Using behavioral insights in early childhood interventions: The effects of Crianza Positiva text and voice messaging program on parenting behavior and competences*

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Abstract

We study whether a text and audio messaging program delivered after a parenting workshop, is effective to increase parental investment and reinforce parental commitment. The messaging program is one of the components of "Crianza Positiva", an intervention for parents of children aged 0-2 designed to promote good parenting practices. Treated families received text and audio messages three times a week for 24 weeks. The messages were aimed at helping parents reorient their attention towards positive parenting practices, simplify complex parental tasks, establish new parenting habits, and reinforce positive identities. We evaluated the intervention using a randomized controlled trial (RCT) of the program in 24 Child and Family Care Centers (CAIF) in Uruguay. We found that the messaging intervention increased the frequency of parental investment and several indicators of investment quality, including parental outreach for social support and parents' reflective capacity. The effects on the frequency of parental investment range around 0.24 standard deviations and the effects on investment quality range around 0.25 standard deviations.

JEL Codes: I28, D91, I38, D80

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1. Introduction

The importance of a nurturing environment for child development has been well established in the psychology, neuroscience, and economics literature. Research has also shown that this environment can be substantially enhanced by programs that expand and increase the quality of pre-school care, and by interventions that foster parental competences. While the policy agendas in many countries have increased their focus on institutional early childcare, parenting programs are yet scarce, targeted at specific populations, and in many cases short-lived and too costly to apply. The challenge is to design cost-effective parenting interventions that can be scaled up to broad fractions of the population and are able to sustain parental behaviors over time.

In this paper, we randomly evaluate a text and audio messaging program aimed at reinforcing and sustaining positive parenting competences over time. We assess the effect of the program on the quantity and the quality of parental investment. The intervention is based on behavioral economics insights, in addition to early child development science. Behavioral economics postulates that despite parents' good intentions, behavioral biases such as time inconsistency, the over-valuation of tangible costs over intangible benefits, cognitive fatigue and inattention, and negative identity, threaten the caregiver-child attachment, prevent parents from investing optimally, and affect the development of the child. By focusing on ways to overcome behavioral biases, behavioral economic interventions offer a set of promising tools to improve the environments in which children grow and develop.

The messaging program that we evaluate is one of the components of "Crianza Positiva", an intervention for parents of children aged 0-2 which was designed to promote good parenting practices. The program has a duration of 24 weeks and messages are delivered right after families complete a workshop of eight weeks at early childhood centers.[1] The messages, delivered three times a week, seek to help parents overcome behavioral biases by refocusing their attention towards their parenting goals and the benefits of good parenting practices, by decomposing complex tasks into simpler ones, and by reinforcing positive parental identities. We randomly assigned families to a treatment and a control group. Families in both groups participated in the 8-week workshop, but only those in the treatment group received text and audio messages after completing the workshop. Our

[1] The design of the workshop does not explicitly focus on overcoming behavioral barriers in parenting.

analysis assesses the effects of the messaging intervention a year after parents initiate the workshop.

The intervention makes use of mobile messaging, a low-cost tool that can help foster parental engagement and contribute to habit formation. Messages can provide continuous encouragement, support and reinforcement to parents over extended periods of time (York, Loeb and Doss, 2018). In addition to their low cost, which makes interventions that rely on them easy to scale-up, the use of mobiles is widespread across large segments of the population which makes the outreach of such programs nearly universal.[2]

We find that the messaging component of Crianza Positiva increased both the quantity of parental investment, as measured by the frequency of parental involvement with the child, and the quality of parental investment, given by measures of parental outreach for social support and parental reflective capacity. The effects on the frequency of parental investment range around 0.24 standard deviations and the effects on investment quality range around 0.25 standard deviations.

Besides contributing to the parenting and child development literature, our intervention sheds light on the impacts of messaging in several ways. First, unlike other messaging programs focused in specific areas, such as reading and language, our program covers a comprehensive range of parenting areas, including sensitive observation and response, the importance of a safe and nurturing environment, the importance of speaking and reading to the child, the key role of free play, and the value of self-caring and of having a reflective parenting attitude. Second, while most existing programs focus on parents with children that are preschoolers or older, our program targets at parents of children aged 0-2. Third, we evaluate the intervention using a large set of outcomes including frequency of parental engagement with the child in different activities, positive parenting competences, parental stress and sense of competence, and children developmental outcomes. Most of these outcomes are measured using validated instruments.

The paper is structured as follows. In section 2, we provide a review of background literature, including the literature on socioeconomic gaps in early childhood investment and its relationship to child development, the recent findings of behavioral economics on

[2] Text and audio messages are a technological resource of high applicability in Uruguay where the use of cell phones is massive (the market penetration of cellphones, as measured by the quantity of unique connections over total population, is above 90% (D'almeida and Margot, 2018)).

parental decision making, and the use of technology in behavioral economics interventions in early childhood. Section 3 provides a description of the program Crianza Positiva and of its text and audio messaging component. In section 4 we present the impact evaluation methodology: we formulate the hypotheses to be tested, describe the experimental design and evaluation instruments, assess compliance with randomization, attrition and balance, and present descriptive statistics of the data. Results are presented in section 5. We discuss and conclude in section 6.

2. Background

2.1 Socioeconomic gaps in early childhood and the importance of parental investments for development

An extensive literature documents differences in parenting practices during early childhood by socioeconomic level. First, vulnerable families spend less time with their children (Guryan, Hurst and Kearney, 2008; Berlinski and Schady, 2015) and show them fewer expressions of affection at an early age. Bradley et al. (2001) show that the probability that a child is kissed or hugged by his mother in the first two years of life is larger for children of non-poor families. In addition, children from poor families are more likely to receive physical punishment. Second, vulnerable families are less likely to stimulate their children's cognitive abilities. Berlinski and Schady (2015) find that in Latin America, mothers who have completed secondary school have a higher probability (of around 22-23 percentage points) of reading to their children than mothers who did not complete primary education. Bradley et al. (2001) establish that children belonging to non-poor families have more access to children's books and show a larger probability of having someone read to them during their first two years of life in comparison to children from vulnerable families. Hart and Risley (1995) find that at age 4, children from vulnerable families have heard about 30 million fewer words than children from higher socioeconomic contexts.

