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Research Article

Children's Non-Compliance Function and Subjective Reinforcement Value

Silvia Morales-Chainé[1]*, Lizeth Santos Torres[1], Luz María Cortés Larios[1], Gisel Gómez-Escobar[1], Leslie Sánchez Loaeza[1], Leonard Green[2] and Carlos Palomero Jandate[1]

[1]National Autonomous University of Mexico, Mexico

[2]Washington University in St. Louis, Mexico

***Corresponding Author:** Silvia Morales-Chainé, Department of Psychology, National Autonomous University of Mexico, Mexico.

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Abstract

This paper describes the relationship between children´s non-compliance function and reinforcement value discounting through remote behavioral procedures. Thirty-two children (6 to 8 years old)-parent dyads participated in this study. We used a within-subject design to remotely get non-compliance baselines through the functional analysis methodology (e.g. Waiting to receive reinforcement) and assess the subjective reinforcement value through delay, probability, and effort discounting tasks. Thus, we used the Children Observational System and the Rabbat software to collect data. We also used the Children Behavior Inventory and the Alabama Questionnaire to describe children´s clinical reported symptoms and caregiver behaviors. Results suggested non-compliance varied between and within children because of reinforcement-specific stimuli. Also, virtual reinforcement subjective value resulted from the delay, probability, and effort tasks quasi-hyperbolic fit. Therefore, children displayed less impatience while their caregivers used fewer negative behaviors during the interaction. Children´s risky choices were also related to getting social attention upon non-compliance and negative behaviors during the interaction. Finally, choosing effort was related to waiting for a reinforcer. We discuss children´s non-compliance function and subjective virtual reinforcement value because of their clinical behavior and behavioral treatment recommendations.

Keywords: *Non-Compliance; Functional Analyses; Temporal; Probabilistic; Effort Discounting*

Introduction

Before the COVID19 pandemic, 20% of the children population were already at risk of showing aggression, opposition, defiant, hyperactivity, inattention, or non-compliance behaviors [1]. Recently, children have been learning as teachers in their homes with their parents. Therefore, problem behaviors like non-compliance would rise, and interaction problems would increase. Specifically, Barkley [2] defined non-compliance as the child´s failure to initiate behaviors requested by an adult (within 15 seconds), to sustain such behaviors (defined as on-task behavior), and to follow rules of conduct in given situations.

Non-compliance, like other children´s behavioral problems, happens because of contextual situations. Behavior is consistently associated with a specific stimulus condition suggesting that within-subject variability is functionally the result of the particular social and physical environment [3]. Therefore, children´s non-compliance is reinforced both from external and internal sources. Thus, positive

reinforcement, such as attention, or negative reinforcement, like the termination of demands, could explain the maintenance of children´s problem behaviors [2].

Children´s behaviors are associated with caregiver behaviors that determine such conditions [4]. Some behavioral mechanisms help identify operant conditioning conditions [5], explaining the relationships between children and parents or their individual choices [6]. Thus, we should understand behavioral learning principles underlying children´s behavior and interaction choices.

Therefore, non-compliance, like other children´s behaviors, is associated with parental practices [4,7,8]. Functional analysis of behavior is the practical procedure to assess the association between caregivers and their children´s behavior [6,9]. Specifically, this operant methodology identifies the functional properties of behavior on a pretreatment basis, where behavior is repeatedly observed across several well-defined analog environments [3].

Functional analysis methodology considers certain stimuli related to specific behaviors. Contextual and immediate antecedents of target behaviors are determiners explaining behavior maintenance [3,6]. In such a sense, basic behavioral principles (e.g. positive, negative reinforcement) underlie the explanation of behavior function in diverse contexts [4,10]. As pioneers, Iwata., *et al*. [3] assessed environmental events that affect the occurrence of self-injury. They exposed their participants to four physical-social conditions in an experimental design through multi-element manipulation. Thus, they used social disapproval (to assess the delivery of positive reinforcement), academic demand (to evaluate negative reinforcement), unstructured play (as a control procedure), and alone (as an impoverished situation from a social o physical standpoint) conditions. They found that self-injury occurrence varied between and within children associated with a specific stimulus condition. The authors concluded behavior was a function of different sources of reinforcement, and findings would enhance effective-based reinforcement procedures to reduce it.

Back then, research has shown that delivering physical punishment, inconsistent discipline, or deficient monitoring or supervision predicted children´s problem behaviors [8]. Specifically, non-compliance can be considered a passive avoidance way of completing parental commands or following previously stated household rules [2]. Some non-compliance exemplars are yelling, whining, complaining, defying, throwing objects, arguing, being sarcastic, etc. The opposition-defiant disorder, hostile-defiant, social-aggression, and overt behaviors are classes of non-compliance [2]. According to Patterson [11], non-compliance behaviors could be the way to escape or avoid commands. Consequently, treating noncompliance would improve other behaviors.

Therefore, it is essential to explore the non-compliance reinforcement mechanisms. Particularly studies should identify the extrinsic sources of positive and negative reinforcement (e.g. attention or demand escape; [2,3]). Through functional analysis of behavior methodology, it is possible to analyze the role of such context conditions (e.g. social disapproval; [3]; or unspecific given instructions; [2]) maintaining children´s non-compliance. Stimuli manipulations would lead to exploring environmental events determining the occurrence of non-compliance and to identifying the operant conditioning procedures underlying the determined variables [5,6]. Nevertheless, translational studies increase our knowledge of basic learning principles solving social behaviors; it is essential to explore other operant procedures with children.

Researchers understand mechanisms predicting children´s choices and behavioral patterns [4]. In this sense, those about the subjective value of reinforcement have rarely been studied, particularly with children. One common way to explore people´s choices is the discounting task, where organisms regularly choose immediate or low probable reinforcement or associated ones with low effort requirements.

There is evidence about behavior-choice-mechanisms related to delaying reinforcement delivery, changing its delivery probability [12] or manipulating the response effort to obtain it [13,14]. Some research validated the adjusting amount procedure [15] to describe

how delaying (days, weeks, or months), odds against (probabilities between 0-1), and increasing effort, to get the reinforcement to affect people choice behavior. The adjusting procedure resulted in as many indifference points as choosing trials where people select one from every pair of choices. The indifference points are considered the subjective reinforcement value of conditional-or-in-conditional stimuli. In consequence, we can talk about impatience (delay), risky choice (probability; [12]), or aversion to performing effort as a different kind of impulsivity [16]. The hyperboloid model is the mathematical way to express the theoretical discounting model proposed by Green, Fry, and Myerson [17] and Myerson and Green [18]:

$$V = \frac{A}{(1 + b\,X)^s}$$ (Equation 1)

Where V is the subjective reinforcement value, A is its magnitude, X represents the delay/odds against/effort requirements, b is a free parameter used as a dependent variable, expressing discounting rate. The s is a second free parameter representing the sensitivity of differences between delay and the linear scale of amount and delay/odds against/effort requirements.

