

Delay of Gratification in Costa Rican Preschoolers: Effect of Trust in the Experimenter and the Socio-Economic Status

Postergación de la gratificación en preescolares costarricenses: efecto de la confianza en el experimentador y el estatus socioeconómico

Adiamento da gratificação nas pré-escolas da Costa Rica: Efeito da Confiança na Pessoa Experiente no Estrato Socioeconômico

Report de la gratification dans les écoles maternelles du Costa Rica: effet de confiance sur la personne expérimentée et la strate socio-économique

Pablo Chaverri-Chaves¹

L. Diego Conejo²

Sara P. León-González³

L. Alonso Arrieta-Ávila⁴

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Abstract. This study analyzed the effect of confidence in the experimenter on the performance of a group of Costa Rican preschoolers on self-control. In addition, the effect of socioeconomic status on performance on the marshmallow task was analyzed by a comparison of children from both different schools (public vs private) and different socioeconomic contexts within each school. The sample of participants was 67 children (26 girls, M of age = 63 months, $SD = 6.03$). Effects were found, both of the confidence in the experimenter and of the socio-economic status in self-control. The implications of this study for future studies with children and families are discussed.

Keywords: Self-control; preschoolers; delay of gratification; candy test; decision making.

Resumen. Este estudio analizó el efecto de la confianza en la persona experimentadora sobre el desempeño de un grupo de niñas(os) preescolares costarricenses en el autocontrol. Adicionalmente, se analizó el efecto del estatus socioeconómico en el desempeño en la tarea de la golosina por medio de una comparación de niños provenientes tanto de diferentes escuelas (pública vs privada) como de distintos contextos socioeconómicos al interior de cada escuela. La muestra de participantes fue de 67 niños(as) (26 niñas, M de edad = 63 meses, $D.T. = 6.03$). Se encontraron efectos, tanto de la confianza en la persona experimentadora, como del contexto socioeconómico en el autocontrol. Se discuten las implicaciones de este estudio para futuros trabajos con niñas y niños, y familias.

Palabras clave: Autocontrol; preescolares; postergación de la gratificación; tarea de la golosina; toma de decisiones.

Resumo. Este estudo analisou o efeito da confiança no experimentador sobre o desempenho de um grupo de meninas pré-escolares costarriquenhas em autocontrole. Além disso, o efeito do status socioeconômico sobre o desempenho na tarefa do tratamento foi analisado por uma comparação de crianças de escolas diferentes (públicas vs privadas) e diferentes contextos socioeconômicos dentro de cada escola. A amostra de participantes foi de 67 meninos (26 meninas, M de idade = 63 meses, $D.T.s = 6.03$). Foram encontrados efeitos, tanto da confiança na pessoa experiente quanto do contexto socioeconômico no autocontrole. As implicações deste estudo para o futuro trabalho com crianças e famílias são discutidas.

Palavras-chave: Autocontrole; pré-escolares; adiamento da procrastinação; teste do marshmallow; tomada de decisão.

Résumé. Cette étude a analysé l'effet de la confiance dans l'expérimentateur sur la performance d'un groupe de filles d'âge préscolaire costariciennes sur la maîtrise de soi. En outre, l'effet du statut socio-économique sur le rendement sur la tâche de la gâterie a été analysé par une comparaison des enfants des deux écoles (publiques vs privées) et des contextes socio-économiques différents au sein de chaque école. L'échantillon de participants était de 67 garçons (26 filles, moyenne d'âge = 63 mois, $D.S. = 6.03$). Des effets ont été constatés, tant de la confiance dans la personne expérimentée que du contexte socio-économique dans la maîtrise de soi. Les implications de cette étude pour le travail futur avec les enfants et les familles sont discutées.

Mots clés: Maîtrise de soi; enfants d'âge préscolaire; report de la gratification; test du marshmallow; prise de décision.

¹ Instituto de Estudios Interdisciplinarios de la Niñez y la Adolescencia (INEINA), Universidad Nacional de Costa Rica, Heredia, Costa Rica. Contact mail: pablo.chaverri.chaves@una.ac.cr. ORCID: <https://orcid.org/0000-0002-2639-4242>

² Instituto de Estudios Interdisciplinarios de la Niñez y la Adolescencia (INEINA), Universidad Nacional de Costa Rica, Heredia, Costa Rica. ORCID: <https://orcid.org/0000-0002-6415-0337>

³ Instituto de Estudios Interdisciplinarios de la Niñez y la Adolescencia (INEINA), Universidad Nacional de Costa Rica, Heredia, Costa Rica. ORCID: <https://orcid.org/0000-0003-2417-6783>

⁴ Universidad de Castro Carazo, San José, Costa Rica. ORCID: <https://orcid.org/0000-0002-4902-8501>

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INTRODUCTION

One of the problems related to the analysis and understanding of the development of people's decision-making and self-regulation processes, has to do with the consideration of the role that social contexts play in this process (Todd & Gigerenzer, 2012; Sheehy-Skeffington, 2020; Tomasello, 2021; Chaverri et al., 2021). Within the conceptual frameworks to investigate the subject, one of the most used is the expected utility model, which assumes that individuals choose the option whose benefit is the highest, that is, that people behave as profit maximizers (Smith & Kosslyn, 2014). However, this model is limited in explaining decision-making because it does not consider context. In response to this limitation, the theory of ecological rationality posits that people make decisions that are adaptations to the context (Todd & Gigerenzer, 2012). In this sense, a decision that could be rational from the point of view of the theory of expected utility, may not be rational approached from the theory of ecological rationality. This difference is essential in the context of this article, which investigates self-control in preschool children with the candy task (Mischel, 1974), in the context of trust vs. distrust in the person administering the test. This variation (trust vs. distrust) was introduced through a task prior to that of the treat, in which the participants were randomly assigned to a group in which a promise was fulfilled (group of trust in the person experimenting) or to a group in which a promise was not fulfilled (group of distrust in the person experimenting).

The approach to explore with this research is that decision-making in the context of the candy test (Mischel, 1974), is affected by the degree of confidence in the experimenter. Thus, when there is little confidence, it is expected that the time of postponement of gratification will be reduced (Kidd et al., 2013).

To better understand decision-making and the ability to postpone gratification, it is necessary to examine variables directly associated with both the immediate (interpersonal trust) and more structural (family socioeconomic status) context of children. This study, following the line of Kidd et al. (2013), is a contribution to improving our understanding of the relationships between context and performance in experimental tasks. For this, in addition to considering the confidence in the experimenter through an experimental manipulation, the relationship between socioeconomic status and performance in the candy task was analyzed, with the aim of expanding the explanatory variables of behavior in a specific situation.