The differences in parenting practices by socioeconomic status are important since family environments in early life largely predict skill development. Heckman and co-authors claim that parental investment impacts both the production of cognitive and non-cognitive skills of children; two types of skills that are critical for social and economic success (see, for example, Cunha et al., 2006). Children who grow up in a sensitive and stimulating parental environment tend to have a greater motor, social, emotional, and reading and

numeracy skills development (Anderson, 2006; Bradley et al., 2001; Melhuish et al., 2008). On the contrary, children who grow up in non-stimulating environments face a disadvantage from an early stage. For example, Waldfogel and Washbrook (2011) document socioeconomic differences in a literacy test among preschool-aged children in US and UK; Schady et al. (2015) find differences in receptive language among children under 5 years of age in several Latin American countries, and Rubio-Codina et al. (2015) find socioeconomic differences in language development among children under the age of 4 in Colombia. In Uruguay, the existence of ability gaps in early childhood by income levels was already documented three decades ago (Terra, 1989) and continues to be a critical problem (Uruguayan Nutrition, Child Development and Health Survey, 2014; Lopez-Boo et al 2019).

The evidence shows that socioeconomic gaps in ability generated in the early years persist throughout the educational cycle. Conventional indicators of quality of the schooling center, such as the student-teacher ratio or teachers' salaries, cannot eliminate the gaps after the first school years (Carneiro and Heckman, 2003; Cunha and Heckman, 2008; Schady et al 2015). For Uruguay, Tansini (2008) and Llambí, Perera and Mesina (2009) highlight the low incidence of the formal education system in reducing inequities in achievement determined during the first years.

Investments in early childhood are not only critical determinants of development in the short run, but also affect outcomes in the medium and long run. A systematic review by Almond and Currie (2011) shows that the characteristics of the child and his family when the child enters school have as much predictive power as the years of education in explaining employment and wage outcomes. In addition, parental investments lead to an intergenerational transmission of inequality (Holmlund, Lindahl and Plug, 2011).

Considering the evidence described above, the key question is why families of low socioeconomic backgrounds show, on average, lower parental investment levels. Yeung, Linver, and Brooks–Gunn (2002) highlight two reasons: (i) lower income available to purchase materials, experiences and services that contribute to the development of children's human capital, and (ii) different family processes. Vulnerable families have fewer resources to invest in education, health, food, housing, child stimulation material, and toys, among others. In addition, poverty can have an impact on the emotional state of the adults in the family and, hence, on their ability to interact with children. Heckman

(2006) argues that the lack of early stimulation is more important than the lack of economic resources in determining the developmental gaps in early childhood.

Cuhna (2015) develops a model that sheds light on the determinants of the heterogeneity in parenting behaviors between socioeconomic backgrounds. The author postulates that parents act with "subjective rationality" to choose parenting styles and investments in children. Parents are rational agents that want to maximize their utility, but lack information on the process of human capital and, therefore, must assess their constraints subjectively. A child's human capital is determined by the interaction between investments (e.g. number of books at home) and institutions (e.g. quality of school) and a parenting style is a way to combine investments and institutions. Parents can adopt either a "concerted cultivation" (active engagement with institutions for the benefit of the child's human capital) or a "natural growth" (passive role) parenting style. Adopting the "concerted cultivation" style has a cost, while the "natural growth" style is costless. As parents from lower socioeconomic backgrounds are more income constrained, the model predicts that they are more likely to adopt a "natural growth" parenting style.[3] Moreover, the model predicts that the choice of the parenting style is determined by the expectation that parents have of the benefits of one style versus the other. The larger the differences in the expected benefits between "concerted cultivation" and "natural growth", the more likely is that parents will adopt the former parenting style.

Several policies have been implemented to counteract the effects of poverty on child development, including cash transfer programs, the expansion of early childhood and preschool centers, and intervention programs with parents. The evidence on the effectiveness of family interventions is vast (Nores and Barnett 2010). In developed countries, these programs have shown positive effects on the development of children of around 0.3 to 0.5 standard deviations, as well as improvements in parental skills (Bakermans-Kranenburg, Van Ijzendoorn and Jufferet, 2003; Blok et al., 2005; Al et al., 2014). Also in developing countries, parental interventions seem to be viable and effective mechanisms to improve the parent-child relationship, the parents' knowledge of the child's development and the child's mental and motor development (Nores and Barnet, 2010; Baker-Heninngham and López-Boo, 2010; Knerr, Gardner and Cluver, 2013).

[3] Context also plays a role in determining which parents adopt which parenting style. Doepke and Zilibotti (2019) show that in European countries many high educated parents adopt a natural growth parenting style.

The most common type of family intervention in vulnerable households are home visits. Home visits seek to improve parenting practices through the identification and assessment of existing resources in the household and their link with community resources. There is evidence that home visits generate positive changes in parenting skills (Wilson, 2010), as well as improvements in children's cognitive abilities (Walker et al., 2015; Attanasio et al., 2014), socio-emotional abilities, and behavior (Pickering and Sanders, 2014). In Latin America, several of these programs have proven highly effective in reducing gaps in child development. One of the most well-known home-visiting programs has been implemented in Jamaica since between 1986 and 1989 (Grantham-McGregor et al., 1991; Gertler et al., 2014; Walker et al., 2011). This program was able to substantially improve children's cognitive development in the short run (0.8 standard deviations in 24 months) and influence the trajectory of cognitive skills, education, wages, and mental health up to 20 years after the implementation of the program. In Colombia, a similar program showed an increase in cognitive and receptive language development of 0.26 and 0.22 standard deviations respectively (Attanasio et al., 2014, 2015). A comparable magnitude of impact has been found in two other Latin-American home visiting programs at scale (Cuna Mas in Peru and Amor in Nicaragua). In Ecuador, Rosero and Oosterbeek (2011) find that home visits improved children's language by 0.4 standard deviations, memory performance by 0.6 standard deviations and fine motor skills by 0.9 standard deviations. In Uruguay, Marroig et al. (2017) find that a home visiting program, "Uruguay Crece Contigo", generated improvements in gross motor skills and had some improvements on communication skills and socio-emotional health, that varied according to the age range of the child.

One limitation of home visiting programs is their high cost of scaling up. These programs require an intensive use of facilitators of a good educational level, as well as high levels of training and supervision to ensure adequate execution of the intervention protocols (Leer et al., 2016). The intensity of these programs makes it difficult to reach broader sectors of the population that can also benefit from education in parenting practices. A second limitation is that the effects of home visiting programs usually fade out after the intervention. Indeed, the literature has found that sustaining effects achieved from early childhood interventions is not trivial and that there are many cases in which early impacts fade out (see overview by Bailey et al. 2017).