The applied papers about subjective reinforcement value based on the hyperboloid mathematical had directed the research with substance use [19], gambling, or eating behaviors with adolescents and adults [12]. Nonetheless, in Mexico, Escobar., *et al*. [20] have evaluated virtual-rewards subjective value, providing evidence about the complexity of children´s choice behavior. Specifically, Escobar., *et al*. [20] created a virtual space context thru a program called Rabbat where an avatar provides the rules to the children. The researchers have programmed the algorithm based on the adjusting amount procedure [15], using four trials along with five parameters (delays: 5, 10, 20, 30, 60 seconds; odds against 0.111, 0.333, 1, 3, and 9 or 10, 25, 50, 75, and 90%; and effort: 0.2, 0.4, 0.6, 0.8, and 1.0 increments of key presses), using virtual trophies and medals as virtual rewards. The standard reward amount was 16 prizes [21]. The research findings suggest that children choosing data adjusted to the hyperboloid model with impatience, risky, or effort aversion conditions. The authors concluded their findings expand the generality of the context choice effect over reinforcement devaluation when using virtual rewards in computational environments with children. The procedure resulted valid to explore their relationship with children non-compliance-function.

The association between non-compliances environmental conditions and subjective reinforcement value may guide planning suitable parent training interventions. Thus, the operant methodology helps identify the non-compliance functional properties on a pretreatment basis; Meaning, several defined analog environments let observe the children´s behaviors. Therefore, non-compliance conditions associated with the children´s impatience, risk aversion, or high preferred effort choices would enhance the knowledge about increasing the effectiveness of reinforcement procedures to reduce problem behaviors [3].

Consequently, the purpose of the study was to describe the relationship between children´s non-compliance-function and the subjective reinforcement value through remote behavioral assessments. It is beneficial to know non-compliance-function and choice ways before initiating an arbitrarily determined and seemingly endless series of interventions [3]. In this sense, describing the association between the subjective reinforcement value and the non-compliance function, based on its variability, promises meaningful assessment and interventions in the self-control field.

Method

Participants

Thirty-two scholar children-caregivers dyads participated in this study; children were between 6 and 8 years old (mean age seven years; 72% were boys) from Mexico City. The sample was non-probabilistic by convenience. The caregivers´ mean age was 35 years old (SD = 6.8); 100% were women, 59% were married, 44% had bachelor´s degrees. The researchers collected the sample during the

COVID-19 pandemic (June to December 2021). Caregivers informedly consent to participate, giving their permission to use the data for research. Researchers informed the caregivers about confidentiality, benefits risks, and the right to decline whenever they like. They also were informed about the advantages of their children´s behaviors assessment to plan an intervention to change problem behaviors.

We established the home-set for all families on a two per two meters space of their homes, asking them to videotape every movement and interaction. Supplementarily, the experimenters asked caregivers to set the table, two chairs, toys, and additional materials to work (e.g. brooms, rags). The University Psychology College Ethical Committee approved the project.

Instruments

Children behavior inventory

The Children Behavior Inventory (CBI, [22]) is a 20-minutes-self-applied questionnaire with 29 items with five-options responses (from never always to happen). The instrument screens the opposition defiant disorder (ODD, eight problems), aggression (3 items), unattention (9 items), hyperactivity (6 items), and impulsive behaviors (3 items). It has a Cronbach alpha = 0.94 and an explained variance of 57.32%. The researchers calculated the mean percentage of every scale by dividing the obtained punctuation by the total one per 100%. The CBI dimensions percentage means over 51% represents a disorder clinical diagnostic (e.g. ODD).

The Alabama questionnaire

The Alabama Questionnaire [23] is a 20-minutes-self-applied questionnaire with 42 items with five-options responses (never, rarely, sometimes, frequently, and always). The scales are positive involvement (10 questions), positive parenting (6 questions), poor monitoring/supervision (10 questions), inconsistent discipline (6 questions), and corporal punishment (3 questions) parental strategies. It has a Cronbach alpha = 0.75 and an explained variance of 60.34% [23,24]. The researchers calculated the mean percentage of every scale by dividing the obtained punctuation by the total one per 100%.

The probability of compliance occurrence questionnaire

The Probability of compliance occurrence Questionnaire [25] is a 20-minute questionnaire with items about the level of compliance of children to commands nearby caring situations (16 items), playing (22 items), cleaning (15 items), eating (16 items), sleeping (17 items), and interacting (36 items). The response options for each prompt are compliance, almost always, sometimes, rarely compliance, or non-learned instructions. It has a Cronbach alpha = 0.97. The commands scored rarely or occasionally followed are classified as low-probability instructions, used in the following-instructions functional analysis procedure.

The observational system

The researchers developed the Observational system (OS) to record the children non-compliance and caregiver behaviors. Thus, the system consisted of three sheet sets: occurrence, partial, and total interval formats. The researchers recorded children´s non-compliance in the first occurrence-sheet set during: five events of reinforcer waiting, five of reinforcer ending up, and ten from the following commands conditions; and the caregiver behaviors during giving ten-commands condition (e.g. obtaining attention, giving specific instruction, waiting for obedience, and praising obedience). Secondly, researchers recorded caregiver behaviors during social interaction in a 60-ten-seconds-partial-interval-type (e.g. praising, disapproval, screaming, or ignoring the caregiver). Third, researchers recorded children´s noncompliance in a 20-thirty-seconds total-interval-sheets set during: social disapproval, alone, and academic alone. Thus, non-compliance avoided completing caregiver commands or following rules instructions (see procedure below; [2]). Some non-compliance exemplars were yelling, whining, complaining, defying, throwing objects, arguing or being sarcastic, etc. during non-compliance.

Thus, researchers calculated the percentage of non-compliance by dividing the number of such behavior intervals or events by the total per 100 [3].

Two observers independently scored the same assessment situation in 30% of the total sessions (the range for each dyad was 10% to 50%) and calculated the inter-observer agreement rate. Thus, we calculated the overall observational reliability percentages on an interval-by-interval basis, dividing the number of agreements by the total agreements plus disagreements per 100 [3]. The inter-observer agreement should always be higher than 80% between observers.

The observational procedure implementation checklist

Therefore, we used an observational procedure implementation checklist of the experimental protocol for collecting the data. It includes eight written instructions for the experimental conditions (e.g. reinforcer waiting, delay discounting task, etc). As a result, we calculated the percentage of intervals by dividing the number of positively scored intervals by the total number per 100.

Apparatus and software

The Rabbat 2.0 is a virtual interface programmed through. NET language using Visual Basic 10 Express® computing software (adapted from Escobar., *et al*. [20]). Then, delay, probability, and effort discounting tasks used trophies and medals as virtual rewards. Rabbat 2.0 programmed the adjusting-amount procedure that converges rapidly on the amount of immediate/sure/easy reward equal in the subjective value of the delayed/risky/hard reward [15,20].

Additionally, we used 32 computers equipped with a processor from Celeron® thru COREi5® and an operative system from Windows® version 7 thru 10. We used Zoom®, Meet®, and Google Forms® platforms to run the study. Experimenters ask caregivers always to use earphones during the interaction with their children.