If trust in the experimenter influences how it is decided in situations that require postponing gratification (in this case, not eating the treat and expecting to get two in return), then it could be argued that we would no longer be simply facing a process that can be analyzed only from the perspective of expected utility, but rather in front of a case that is best described by the approaches of ecological rationality (already explained) and linked or bounded rationality. The theory of bounded rationality states that, due to the cognitive limitations of individuals, it is not possible to have or manage all the information related to decision making, so the objective of the decision is not to obtain the best option of all, but the one that is most satisfactory for the objectives of the actor (Simon, 1955).

From this approach, our information processing systems develop adaptive strategies that provide a balance between the cognitive effort of seeking and processing information and choosing the best possible alternative. Simon (1955) described this strategy as satisfactory, because it does not necessarily find the best of all possibilities, but one that is good enough to meet the objectives of the decision maker.

The theory of ecological rationality posits that decision-making can be better understood when analyzed in terms of its adaptation to the environment in which it occurs. In other words, that the rationality of a decision depends on the circumstances in which it takes place. In this way, something that is considered rational from the theory of expected utility might not be rational from the perspective of the theory of ecological rationality. Thus, while expected utility theory focuses on logical consistency, ecological theory focuses on real-world performance (Todd & Gigerenzer, 2012). Currently, there is an important discussion about how the social context influences individual decision-making, with trust being a key element within this context (Kidd et al., 2013), as well as socioeconomic status (Watts et al., 2018) and culture (Lamm et al., 2018).

As is known, preschoolers often have difficulties in tasks that require postponing immediate gratifications to achieve greater rewards later (Lamm et al., 2018). Some are better than others at waiting and individual differences in this ability have been attributed to the ability to self-control (Shoda et al., 1990) as well as rationality of decision-making (Kidd et al., 2013). The specialized literature on the postponement of reward has established that those who manage to wait longer in tasks of postponement of gratification, tend to be more successful in several aspects in their adult life (Shoda et al., 1990), which has been questioned in more recent works (Watts et al., 2018; however see Doebel et al., 2019, for an explanation of the inconsistencies).

In the study carried out by Kidd et al. (2013) it is proposed that in addition to self-control, there is an implicit process of rational decision-making that considers the reliability of the social context and that affects the waiting times in the task of the candy. Kidd et al. evaluated children between 4 and 6 years old ($n = 28$) using the classic paradigm of the candy task (Mischel, 1974) under two conditions: an environment of trust in the experimenter and an environment of distrust in the experimenter. They found that children in the trust condition waited significantly longer than those in the distrust condition. This would suggest that wait times reflect reasoned beliefs about whether the wait will ultimately yield a reward or not. In this way, these authors consider that sustained waiting times in tasks of delaying gratifications could reflect differences not only in terms of self-control capacity, but also about the perception of the stability and predictability of the context that surrounds people (Kidd et al., 2013).

In addition to these results suggesting that preschool children can make decisions based on conditions of trust in the person with whom they interact, evidence from other studies suggests that even younger children possess sophisticated abilities to make decisions and reason about physical causality (Gopnik et al., 2004; Gweon & Schulz, 2011), social behavior (Gergely et al., 2002), future events (Denison & Xu,

2010; Kidd et al., 2013; Teglas et al., 2011), concepts and categories (Piantadosi et al., 2012; Xu et al., 2009), and the meaning of words in social contexts (Xu & Tenenbaum, 2007).

Classic studies with the candy task indicated a high correlation between the ability to delay gratification and performance in cognitive and social competency tasks (Mischel et al., 1988). Later studies showed that these correlations decreased, and even canceled, if other variables such as household characteristics were considered (Shoda et al., 1990). More recently, Kidd et al. (2013) presented evidence suggesting that the ability to make rational decisions is also used in childhood in a domain of behavioral inhibition. According to these authors, in the task of the candy most children fail to postpone gratification and end up eating the treat, at least partially, before time runs out and they can receive two. The causes of this apparent failure of self-control and rationality, in any case, are not yet fully understood. While the weakness to wait is probably the result of a combination of various temperamental, sociocognitive and environmental variables, these authors consider that there would be two potentially more important factors: the ability to self-control and established beliefs.

The evidence reviewed above suggests that children's sustained decision to wait for a larger reward rather than more quickly take a small reward is strongly influenced by the trust generated by the person with whom they interact. More specifically, children's performance in delaying gratification may be strongly influenced by an implicit rational decision-making process that considers the likelihood of obtaining a greater benefit if expected, in addition to variables associated with the interpersonal context and socioeconomic status of the families from which people come.

Neural correlates of self-control

Self-control is a highly complex capacity that depends on the interaction of various neurocognitive processes in different brain regions, which operate in its production, and which develop gradually throughout childhood and adolescence, until about 25 years, when the human brain reaches its most advanced maturation in the prefrontal cortex (Sharma et al., 2013).

Self-control can be seen as the opposite of impulsive behavior, as it involves goal-oriented behaviors, and this is usually presented as one of the main differences between humans and other species, although recent evidence questions a sharp separation (Beran, 2018).

One of the outstanding functions of self-control is the postponement of rewards, which is a necessary skill to be able to fulfill previously planned actions. Without the ability to postpone rewards, it is not possible to execute complex plans or maintain behaviors oriented to non-immediate objectives that require sustained effort. That is, the ability to reject the immediate temptations to service for greater rewards later in time (Mischel, 1974).

A subsidiary element of self-control is the ability to shift the focus away from immediate gratification, which would occur thanks to a strong functional coupling between the nucleus accumbens (a region of the brain that supports approachability and

avoidance behaviors, such as motivation and aversion) and the prefrontal cortex (a region associated with reasoning, planning and executive function, both of which support self-control). The prefrontal cortex operates the internal organization between thoughts and behaviors in relation to goals, which is why it plays a fundamental role in making self-control possible (Miller et al., 2002).

The distinction between immediate and subsequent rewards, as well as their valuation, are also elementary processes of self-control. These processes exhibit differentiated patterns of neuronal activation. In more concrete terms, as McClure et al. (2004) claim in their research, there are different brain activation patterns when people are considering immediate or delayed prizes. According to their neuronal data, some brain regions associated with emotional responses are activated when immediate rewards are taken, while bigger activity of areas associated with rational processes is registered when delayed choices are chosen.

