 10 years and 10 months; standard deviation: 4 months)
- Anti-cooperation group (n=24; 16 girls; mean age: 10 years and 11 months; standard deviation: 4.6 months)
- Control group (n=18; 14 girls; mean age: 10 years and 9 months; standard deviation: 3.9 months)

Condition 2: Thirty-one children (18 girls; mean age: 10 years and 8 months; standard deviation: 6 months) from a regular class in a different public school in the interior of São Paulo participated in this study.

The guardians of the participants were informed about the research and provided consent through a Free and Informed Consent Form. Notably, the majority of the participants' families (74%) reported an income of up to three minimum wages. This information was obtained via a socioeconomic questionnaire completed by 65% of the guardians of the participants in Study 2. These socioeconomic data are applicable to all participants, considering the similarity in participant demographics and the average monthly income (2.9 minimum wages) reported for the municipality where the research was conducted (Brazilian Institute of Geography and Statistics [IBGE], 2016).

2. Location

The procedures were conducted in two locations: the collective activity took place in the participants' classroom (the “doing”), while individual reports were provided in a separate area within the school (the “saying”).

3. Materials

Plastic coins were employed as items to be donated into a collection box and served as generalized reinforcers. Each coin was valued at one point. Participants could either save their coins between experimental sessions (maintained in a "Bank," with each participant having an "open account") or exchange them for school supplies and small toys at a "Shop."

This "Shop" had three boxes labeled with values of 5, 10, and 15, indicating the number of coins required to "purchase" specific items from within. The items in each box were organized according to the interests of the children, which had been assessed in advance through sampling (counterbalanced by gender). In this sampling, items were displayed before the child, who was then asked to rank them from most to least interesting. This token economy system aimed to sustain the children's engagement in the studies (Borges, 2004; Galizio & Buskist, 1988). Additional materials included a coin pouch for each participant (to maintain the secrecy of donations), a cardboard apparatus which children could anonymously make their donations behind, and a plastic collection box for depositing the coins. These materials were designed to be easily adaptable to existing school furniture.

4. General Procedure

An introductory activity was conducted with all participants, involving various multiplication and division exercises using the coins to ensure that the children would fully understand the task instructions, which included these mathematical operations.

The overall procedure comprised two parts: (a) the group activity, which involved the donations (the “doing”) and the subsequent opening of the box for redistributing the coins; and (b) the individual reports from each participant (the “saying”). The teacher of the class coordinated the group activity, while the researcher managed the individual reports. These two components together constituted an experimental session.

4.1 The Doing: Group Activity

The children were invited to participate in a group activity designed as an experimental adaptation of the Public Goods Dilemma (Alencar, Siqueira, & Yamamoto, 2008). Each child received three plastic coins and was given the option to donate them to a group fund for the class. Participants could choose to donate 0, 1, 2, or 3 coins. Instructions indicated that for each coin donated, the researcher would contribute an additional two coins to the group fund. The total amount (tripled) would then be redistributed equally to all participants present in that session. All donations were made individually and anonymously, and the instructions were reiterated at the start of each session.

4.2 The Saying: Reporting the Donation

After the group activity, immediately following it, each participant was asked to report their donation in a separate area from the classroom. The researcher spoke: "I'm going to ask you a question, and you have to answer with Yes or No, okay? In the activity you just participated in, did you give all three coins to the class? Yes or No?" If the child answered “yes” and was truthful, it indicated that they had donated all three coins. Conversely, a “no” response indicated that they had not donated all the coins, which could imply donations of 2, 1, or none.

5. Experimental Design

5.1 Condition 1

Participants were organized into three groups: the pro-cooperation group, the anti-cooperation group, and the control group. The control group participated solely in the group activity, which comprised 10 sessions.

The other two groups underwent two phases: a baseline phase and an experimental phase (in which differential reinforcement of reports was introduced). During the baseline phase, no differential reinforcement of reports occurred; the researcher would ask the child about their coin donation, and upon receiving a response, the researcher would say: “Now, I’m going to give you two more coins because you played with me!”. The criterion for transitioning from the baseline to the experimental phase for the two groups was based on stability during the group activity: three consecutive sessions where the number of shared coins varied by only one point (either up or down, avoiding trends).

Five sessions were conducted in the experimental phase for each of the two groups. In the pro-cooperation group, the researcher would respond back to the children's report: “Since you said yes, I will give you two more coins.”. In contrast, participants in the anti-cooperation group were subject to the opposite condition: their reports were reinforced if they claimed they had not donated all three coins. Reinforcement, therefore, depended on a specific verbal response: pro-cooperative (in the pro-cooperation group) or anti-cooperative (in the anti-cooperation group).

5.2 Condition 2

Initially, Study 1 planned for a reversal of conditions for both groups; however, this was not feasible as data collection needed to be concluded. Consequently, the previous procedures were replicated within a single group that experienced both experimental conditions—anti-cooperative and pro-cooperative—in that order. Six baseline sessions were conducted, maintaining the same criterion for phase transitions as in the previous study. Four sessions were held in the anti-cooperation phase and six in the pro-cooperation phase. In the latter phase, a correction procedure was employed to clarify the change in contingencies. When children answered “No” during the pro-cooperation phase, the researcher responded, “Since you said no, I won’t give you the two coins I used to give you.”

Response Recording

Responses—including both verbal reports and the number of coins accumulated by each child—were documented in a data collection notebook. In condition 2, responses were additionally recorded via video. Following the report, the researcher would say to the child, "Let's see how many coins you have!" The researcher then counted the coins with the child and recorded the total on the record sheet (“bank account”).

To determine how many coins each child donated to the collection box and also verify the correspondence of the reports, the mathematical formula utilized was: [D] = T - S - 3, where T represents the total coins held by the child at the time of the report, S is the number of coins shared from the tripled collection box for that session, and “3” indicates the initial number of coins each child received before each session. This method enabled the researcher to ascertain the number of coins each participant donated to the collection box at the end of each experimental session, despite the anonymity of the donations.

At the conclusion of the research, children in condition 2 were interviewed to assess their awareness of this information, with the question: "Do you think there was any way someone could know how many coins you put in the collection box?" Most children responded negatively or speculated that some classmates might have been observing. Only one child grasped the mathematical reasoning underlying the donations, although this did not seem to cause them any discomfort.