Procedure

We used a within-subject design through three baseline functional analysis sessions [3] and one session of subjective reinforcement evaluation [20]. Thus, remotely experimenters run experimental procedures inside participant homes through Zoom®, Meet® and Google Forms® platforms, accomplishing APA [26] ethical guidelines. In the three behavior-functional-analysis sessions, experimenters asked caregivers to use earphones, avoiding children listening to the caregivers-experimenters interaction. Therefore, caregivers collaborated with experimenters in the children´s behavior assessment in their homes. Experimenters gave caregivers instructions following the written instructions and asked them to do every action from the experimental protocol [5]. Afterward, experimenters assessed the subjective reinforcement value remotely in the fourth session.

Pre-baseline-condition staff training

All observers and experimenters of the study participated in a 20-hour-based training about the behavioral and experimental procedures. Therefore, we employed modeling, roleplaying, and feedback, teaching activities to ensure that staff could reliably observe behavior and respond appropriately during sessions where they served as an experimenter. Each experimenter received written instructions describing the observational and experimental protocols at the implementation and followed the protocols after demonstrating competence as an observer. At least one of the authors was present in each session and provided feedback regarding follow-up procedures as needed [3].

Non-compliance functional-analyses sessions

Through three 120-minute-based functional-analysis-baseline sessions, we repeatedly exposed each child to seven different conditions per session: reinforcer waiting, reinforcer ending-up, social disapproval, alone, academic-alone, following-commands, and social interaction.

To prepare the home-set, the experimenters asked the caregivers to use their earphones throughout the whole session. Thus, the experimenters prompted caregivers to set their computer on a two-per-two-meter-view-field in their homes. Lastly, the experimenters prompted caregivers to set the table with two chairs, preferred and non-preferred toys, and several materials as needed (e.g. brooms, rags).

Reinforcer waiting

This condition assesses non-compliance by asking the children to wait for a preferred toy [25]. Thus, the experimenters prompted the caregivers to set the table with five preferred toys, sit their children down at the table, and run five trials. Namely, at every trial, caregivers set one of the children´s preferred toys at the table and commanded them: Do you want to play with the toy? Then, you must wait. If the children waited 10 seconds, thus they had access to the toy. If they did not wait for such latency, the experimenters prompted the caregivers to repeat the instruction: you must wait, using the same first command tone of voice, and interrupting the contact with the toy dimly. After the second command, and if the children waited, they had access to the toy, but if they did not thus, the caregivers allowed them to play with the toy. The experimenters prompted the caregivers to follow this procedure five times, one for a preferred plaything.

Consequently, the observer registered if the children obeyed the commands at first, second chance, or did not obey at all, calculating the percentage of non-compliance events (children´s failure to hang on receiving the toy and the opportunity to play). This condition aimed to approximate one type of reinforcement contingency assessment that might maintain the behavior. Thus, immediate access to a stimulus contingent upon non-compliance (attention and toys) while waiting condition may maintain it via inadvertent delivery of positive reinforcement.

Reinforcer ending up

This condition assesses non-compliance by asking the children to end contact with a preferred toy [25]. Thus, the experimenters prompted the caregivers to set the table with five preferred toys, sit their children down at the table, and run five trials. That is, at every trial, caregivers set one of the children´s preferred toys at the table, allowing them to play for 30 seconds, and when the time was up, commanded them: give me the toy. If children had obeyed within the 10 seconds latency, caregivers would move on to the following command. If they had not given the toy back at the end of such latency, the experimenters prompted the caregivers to repeat the instruction: give me the toy, using the same first command tone of voice, and interrupting the contact with the toy dimly. After the second command, if the children had not given the toy back, caregivers gave access to the toy for 30 more seconds, after which they subtly pulled the toy out. The experimenters prompted the caregivers to follow this procedure five times, one for a preferred plaything.

Consequently, the observer recorded if the children obeyed the commands at first, second chance, or did not obey at all, calculating the percentage of non-compliance events (children failure to end the contact up with a reinforcer). This condition aimed to assess one type of reinforcement contingency that might maintain the behavior. Thus, immediate access to reinforcement contingent upon non-compliance (attention plus access to the toy) while ending contact with a stimulus may maintain it via inadvertent delivery of positive reinforcement.

Social disapproval

This condition assesses non-compliance by giving attention to the children who are neglecting an instruction [3,25]. Thus, the experimenters prompted the caregivers to set the table with preferred-and-unpreferred toys, sit the children down the table, and instruct: You can play with these toys (pointing out the non-preferred toys), but no with these (pointing out the preferred ones). The experimenter then prompted the caregiver to sit still and assume the appearance of reading a book during the 10 minutes session. The experimenters asked the caregivers to ignore compliance and give contingent attention to each episode of children´s non-compliance (e.g. touching the non-preferred toys). That is, caregivers gave contingent attention stating disapproval, with a non-punitive-physical contact (e.g. hand on a shoulder), interrupting the contact with the toy subtly, and saying: Don´t do that. You can play with these toys (non-preferred), but not with these (preferred toys), with a regular tone-voice. The caregivers repeated this contingent attention as needed until 10 minutes concluded. Thus, the observers recorded non-compliance (neglecting the instruction) on a 30 seconds-interval-basis and calculated the total percentage of such behavior. Once again, this condition aimed to approximate one type of reinforcement contingency that might maintain non-compliance. Thus, a statement of social disapproval paired with physical contact contingent upon behavior may maintain it via delivery of positive reinforcement [3].

Alone

This condition assesses non-compliance in a situation where caregivers leave children alone (adapted from Iwata., *et al*. [3]). Thus, the experimenters prompted the caregivers to set the table with preferred toys, sit their children down at the table, and give the instruction: Please (children name), keep still, sit down, and do not touch anything. Thus, caregivers should leave the room for 10 minutes, maintaining supervision out of children´s sight. The observers registered non-compliance (neglecting to stay still, without touching table toys) on a 30 seconds-interval-basis and calculated the total percentage of such behavior. In this condition, we assessed delivery of positive reinforcement maintaining non-compliance (access to a preferred activity) of display alternative behaviors (e.g. playing).

Academic-alone

This condition assesses non-compliance in a situation where the caregivers leave their children doing their homework alone (adapted from Iwata., *et al*. [3,25]). Thus, the experimenters prompted the caregivers to set the table with the math-academic materials (arithmetic operations according to children´s skills), sit their children down at the table, and give the instruction: Please (children name), keep still, sitting down, and do your homework. Thus, caregivers should leave the room for 10 minutes, maintaining supervision out of children´s sight. The observers registered non-compliance (neglecting to stay still and do their homework) on a 30 seconds-interval-basis and calculated the total percentage of such behavior. Thus, the academic demand situation assessed a stimulus condition where we planned the absence of an adult as an external contingency upon non-compliance (e.g. punishment or simple correction). In this condition, we assessed if non-compliance may be maintained via the delivery of negative reinforcement (escape from un-preferred activity) and the opportunity to display alternative behaviors (e.g. playing).

Following commands

This condition assesses caregiver behavior giving commands and its effect on children´s non-compliance (adapted from Barkley, [2,25]). The experimenters prompted the caregivers to set the needed materials (e.g. groom, rags, toys, containers, etc.), work inside camera two-meters-visual-range and give ten low-probability-commands to their children. On an occurrence basis, the observers registered caregiver behaviors (attention, specific commands, compliance waiting, and praising) and children´s non-compliance and calculated the total percentage of such behavior. Thus, following-commands situation assessed stimuli related to the caregiver external contingency

upon non-compliance (reinforcement/punishment like), maintaining it via delivery of negative reinforcement (escape from un-preferred activity; [2]).