According to McClure et al. (2004), parts of the limbic system linked with the midbrain dopamine system, including the paralimbic cortex, are more activated in decisions involving immediately available rewards. But when decisions imply delayed choices, the regions of the lateral prefrontal cortex and the posterior parietal cortex are uniformly recruited in their processing. That is, the response of regions mostly active in emotional processing is directed to the preference of immediate stimuli, while the response of regions associated with rational and planned behavior emerges before the choice of postponed stimuli. This is related with the differentiation of automatic and controlled processes in the brain, which posits that the default mode is to opt for the immediate reward, except if there is cognitive effort to inhibit the instant satisfaction (McClure et al., 2004).

Just as self-control requires keeping the focus on non-immediate goals, it also needs to discard irrelevant stimuli or stimuli that may deviate from the larger goal. This occurs through inhibitory control, which is the ability to ignore stimuli irrelevant to the task, facilitating the achievement of the planned goal. Executive function coordinates inhibitory control and manages attentional flexibility as part of its task, which integrates these processes to conduct behavior towards the planned goal and away from the immediate desire (Takeuchi et al., 2013).

Inhibitory control and self-control can be seen as complementary functions. The first one is related to avoid or suppress stimuli that harms the goal, and the second one is the more general ability to regulate emotions, thoughts, and behavior in the face of immediate temptations and impulses to maintain orientation to non-immediate goals. As part of executive function, self-control and inhibitory control are processes that require effort, so they are highly resource consuming processes for the individual, which implies that they cannot be sustained indefinitely (Diamond, 2013).

When conducting inhibitory control tasks, people with greater capacity for self-control show greater activity in the frontostriatal circuits (linked to motivation and control) and greater activity in the prefrontal cortex (associated with problem solving and impulsivity management). On the other hand, those who have less capacity for self-control in this type of tasks, show greater activity in the ventral striatum

(related to desire, pleasure, and addictions) (McClure et al., 2004; Luerssen et al., 2015).

In other words, the choice of immediate rewards is associated with a greater activation of an automatic, reflex, and unconscious neurocognitive system in the limbic system (“hot”), which does not evaluate the long-term consequences. On the other hand, leaning towards the postponement of rewards requires a neurocognitive system that is more controlled and slower in its response, which is rational and reflective, and is supported by the areas of the prefrontal cortex of the brain (“cold”), which make it possible to consider the consequences of long-term acts (Mischel, 1974; Luerssen et al., 2015).

These neurocognitive processes that enable self-control are also influenced by socioeconomic status, since evidence from several studies suggests that children living in poverty show less relative development of the prefrontal cortex (functional and structural), which can hinder more controlled responses to tasks of postponing rewards (Noble et al., 2005; Farah et al., 2006; Hackman & Farah, 2009; Noble et al., 2015; Johnson et al., 2016; Brito et al., 2017; Lawson et al., 2018).

Objective and Hypothesis

The aim of this study was to explore the effect of the induced condition of trust or distrust, as well as socioeconomic status, on the performance of the candy task. The hypothesis tested was that children in the trust condition would show longer wait times to touch the treat, and that they would touch it fewer times, compared to children in the distrustful condition. Those from a high socioeconomic status were also expected to achieve longer waiting time than those from low socioeconomic status.

MATERIALS AND METHODS

Participants

For this study, 41 boys and 26 girls participating were recruited from two preschool centers in the province of Heredia, Costa Rica, with a mean age of 63 months ($SD = 6$ months).

Eighteen participants were recruited in a private educational center (hereinafter, private school), with a high monthly payment in the Costa Rican context. The other preschool was public ($n = 49$, hereinafter, public school) and therefore free access. Given the unequal number of participants from each type of school, when comparisons are made between these schools, it will be done with only 18 participants from each of them. In the case of the public school, these 18 participants are randomly selected from the 49 participants in total. It is important to mention that previous studies have detected differences in groups with fewer than 18 children (e.g., Kidd et al., 2013, compared groups of 14 children and were able to detect significant differences).

With respect to age, the private school group ($M = 66$, $SD = 1.56$ months) was higher as a whole than the public school group ($M = 62$, $SD = 6.61$ months; $W = 630$, $p = 0.008$).

Also, in the private school group, all mothers reported at least having incomplete university. In contrast, in the public school group, 36% of mothers reported having at most incomplete secondary school, and only 9% of mothers reported that they had completed a university degree.

The participating children had the prior approval of their legal guardians by signing an informed consent, as well as giving their own assent. This project was reviewed and approved by the Scientific Ethics Committee of the National University of Costa Rica (through the official letter UNA-CECUNA-ACUE-002-2018, dated January 31, 2018).

Tools and procedures

The instruments used in this study are detailed below.

- *Drawing task*

This task was applied following the protocol of Kidd et al. (2013). At first, to manipulate trust, each participant was asked to draw a drawing freely in an isolated room, for which they were offered to do it with a piece of crayon in poor condition, or with a large and colorful material, composed of a diversity of markers and colored pencils in good condition. The enhanced material was shown in a photograph, and they were told that if they waited until the experimenter returned with this material from elsewhere, it would be given to them to draw. All 67 participants agreed to wait for the improved material.

Randomly it was defined which children corresponded to a situation of trust (the improved material was delivered, $n = 33$) or to a situation of distrust (the improved material was not delivered, $n = 34$). After delivering or not delivering the promised material, each child was asked to draw for a few minutes and immediately after proceeded with the homework of the treat. The group in the confidence condition ($M = 64$, $SD = 5.95$ months) and the group in the distrust condition ($M = 62$, $SD = 5.95$ months) showed no significant differences with respect to age, according to a nonparametric mean comparison test ($W = 619$, $p = 0.235$).

- *Task of the candy*

Once the drawing task was completed and following the same protocol of Kidd et al. (2013), the candy test was performed. While the children were sitting in a chair in front of a table, the candy was placed in front of them on a napkin. They were told that this treat was theirs, and that if they wanted they could eat it, but that, if they waited for the experimenter to return to the room, then they could receive two treats instead of one.

This task was operationally effective, as the vast majority chose to wait for the second treat (64 children out of 67). The maximum waiting time established in this study was up to 12 minutes, after which the experimenter returned to the room with a second treat. Interestingly, it was obtained that 63 of 67 children managed to wait the established 12 minutes without completely eating the treat, which is inconsistent with other studies reviewed, in which, on the contrary, most children eat, at least partially, the candy before the experimenter returns.