Data Analysis

The average number of coins donated during the collective activity served as an indicator of cooperative behavior across the different groups and was analyzed descriptively. Additionally, the frequency of “three-coin” and “no-coin” donations was analyzed descriptively. The correspondence between verbal and non-verbal reports was assessed based on the frequency of matching responses.

To evaluate the effect of verbal behavior intervention on cooperative behavior, a Generalized Estimating Equations (GEE) model was constructed, using a Wald chi-square probability distribution. This analysis considers the entire dataset, treating groups as between-subject measures and sessions as within-

subject measures, with covariance accounted for in the model. A multinomial distribution with cumulative (or ordinal) logit was used for the number of items donated in each session. Both group and experimental phase were included as predictors, as well as their interaction, and the outcome was the number of coins donated in each session. The covariance matrix structure used was unstructured.

Non-parametric Friedman analyses were used to verify whether there were differences within groups across the sessions of the experimental phase, and Wilcoxon tests were used for pairwise comparisons. All statistical analyses were conducted using SPSS v2.0.0, and a 5% significance level was adopted. When a child was absent, their data were considered missing only for the sessions they did not attend.

Results

Condition 1

The figure 1 presents the results of the average donations from the three groups. All three groups exhibit a decline in the amount of donations during the baseline. Shortly after the experimental phase was introduced, donations from the pro-cooperation group became consistently greater than those from the other groups. Conversely, donations from the anti-cooperation group become consistently lower following the intervention. In other words, the pro-cooperation group demonstrated more cooperative behavior, while the anti-cooperation group exhibited less cooperative behavior during the collective activity. The control group did not appear to demonstrate consistent behavior when examining the average donations.

Analyses conducted using a Generalized Estimating Equations (GEE) model indicated an interaction effect between session and group ($\chi^2(8) = 20.975$, $p = 0.007$). This suggests that membership in a particular group can be considered a predictor of a specific behavioral pattern within that group. Pairwise comparisons using the Wilcoxon test indicated that the differences within the pro-cooperation group are consistently between the donations of the first session and the others, which do not differ from each other, indicating that the intervention on verbal behavior, following its initiation, had a stable effect.

The five sessions of the experimental phase were compared across each of the groups using non-parametric Friedman analyses. This analysis indicated a difference in the average donation rankings across the sessions for the pro-cooperation group ($\chi^2(4) = 15.824$, $p = 0.003$), but not for the anti-cooperation ($\chi^2(4) = 5.479$, $p = 0.242$) and control groups ($\chi^2(4) = 4.839$, $p = 0.304$). This indicates that the pro-cooperation intervention had a more pronounced effect.

In the pro-cooperation group, the proportion of participants who chose zero coins for their donation decreased during the experimental phase (falling below 50%), while the proportion of participants who chose “three coins” increased and remained above 25% throughout subsequent sessions of the experimental phase (see Figure 2). Thus, the increase in cooperative behavior observed in the pro-cooperation group was due both to the increase in the number of coins donated and to the number of

participants making donations. During the experimental phase, 52% of participants (P1, P2, P3, P4, P5, P7, P10, P12, P13, P17, P19, P20, P22, P23, P24, and P25) donated three coins in one or more sessions of this phase and consequently came into contact with the programmed contingencies for this group (the gain of two additional coins after reporting the donation of three coins).

In the anti-cooperation group, the proportion of participants donating zero coins increased slightly during the experimental phase and remained above 50%, ensuring that all participants came into contact with the programmed reinforcement contingencies throughout the phase. The proportion of participants who donated three coins, which was already low, decreased further and remained low (below 25%—see Figure 2). In this group, few participants were donating many coins, while many participants were not donating any coins at all, resulting in low cooperation overall. The control group appears to be, among all, the group with the most cooperative profile, especially when compared to the baseline performance of the other two groups, as can be observed in Figure 2.

The results of the do-say correspondence indicated that, in both the pro-cooperation and anti-cooperation groups, the majority of participants behaved correspondingly between their reports and donations. In other words, in the pro-cooperation group, the majority of participants answered “Yes” for the researcher's question about having donated the three coins. In the anti-cooperation group most participants answered “No” to the researcher’s question. These behaviors can be considered congruent with the contingency programmed for each group, as the participants receive as many coins as possible for themselves. Table 1 summarizes the reporting data.

Table 1. Quantity of corresponding and non-corresponding reports from both groups. The quantity of non-corresponding reports (lies) is highlighted in gray. Participants who lied are identified below, in the column corresponding to the session in which they lied.

Pro-Cooperation (yes)	Baseline						Experimental Phase				
Trial	1	2	3	4	5	6	7	8	9	10	11
Correspondents	19	20	26	20	25	27	23	23	24	21	13
Non-correspondents	0	1	0	0	0	0	0	1	1	3	2
Participant’s reports Y-yes N-no M-missing		P17- N						P3-N	P25-N	P1-Y P13-Y P25-N	P1-N P13-Y P24-Y
Total of participants	19	21	26	20	25	27	23	24	25	24	15

Anti-Cooperation (no)	Baseline						Experimental Phase				
Trial	1	2	3	4	5	6	7	8	9	10	11
Correspondents	17	20	22	19	20	22	21	22	22	22	22
Non-correspondents	2	0	2	2	1	0	1	1	1	1	0
Participant’s reports Y-yes N-no	P6-Y P24-Y	P24-M	P20-Y P24-Y	P4-Y P6-Y	P4-Y		P4-Y	P12-Y	P12-Y	P22-Y	
Total of participants	19	20	24	21	21	22	22	23	23	23	22

Source: Own authoring

Considering corresponding reports, there are some exceptions : in the pro-cooperation group, participant P13 consistently lied during sessions 10 and 11, in accordance with the contingency favoring him (he responded “Yes” to the researcher’s question in these two sessions, despite having donated no coins). Another participant (P24) exhibited the same behavioral pattern only in session 11. The researchers believe that they communicated between one session and another. Another participant presented a non-corresponding report of “Yes” (P1, session 10) but was absent from the following session. Another participant (P25) consistently provided a non-corresponding report in two consecutive sessions (9 and 10), yet responded “No” to the researcher’s question (and donated three coins in those sessions). This behavior can be considered incongruent with the contingency in effect for his group, as the participant ceased to receive coins. Two additional participants exhibited similar behavior: P3 in session 8, and P17 in session 3.