Social interaction

This condition assesses non-compliance in a situation where the caregiver and the child are in a leisure activity, freely playing (adapted from Iwata., *et al*. [3,25]). The experimenters prompted the caregivers to set playing materials (e.g. toys), work inside camera two-meters-visual-range and give the command to their children: let´s play. The observers registered caregiver behavior (laughing, smiling, physical-eye contacting, praising, provoking verbal responses, and sharing) and children non-compliance (e.g. disapproving, ignoring, and screaming) on a 10-seconds-partial-interval-basis, and calculated the total percentage of non-compliance. This condition served as a control procedure assessing stimuli from commands´ absence and social interaction. Additionally, it was an enriched environment where we expected relatively minor non-compliance.

Consequently, we observed 21 trials of baseline (e.g. waiting) per child, getting 672 non-compliance functional analysis trials.

Experiential discounting tasks

In the fourth 45-minute-based session, the experimenter monitored and prompted children, through the Zoom® platform, to respond to the delay, probability, and effort discounting tasks using their mouse and keyboard (employing Rabbat program [20]). Thus, the discounting session through Rabbat 2.0 entailed five steps.

Step one

In the first step, the experimenters assessed the reward preference, displaying a four-trophies-left-column and a four-medals-right-column and asking children to choose one of the eight awards: Choose the reward you like the most. Presenting a 0-to-10-visual-analog-scale, the experimenters asked the children to indicate how much they enjoyed the chosen prize. The experimenters used the children´s preferred prize image as a reward through their three discounting tasks.

Step two

In the second step, Rabbat 2.0 taught the children the probability concept due to the children´s young age, based on the Mexican Education Model. That is, the experimenters on a-three-exercises-basis explained the risky-vs-safe-option choice, describing the chance/random terms through animations. Namely, semi-filled figures partially displayed a green section, meaning the proportion of the real opportunity to win, and a white one, representing the proportion of the real chance to lose. The experimenters confirmed the probability concepts understood by children, consistently reporting the possibility versus the certainty in the exercises. Thus, children completed three forced-choice trials regarding the probability discounting task. In one trial, children received the reward for sure, whereas the experimenter deactivated the other low-probability alternative. In a second trial, children received the prize with a low-probability opportunity (e.g. 20%), whereas the experimenter deactivated the sure one. Nonetheless, in this second trial, the children received the reward, with the green image section (that 20%) pointed out, representing the prize´s presence. Rabbat displayed the same options to children for the third trial, but they didn´t earn the reward, with the white image section (80% of the figure) pointed out, representing the prize´s absence.

Step three

In this third step, the effort discounting task also included a calibration before the choice trials. The experimenters prompted children to press their space keyboard many times and as quickly as possible on a three-10-seconds-intervals-basis, calculating effort mean indi-

vidual requirement. The time to do the keypress was not indicated or mentioned to the children. At the end of the calibration, Rabbat multiplied the pressures effort mean per five increments levels: 0.2, 0.5, 1.0, 1.20, and 1.50. For example, if a child obtained an average of 50 key presses, the levels of effort required in the effortful choices were: 10, 25, 50, 60, and 75. The purpose of establishing these increments was to describe children´s choice, surrounding the 50% of their maximum individual effort. Afterward, children performed two forced-effort-choice trials. In the first trial, the experimenter instructed the children to receive the reward with some effort, whereas deactivated the other alternative with lower effort (one keypress). In the second trial, the experimenter instructed the children to receive the reward with lower effort (one keypress), whereas deactivated the other alternative (effortful).

Step four

In the fourth step, the children performed two delay-discounting-forced choices. First, the experimenters prompted the children to receive the reward with some delay (e.g. 5 seconds), deactivating the immediate reward alternative. Afterward, the experimenters prompted children to receive the immediate reward, deactivating the delayed one (e.g. 5 seconds). The experimenters did not display the time to the children but presented a dark window during the delay.

Step five

In the fifth step, the Rabbat 2.0 algorithm randomly displayed the three discounting tasks, each one associated with a specific discriminative stimulus. Thus, Rabbat presented a Demo in which an avatar loudly delivered the instructions while children could read them, as well: Welcome to Rabbat! In this game, you will automatically travel in a spaceship through different worlds. In Rabbat, you can choose between two options at once to win prizes that you like the most, like trophies and medals. There are no 'right' or 'wrong' answers. Thus, please pick the choice you prefer, using your computer mouse.

Hence, the Rabbat algorithm used the adjusting-amount procedure that converges rapidly on the amount of immediate/sure/easy reward equal to the delayed/risky/hard reward [15,20]. For each discounting tasks, children made four choices at five delays (5, 10, 20, 30, and 60 seconds; [21]), five probabilities (0.11, 0.33, 1, 3, and 9, or 90, 75, 50, 25, and 10% odds against/percentage; [27]); and five efforts (mean effort per 0.2, 0.5, 1.0, 1.20, and 1.50; [20]). Consequently, each child responded to 60 trials (20 for each discounting task). The standard-earned-reward amount was 16 prizes [21]. At each of the five parameters, the first choice was between a delayed/risky/hard reward and an immediate/sure/easy reward, one-half of the delayed/risky/hard one. For instance, if the delayed/risky/hard alternative was 16 prizes in 5 seconds/50% chances/5 keypresses, then the immediate/sure/easy alternative was eight prizes now/for-sure/easy. For subsequent choices, the size of the adjustment amount was half of the previous one. We repeated this procedure until children made four choices per parameter.

During the discounting tasks, the Rabbat accumulated the number of prizes through the trials. A scoreboard displayed the number of awards per trial in the upper center of the screen. For example, if the children chose 16 prizes in one trial in 20 seconds instead of eight prizes now, they experienced the delay. Thus, the Rabbat displayed a window with the image with the 16 awards. Consequently, in the subsequent trial, the scoreboard showed 16 accumulated prizes. If the child chose 12 immediate prizes instead of 16 - 20-seconds prizes, the scoreboard displayed 28 accrued rewards. The Rabbat repeated this accumulative procedure until the children completed the three tasks. If the children earned 47 prizes in the delay discounting task, this number passed thru the next discounting task first trial. If the children accumulated 94 awards and the two previous tasks, this number passed thru the last discounting task first trial.

The experimenters translated the amount of the total rewards to minutes of videogame access into Rabbat. The experimenters presented four video games, and the children chose one of them to play. The maximum number of programmed earned prizes/minutes was 960 prizes or 9.60 minutes of playing, and the minimum was 225 prizes, or 2.25 minutes of playing.

Data analysis

First, the experimenters calculated the mean percentage of functional analysis and discounting tasks implementation procedures.

Afterward, we calculated the mean percentage and standard deviations of reported children problem behaviors (CBI) and the reported - observed parents raise behaviors (Alabama and OS) to describe the clinical characteristics of the participants.

We calculated the non-compliance percentage from each baseline functional analysis condition in the third place. We also represented the overall mean percent of non-compliance and every means for all experimental conditions to explore its occurrence under specific environmental events. Consequently, we calculated the Z-scores of the standard deviations to compare the results.