Both tasks were applied by the same adult experimenter. To carry them out, an appropriate physical space was prepared to film the application of the technique with a hidden camera in both schools, so that the participants did not realize that they were being filmed. This experimentation was recorded in audio and video, which was explained in the informed consents signed by the parents. The coding of the videos to determine if they ate the candy, the times they touched it and the time they lasted before touching it, was done by the main researchers of the project and by assistants trained in the protocol. 20% of the material was coded to determine the reliability between judges, which was established at least in 90% agreement between them. It was coded if they ate the marshmallow, the time they lasted to touch it for the first time, the times they touched it.

- *Index of services and facilities in the home*

An index was constructed that incorporated the possession of the following elements: computer, own house, internet access, cable television, hot water tank, dishwasher, air conditioning and own vehicle, with the intention of having an index of the socioeconomic status of the participating families. For each item, one point was added on the socioeconomic status scale.

- *Analysis*

The analysis plan for the present study included exploratory analyses and median comparisons by means of robust nonparametric tests due to the lack of homoscedasticity and normality of the data. Specifically, R (Ihaka & Gentleman, 2022) Psych packages were used to explore the data and *WRS2* (Mair & Wilcox, 2020) to perform the robust analyses. Median comparisons were performed with the iterative procedure (100 iterations) to determine the critical value of the tests more reliably.

RESULTS

Exploratory analysis

Of the total 67 participants in the study, only four ate the candy completely. One boy from the private school, and three from the public school (two boys and one girl). Given the low number of children who ate the treat, it was decided to do a more specific analysis of the participants' performance. This included examining the time it took before they touched the treat and the number of times they touched it.

Table 1 shows the variables that measure the performance of the candy task by experimental condition (trust or distrust). Table 2 shows the variables by type of school (private or public).

TABLE 1. Descriptive of study variables by experimental condition (trust vs. distrust).

Variables	Group	Median	Minimum and Maximum
Times the candy is touched	Confidence	5	0 - 32
	Distrust	5	0 - 37
Waiting time to touch the candy*	Confidence	86.33	6 - 339.67
	Distrust	33.33	9.67 - 193

Note: * = in seconds. Source: Authors.

TABLE 2. Descriptive data of study variables by school (private vs. public).

Variables	Group	Median	Minimum and Maximum
Times the candy is touched	Public School	5.5	0 - 37
	Private school	5	0 - 32
Waiting time to touch the marshmallow*	Public School	46.67	6 - 339.67
	Private school	79.33	11.33 - 324.67

Note: * = in seconds. Source: Authors.

Initially, the relationship between children’s performance on the candy task and their age, sex and socioeconomic status was estimated. The possible relationships between these sociodemographic variables and the times they touched the candy and how long it took participants to touch the candy for the first time were explored. As shown in Table 3, a negative association was detected between the times they touch the candy and the waiting time before touching it. This relationship was expected, because the longer the waiting time, it is assumed that the participants have greater abilities to postpone gratification, and therefore, they will touch the candy fewer times. In addition, the longer the waiting time, the less time to touch the treat.

TABLE 3. Spearman’s bivariate correlations between sociodemographic variables and performance on the candy task (marshmallow).

Variables	2	3	4	5
Age	0.05	0.32*	0.01	0.01
Sex	1.00	0.09	-0.15	-0.09
Socioeconomic status		1.00	-0.24*	0.35*
Times the candy is touched			1.00	-0.34*
Waiting time before touching the marshmallow				1.00

Note: * = p < .05. Source: Authors.

On the other hand, it was detected that socioeconomic status was negatively related to the number of times they played the marshmallow and positively with the waiting time before playing the marshmallow. Again, these relationships are consistent with the theory, because the higher the socioeconomic status, the greater the capacities for self-control were expected and therefore that they would touch the candy less and that they would last longer postponing contact with the candy. Finally, a significant relationship between age and socioeconomic status was detected, which is explained because the participants of the private school (higher socioeconomic status) were slightly older than the participants of the public school, as reported in the participants' section. It is important to note that age was not related to performance on the task (it did not correlate with the times they touched the treat, nor with the time it took to touch it for the first time). Therefore, the difference in age between the groups of children in private and public school is not sufficient to explain possible differences in their performance on the candy task.

Interaction between induced environment (trust or distrust) and type of school (public or private)

Since they had two induced environments and two types of school, differences were explored in the times they touched the treat, and the waiting time before touching it by the factors of the condition to which they were assigned (trust vs. distrust) and type of school. Interaction analyses calculated by means of a bifactorial median comparison analysis suggest that there are no interaction effects between the two factors explored ($F = 0.6383$, $p = 0.424$). Once the possible effects of interaction were ruled out, we proceeded to analyze the main effects of the factors induced environment and type of school.

Comparison by type of induced environment (trust or distrust)

It was explored whether there were differences in performance in the candy task, depending on whether they had been induced an environment of trust or an environment of distrust with the task of drawing, prior to the evaluation of the task of the treat. In the private school group, nine participants were induced into a trusting environment (equivalent to 53% of the private school group), while in the public school group, 24 participants were induced into a trusting environment (equivalent to 48% of the public school group). For the data to be comparable between schools, it was expected that there would be no significant differences in the proportions of children in each condition by type of school, which was demonstrated by a comparison of proportions, which indicated the absence of such differences ($\chi_{(1)} = 0.01$, $p = 0.943$).

The results indicated that, according to the induced environment, there are no differences in terms of gender with respect to the latency of touching the candy ($\chi_{(1)} = 1.24$, $p = 0.265$) or the number of times they touch it ($F = 0.09$, $p = .700$).

On the other hand, significant differences were detected according to the condition in the time they lasted before touching the candy with some part of the body ($F = 3.46, p = .003$). Participants in the distrust condition (median = 33.33) lasted less time before touching it than participants in the confidence condition (median = 86.33).

Comparison by type of school (public or private)

For this analysis, only 18 children from private school and 18 children from public school were taken into account. The reason for making this decision, as mentioned in the method section, is because it was only possible to recruit 18 participants in the private school, and since the schools were going to be contrasted, it was decided to keep the groups balanced and matched by age. Of the 36 girls and boys in this analysis, only one ate the candy completely and three did not touch it at all during the experiment. Of the latter, two children were from public school and one child was from private school.