In the anti-cooperation group, participants P4 and P24 presented non-corresponding “Yes” reports consistently across multiple sessions of the baseline. Only one participant (P12) exhibited this incongruent pattern with the prevailing contingency during the experimental phase.

Condition 2

The figure 3 presents the average donations through the experimental phases. It can be observed that during the baseline, the average donations progressively decreased, stabilized at low levels during the anti-cooperation phase, and, during the pro-cooperation phase, the averages increased progressively.

An ordinal logistic regression model was used for the three phases, with session and phase as predictors and a permuted covariance matrix for the repeated measures, as it yielded the lowest QIC (Quasi-likelihood under the Independence model Criterion, an index indicating how well the model fits the data; the lower the value, the better the fit). An interaction effect between session and phase was observed ($\chi^2(7) = 25.996$, $p = 0.001$), as well as a session effect ($\chi^2(5) = 16.437$, $p = 0.006$). As there appears to be no difference between the amount of donations in the first session of the baseline and the fifth session of the pro-cooperation phase ($z = 0.620$, $p = 0.535$), we can conclude that the number of donations was restored in the last phase, approaching the start of the baseline.

The proportion of participants donating no coins increased throughout the baseline and remained high (above 50%) during the anti-cooperation phase. In the pro-cooperation phase, there was a subtle and progressive decrease in the proportion of participants donating no coins (except for the last session) and a significant increase in participants donating three coins starting from the thirteenth session (24% of participants). The frequency of donations of three coins was significantly higher in the pro-cooperation phase (60% of all donations of three coins occurred during this phase). Figure 4 illustrates these results.

Again, there was a prevalence of correspondence between the report and the donation of coins. A greater presence of non-corresponding reports (P6, P7, and P10) was noted in the first session of the baseline. One participant (P6) lied in almost all sessions, regardless of the prevailing reinforcement. This

participant consistently reported having donated three coins while donating less. In the eleventh session and then in the last two sessions (in the pro-cooperative condition), the participant continued to respond "yes" to the researcher's question but changed her non-verbal behavior, donating three coins. This participant serves as a good example of how the reinforcement of a cooperative verbal behavior topology altered non-verbal behavior. Other participants (P2, P5, P22) exhibited non-corresponding reports that did not persist in subsequent sessions. Table 2 summarizes these data.

Table 2. Quantity of corresponding and non-corresponding reports. The quantity of non-corresponding reports (lies) is highlighted in gray. Participants who lied are identified below, in the column corresponding to the session in which they lied.

Experimental Phase	**Baseline**						**Anti-Cooperation**				**Pro-Cooperation**					
Trials	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Correspondents	25	27	28	25	27	28	29	30	27	28	30	28	25	28	29	29
Non-correspondents	3	0	1	1	1	2	1	1	1	2	0	1	0	1	1	0
Participant's reports Y-yes N-no	P6-Y P7-Y P10-Y	P6-X	P6-Y	P6-Y	P6-Y	P5-N P6-Y	P6-Y	P6-Y	P6-Y	P6-Y P22-Y		P6-Y	P6-X	P6-Y	P2-Y	
Total of participants	28	27	29	26	28	30	30	31	28	30	30	29	25	29	30	29

Source: Own authoring

Discussion

Two experimental conditions were conducted with children aged 9 and 10 years, aiming to investigate whether manipulations in verbal behavior could alter non-verbal behaviors in a social context. The manipulation involved reinforcing reports of donating coins to a collective fund, in an experimental adaptation of the Public Goods Dilemma. The reinforcement of reporting was based on both socially desirable content (pro-cooperative condition) and socially undesirable content (anti-cooperative condition). Two dependent variables are presented: cooperative behavior (measured based on the frequency of coin donations) and the corresponding reports (which could be either corresponding or non-corresponding), with the latter also serving as an independent variable. The outcomes of the manipulation of these two variables will be discussed below.

Cooperative behavior decreased in the three groups in condition 1 and among participants in condition 2 during the baseline sessions. This decline represents a common behavioral pattern widely recognized in the literature: cooperation typically diminishes over sessions (Alencar et al., 2008; Andreoni, 1988; Dutra et al., 2018; Ferreira, 2017; Ferreira, 2018; Silva et al., 2016). During the baseline, where no manipulations of antecedent conditions occurred, it would be expected that the frequency of coin donations would decrease over the sessions. In a review of the public goods game, Ferreira (2018) describes the

contingencies controlling the behavior of participants in repeated games: the behavior of not donating is reinforced both positively (when the participant receives more) and negatively (when they avoid losing), which results in making no donations more likely to occur.

This type of outcome is also found in the work of Dutra (2012), in which the author investigated the relationships between cooperation and morality by combining the public goods game with verbal feedback among children aged 7 to 9 years. Participants received three wafers in an envelope and could decide how many to donate to the collective fund, which was tripled and redistributed equally among all. There were three experimental conditions: positive feedback, negative feedback, and a control condition. Upon opening the envelopes with individual anonymous donations in front of everyone, the researcher provided verbal feedback. In the positive feedback condition, the researcher would say, "That's great, this person was generous to the group," while in the negative feedback condition, they would say, "That's unfortunate, this person was not generous to the group." Eight sessions were conducted with each group, and the results showed that the group receiving negative feedback cooperated more than the other two groups. However, all three groups (positive, negative, and control feedback) exhibited the previously described pattern (decline in cooperation observed during the baseline of the current studies).

The author argues that negative feedback delayed the decline in donations. One described method to promote cooperation is the use of punitive strategies (Ferreira, 2018). Dutra's (2012) study serves as an excellent example of utilizing punitive strategies. Negative feedback can be understood as a punishment for those who did not make donations and a negative reinforcement (avoiding the verbal punishment) for those who did donate. In the positive feedback condition, those who made donations received verbal reinforcement (which may have been "diluted" among all present, which could be considered a “weak” reinforcement), while those who did not donate were unaffected. In other words, criticism is aversive for everyone, as the author said “had a moral effect” (p.42), but praise is only reinforcing for those who donated.