Fourth, we fitted the median indifference points for each discounting task to the hyperboloid model [17,18] to figure the subjective reinforcement value. We took the original code from Frye., *et al*. [28] and adapted it to our parameters [29]. We also calculated the area under the curve (AUC; [30]) for each child discounting tasks indifference points. We first normalized the delays/probabilities/effort and the indifference points in Excel® to calculate the AUC. The AUC is the sum of the area between each indifference point: $x_2 - x_1[(y_1 + y_2)/2]$. The values x_1 and x_2 represent the delays/probabilities/effort, and the values y_1 and y_2 express the indifference points for those delays/probabilities/effort. The AUC ranges from 1 (zero discounting) to 0 (higher discounting).

Finally, we conducted Pearson correlations analysis between non-compliance, subjective reinforcement value, and reported children and caregiver behaviors to describe their associations.

The data analysis allows exploring and describing the non-compliance variability associated with the external stimulus conditions, the correlation of variables with the subjective reinforcement value, and the clinical characteristics derived from reported behavior. For all the analysis, we used IBM® SPSS® and the nonlinear regression library nlmrt in RStudio® (R Core Team, 2020).

Results

According to the findings, we display results from nine reported-behavior dimensions, 672 observed-behavior conditions, and 1,920 discounting task trials (640 of delay, 640 of probability, and 640 of effort), the significant association between them.

First, we obtained a mean of 100% of the procedure implementation on the experimental protocol. Such protocol had eight sections of written instructions for the experimental condition: reinforcer waiting, reinforcer ending up, social disapproval, alone, academic-alone, following commands, social interaction, and discounting tasks.

Secondly, table 1 displays the averages of the CBI, Alabama questionnaire, and caregiver behaviors. Results indicated variability on all reported and children and caregiver behaviors. Thus, the ODD mean was 61.33%, with a standard deviation of 23.23%. The aggression mean was 32.81, with a standard deviation of 25.57%. The attention-deficit average was 54.69%, with a standard deviation of 25.92%. The hyperactivity mean was 48.57%, with a standard deviation of 22.39. The impulsive behavior mean was 58.85%, with a standard deviation of 26.52. The results also indicated caregiver high positive involvement (M = 73.98; SD = 16.10), and positive parenting (M = 70.05; SD = 18.13) levels. Moreover, finding suggested a caregiver´ low poor-monitoring/supervision (M = 26.02; SD = 9.18), moderate inconsistent discipline (M = 51.30; SD = 15.32), and corporal punishment (M = 37.50; SD = 19.63). Lastly, findings indicated low social-interaction (M = 7.32; SD = 5.33), negative interaction (M = 1.55; SD = 2.24) and following-commands behavior-percentages (M = 25.57; SD = 19.98).

Children Behavior Inventory					
Dimension	**M**	**SD**	**Q25**	**Q50**	**Q75**
ODD	61.33	23.23	46.80	62.50	81.25
Aggression	32.81	25.57	16.67	25.00	50.00
Attention Deficit	54.69	25.92	28.47	54.16	75.69
Hyperactivity	48.57	22.39	29.17	50.00	65.63
Impulsivity	58.85	26.52	50.00	58.33	75.00
Alabama Questionnaire					
Dimension	**M**	**SD**	**Q25**	**Q50**	**Q75**
Positive Involvement	73.98	16.10	62.50	72.50	87.50
Positive Parenting	70.05	18.13	55.21	70.83	83.33
Poor Monitoring/Supervision	26.02	9.18	20.00	22.50	32.50
Inconsistent Discipline	51.30	15.32	45.83	50.00	61.46
Corporal Punishment	37.50	19.63	20.83	41.67	50.00
Caregivers´ behaviors					
Condition	**M**	**SD**	**Q25**	**Q50**	**Q75**
Social interaction	7.32	5.33	0.83	8.55	10.85
Negative interaction	1.55	2.24	0.00	0.31	2.36
Following-commands	25.57	19.98	4.52	24.30	42.43

Table 1: *Children behavior inventory (CBI), Alabama questionnaire, and caregiver condition behavior´s mean-standard deviation-quartiles percentages.*

Figure 1 resumes children´s data across non-compliance functional analysis. It displays the children´s overall non-compliance means and standard deviation in the left-side table. Therefore, solid bars represent each condition in standard deviation units, above/below the overall subject mean. Consequently, the figure displays the overall response comparing children´s replies and condition responses per child. Data represent variability between and within children´s non-compliance conditions. Thereupon, responding varied widely across children, with the overall non-compliance mean from 18.33% (SD = 36.77%; Child 12) to the high mean of 39.01% (SD = 47.96%; Child 27).

Therefore, figure 1 displays children within-between variability evidence across experimental conditions. Consequently, data provide information regarding specific stimuli that may affect non-compliance. First, the thirty-two non-compliance standard deviation units were neutral in the total sample, indicating the expected low non-compliance pattern during the social interaction condition. Secondly, thirteen non-compliance standard deviation units were positive in the entire sample at the condition of the following commands. However, the regarding eighteen obtained a positive low standard deviations unit, indicating a non-compliance pattern related to a negative reinforcement delivered through particular-adult-behaviors.

Also, figure 1 displays a non-compliance pattern found in the social disapproval condition. Twenty-six non-compliance standard deviation units were positive in the total sample, positively reinforcing non-compliance through social attention. Also, we found a non-compliance pattern in the academic alone condition. Twenty-four non-compliance standard deviation units were positive in the total sample, where stimuli represented escaping from an un-preferred activity. Results showed another non-compliance pattern in the reinforcer

ending-up condition where ten non-compliance standard deviation units were positive in the total sample. In these conditions, children received positive reinforcement by direct-playing access.

Moreover, figure 1 displays a non-compliance pattern found in the alone condition, and it shows twenty-four positive non-compliance standard deviation units in the total sample. In that situation, non-compliance of rules got positive reinforcement through direct-playing access, without external-adult contingencies. Finally, results indicated a non-compliance pattern on the waiting condition, where children escaped from obedience, getting immediate playtime-toy access. In that situation, we observed eight positive non-compliance standard deviation units in the total sample.