The great challenges in the design of public policies that aim to enhance parenting skills include generating interventions that are sufficiently short and of low cost to be scaled up to a large fraction of the population and designing programs that can boost parenting practices in a sustainable way. Behavioral economics offers some promising tools to contribute in this regard.

2.2 The recent findings of behavioral economics on parental decision making

To a large extent, parental interventions have been designed assuming that individuals act rationally (Gennetian et al., 2017). However, many parental decisions can be difficult to analyze and understand through the lens of the rational model. Recent findings at the intersection of psychology and economics -behavioral economics- are changing the way we understand how individuals make decisions and behave, offering new opportunities for the design of public policies (Rabin 1998; Thaler and Sunstein 2008; Congdon, Kling, and Mullainathan 2011).

Behavioral economics postulates that there are a series of behavioral biases that lead people to make decisions that are not standard and establishes that some of these behaviors can be modified. In the context of parenthood, the behavioral economics approach assumes that, despite the good intentions of parents, the pace of life, the economic insecurities and social isolation create behavioral barriers that threaten the caregiver-child bond and prevent an optimal development of the child. The limited attention of parents, the preference for the present, the over-valuation of tangible costs over intangible benefits, or the bias of the status quo, are some of the behavioral biases that could change our understanding of the challenges that policymakers must take into account when designing programs for parents.

Behavioral economics has grown rapidly due to its ability to explain irrational results as well as its implications for public policies. Public policies that incorporate the principles of behavioral economics have the potential to be highly cost-effective once they consider how small changes in the way information is transmitted, or in the way in which decision options are presented, change individual behavior. In recent years, the insights from behavioral economics have been used to design mechanisms that increase the saliency of certain behaviors. These mechanisms have been effective in changing behaviors in the areas of finance, nutrition and energy conservation, among others. However, only a few studies have demonstrated the effectiveness of behavioral economics tools in educational

and parenting programs (Lavecchia, Liu and Oreopoulos, 2016; Koch, Nafziger and Nielsen, 2015). Lavecchia, Liu and Oreopoulos (2016) describe the behavioral biases and the literature associated with behavioral economics interventions in the area of education and the tools that have been proved effective to overcome those biases. The main biases identified are detailed in Appendix A.

2.3 The use of technology in behavioral economics interventions in early childhood

In education, recent evidence on the effectiveness of text-message based programs has shown promising results. Escueta et al. (2017) provide a review of the literature on behavioral economics interventions that use technology to support education decisions. The authors review five studies that experimentally evaluate programs that promote parental involvement in parents of preschool-aged children. They find positive effects in all the studies reviewed, which suggests that the use of technology holds great promise for early childhood interventions. The studies reviewed by Escueta et al. (2017) are described below.

York, Loeb and Doss (2018) analyze the impact of a program that promotes reading to preschoolers and that was implemented in San Francisco. The program, named "Ready for K!", consists of three weekly text messages with tips and motivational phrases for caregivers that aim to promote involvement in literacy activities with the children. The program had a favorable impact on parental involvement as measured by time spent on literacy activities, reading to the child, and trips to museums or libraries. In turn, the program also had a favorable impact on child development of around 0.21 and 0.34 standard deviations in the PALS literacy test. Doss et al. (2017) implemented the "Ready for K!" program in families with slightly older children and extended the program by adding a treatment arm where the messages were personalized and differentiated according to the child's level of development. The authors find no impact of the original program "Ready for K!", although they find that personalized messages increase the likelihood that parents read to their children by 50%.

In the same line of previous studies, Meuwissen et al. (2017) study the effects of the Text2Learn program: a 12-week text message program for parents of low socioeconomic status in Minnesota, United States. The authors find that the program was successful in promoting the involvement of adults in the literary activities of their preschoolers.

Mayer et al. (2018) analyze the effect of a 6-week family intervention in which families were given a tablet with children's books. The treatment group received three weekly messages with: (i) reminders for the caregiver to read to the child, (ii) a tool to set weekly reading goals and give a feedback on the caregiver's progress, and (iii) messages of social gratification in the form of congratulations when the weekly objective was fulfilled. The authors find that parents in the treatment group used the tablets more than those in the control group and read more than twice as many books to their children. Hurwitz et al. (2015) study the impact of an intervention that consisted of daily messages to motivate parents to become more involved in didactic activities with their children and find positive impacts of this treatment.

The effectiveness of text-message based programs is highly dependent on their design. Cortes et al. (2018) find that parenting programs based on text messages can provide excessive or insufficient information. A three-text-per-week approach that includes information, actionable advice and encouragement is more effective to improve parenting practices than approaches that include only one text per week or that include five. Fricke et al. (2018) analyze opt out of text messaging programs that aim to improve school readiness, and find that a high quantity of texts and more complex texts lead recipients to opt out more. Moreover, the authors find that programs that provide context and encouragement have lower opt out. In the context of a field experiment with charity, Damgaard and Gravert (2018) find that reminders via text messages and emails increase the intended behavior but also the avoidance behavior in terms of un-subscription from the mailing list.

3 Crianza Positiva and the Text and Audio Messaging Intervention

Crianza Positiva is a brief, preventive, highly protocolized and evidence-based intervention aimed at improving parenting practices and reinforcing children development. The program was originally designed to be implemented at “Children and Family Care Centers” (CAIF) of Uruguay. CAIF centers are publicly-funded, privately-managed [4] early childhood centers, whose purpose is "to guarantee the protection and

[4] CAIF centers arise from an inter-sectoral alliance between Civil Society Organizations, the Uruguayan State, and Municipalities.

promote the rights of children since their conception until the age of 3, prioritizing the access of those who come from families in poverty and/or social vulnerability".[5]

Crianza Positiva is a multilevel intervention, with varying treatment intensities according to the needs of each family. In the first level, families participate in a workshop of eight weekly sessions[6], organized around four parental competences: caring, stimulating, safety-enhancing, and reflective.[7] The curriculum is based on the "Positive Parenting Scale Manual", developed by Gómez and Muñoz (2014), the "Nobody is Perfect" program in Canada[8], and the Parents First program (Goyette-Ewing and Slade, 2003), replicated in Finland under the name of Families First. The second level consists of a series of text and audio messages sent to workshop participants right after completing the workshop. This intervention seeks to help families incorporate the skills introduced in the workshop to their daily routines and nudge parents towards sustaining good parenting habits over time. This is the component that we evaluate in this paper. At the third level, four parental counseling home visits are offered only to the most vulnerable families. The visits seek to deepen the development of the competences discussed in the workshop, accompanying the family in the management of sensitive observation, sensitive interpretation, and sensitive response to the child.