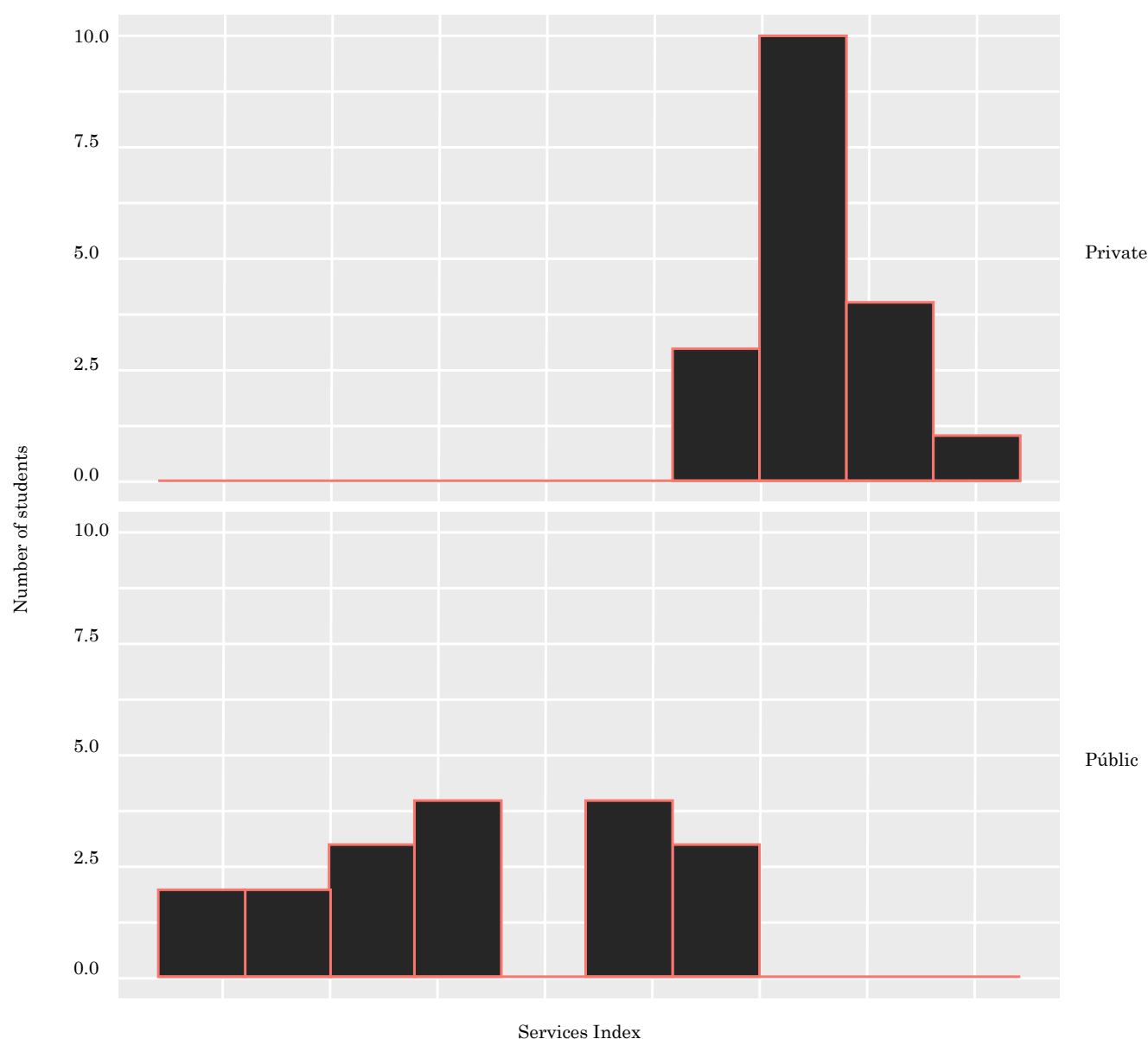
After exploring the existence of possible differences in the age of preschoolers who do or do not touch the treat, it was determined that both groups did not differ in age ($W = 57, p = .400$). We also analyzed whether there were significant differences in the proportion of children who touched it and those who did not, and no differences were detected in the proportion of those who touched it or did not touch it between the two participating schools ($\chi_{(1)} = 0.01, p = 1.00$).

Among those who did touch the candy, differences were investigated in the time they managed to wait before touching it, due to the type of school. No significant differences were detected according to the school in the time they lasted before touching the candy with any part of the body ($W = 53, p = 0.549$), or the number of times they touched it, ($W = 122.5, p = 0.850$).

Comparison by socioeconomic status

The service index was taken as an indirect indicator of the socioeconomic status of the people participating in the study. The index was constructed between 0 (access to no service consulted) and 1 (access to all services consulted). [Figure 1](#) shows the distribution of the service index by school, which suggests differences in this index across the two schools. As expected, when this indicator was evaluated by means of a statistical analysis, a significant difference was detected in the index of services by type of school ($W = 909, p < 0.001$), such that participants of the private school had significantly more services (median = .56) than participants in the public school (median = .33).

Additionally, a factor was constructed in which participants were divided by the median into two groups, low ($n = 24$) and high ($n = 43$) in socioeconomic status, measured by the service index. All participants in the private school were classified as high, as all were above 0.44, which was the median of this indicator. Regarding the public school participants, 24 were classified as belonging to the low socioeconomic

FIGURE 1. *Distribution of the Service Index by School.*

Source: Authors.

status group and 25 to the high socioeconomic status group. We explored the existence of differences between groups of socioeconomic status in the performance variables in the candy test. It was determined that the low socioeconomic status group took significantly less time to touch the treat (median = 33 seconds) compared to the high socioeconomic status group (median = 98 seconds; $W = 100$, $p = 0.03$). A marginally significant difference was also detected in the times they touched the treat. The low socioeconomic status group showed a median of nine times, while the high group a median of five times ($W = 608$, $p = 0.056$). Finally, no differences were detected in the proportion of children who touched or did not touch the candy between the two participating schools ($\chi_{(1)} = 0.01$, $p = 0.99$)¹.

¹ The same analyses were carried out only with children from private and public schools used in the contrasts of the previous section. Interestingly, although the results vary by sample size, the tendency continues to find differences in greater postponement in favor of those with higher scores on the service index scale.