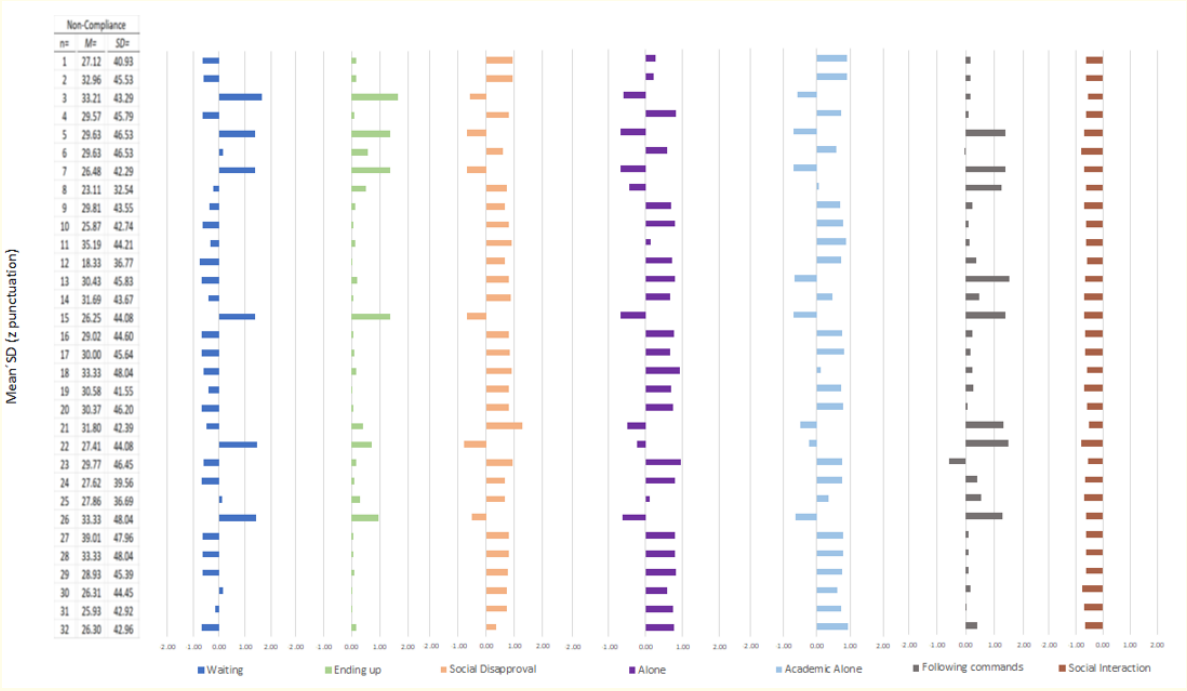

Figure 2: *Summary of children data across non-compliance functional analysis.*

Note. The left-side table shows every child´s overall non-compliance means and standard deviation. Therefore, solid bars represent each condition (e.g. waiting) in standard deviation units, above/below the subject´s overall mean.

Figure 2 displays delay, probability, and effort discounting functions from the indifference points and the AUC across discounting tasks. Regarding the delayed discounting task, the mean subjective value resulted in a k = 0.26, an s = 0.43, and an R^2 = 0.88. According to the probabilistic discounting task, the mean subjective value resulted in an h = 5.50, s = 0.30, and an R^2 = 0.98. Lastly, the mean subjective value of the effort discounting data resulted in an l = 0.85, s = 0.42, and R^2 = 0.90. Figure 2 displays the three graphs about delaying, probabilistic, and effort discounting AUC boxplots. Note that the three-discounting upper-median-section overlap between them. Also, notice there were no outliers. The AUC median to delay discounting was 0.50 (M = 0.48, SD = 0.24), to probability discounting was 0.51 (M = 0.47, SD = 0.30), and to effort discounting was 0.43 (M = 0.47, SD = 0.28).

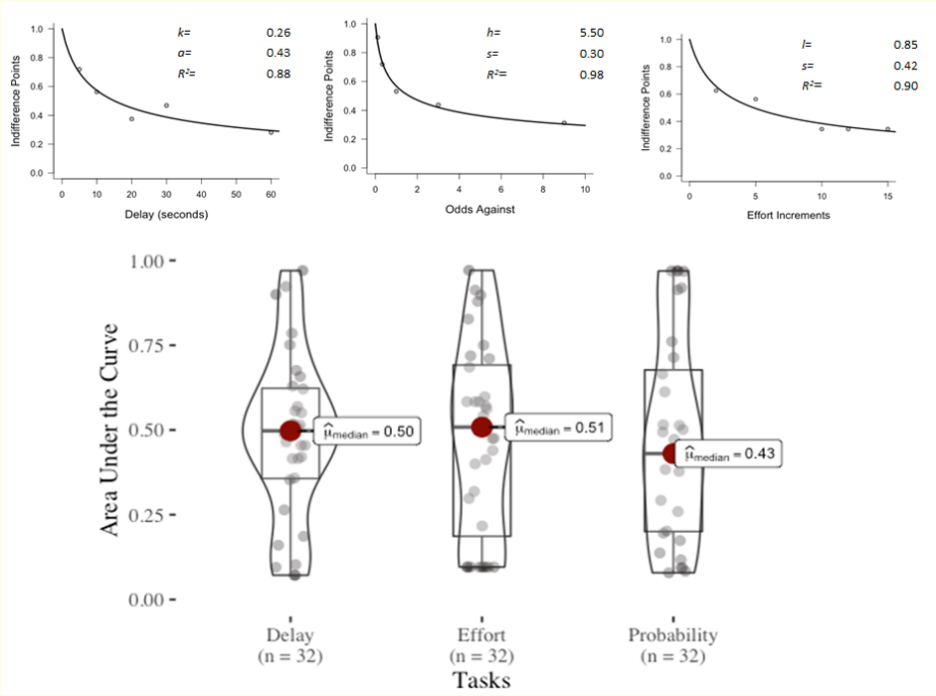

Figure 2: *Delay, probability, and effort discounting functions to indifference points and AUC across discounting tasks.*

Table 2 displays Pearson correlations between the children caregivers observed behavior and the discounting AUCs. Findings indicated significant-negative associations between positive caregiver involvement and reported impulsivity ($r = -0.411$, $p < .05$). The positive correlations between CBI scales (ranging from $r = 0.466$ and $r = 0.763$, $p < .01$) suggested independent but related children´s problem behavior dimensions. Likewise, the positive correlation between involvement and positive parenting ($r = -0.484$, $p < .01$) indicated that they are independent-related caregivers dimensions.

According to table 2, the aggression and hyperactivity dimensions related to children´s negative interaction ($r = 0.359$, $p < .05$, $r = 0.364$, $p < .05$, respectively). Therefore, positive involvement was positively associated with caregivers following commands ($r = 0.414$, $p < .05$). Poor monitoring/supervision was negatively associated with caregiver social interaction ($r = -0.366$, $p < .05$) and with children´s non-compliance social disapproval ($r = -0.366$, $p < .05$). The correlations between functional analyses children´s non-compliance conditions (range from $r = -0.927$ to $r = 0.927$, $p < .01$) suggested they are independent-related children non-compliance complex-stimuli. The reinforcer waiting is an example where it positively correlated to reinforcer ending up ($r = 0.927$, $p < .01$) and negatively with social disapproval ($r = -0.927$, $p < .01$). Likewise, results indicated a correlation between caregiver social interaction and negative interaction ($r = -0.563$, $p < .01$) are independent-related complex-stimuli.

Therefore, caregivers´ negative interaction related to aggression dimension ($r = 0.390$, $p < .05$), and attentional deficit ($r = 0.397$, $p < .05$).

Moreover, data suggested caregiver following-commands behaviors negatively related to children´s non-compliance in the same condition ($r = -0.734$, $p < .01$). Therefore, negative caregiver interaction related to children negative interaction ($r = 0.662$, $p < .01$). Moreover,

results showed that social caregiver interaction negatively correlated with children´s non-compliance during following commands (r = -0.468, p < .01).