3.1 The Crianza Positiva Text and Audio Messages Component

The messaging component of Crianza Positiva consists of 72 messages sent to families three times a week over a period of 24 weeks. We chose to send three messages per week

[5] http://www.plancaif.org.uy/plan-caif/que-es-plan-caif

[6] The workshop was tailored to fit within Experiencias Oportunas, a weekly space at CAIF centers oriented to children aged 0 to 2 and their caregivers.

[7] Theoretically, Crianza Positiva is based on the principle of positive parenting. Positive parenting encourages the creation of solid bonds and structured environments at the family level, promotes the stimulation, support and recognition of the value of children, and trains parents to be agents of change, competent, and able to positively influence their lives and the lives of their children. It builds on three theoretical strands: the attachment theory, the theory of the mind and the ecological approach to parenthood. In relation to the attachment theory (Main, 1991, Fonagy, 1991, Slade, 1999), the positive parenting principle seeks to encourage caregivers to be more skilled in the performance of their functions as facilitators of exploration and contributors of comfort and regulation of the child. Children who, during their first year of life, develop an insecurely attached relationship with their primary caregiver are at risk of deficits in socioemotional and cognitive development (Zeanah, 2000). Following Baron Cohen's Theory of Mind (1995), the positive parenting principle seeks to strengthen the caregiver-child bond and good parenting practices through the stimulation of the reflective function of parents about the child's internal states and their role as caregivers. From an ecological perspective, positive parenting aims to help adults identify and rely on the ecological resources they have at their disposal (Bronfrenbrenner 1994). It also marks the commitment of community agents, who contribute from their role to the healthy development of parenthood.

[8] The program was adapted by the Chilean government in the "Chile Crece Contigo" program.

following the finding in Cortes et al. (2018) that the three-message-per-week approach is more effective than other approaches with fewer or more messages per week. The messages are sent right after families complete the workshop. Treated families receive the same messages both in text (via SMS) and in audio format (via WhatsApp).[9][10] Audio messages have exactly the same content as text messages, except for the fact that the latter are personalized with the name and the gender of the child, whereas audio messages refer to "your baby". Messages are sent the same days of the week and at the same time to all members of the family willing to receive them. We chose to send messages on Mondays, Tuesdays and Fridays, always at 6pm, a time in which most parents are more likely to be back home or to pay attention to parenting information.

The 24 weeks of intervention are divided into 12 modules of two weeks. Each module refers to a different topic that was discussed in the positive parenting workshop. The topics included are: sensitive observation, affection and good treatment, protection at home, routines, speaking to the child, reading to the child, playing with the child, parental self-care, parental involvement, and the reflective capacity of parents. The contents of the messages are rooted on the theory of attachment (Main, 1991; Fonagy, 1991; Slade, 1999), the theory of the mind (Baron Cohen 1995), and an ecological perspective towards childrearing (Bronfrenbrenner, 1994). Table 1 depicts the order of topics in the program by week of intervention.

[9] Treated families received an opening message before the intervention and a closing message after the intervention.
[10] Four of the audio messages were sent in a video format to females.

Table 1: Topics of messages by week of intervention and associated parental competence

Week	Topic	Parental competence
	Opening message	
1-2	Sensitive observation	Caring
3-4	Expressions of affection/sensitive approach	Caring
5-6	Safety and protection at home	Safety-enhancing
7-8	The importance of routines	Safety-enhancing
9-10	Self-caring for caring	Safety-enhancing
11-12	Language: Speaking to the child	Stimulating
13-14	Language: Reading to the child	Stimulating
15-16	Free play	Stimulating
17-18	Relieving tensions	Reflective/Self-care
19-20	Learning how to calm oneself	Reflective/Self-care
21-22	Parental involvement	All competences
23-24	Reflection about parenting	Reflective
	Closing message	

The message structure within each biweekly module was designed to address behavioral biases associated with poor parenting. In order to explore behavioral barriers that interfere with the parent-child attachment quality, we conducted a linear regression analysis with the purpose of studying how parental involvement relates to time preferences, parental stress, and parental sense of competence. We find that parental involvement in stimulating activities with the child correlates negatively with the parents' time discount rate, suggesting that present-oriented caregivers place a higher weight on the current costs of parental investment relative to future benefits.[11] Parental investment in stimulating activities decreases also with parental stress, and the same happens with parental involvement in physical games. The literature shows that inattention and cognitive fatigue are potential mediators of the relation between stress and parental investment (Cookley et al 2012). Finally, parental involvement in physical games and social activities correlates positively with parents' sense of competence, suggesting that parental identity and self-efficacy play a role at some level on parental investment decisions.

[11] A negative association between parental investment and the discount rate is a necessary but not sufficient condition for time inconsistency.

Based on behavioral economics theory and on the exploration of its predictions using the baseline data (see Table A1 in Appendix B), we built messages around the following theory of change:

(i) reminding parents about the benefits of engaging in positive parenting practices will mitigate the effects of present bias, time inconsistency and status quo bias on parental investment, by making the benefits of the decision more salient

(ii) providing parents with suggestions of simple and concrete positive parenting activities will help address inattention and decision fatigue by decomposing complex tasks into simpler ones

(iii) providing parents with self-relaxation techniques will help address inattention and decision fatigue by improving parental self-control and emotional status

(iv) telling parents that they have the resources their child needs, that they are not alone in facing difficulties and making mistakes when it comes to raising children, and that it is good to rely on others will help them overcome negative identities and strengthen parental self-efficacy.