DISCUSSION

This study investigated the effect of inducing an environment of trust or distrust in the performance of a group of preschoolers on the candy task to measure the ability to postpone gratification. The results showed that, overall, study participants almost never ate the treat, as only 4 of 67 participants ate it before the experimenter returned to the evaluation room at the end of the preset 12 minutes. Given the above, it was proposed to examine in more detail the performance in the task of the treat, specifically the number of times they touched it, and the time they waited before touching it. Interestingly, in the trust condition, participants waited on average longer before touching it than those in the distrust condition. Also, it was determined that the longer they managed to wait before touching the candy, the fewer times they touched it. On the other hand, no significant differences were detected by type of school in the performance of the task. Taken together, these data indicate that context variables, such as trust in experimenter, may have an effect on the postponement of gratification assessed through the candy task.

These results are consistent with previous studies. Analyses suggest that children take contextual conditions into account to decide whether or not it is worthwhile to postpone gratification and thus receive a reward of greater value (Kidd et al., 2013). That is, this evidence suggests that preschoolers are able to establish a relationship between the value of the reward and the chances of it being obtained, given the previous evidence of confidence or distrust on the part of the experimenter.

From this approach, it is assumed that children would be implicitly analyzing rationally the decision making whether or not to eat the treat, in relation to the immediate environment of the task. This is consistent with evidence from studies with preschoolers that suggest that what at first glance may seem like self-control failures may underlie an adaptive response. In this same sense, Lee and Carlson (2015) demonstrated that there are personal, situational and sociocultural circumstances that can affect the decision making of preschoolers, and that what is considered a *rational behavior*, varies depending on the context. These authors demonstrated that children can modulate their tendencies to postpone gratification by considering the benefit of such an effort in light of their context. The results of Lee and Carlson (2015) and those of the present study, question the belief that the greater rewards for postponing gratification are always more beneficial, since in certain cases there are other immediate needs that require to be satisfied (such as the need to trust others). The above, applied to the social context, could indicate that the unstable and unpredictable environments that are experienced can affect the development of the ability to postpone gratification, given the insecurity that the rewards for postponing gratification are not assured and are not always fulfilled in such environments (Kia-Keating et al., 2018; McCoy & Raver, 2014).

This study also explored probable differences in candy test performance due to school type, and since it was a private high-income school and a public school, the schools were indirectly considered to represent distinct socioeconomic statuses. It was not possible to find significant differences between schools. This finding should be interpreted with caution, since given the number of participants in the private school ($n = 18$), the contrasts per school should be made with small groups. However, when an analysis

was applied by the index constructed here of *services and facilities* in the home, it was possible to obtain differentiated results in favor of those children of higher socioeconomic status, regardless of the type of school. This last finding is consistent with other cross-sectional (Sturge-Apple et al., 2016) and longitudinal (Kia-Keating et al., 2018) studies that have reported differences by socioeconomic status, suggesting that those who come from environments with greater facilities and stability show a greater ability to self-control and postpone rewards, which is associated with better future benefits.

The results sensitive to the trust or distrust induced are not satisfactorily explained by the theory of rational decision making, since it predicts that individuals privilege those options that imply a greater expected utility, regardless of the context in which they are located. Instead, it seems that the findings of the present work would be more in tune with the theories of bounded rationality (Smith & Kosslyn, 2014), and ecological rationality (Todd & Gigerenzer, 2012). The results obtained support that people are as rational as they can be considering the level of certainty about the expected consequences. This last part on the confidence of the situation, would be consistent with the theory of ecological rationality, since it assumes that people make decisions in an adaptive way to the context in which they are located.

It is of interest, for the results presented here, to consider that the context can not only influence how decisions are made, but also change the way in which the situation is approached, since what in specific conditions is considered a better decision, would turn out not to be so under others. In this way, not postponing gratification in the face of evidence of no trust would not be an irrational act. On the contrary, it is a rational act in the face of the fact that the person with whom the child interacts is of little trust, that is, the expected utility is not socially safe and therefore it is better to take advantage of what it is there at hand.

It is particularly important to consider the implications of this work for the understanding of the decisions made by children in contexts of poverty or uncertainty. For its proper understanding, it is necessary to consider linked or bounded approaches, as well as ecological with respect to their particular context (Todd & Gigerenzer, 2012), as has been tried to do in the present study.

From this perspective, showing few skills to postpone gratification or inhibiting inadequate responses would not be associated with low rational capacity, but rather with the knowledge that environmental conditions are highly changing and there is high uncertainty about what will happen next. The chaotic conditions experienced in circumstances of instability and poverty must therefore be taken into account when designing and implementing interventions with populations living in vulnerable contexts.

CONCLUSIONS

The results of this study underscore the importance of public programs and policies that protect families from the negative effects of uncertainty and instability associated with vulnerable living conditions, and that support parents in the task of raising children to achieve optimal sociocognitive and socio-emotional development. It is necessary to support families through education on parenting issues and on how to offer children family environments that generate trust, based on the rights-based approach, attentive care of

minors and adequate levels of attention and stimulation, as these conditions could offer the stability, security, and confidence that children need to make better decisions. There are recent successful experiences in other countries that could serve as examples (see [Holland et al., 2019](#); [Lahti et al., 2019](#)). Evidence of the effects of context on children's socio-emotional and sociocognitive development should be used to promote equity and protection of the most vulnerable populations, which is particularly urgent in Latin America, which is the most unequal area in the world ([Cecchini & Martínez, 2011](#)).

The present study has limitations that must be considered when interpreting the results. The small size of the sample is an element to consider, as well as the fact that very few participants ate the marshmallow and then other variables had to be analyzed such as the times they touched the marshmallow and the time it took to play it for the first time. However, previous research has used smaller samples and has managed to capture the effects (see [Kidd et al., 2013](#)), in addition to the indicators used in this study have also been reported by other research that has implemented the candy test (see [Lamm et al., 2018](#)). This study also presents strengths that make a remarkable contribution to the field of child development. For example, there was a randomized design to assign participants to the conditions of trust versus distrust, which avoids introducing biases into the conformation of groups. Likewise, a study conducted in other cultural contexts was replicated and variables of the family and socioeconomic environment of the participant population were evaluated. Future studies should analyze the context in which children make the decisions that are recorded and evaluated in the protocols to draw conclusions about the socio-emotional and sociocognitive abilities of the participants. Future studies should not interpret which groups of children in private or public schools are homogeneous in terms of socioeconomic status, but that there are intragroup variations that should be taken contemplated.

Self-control skills are developed and enhanced in the contexts in which children are immersed. Better understanding the interaction between individual and contextual characteristics provides useful information for the design of educational and intervention programs. This objective will be achieved to the extent that future studies capture the richness of the different environments in which children develop and also to the extent that it is from their situations that their performance and evaluations are to be interpreted.