Additionally, data indicated social caregiver interaction negatively related to waiting and ending-up non-compliance (r = -0.578, p < .01, r = -0.536, p < .01, respectively); Social caregiver interaction positively related to alone, academic-alone, and social disapproval non-compliance (r = 0.637, p < .01, r = 0.500, p < .01, and r = 0.578, p < .01, respectively). Also, results indicated negative caregiver interaction negatively related to non-compliance waiting (r = -0.371, p < .05).

Table 2 also displayed caregivers following-commands behaviors negatively related to waiting and ending-up non-compliance (r = -0.407, p < .05, r = -0.420, p < .05, respectively). Moreover, caregiver following-commands behaviors positively related to academic alone non-compliance (r = 0.490, p < .01).

Lastly, findings suggested delay-discounting AUC negatively related to negative caregiver interaction (r = -0.380, p < .05). Probability-discounting AUC positively related to social-disapproval, children negative interaction, and caregiver social interaction (r = 0.483, p < .01, r = 0.398, p < .05, r = 0.389, p < .05, respectively). Likewise, effort-discounting AUC negatively correlated to non-compliance waiting (r = -0.436, p < .05). Finally, delay-discounting AUC was related to effort-discounting AUCs (r = 0.476, p < .01), suggesting independent but related reinforcement subjective values.

	Aggression	Attention	Hyperactivity	Impulsivity	Positive Involvement	Positive Parenting	Ending-up	Alone	Academic Alone	Social Disapproval	Children´s Following Commands	Children´s negative Interaction	Caregivers´ Social Interaction	Carevigers´ negative Interaction	Caregivers´ Following Commands	Delay Discounting AUC	Probability Discounting AUC	Effort Discounting AUC
ODD	0.628**	0.668**	0.597**	0.630**														
Aggression		0.523**	0.574**	0.572**								0.359*		0.390*				
Attention Deficit			0.715**	0.466**										0.397*				
Hyperactivity				0.763**								0.364*						
Impulsivity					-0.411*													
Positive Involvement						0.484**									0.414*			
Poor Monitoring/Supervision										-0.366*			-0.366*					
Waiting							0.927**	-0.737**	-0.696**	-0.927**	0.648**		-0.578**	-0.371*	-0.407*			-0.436*
Ending up								-0.728**	-0.727**	-0.891**	0.641**		-0.536**		-0.420*			
Alone									0.795**	0.778**	-0.625**		0.637**					
Academic Alone										0.741**	-0.780**		0.500**		0.490**			
Social Disapproval											-0.680**		0.578**				0.483**	
Children´ negative interaction																	0.398*	
Caregivers´social interaction											-0.468**	0.575**		0.563**			0.389*	
Caregivers´ negative interaction												0.662**				-0.380*		
Caregivers´following commands											-0.633**							
Delay Discounting AUC																		0.476**

Table 2: *Significative correlations between the children-caregivers´ reported and observed behaviors and the discounting´s AUC. Note. *p value < 0.05, **p value < 0.01.*

Discussion and Conclusion

The purpose of the study was to describe the relationship between children´s non-compliance-function and the subjective reinforcement value through remote behavioral assessments. First, the findings showed that caregivers of the sample reported clinical behavioral problems like the ones written by Morales., *et al.* [24]. Specifically, caregivers reported defiant - opposition behaviors such as tantrums, fights, non-compliance, bothering, blaming, resentfulness, madness, and vindictive behaviors. They also reported their children being physical or verbally aggressive and behaving inattentive by failing to pay attention or committing careless mistakes. Caregivers also reported hyperactive-impulsive behaviors such as exciting, running, climbing, not-waiting turns, or interrupting others. Such propositions

supported the findings suggesting that each group of symptoms was independent but related dimensions in the study sample. Additionally, findings indicated that aggression and hyperactivity were related to non-compliance negative children interaction (e.g. disapproval, screaming, and ignoring caregivers).

Outcomes also suggested high levels of positive involvement and parenting, despite low punishment and inconsistent discipline [31]. Specifically, in the sample, positive involvement related to delivering commands through effective behaviors (e.g. getting children´s attention), and caregivers positive involvement related to less impulsivity, just like Morales., *et al*. found in 2016. On the other hand, poor monitoring/supervision is related to low caregiver social interaction. Such conditions were like those Frick [32] reported, indicating a high risk of negative children´s behaviors.

Beyond that, observational findings suggested sample caregivers displayed low following-commands and social-interactions behaviors levels. These outcomes were like the ones reported by Morales., *et al*. [31], registering behaviors in simulated interaction situations but now in actual conditions. Specifically, negative caregiver interaction was related to high reported aggression and attentional deficit, and negative caregiver interaction was associated with the same negative children interaction. In contrast, findings suggested a relationship between social caregiver interaction and low children´s non-compliance following commands. Consequently, such contexts served as a non-compliance appropriate assessment context [2,24,25,33] and were valuable in describing behavior cost-choice-mechanisms while delivering operating rewards.

Children´s non-compliance varied considerably between and within children, and such variability was associated with stimuli conditions, just like Iwata., *et al*. [3] reported for self-injury behavior. Such finding also agrees that functional analyses were independent but related to children´s non-compliance complex-stimuli. Our empirical evidence suggested that non-compliance may function with reinforcement of different sources, with significant implications for treatment. Knowing the specific reinforcement obtained by the non-compliance would significantly enhance the effectiveness of operant procedures designed to reduce it [3].

Notably, findings suggested a neutral non-compliance pattern observed as expected during the social interaction condition (control situation). In such a situation, playing stimuli were potentially available, and caregiver demands were absent. Thus, the condition served as an enriched environment where children behaved well like expected.

Consequently, findings suggested a whole non-compliance pattern related to negative reinforcement delivered through the following-commands condition. Just like Barkley [2], Sanders, and Dadds [6] already signaled, commands characterized by un-specific instructions without getting children´s attention, waiting for obedience, and praising it, were related to non-compliance. Non-compliance looks to help children to escape from such stimuli conditions. Such outcomes agree that caregivers´ following-commands behaviors are negatively associated with children´s non-compliance in the same situation. In contrast, findings indicated that caregivers´ following-commands behaviors were associated with non-compliance in the academic alone condition. In that sense, some children exhibited non-compliance during the academic alone condition, where also children might be scaping from an-preferred activity. Still, caregivers weren´t there to provide an external contingency to such behavior. Moreover, children exhibited non-compliance in the social disapproval condition, evidently reinforced through caregiver social attention. Such finding also agrees with the poor monitoring/supervision dimension found.

Complementary to the primary outcomes, positive reinforcement seemly maintained non-compliance like that given during the reinforcer ending-up-waiting and alone conditions, through direct playing access. In such a sense, findings indicated that social caregiver interaction was related to waiting-ending more minor non-compliance. Plus, caregivers following-commands behaviors related to waiting-ending´s low non-compliance. Nevertheless, findings also suggested that social caregiver interaction could be related to alone, academic-alone, and social disapproval non-compliance, indicating non-compliance when caregivers were absent or provided social attention. In such a sense, a combined negative reinforcement might be explaining the negative caregiver interaction associated with minor waiting non-compliance. However, further research should address such evidence.