The structure of the bi-weekly modules followed the following pattern (see Table 2 for examples of the different types of messages):

- Week 1 - Monday: Information about the importance of a certain parenting competence.
- Week 1 - Tuesday: Suggestion of a specific activity to be undertaken with the child related to that competence.
- Week 1 - Friday: Invitation to parents to reflect on their performance during the week and their personal feelings regarding the task proposed, and reinforcement of a positive parental identity.
- Week 2 - Monday: Reinforcement of self-esteem and parental empowerment.
- Week 2 - Tuesday: Suggestion of a new task for the caregiver and the baby related to the module's topic.
- Week 2 - Friday: Reinforcement of the importance of the parental competence discussed in the module and motivation to continue practicing in the future.

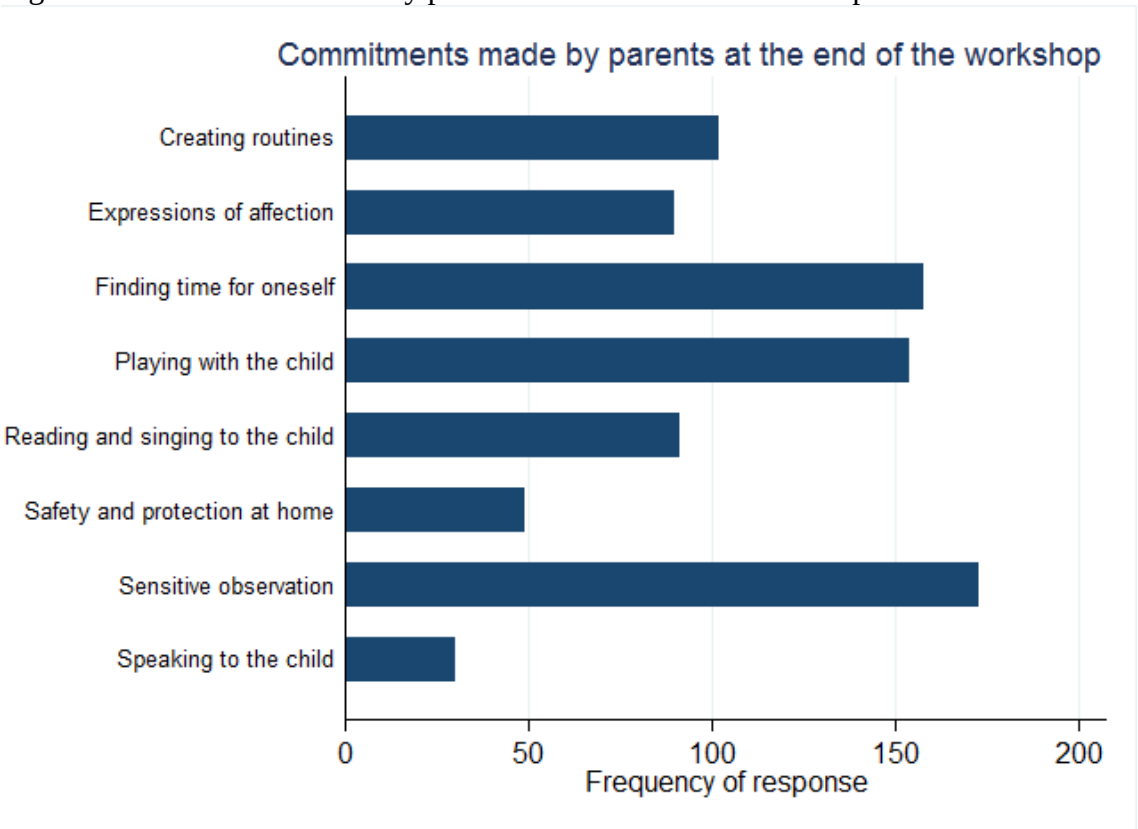
Table 2: Examples of messages by type of behavioral bias

Behavioral bias	Type of message to address this barrier	Example
Present bias and time inconsistency	Messages that underscore the benefits of parenting practices Reminders about the importance of parenting practices Reminders of personal parenting commitments	*Children's brains are like sponges, they absorb everything: the sounds, the pitches of voices, the language they listen to. The more words your child listens to at this stage, the more [she] will develop [her] language. It is therefore very important that you speak to [child's name], this will impact heavily on [her] ability to learn.*
Complexity of parental role, inattention, decision fatigue	Messages that decompose complex parental tasks into simple ones. Messages that relieve stress through breathing and relaxation techniques	*Talk to [child's name] while you are washing [him] or changing [his] diapers. Look [him] in the eye when you speak to [him]. When [child's name] tries to respond, don't interrupt [him] and do not get distracted. [Child's name] needs to know you are listening.*
Negative identity	Messages that strengthen parental self-efficacy and empowerment Messages that show that feeling stressed out or underconfident is normal, and that parents do overcome it	*There is no one that wants as much for [child's name] as you do. Think about one or two moments in the past days in which you felt you really contributed towards [her] wellbeing. Trust yourself and continue seeking more of these moments during the week.*
Status quo bias	Messages suggesting concrete and simple activities Messages reminding benefits of parental involvement	*The more you speak to [child's name], the better will [his] language develop and the more [he] will learn. Today and in the following days, remember and repeat this thought: "I take advantage of all the moments with [child's name] to speak to [him]."*

The messages included a few other components that aimed to strengthen personal commitment and to provide parents with other sources of information and ideas. First, on the last day of the Crianza Positiva workshop, participants were asked to choose three behaviors that they could commit to practice in the following months and that they would like to be reminded of in the future. The options involved behaviors related to the topics covered in the messages. Figure 1 shows the frequency of the selected options. We used these selections to send each treated family a reminder of their commitments. These

reminders were sent the last day of the bi-weekly module that dealt with the corresponding topic.

Figure 1: Commitments made by parents at the end of the workshop



In addition, treated families were provided via SMS with a username and password to access "Radio Butiá", a Uruguayan web server that hosts Latin American songs and stories online. We also directed families via SMS to access a virtual platform in Facebook to find additional information about specific topics that were mentioned in the messages. We updated this information every week.

4 Impact Evaluation: Methodology

4.1 Hypotheses

Based on our theory of change, we formulated the following hypotheses:

1) We expect that messages increase the quantity and quality of parental investment. Quantity is measured by the time and material resources parents devote to children, while quality is given by attributes of this investment, such as the extent of parent-child attachment, the degree of stimulation and

environmental safety, parents' ability to seek social support, and parental reflective capacity.