CONTRIBUTOR ROLES

Pablo Chaverri-Chaves. Conceptualización, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing-original draft, Writing review/editing.

L. Diego Conejo. Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Writing-original draft, Writing review/editing.

Sara P. León-González. Methodology, Resources, Validation, Visualization, Writing review/editing.

L. Alonso Arrieta-Ávila. Methodology, Resources, Validation, Visualization, Writing review/editing.

REFERENCES

- Beran, M. J. (2018). *Self-control in animals and people*. Academic Press.
- Brito, N. H.; Piccolo, L. R. & Noble, K. G. (2017). Associations between cortical thickness and neurocognitive skills during childhood vary by family socioeconomic factors. *Brain and Cognition*, 116, 54–62.
<https://doi.org/10.1016/j.bandc.2017.03.007>
- Chaverri, P.; Barrantes, R. & Conejo, D. (2021). El test de la golosina en contexto: ¿cómo influye el entorno social en la toma de decisiones y el autocontrol? *Ciencias Psicológicas*, 15(2), 1–11.
<https://doi.org/10.22235/cp.v15i2.2486>
- Cecchini, S. & Martínez C., R. (2011). *Protección social inclusiva en América Latina: Una mirada integral, un enfoque de derechos* (1. ed). Organización de las Naciones Unidas; Comisión Económica para América Latina y el Caribe-CEPAL.
<https://www.cepal.org/es/publicaciones/2593-proteccion-social-inclusiva-america-latina-mirada-integral-un-enfoque-derechos>
- Denison, S. & Xu, F. (2010). Twelve- to 14-month-old infants can predict single-event probability with large set sizes: Twelve- to 14-month-olds can predict single-event probability. *Developmental Science*, 13(5), 798–803.
<https://doi.org/10.1111/j.1467-7687.2009.00943.x>
- Diamond, A. (2013). Executive Functions. *Annual Review of Psychology*, 64(1), 135–168.
<https://doi.org/10.1146/annurev-psych-113011-143750>
- Doebel, S.; Michaelson, L. E. & Munakata, Y. (2019). Good Things Come to Those Who Wait: Delaying Gratification Likely Does Matter for Later Achievement (A Commentary on Watts, Duncan, & Quan, 2018). *Psychological Science*, 31(1), 97–99.
<https://doi.org/10.1177/0956797619839045>
- Farah, M. J.; Shera, D. M.; Savage, J. H.; Betancourt, L.; Giannetta, J. M.; Brodsky, N. L.; Malmud, E. K. & Hurt, H. (2006). Childhood poverty: Specific associations with neurocognitive development. *Brain Research*, 1110(1), 166–174.
<https://doi.org/10.1016/j.brainres.2006.06.072>
- Gergely, G.; Bekkering, H. & Király, I. (2002). Rational imitation in preverbal infants. *Nature*, 415(6873), 755–755.
<https://doi.org/10.1038/415755a>
- Gopnik, A.; Glymour, C.; Sobel, D. M.; Schulz, L. E.; Kushnir, T. & Danks, D. (2004). A Theory of Causal Learning in Children: Causal Maps and Bayes Nets. *Psychological Review*, 111(1), 3–32.
<https://doi.org/10.1037/0033-295X.111.1.3>
- Gweon, H. & Schulz, L. (2011). 16-Month-Olds Rationally Infer Causes of Failed Actions. *Science*, 332(6037), 1524–1524.
<https://doi.org/10.1126/science.1204493>
- Hackman, D. A. & Farah, M. J. (2009). Socioeconomic status and the developing brain. *Trends in Cognitive Sciences*, 13(2), 65–73.
<https://doi.org/10.1016/j.tics.2008.11.003>

- Holland, M. L.; Condon, E. M.; Younts, C. W. & Sadler, L. S. (2019). Birth outcomes of second children after community-based home visiting: A research protocol. *Research in Nursing & Health*, 42(2), 96–106.
<https://doi.org/10.1002/nur.21931>
- Ihaka, R. & Gentleman, R. (2022). R (version 4.1.3). [Software]. R Development Core Team.
<http://www.R-project.org/>
- Johnson, S. B.; Riis, J. L. & Noble, K. G. (2016). State of the Art Review: Poverty and the Developing Brain. *Pediatrics*, 137(4), 1–16.
<https://doi.org/10.1542/peds.2015-3075>
- Kia-Keating, M.; Nylund-Gibson, K.; Kia-Keating, B. M.; Schock, C. & Grimm, R. P. (2018). Longitudinal Patterns of Self-Regulation among Ethnic Minority Children Facing Poverty. *Journal of Child and Family Studies*, 27(2), 398–411.
<https://doi.org/10.1007/s10826-017-0883-5>
- Kidd, C.; Palmeri, H. & Aslin, R. N. (2013). Rational snacking: Young children’s decision-making on the marshmallow task is moderated by beliefs about environmental reliability. *Cognition*, 126(1), 109–114.
<https://doi.org/10.1016/j.cognition.2012.08.004>
- Lahti, M.; Evans, C. B. R.; Goodman, G.; Schmidt, M. C. & LeCroy, C. W. (2019). Parents as Teachers (PAT) home-visiting intervention: A path to improved academic outcomes, school behavior, and parenting skills. *Children and Youth Services Review*, 99, 451–460.
<https://doi.org/10.1016/j.childyouth.2019.01.022>
- Lamm, B.; Keller, H.; Teiser, J.; Gudi, H.; Yovsi, R. D.; Freitag, C.; Poloczek, S.; Fassbender, I.; Suhrke, J.; Teubert, M.; Vöhringer, I.; Knopf, M.; Schwarzer, G. & Lohaus, A. (2018). Waiting for the second treat: Developing culture-specific modes of self-regulation. *Child Development*, 89(3), e261–e277.
<https://doi.org/10.1111/cdev.12847>
- Lawson, G. M.; Hook, C. J. & Farah, M. J. (2018). A meta-analysis of the relationship between socioeconomic status and executive function performance among children. *Developmental Science*, 21(2), 1–22.
<https://doi.org/10.1111/desc.12529>
- Lee, W. S. C. & Carlson, S. M. (2015). Knowing When to Be “Rational”: Flexible Economic Decision Making and Executive Function in Preschool Children. *Child Development*, 86(5), 1434–1448.
<https://doi.org/10.1111/cdev.12401>
- Luerssen, A.; Gyurak, A.; Ayduk, O.; Wendelken, C. & Bunge, S. A. (2015). Delay of gratification in childhood linked to cortical interactions with the nucleus accumbens. *Social Cognitive and Affective Neuroscience*, 10(12), 1769–1776.
<https://doi.org/10.1093/scan/nsv068>
- Mair, P. & Wilcox, R. (2020). WRS2: A Collection of Robust Statistical Methods (version 1.1-0).
<https://CRAN.R-project.org/package=WRS2>
- McClure, S. M.; Laibson, D. I.; Loewenstein, G. & Cohen, J. D. (2004). Separate Neural Systems Value Immediate and Delayed Monetary Rewards. *Science*, 306(5695), 503–507.
<https://doi.org/10.1126/science.1100907>