Consequently, findings indicated non-compliance consisted of children´s failure to initiate requested behaviors, sustain it, and follow given rules [2]. Mainly, non-compliance might function like escaping an undesirable caregiver´s demands [3] but through positive reinforcement by access to attention and playing pass. Specifically, children might be maintaining non-compliance due to negative reinforcement mechanisms on the presence of stimuli like those in the high non-preferred demands. In such a sense, Barkley [2] already described these commands as those producing non-compliance. Thereby, low-probability-obedience commands were the stimuli where children exhibited non-compliance. Such behavior looked like an escape mechanism from un-specific caregiver instructions [4,6,10,24,31]. Even though non-compliance was maintained by attention plus playing access [4-6,24]. Namely, non-compliance behaviors belong to oppositional defiant disorder, hostile-defiant behavior, or social aggression, which function to escape or avoid commands [7,11] and get social reinforcement. Hence, outcomes suggested study accomplished a translation role, using basic learning principles to understand children´s non-compliance [6,25,34].

Besides, in this study, we have described other basic learning principles to innovate and plan effective behavioral treatments. Thus, the description of behavioral mechanisms also allowed to associate them to other children´s behavioral patterns through the temporal, probabilistic, and effort discounting tasks. Findings suggested children devalued the virtual-reinforcement subjective value because of reinforcement time-probability-effort manipulations. Precisely, outcomes indicated children discounted the subjective reinforcement value due to delaying its delivery [35], changing its delivery probability [12] or manipulating the operand effort to obtain it [13,14,20]. The area under the curve from delay, probabilistic, and effort discounting were quite similar and with good adjustment to the quasi-hyperbolic fit [12]. So, each condition was associated with a particular type of discounting pattern.

Consequently, findings expanded the generality of the children´s context choice effort, delay, and probability over virtual reinforcement devaluation. Specifically, children displayed a moderate level of impatience, risk aversion, and effort, suggesting impulsivity is a multifaceted construct under the control of several mechanisms [12]. Mainly, outcomes indicated children´s choices as an explicit function of their real experienced consequences [10,20]. Thereby, this study addressed virtual reinforcement subjective value in children through delay, probability, and effort discounting tasks in practical and ethical procedures. The actual study was a remote procedure using virtual but real rewards in a fast and helpful way [20]. So, virtual rewards, like those used in this study (e.g. trophies), saved more time and were programmed and delivered from an algorithm that allows to compare them to other findings as the ones obtained from behavior functional analysis.

Hereafter, findings indicated that caregiver low negative interaction was related to children low delay-discounting rate. Such findings suggest that children are less impatient while their caregivers use fewer negative behaviors during the interaction. Of course, additional evidence should explain which mechanisms are related to it. Future research might consider designing functional analyses that provide social disapproval of non-compliance waiting but mainly display treatment where children´s patience might be socially reinforced, though.

Moreover, probabilistic discounting was related to non-compliance in social disapproval and children´s negative interaction in the sample. Thus, it suggests that risky choices could get social attention upon non-compliance and negative behaviors during the interaction. Once again, additional research might assure such evidence, mainly considering the relationship between risky-impulsivity choices and social disapproval. Functional analyses might consider whereafter treatment socially reinforces aversion to risky decisions. Nevertheless, outcomes indicated risky choices related to the caregiver´s social interaction. Thus, future research might confirm and understand underlying assets, identifying specific interactional behaviors related to them.

Finally, findings suggested that effort-discounting was related to fewer children´s waiting non-compliance. Thus, choosing effort could be related to waiting for a reinforcer. Future research might consider designing functional analysis where children stay while displaying effort responses, with interventions reinforcing those behaviors. In this regard, it is essential to note that delay-discounting was related to effort-discounting, suggesting independent but related reinforcement subjective values [20].

In summary, the operant methodology has helped describe children´s non-compliance associated with caregiver practices, identifying its functional properties on a pretreatment basis, observing across several analog environments [3] and experimental choices. However, we did not control all contingencies that may affect behavior [3] and the sample size compels researchers to look forward to additional evidence. However, findings indicated that testing the clinical assessment utility is essential while selecting effective treatments. The present study´s primary focus was on identifying variables associated with (and might serve to maintain) the occurrence of non-compliance [3] and their association to subjective reinforcement value. The physical and social characteristics of working within an enriched environment might produce several beneficial outcomes, including reductions in goal behavior. It may be possible to empirically identify variables that affect behaviors before implementing lengthy treatment conditions. Thus, subsequent studies might consider using functional analysis context and discounting model clinical utility to assess the effectiveness of children interventions.

Reducing non-compliance would affect other behavioral disorders of a similar class. The evidence suggested the reinforcement sources of non-compliance enhance specific behavioral procedures that can effectively mitigate it [2,6,24]. Thus, behavioral strategies to change non-compliance may positively reinforce alternative or incompatible behaviors through the caregiver´s attention and extinguish non-compliance when negative reinforcement maintains it [4,5].

Explaining how children discount the subjective value of reinforcement might extend the comprehension about operant procedures underlying successful and specific behavioral treatment to solve non-compliance in the clinical and ecological contexts. Consequently, identifying the operant procedures underlying non-compliance and the subjective reinforcement value might help plan effective behavioral interventions. Therefore, non-compliance maintained by negative reinforcement like escaping non-specific instructions might be extinguished by maintaining the task on, reinforcing immediately, and ensuring any short sample of compliance effort.

Likewise, researchers might study self-control generalization by lengthening the time to get positive reinforcement. Such treatment might reduce the reinforcement devaluation, fading waiting time [36], prising risk aversion, or establish effort to get it. Lately, some studies have described how children learn self-control through multiple-exemplars training. Researchers have trained to wait by signing the stimuli associated with reinforcement, fading the time until they reach the self-control criteria [37]. Binder., *et al*. [38] also trained children self-control through fading waiting time plus repeating self-instruction to reach the waiting goal. Dunkel-Jackson., *et al*. [39] also taught children self-control by delaying fading and reinforcing alternative behavior while waiting to receive reinforcement. Thus, to treat negatively maintained non-compliance under following-commands conditions, Carr., *et al*. [40] already suggested including non-demands periods (reading entertaining stories) during a demand condition. Plus, the guided compliance trials, where researchers prompt children´s behavior until reaching a performance criterion, also extinguish negatively reinforced behavior [3].

Future research might describe how basic behavioral principles underlie the children´s behavior function explanations in several contexts [6,10,20]. Although this study helped describe the proximal children´s behavior determinants and the reinforcement´s subjective value, it is essential to design evidence-based strategies for each functional analysis situation: reinforcement, extinction, negative punishment, or stimulus control. Even though we had worked remotely, we implemented a methodological approach to describe the relationship between non-compliance functional analyses, subjective reinforcement value, and clinical symptoms through ethical guidelines. As a result, remote assessment of children´s behavioral problems let use basic behavior principles via experimental studies with caregivers as change agents at their ecological contexts during the COVID19 pandemic. We have evaluated virtual rewards in the natural context and choice processes associated with children´s behavior in realistic situations. Therefore, we should also design more effective behavioral interventions to solve children´s behaviors.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be constructed as a potential conflict of interest. PAPIIT-UNAM Project IN305120 supported this work.

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