2) Messages could improve the quantity and quality of parental investment through the following mechanisms:
   a. Messages could decrease time inconsistency bias by making more salient and tangible the benefits of positive parenting, through activation and recall of information acquired at the workshop. If parents with higher time inconsistency show also higher discount rates, we expect parents with higher discount rates to benefit more from the messaging program.
   b. Messages could decrease cognitive fatigue by deconstructing complex behavior into suggested simpler actions, and by offering self-care tools to parents. If parents with higher levels of stress have more cognitive fatigue, we expect those with more stress at baseline to benefit more from the intervention. The intervention could also affect directly (i.e. decrease) the levels of stress perceived by parents.
   c. Messages could decrease negative identities by helping parents increase self-confidence in their capacity to raise children through messages of encouragement, and by helping them identify resources in their communities. We expect the intervention to increase parental self-confidence, and to have a larger effect on families with lower self-confidence at baseline.

      Messages could also increase the information available to parents. We do not expect this to be a significant channel, though, considering that parents were already exposed to an 8-week workshop transmitting all the concepts in the messages.

4.2 Experimental Design

a) Sample and randomization

The Crianza Positiva workshop took place between September and November 2017 at 24 CAIF early childhood centers. After workshop completion, we conducted an RCT to assess the effects of the Crianza Positiva text and audio messages component. 529 families from the 24 CAIF centers were randomized to treatment in two steps (Figure 2 illustrates the randomization process). First, we stratified early childhood centers by

average maternal education[12] and within each strata randomly allocated 60% of centers to a treatment arm and 40% of centers to a control arm. As a result of the first step of the randomization, 14 early childhood centers (with 296 families having completed the Crianza Positiva workshop) were assigned to treatment and 10 centers were assigned to a pure control (none of the 233 families in these centers were treated). Secondly, within each center in the treatment arm, we randomized families into receiving or not receiving messages. In centers that were treated, 80% of families were selected to receive messages. From the second stage of the randomization, 237 families were assigned to receive messages and 59 were assigned to control. Following Baird et al. (2018), the second level of randomization was included in order to assess the degree of spillovers of the messaging intervention.[13]

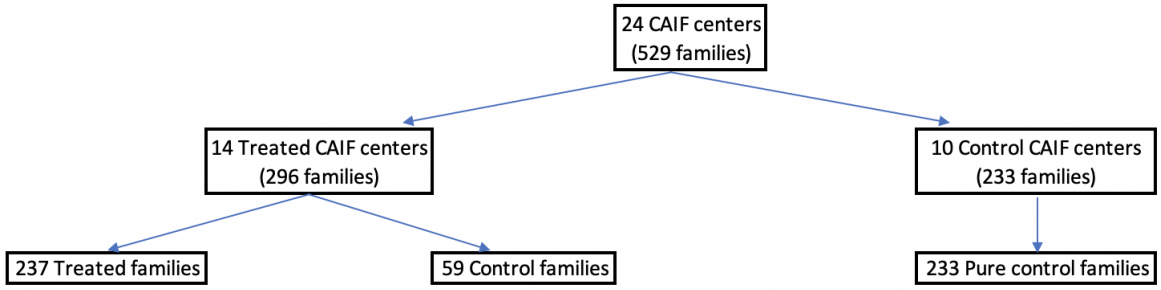


Figure 2 - Randomization

b) Timeline

The messaging intervention took place between January 8, 2018 and June 27, 2018. We selected this timeline to reduce potential spillovers from treated families within treated centers to control families within treated centers. The school year in Uruguay runs from March to December, so one third of the program was delivered during summer holidays when it is less likely that families have contact with each other. In March 2018, both children of families in the treatment group and children from families in the control group started their regular encounters at the CAIF centers.

c) Implementation

[12] As a proxy for socioeconomic level we used mother's average years of completed education of children that attended the early childhood centers. We constructed two strata according to whether the average of years of education was equal to or above 9 years.

[13] The proportion of centers assigned to pure control and the saturation of the treatment within treatment centers was based were selected in order to maximize power. Power calculations were performed using the Matlab code provided in the Supplemental Appendix of Baird et al. (2018).

In a survey conducted prior to the launch of the messaging intervention, we asked families to provide us with at least two mobile numbers where they could be reached. When no information was available, we asked the CAIF center to provide us with the numbers. We delivered the intervention to all the contact numbers we had for each family (mothers, fathers and other caregivers). This allowed us to maximize the chances of reaching the family, and to increase fathers' participation, at least in one of the interventions of Crianza Positiva. In total, we had 373 mobile phone numbers corresponding to the 237 treated families.

We sent all treated families a welcome message (both via SMS and WhatsApp) on January 5, 2018 and a closing message on June 27, 2018 that thanked them for participating in the program. Control families, on the other hand, received one SMS on January 26, 2018 that thanked them for participating in the Crianza Positiva workshop.
Messages were sent to families at the same day and time of the week. We delivered text messages through a platform that enabled us to send the same message to all families at once. Audio messages were sent via a broadcast list from WhatsApp. SMS were sent as planned, but we could not control whether messages were delivered or received. Messages could fail because of several reasons, including an incorrect or unavailable mobile number, a busy line, no credit in cellphone, etc. WhatsApp messages could only be delivered to recipients in the broadcast list who had saved the Crianza Positiva phone number in their contacts due to the specific characteristics of broadcast lists in WhatsApp.[14]

4.3 RCT compliance

Messages were sent as planned, but we could not control whether they were delivered or received. Messages could fail because of incorrect or unavailable mobile number, busy line, no credit in mobile, etc. We re-contacted all treated families by the end of January 2018 and a random sample of treated families in March 2018 to verify whether they were getting the messages. By January, we detected that 20% of families were not receiving SMS messages (47 out of 237 treated). Whenever we could identify that messages were failing, we asked the early childhood center to update families' telephone numbers. We could update 36% of failing lines, which reduced our SMS failure rate to 13%. Regarding

[14] In our welcome SMS message to the program, we included our cellphone number and asked recipients to save our contact phone in order to keep receiving messages through this channel.

WhatsApp messages, we found that in 74% of families, at least one member of the family received WhatsApp messages. We also found that 90% of individuals that received messages via WhatsApp read them.

We had an additional source of failure with messages sent to cellphones belonging to one of the carriers,[15] which in total represented 36% of our sample, and that took place between 30 January 2018 and 20 March 2018. We detected that the carrier labeled our messages as "spam" and the messages were not delivered. However, 64% of these cellphones kept receiving WhatsApp messages during this period. Furthermore, the randomization was balanced across different carriers.