In another study, Dutra *et al*., (2018) added an additional condition by introducing an adult (a confederate researcher) during the donation phase . In this condition, participants cooperated even more than in the negative feedback condition, yet the decline in donations across sessions was not prevented. Contrary to these findings, in the pro-cooperative experimental phase of the current research, the frequency of participants donating increased, while the frequency of participants not donating any coins decreased (see Figure 3). This result is unusual in the context of public goods research (Ferreira, 2018). Neither of the two interventions conducted by Dutra *et al*. (2018) resulted in an increase in cooperation. This effect was observed not only in the pro-cooperative group of condition 1 but was also replicated in the pro-cooperative phase of condition 2. The influence of the verbal behavior on the group behavior can be understood as a possible explanation of these outcomes.

Glenn (1989) argues that the behaviors of speakers and listeners are interlocked in cultural practices. As the author describes, "Human cultures always include verbal behavior, which requires speakers and

listeners, and involves interlocking contingencies among individuals” (p.11). In this sense, through the interlocking contingencies between the researcher and participants' behavior as a speakers and listeners, and the participants' behavior, the reinforcement of reporting donation established the act of donating three coins into the urn as a cultural practice in the pro-cooperation condition. “In the interlocking contingencies of reinforcement comprising a cultural practice, each individual participating in the practice provides critical components of the behaviorally potent environment for the other participants" (p. 11). At least two of Skinner's works (1953/2003 and 1981) are relevant to this discussion.

About cultural selection, Skinner (1981) argues that "it is the effect upon the group, not the reinforcing consequences for individual members, which is responsible for the evolution of culture" (p. 502). The results found here corroborate this assertion, and the increase in group cooperation maintained by the reinforcement of individual reporting can be considered an example of cultural selection. Skinner (1953/2003) describes how the group can exert control over the individual, reducing the occurrence of selfish behaviors. In the present research, punishment was not employed; instead, the focus was on the positive reinforcement of reporting donations. Consequently, this procedure can be understood as a non-punitive strategy to promote cooperative behavior, as the reinforcement of verbal behavior with a pro-cooperative topography seems to have fostered group cooperation. Positively reinforcing reports of donating three coins increased the frequency of donations of three coins in subsequent sessions. The results indicate the establishment of a saying-doing correspondence. To understand better the outcomes, it is necessary to look at the results of the verbal behavior.

Most reports in both conditions showed doing-saying correspondence. Considering the individual benefits involved in the pro-cooperative group/phase it was expected that participants would emit corresponding reports. It would be unlikely, based on the planned experimental contingencies and what could be expected socially, for someone who cooperated (donating three coins) to claim they did not cooperate. The opposite, however, would be more likely to occur: someone who did not donate three coins might lie about it, considering that cooperating is socially desirable. In this scenario, cooperation would decrease, and the frequency of non-corresponding reports would increase.

In the doing-saying sequence, reinforcing the report generally leads to the emission of distorted reports. This recurring effect has been observed in various studies investigating different variables (e.g., Cortez, de Rose, & Montagnoli, 2013 – the reinforcement history of the participating population; Domeniconi, Perez & De Rose, 2014 – the effect of removing correspondence training on the maintenance of this behavior; Gomes, Kawakami, Pereira, Fidalgo, 2018 – the effect of punishment on reports). This effect was expected particularly because, with donations being anonymous and reports being individual, there was no chance for peers to discover a possible lie. The lack of the possibility of being caught increases the likelihood of dishonest behavior (Ariely, 2012). The results, however, indicated a high frequency of corresponding reports among participants, along with a high frequency of donations of three coins in the pro-cooperative group/phase in both condition 1 and condition 2. In other words, the frequency of donations of three coins was accompanied by their corresponding reports. The reinforcement of a

specific topography of reporting (pro-cooperative and anti-cooperative) did not increase the frequency of non-corresponding reports, raising the question of why participants did not lie.

There is an inherent aversiveness to behaviors considered morally negative (Freud, 1930; Skinner, 1953/2003). This may have favored the prevalence of cooperation and correspondence in the results of the present research. Both not lying and not cooperating may have been maintained by the avoidance of feelings such as guilt or shame, or antecedent conditions could alter the probability of dishonest behavior occurring. In this sense, receiving reinforcement for reporting "yes" in the pro-cooperative sessions had an effect on cooperative behavior in the subsequent session. Beside that, the benefiting from the behavior of a cooperative group in this a session served as another antecedent condition to promote and maintain the emission of corresponding reports, and so forth. Another possible interpretation is that reinforcing the saying increased the saying, which had an effect on the doing in a process of self-regulation.

It is important to consider that there was no guarantee that participants would say "yes" or "no," a necessary condition for receiving reinforcement in their respective groups. Additionally, there were more opportunities to act non-cooperatively (donating 0, 1, or 2 coins), and therefore more options for non-corresponding behaviors in the "saying yes" situation. Nevertheless, despite this, even though not all participants encountered the programmed contingency (some of them never responded "yes" to the researcher's question in the pro-cooperative condition), the effect on the doing behavior (cooperation) is quite significant. Although the reinforcement was programmed for the reports (i.e., reporting what the children had just donated), in an doing-saying sequence, the results indicated that a correspondence between saying and doing was established in both condition 1 and condition 2 (i.e., reporting "yes" and receiving reinforcement for it affected the behavior of donating coins in the following session). In the saying-doing sequence, reinforcing the report seems to increase the likelihood of subsequent doing (Risley & Hart, 1968), and reinforcing the correspondence appears to further increase the probability of this subsequent doing occurring (Lima & Abreu-Rodrigues, 2010). It seems that in each experimental condition, a correspondence of doing-saying-doing was established, promoting the emission of cooperative behavior.