- McCoy, D. C. & Raver, C. C. (2014). Household instability and self-regulation among poor children. *Journal of Children and Poverty*, 20(2), 131–152.
<https://doi.org/10.1080/10796126.2014.976185>
- Miller, E. K.; Freedman, D. J. & Wallis, J. D. (2002). The prefrontal cortex: Categories, concepts and cognition. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, 357(1424), 1123–1136.
<https://doi.org/10.1098/rstb.2002.1099>
- Mischel, W. (1974). Processes in Delay of Gratification. L. Berkowitz (Ed.), *Advances in Experimental Social Psychology* (Vol. 7, pp. 249–292). Elsevier.
[https://doi.org/10.1016/S0065-2601\(08\)60039-8](https://doi.org/10.1016/S0065-2601(08)60039-8)
- Mischel, W.; Shoda, Y. & Peake, P. K. (1988). The nature of adolescent competencies predicted by preschool delay of gratification. *Journal of Personality and Social Psychology*, 54(4), 687–696.
<https://doi.org/10.1037/0022-3514.54.4.687>
- Noble, K. G.; Norman, M. F. & Farah, M. J. (2005). Neurocognitive correlates of socioeconomic status in kindergarten children. *Developmental Science*, 8(1), 74–87.
<https://doi.org/10.1111/j.1467-7687.2005.00394.x>
- Noble, K. G.; Houston, S. M.; Brito, N. H.; Bartsch, H.; Kan, E.; Kuperman, J. M.; Akshoomoff, N.; Amaral, D. G.; Bloss, C. S.; Libiger, O.; Schork, N. J.; Murray, S. S.; Casey, B. J.; Chang, L.; Ernst, T. M.; Frazier, J. A.; Gruen, J. R.; Kennedy, D. N.; Van Zijl, P.; Mostofsky, E.; Kaufmann, W. E.; Kenet, T.; Dale, A. M.; Jernigan T. L. & Sowell, E. R. (2015). Family income, parental education and brain structure in children and adolescents. *Nature Neuroscience*, 18(5), 773–778.
<https://doi.org/10.1038/nn.3983>
- Piantadosi, S. T.; Tenenbaum, J. B. & Goodman, N. D. (2012). Bootstrapping in a language of thought: A formal model of numerical concept learning. *Cognition*, 123(2), 199–217.
<https://doi.org/10.1016/j.cognition.2011.11.005>
- Sharma, S.; Arain, M.; Rais, A.; Nel, W.; Sandhu, R.; Haque, M. & Johal, L. (2013). Maturation of the adolescent brain. *Neuropsychiatric Disease and Treatment*, 449–461.
<https://doi.org/10.2147/NDT.S39776>
- Sheehy-Skeffington J. (2020). The effects of low socioeconomic status on decision-making processes. *Current Opinion in Psychology*, 33, 183–188.
<https://doi.org/10.1016/j.copsyc.2019.07.043>
- Shoda, Y.; Mischel, W. & Peake, P. K. (1990). Predicting adolescent cognitive and self-regulatory competencies from preschool delay of gratification: Identifying diagnostic conditions. *Developmental Psychology*, 26(6), 978–986.
<https://doi.org/10.1037/0012-1649.26.6.978>
- Simon, H. A. (1955). A Behavioral Model of Rational Choice. *The Quarterly Journal of Economics*, 69(1), 99–118.
<https://doi.org/10.2307/1884852>
- Smith, E. E. & Kosslyn, S. M. (2014). *Cognitive psychology: Mind and brain* (First edition, Pearson new international edition). Pearson.

- Sturge-Apple, M. L.; Suor, J. H.; Davies, P. T.; Cicchetti, D.; Skibo, M. A. & Rogosch, F. A. (2016). Vagal Tone and Children's Delay of Gratification: Differential Sensitivity in Resource-Poor and Resource-Rich Environments. *Psychological Science*, 27(6), 885–893. <https://doi.org/10.1177/0956797616640269>
- Takeuchi, H.; Taki, Y.; Sassa, Y.; Hashizume, H.; Sekiguchi, A.; Fukushima, A. & Kawashima, R. (2013). Brain structures associated with executive functions during everyday events in a non-clinical sample. *Brain Structure and Function*, 218(4), 1017–1032. <https://doi.org/10.1007/s00429-012-0444-z>
- Teglas, E.; Vul, E.; Girotto, V.; Gonzalez, M.; Tenenbaum, J. B. & Bonatti, L. L. (2011). Pure Reasoning in 12-Month-Old Infants as Probabilistic Inference. *Science*, 332(6033), 1054–1059. <https://doi.org/10.1126/science.1196404>
- Todd, P. M. & Gigerenzer, G. (2012). *Ecological Rationality Intelligence in the World*. Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780195315448.001.0001>
- Tomasello, M. (2021). *Becoming human: A theory of ontogeny*. Belknap Press of Harvard University.
- Watts, T. W.; Duncan, G. J. & Quan, H. (2018). Revisiting the Marshmallow Test: A Conceptual Replication Investigating Links Between Early Delay of Gratification and Later Outcomes. *Psychological Science*, 29(7), 1159–1177. <https://doi.org/10.1177/0956797618761661>
- Xu, F.; Dewar, K. & Perfors, A. (2009). Induction, overhypotheses, and the shape bias. B. M. Hood & L. R. Santos (Eds.), *The Origins of Object Knowledge* (pp. 263–284). Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780199216895.003.0011>
- Xu, F. & Tenenbaum, J. B. (2007). Sensitivity to sampling in Bayesian word learning. *Developmental Science*, 10(3), 288–297. <https://doi.org/10.1111/j.1467-7687.2007.00590.x>