Regarding the Facebook component of the intervention, we found that 83 families (35% out of the 237 that were randomized to receive messages) signed up to the Crianza Positiva Facebook informative web. We were unable to assess which families downloaded the Radio Butiá stories and songs.

We also asked families in the follow up questionnaires if they had received any messages with parenting information and if messages had been useful. Eighty nine percent of families randomized to treatment reported receiving a message. However, among those not assigned to treatment, the likelihood of a positive response was 39%. It is quite possible that these families referred to the placebo message that control families received at the beginning of the messaging program. Another possibility is that control families in treated centers were getting the messages through peers. We checked this out, and found that half of non-treated families in treated centers mentioned receiving messages versus 36% of non-treated families in non-treated centers. These messages were mostly SMS messages. When asked if they had received messages through WhatsApp (which were only sent to treatment families), 79% of those assigned to treatment responded receiving at least one message while the rate was 19% among control subjects.

4.4 Evaluation scales

We collected data on the quantity and quality of parental investment, and on parental knowledge about positive parenting, self-efficacy, parental stress, and time preferences

[15] In Uruguay there are three carriers: Ancel, Claro, and Movistar. The problem appeared with cell phones carried by Movistar.

through a self-administered questionnaire. We collected these outcomes at baseline (before the workshop) and in a follow-up survey administered to families at least 2 months after the messaging intervention had ended (between August and November 2018). The questionnaire had to be filled in by the parent or another caregiver either at home or at the early childhood center (depending on family preferences) and took approximately 40 minutes to complete.

A sociodemographic section contained 25 questions that covered demographic characteristics of the child and the respondent (usually the child's mother), the relationship between the respondent and the child, and household characteristics, such as household composition, maternal and paternal education, maternal and paternal employment, household assets, indicators of unsatisfied basic needs in the household, and cash transfers recipient status.

a) Quantity of parental investment

To test this hypothesis, we administered a set of items capturing the frequency of parental involvement in different activities with the child (e.g. singing songs, playing, going for a walk). These items were taken from Cabrera et al. (2004) and were used in the evaluation of the Early Head Start program in the United States. The scales include 32 items that were divided into 4 subgroups: physical games with the child (7 items), caring for the child at home (8 items), didactic activities with the child (7 items), and socialization activities with the child (10 items). Respondents had to report their frequency of performance of each task on a Likert scale ranging from 1 to 6. The lowest value corresponds to never getting involved in that activity and the highest value corresponds to getting involved several or all days of the week. We constructed dummy variables that take the value 1 if the respondent reported engaging in a certain activity every day and 0 if not. We constructed a general score in each scale by averaging the dummy variables for the different items. A higher score is associated with a greater parental involvement.

Also related to parental involvement, the questionnaire included some items from the Father's Involvement subscale of the Etxadi-Gangoiti Scale of Arranz et al. (2012). These questions gathered information about the participation of the father in the nurture of the child, his daily participation in the tasks of the household and the quality of his interaction with the child. Nine out of the eleven items of the original scale were included in our questionnaire since the other two items were not applicable to the age group of the

children under evaluation. For each item, the respondent had to answer "yes" or "no" depending on whether the father of the child was regularly involved with certain activity. The results were coded as 1 or 0, with 1 being the equivalent of a "yes" answer. The total score added the answers to the 9 questions. The total score of the scale ranges from 0 to 9 and a higher score indicates greater parental involvement.

In addition, we asked parents about material resources at home, such as availability of books and different types of toys (role playing toys, push or pull toys, musical instruments, etc), with which we built a stimulating material resources index.

b) Quality of parental investment

To assess investment quality, we administered a subset of items from the Positive Parenting Scale (E2P), by Gomez and Muñoz (2015). The manual classifies the parental-child relationship in four groups: (i) attachment, (ii) safety and protection, (iii) stimulation, and (iv) parental reflection ability. These are the same competences around which the Crianza Positive workshop and messages were built. Respondents had to report their degree of agreement with several statements on a Likert scale ranging from 1 to 5. We selected 7 items from the parental attachment competence subscale[16], 4 items from the reflective capacity subscale,[17] and 4 items from the safety and stimulation subscales[18], from which we constructed an index of outreach for social support and another one indicating the degree to which parents could organize the child activities around a daily routine.

And we included a set of items from UNICEF MICS6 questionnaire for families of children under five inquiring about the disciplinary methods that parents used in the past month with their child. We constructed a dummy variable equal to 1 when the parent reported shaking, slapping, hitting the child, shouting at her, or calling her “silly” or “useless” during the past month in order to “teach the child how to behave”.

c*) Parental discount rates*

To elicit time preferences, we administered the Kirby, Petry, and Bickel (1999)’s Monetary Choice Questionnaire (MCQ). This questionnaire includes 27 questions with

[16] Items 4, 6, 7, 10, 12, 13, 14.
[17] Items 44, 46, 47, 49.
[18] Items 23, 33, 35 and 40.

binary options of an amount of money to receive today or a larger amount of money to receive at some point in the future. For example: "Which of these two options would you prefer: $ 1512 today or $ 1540 in 117 days?". Individuals are asked to choose between one of the two options for each question. The instrument identifies a temporary discount rate for each individual. In particular, there exists a value k that represents the point for which the person is indifferent between the two rewards. The values of the time discount rate range from 0 to 0.249, and a higher value indicates a greater preference for the present.[19]

d) Parental stress

We gathered information on parental assessment of the quality of their interaction with the child, by administering Abidin's (1995) Parenting Stress Index (Short Form) (PSI/SF). The PSI/SF is an instrument aimed at parents with children between the ages of 1 month and 12 years old, designed to assess stress experienced when exercising parenting activities. The scale consists of 36 statements to which parents must respond on a Likert scale with 1 being the lowest value and 5 the maximum value. The scale is divided into three subscales of 12 items each. The first subscale is called "Parental discomfort" and identifies the discomfort that parents experience when performing parenting functions and that is derived directly from personal factors that are related to parenting (tensions or conflicts). The second subscale is called "Dysfunctional Interaction between father or mother and child" and focuses on assessing whether children meet the expectations that their parents had of them and the degree of satisfaction that children provide. The third subscale is called "Difficult Child" and identifies whether the caregivers value their child-rearing tasks as easy or difficult, depending on the behavioral characteristics of the child. The sum of the scores obtained in each subscale determines the total stress of the individual. The total stress scores vary between 36 and 180, and a higher score indicates a higher level of parental stress. In addition to the 36 main items, the scale includes a questionnaire about stressful events that occurred to the household in the last 12 months. These answers are not considered in the overall score of the PSI/SF.

e) Parental Sense of Competence

[19] In the follow-up survey, overall consistency is greater than 75% for 97% of respondents.