As this research focuses on correspondence in a social context, the investigation necessarily had to be conducted in groups. In the study by Alencar *et al.* (2008), the authors defined large groups as those with more than 12 children. Based on this definition, all groups in the present study were large, which would make cooperation less likely and avoid potential ceiling effects. Considering that Silva *et al*. (2016) found differences in cooperative behavior depending on whether stickers or chocolate bars were used as game items, the experimental strategy of maintaining a control group was chosen to better evaluate the effect of implementing a token system (Borges, 2004) in the context of this research. By observing the results of the control group and the baseline of the other three groups (condition 1 and condition 2), the only effect observed was the maintenance of the children's interest in continuing to engage in the activities, which was precisely the objective of this application. The combined group and single-subject design, as used in condition 1, allowed for a more precise assessment that the results obtained were due to the

intervention and not to individual differences among the members of each group. This refinement in variable control is one of the major contributions of Behavior Analysis to experimental investigations (Sampaio et al., 2008).

However, in a classic single-subject design, it would be expected that there would be reversals of experimental conditions between groups (between subjects). Due to external circumstances beyond the research, this was not possible. As a result, condition 2 complements the findings of condition 1, as the same group underwent the baseline and both experimental conditions, and the results obtained were very similar: a decline in cooperation during the baseline, a low frequency of cooperative behaviors in the anti-cooperation condition, an increase in the frequency of cooperative behaviors in the pro-cooperation condition, and a high frequency of corresponding reports across all phases. Nevertheless, even in condition 2, there is no group that undergoes the experimental conditions in the reverse order (pro-cooperation phase first, followed by the anti-cooperation phase, in a classic reversal design), nor is there a return to the baseline. Ideally, these should have been the designs employed, but ethical considerations justify the decision not to do so. This research was conducted with 10-year-old children, who are in a critical stage of development; thus, it is not ethically desirable to conclude the procedure with the anti-cooperation phase, where non-cooperative reporting is reinforced. To minimize the potential negative effects of this in condition 1, a "lesson on cooperation" was conducted at the end of data collection for all participants.

Future research could subject a group to the reinforcement of reporting without it being contingent on any specific topography of donation, as was done during the baseline of the experimental groups. This would help clarify the effect of reinforcing verbal behavior. Other examples of future research that could be developed on correspondence in a social context include investigating the effect on cooperation and the accuracy of reports if they are made in a group setting, and the effect of reinforcing the correspondence between saying and doing, in that sequence, in an investigation of promises and cooperation.

Declarations

Ethics statements

This study received approval from the Research Ethics Committee of FFCLRP-USP (CAAE No. 52323415.7.0000.5407)

Funding statements

This study received financial support from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior/Brazilian Government.

References

1. Alencar, A. L., & Yamamoto, M. E. (2008). A teoria dos jogos como metodologia de investigação científica para a cooperação na perspectiva da psicologia evolucionista. *Psico*, 39(4), 522–529.
2. Alencar, A. I., Siqueira, J. O., & Yamamoto, M. E. (2008). Does group size matter? Cheating and cooperation in Brazilian school children. *Evolution and Human Behavior*, 29, 42–48.
3. Alves, C. (2018). *Correspondência fazer-dizer em adultos: o controle pela audiência em um jogo virtual*. Tese de Doutorado. Universidade Federal de São Carlos, SP.
4. Andreoni, J. (1988). Why Free Ride? Strategies and Learning in Public Goods Experiments. *Journal of Public Economics*, 37, p. 291–304.
5. Ariely, D. (2012). A Mais Pura Verdade sobre a Desonestidade. Rio de Janeiro: Campus / Elsevier.
6. Beckert, M. E. (2005). *Correspondência verbal/não-verbal: pesquisa básica e aplicações na clínica. In*: Abreu-Rodrigues, J. & Ribeiro, M. R. (Org.), Análise do comportamento: teoria, pesquisa e prática. Porto Alegre: Artmed.
7. Borges, N. B. (2004). Análise Aplicada do Comportamento: utilizando a economia de fichas para melhorar desempenho. *Revista Brasileira de Terapia Comportamental e Cognitiva*, 4 (1), 31–38.
8. Boyd, R., & Richerson, P. (2009). Culture and evolution of human cooperation. *Philosophical Transactions of the Royal Society*, 364, 3281–3288.
9. Brazilian Institute of Geography and Statistics [IBGE] (2016)
10. Brino, A.L.F., & de Rose, J.C.C. (2006). Correspondência entre auto-relatos e desempenhos acadêmicos antecedentes em crianças com história de fracasso escolar. Revista Brasileira de Análise do Comportamento, 2(1), 67–77.
11. Cortez, M. D., de Rose, J. C.; & Montagnoli, T. A. S. (2013). Treino e manutenção de correspondência em autorrelatos de crianças com e sem história de fracasso escolar. *Acta Comportamentalia*, 21(2) 139–157.
12. Ding, X. P, Wellman, H. M., Wang, Y., Fu, G., & Lee, K. (2015). Theory-of-Mind Training Causes Honest Young Children to Lie. *Psychological Science*, 2, 1–10.
13. Domeniconi, C. de Rose, J. C., & Perez, W. F. (2014). Effects of correspondence training on self-reports of errors during a reading task. *Psychological Records*, 64, 381–391.
14. Dutra, N. B. (2012). *A influência do feedback verbal na cooperação em crianças*. Dissertação de Mestrado. Faculdade Federal do Rio Grande do Norte, Natal.
15. Dutra, N. B., Boccardi, N. C., Silva, P. R. R., Siqueira, J. de O., Hattori, W. T., Yamamoto, M. E., & Alencar, A. I. de. (2018). Adult criticism and vigilance diminish free riding by children in a social dilemma. Journal of Experimental Child Psychology, 167, 1–9.
16. Ferreira, A. L. (2017). *Contribuição e distribuição de recursos: uma análise comportamental dos Jogo dos Bens Públicos*. Dissertação de Mestrado. Universidade Federal de São Carlos, São Carlos.
17. Ferreira, A. L. (2018). *Uma análise comportamental dos Jogos dos Bens Públicos. In*: Análise do comportamento e Teoria dos Jogos. (Escobal, G. Faleiros, P. B., Ferrari, A. L.Orgs.). São Paulo: Edicon, p 61–81.

18. Freud, S. (1930/1974). *O mal-estar na civilização.* Rio de Janeiro: Imago.
19. Galizio, M., & Buskist, W. (1988). Laboratory lore and research practices in the experimental analysis of human behavior: selecting reinforcers and arranging contingencies. *The Behavior Analyst*, 11(1), 65-69.
20. Glenn, S. S.(1989). Verbal Behavior and Cultural Practices. *Behavior Analysis and Social Action*, 7 (1 & 2) 10–15.
21. Gomes, C. T., Kawakami, D. T., Pereira, M. E., & Fidalgo, A. P. (2018). Efeitos da Apresentação e Retirada de Reforçadores sobre a Correspondência Verbal. *Psicologia: Teoria e Pesquisa*, 34 (3425), p. 1–10.
22. Guerin, B. (2004). *Handbook for analyzing the social strategies of everyday life*. Reno: New Harbinger Publications, Inc.
23. Kollock, P. (1998). Social Dilemmas: The Anatomy of Cooperation. *Annual Review of Sociology*, 24, 183–214.
24. Lima, E. L., & Abreu-Rodrigues, J. (2010). Verbal mediating responses: effects on generalization of do-say correspondence and noncorrespondence. *Journal of Applied Behavior Analysis*, 43(3), 411–424.
25. Lloyd, K. E. (2002). A review of correspondence training: suggestions for a revival. *The Behavior Analyst*, 25, 57–73.
26. Oliveira, M. A., Cortez, M. D., & de Rose, J. C (2016). Efeitos do Contexto de Grupo no Autorrelato de Crianças sobre seus Desempenhos em um Jogo Computadorizado. *Perspectivas em Análise do Comportamento*, 7(1), 70–85.
27. Ostrom, E. (1990). *Governing the Commons – The evolution of institutions for collective actions*. Cambridge: Cambridge University Press.
28. Perez, W. (2017). Explicações comportamentais da correspondência dizer-fazer. *Revista Brasileira de Análise do Comportamento*, 13(1), 16–28.
29. Ribeiro, A.F. (1989). Correspondence in children's self-report: Tacting and manding aspects. *Journal of the Experimental Analysis of Behavior*, 51, 361–367.
30. Risley, T. R., & Hart, B. (1968). Developing correspondence between the non-verbal and verbal behavior of preschool children. *Journal of Applied Behavior Analysis*, 1, 267–281.
31. Sampaio, A. A. S., Azevedo, F. H. B. de, Cardoso, L. R. D, Lima, C. de, Pereira, M. B. R., & Andery, M. A. P. A. (2008). *Interação em Psicologia*, 12(1), p. 151–164.
32. Silva, P. R. R. da, Boccardi, N. A. C., Dutra, N. B., Hattori, W. T., Yamamoto, M. E., & Alencar, A. I. (2016) Stickers versus wafers: The value of resource in a public goods game with children. *Estudos de Psicologia Estudos de Psicologia*, 21(2), 117–124.
33. Skinner, B. F. (1953/2003). *Ciência e Comportamento Humano*. (Todorov, J. C., Azzi, R. trads.11ªed.) São Paulo: Martins Fontes (Trabalho original publicado em 1953).
34. Skinner, B. F. (1981). Selection by consequences. *Science*, 213(4507), 501–504.

35. Suarez, C. J., Nascimento, C. A. V. S. do, & Benvenuti, M. F. (2018). Estudo experimental da cooperação na análise do comportamento: Buscando integrar aprendizagem, evolução e desenvolvimento. *Revista Brasileira de Terapia Comportamental e Cognitiva*, 2018, 20(4), 27–47.
36. Warneken, F., & Tomasello, M. (2008). Extrinsic rewards undermine altruistic tendencies in 20-months-old. *Developmental Psychology*, 4(6), 1785–1788.
37. Yamamoto, M. E. (2019). *Cooperation from an evolutionary perspective*. *In:*Psychology in Brazil – Scientits Making a Difference. Koller, S. H. (Ed), Porto Alegre: Springer, 333–343.

Figures

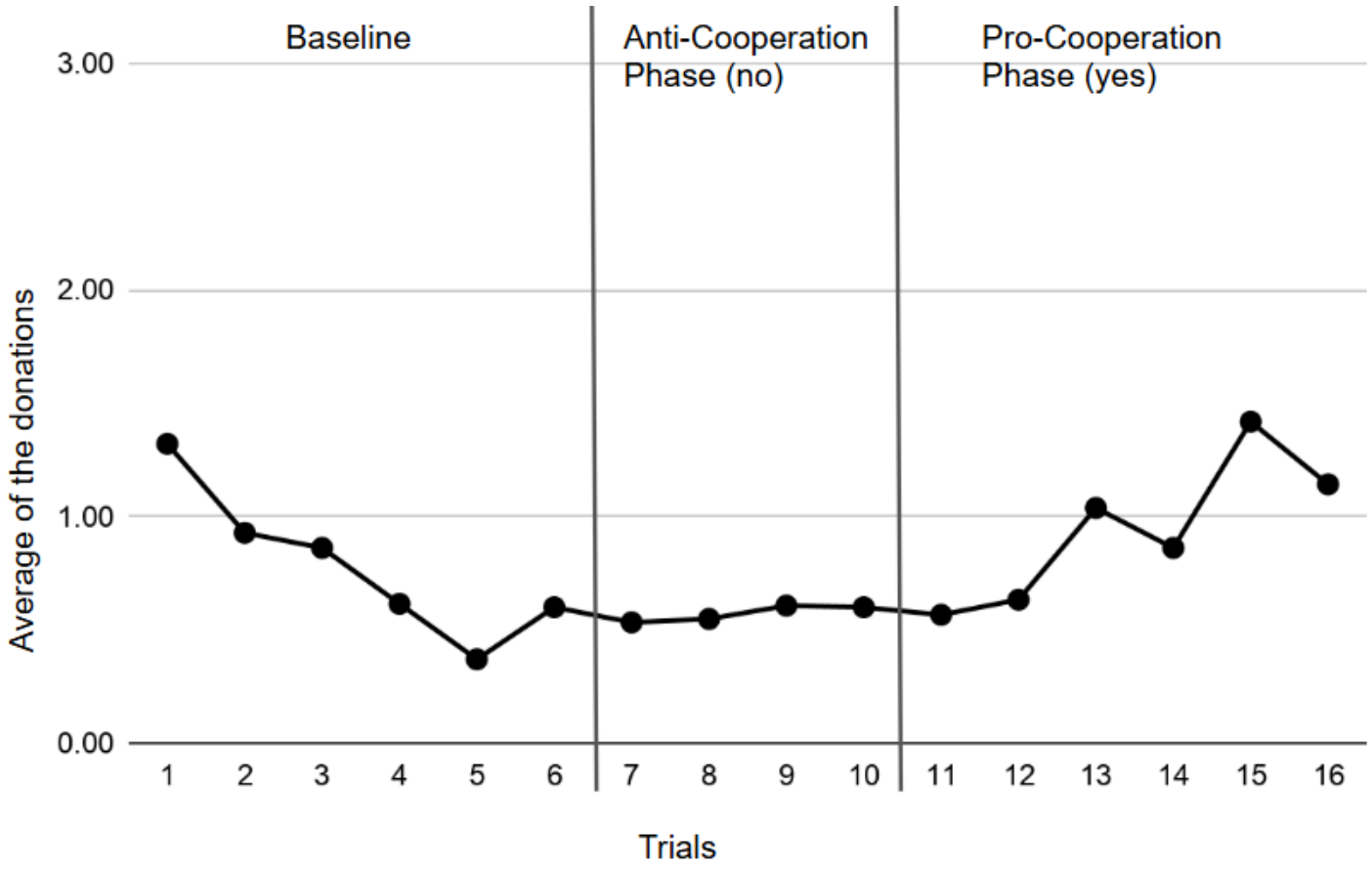


Figure 1

Average donations from the groups throughout the sessions of the group activity. In the experimental phase, the pro-cooperation group (reinforcement of the “Yes” report) showed higher values, indicating a more cooperative behavior.

Source: Own authoring

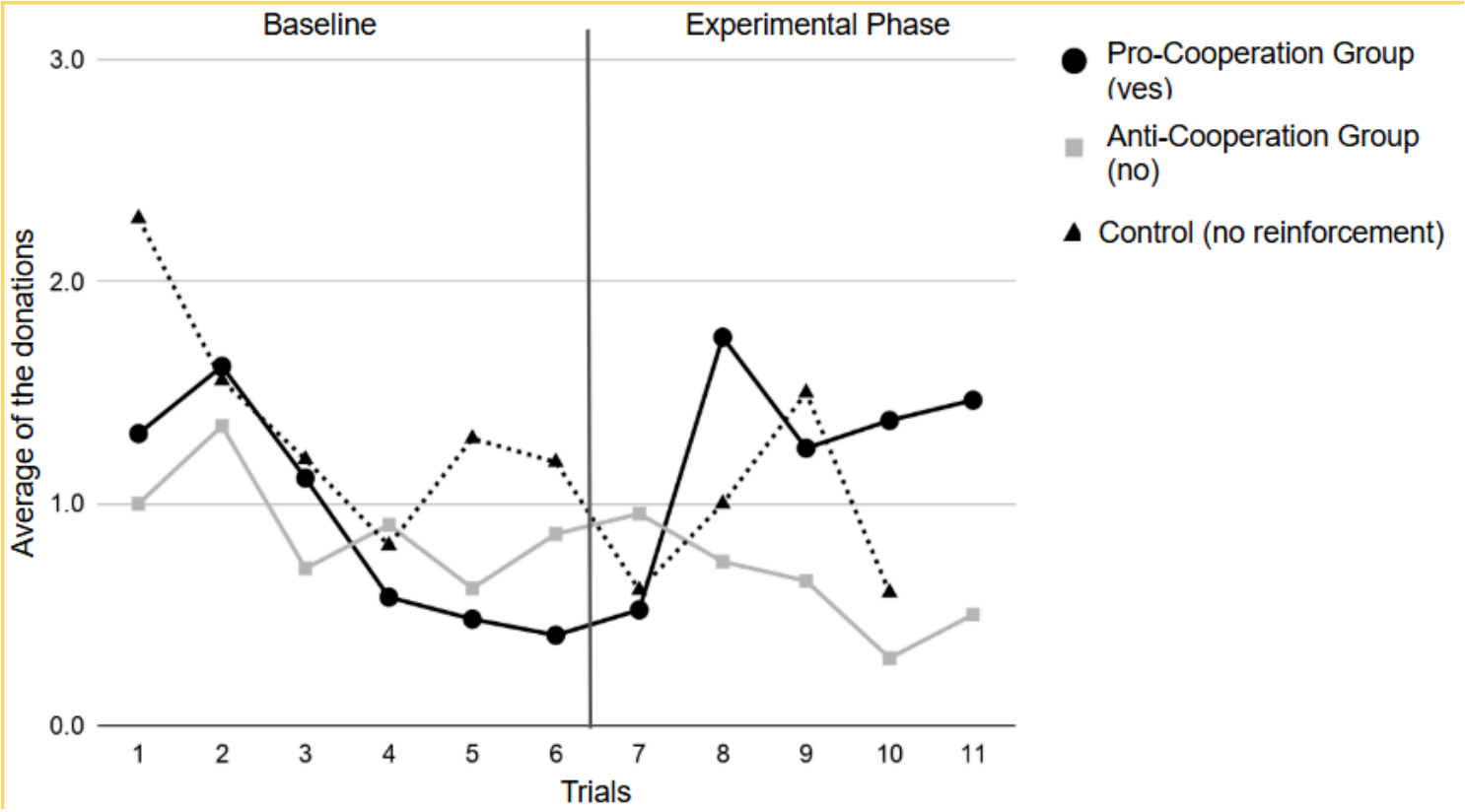


Figure 2

Frequency of donations from participants in the three groups.

Source: Own authoring

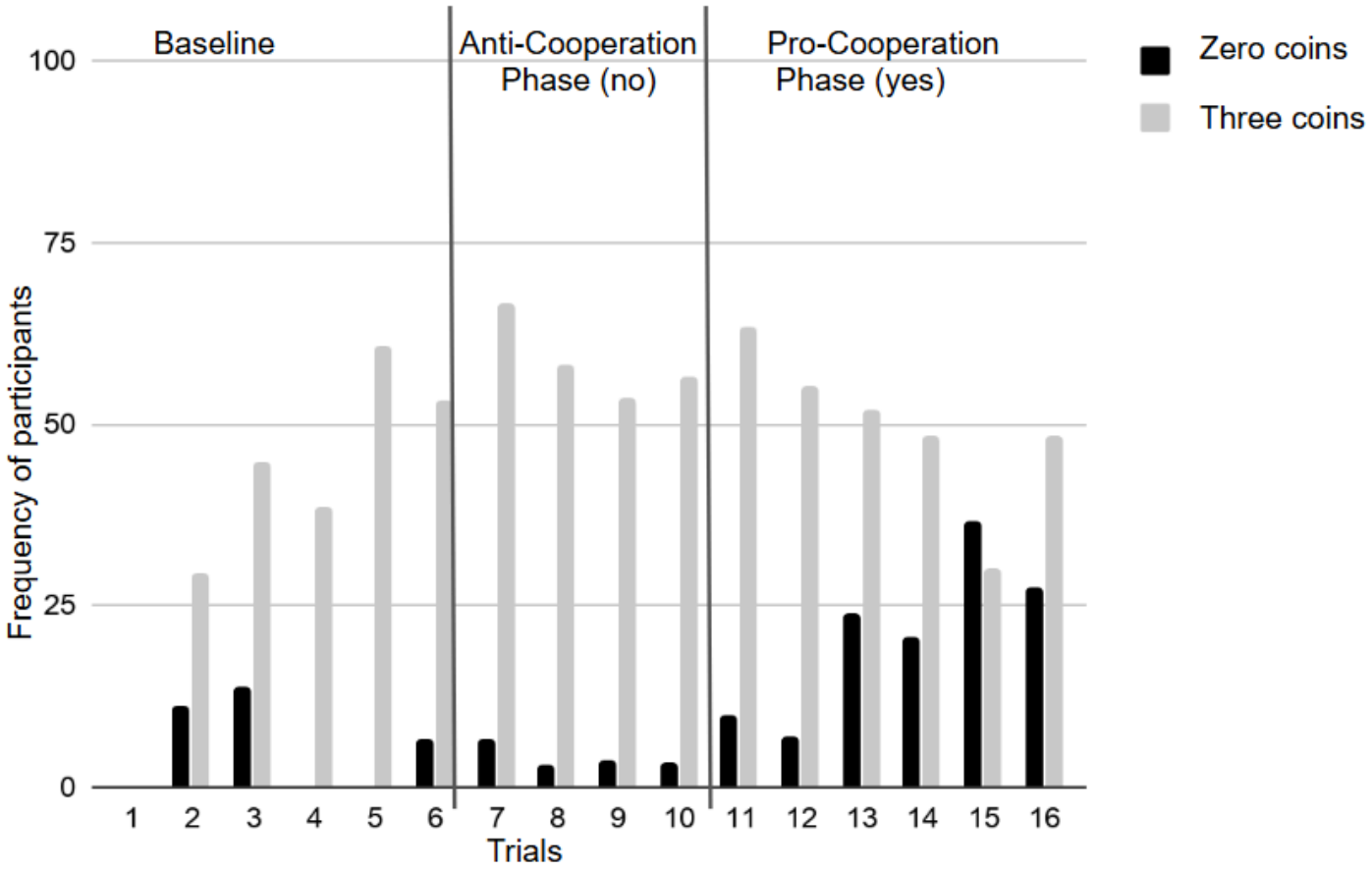


Figure 3

Average donations throughout the sessions of the collective activity. The experimental phase was divided into two sub-phases, the anti-cooperation phase (reinforcement of the “No” report) and the pro-cooperation phase (reinforcement of the “Yes” report).

Source: Own authoring

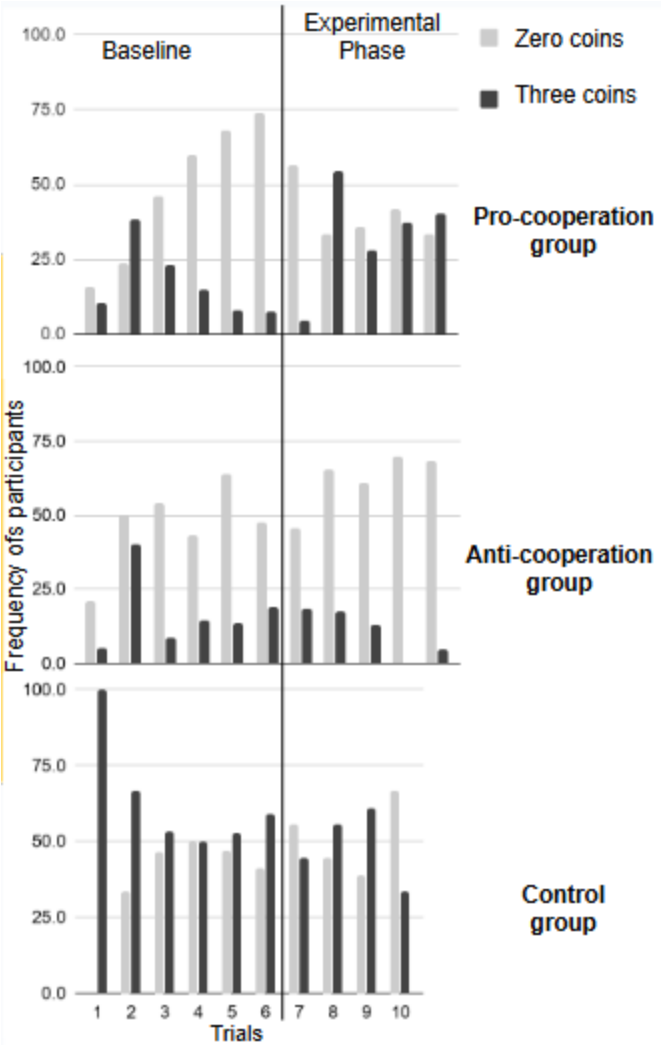


Figure 4

Frequencies of donations of three coins and of no coins from participants in condition 2.

Source: Own authoring