Parents' perceptions about their role as parents were gathered with the Johnston and Mash (1989) version of the Parental Sense of Competence Scale (PSOC). This is a 16-item instrument in which the parent or caregiver classifies responses according to the degree of agreement with various statements. Each item is scored on a Likert scale that takes values between 1 and 6, where 1 represents total disagreement with the proposed statement and 6 complete agreement. We constructed two subscales of the PSOC identified by Menéndez, Jiménez and Hidalgo (2011), one related to "effectiveness" and the other one capturing "controllability" of the parenting role. Perceived effectiveness refers to expectations about the degree to which the adult feels capable and competent to act effectively as a parent. Controllability is determined by the degree to which parents feel responsible for education situations and consequences. Responses were averaged out for each subscale. A higher score is associated with a greater sense of parental competence.

We also assessed parental mental health with the Center for Epidemiologic Studies Depression Scale (Radloff, 1977). This is a 20-item self-report scale designed to measure self-reported symptoms associated with depression experienced in the past week.

f) Parental knowledge about positive parenting

We assessed parental knowledge about positive parenting by including 13 True/False items. We constructed an index of parental knowledge as the count of the items responded correctly by the parent.

4.5 Attrition

Out of the 237 families randomized to receive messages (ITT=1), 72% responded to the follow-up questionnaire (171 families). The response rate for the 292 families randomized to the control arm was 78% (see Table 3). This difference in the probability of being surveyed between treated and control subjects is not statistically significant at usual levels. However, once we account for missing responses in the questionnaire, some of the outcomes show higher differences in attrition (with up to a 9 percentage points difference). In the next section we assess balance in covariates across treated and control families that responded to the questionnaire and check also for balance considering the different subsets of observations due to differential missingness in responses to the questionnaire.

Table 3: Attrition by ITT

	Probability of being surveyed
Difference in response rate between ITT=1 and ITT=0	-0.056
	(0.038)
Response rate control arm	0.777***
	(0.024)
N	529

Coefficients and standard errors in parentheses. * p<0.1, ** p<.05, *** p<.01

4.6 Descriptive Statistics and Balance

We begin by describing evaluated families and children according to a set of sociodemographic indicators reported by the family between August and December 2017 (note that the first message was sent in January 2018). We then use this data to check for randomization balance after accounting for attrition. [20]

Table 4 presents descriptive statistics of the respondents, the children and the households at baseline, by ITT status. Mothers are around 29 years old and children are 2 years old on average at the time of initiation of the messaging intervention. Eight percent of the children were born prematurely. Three out of four children live with their biological father and mother and one out of four is still being breastfed by the time the intervention begins. On average, there is one other child in the household aside from the evaluated child and 0.2 other adults aside from the child's parents. One out of three households faces material housing problems (problems in walls or floors, overcrowding or lack of a space to cook); only 2% lack running water, 3% lack sanitation, and 21% have no access to at least one basic comfort asset, including heating, a fridge, and a water heater. We construct an asset index including 18 household and family assets and utilities (oven, refrigerator, water heater, TV, DVD, subscription to cable TV, laundry washer, laundry heater, dishwasher, microwave, air conditioner, government awarded laptop, other laptops, access to wi-fi, household phone line, motorcycles, and cars). The index ranges from 0 to 0.77 with higher

[20] Some families were administered the baseline survey in August-September 2017 (before the workshop) while for others it was administered in November-December 2017 (before the messaging intervention).

values indicating higher availability of the assets. The average value of the asset index for families participating in the study was 0.25 with a standard deviation of 0.14. Sixty seven percent of families were recipients of government cash transfers. Mothers are by far the main respondents to the questionnaire (93%), followed by fathers, grandmothers and other caregivers. The child under study is the mother's only child in 38% of the cases. Almost 30% of mothers are high school graduates; one out of three completed middle school but not high school, and the rest did not complete middle school. Fathers work full time in 79% of the cases. Nearly three out of five families report having experienced a negative shock in the past year (a death, a divorce, unemployment, money problems, a relative that changes of place of living or problems with the law or with drugs in the family); the average number of problems is 1.34. On average, 38% of families are classified as having a high discount rate, meaning that the discount rate of the respondent is higher than 0.1 (discount rates range from 0 to 0.249). Lastly, around half of respondents have a low parental sense of efficacy at baseline (which implies scoring 4 or less in the subscale of efficacy of the Parental Sense of Competence Scale).

Table 4: Descriptive statistics and balance in covariates across treatment arms

	----------Treatment------			---------Control-------				Balance	
	N	Mean	Std. Dev	N	Mean	Std. Dev.	N full sample	Diff.	Diff. s.e.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mother's age	168	30.292	6.626	225	28.311	6.552	393	1.981***	(0.672)
Female child	170	0.482	0.501	227	0.498	0.501	397	-0.015	(0.051)
Child's age (in months)	167	23.343	7.014	226	24.419	6.115	393	-1.076	(0.678)
Premature child	170	0.065	0.247	225	0.089	0.285	395	-0.024	(0.027)
Intact family	167	0.719	0.451	224	0.777	0.417	391	-0.058	(0.045)
Child still being breastfed	170	0.253	0.436	226	0.248	0.433	396	0.005	(0.044)
# of other children in household	159	1.138	1.285	216	0.903	1.151	375	0.236*	(0.129)
Other adults in household	158	0.158	0.366	215	0.228	0.420	373	-0.070*	(0.041)
Housing material problems	158	0.291	0.456	218	0.303	0.461	376	-0.012	(0.048)
No running water	168	0.018	0.133	226	0.022	0.147	394	-0.004	(0.014)
No sanitation	168	0.024	0.153	226	0.031	0.174	394	-0.007	(0.017)
No basic comfort goods	159	0.226	0.420	223	0.202	0.402	382	0.025	(0.043)
Asset index	150	0.241	0.140	222	0.256	0.139	372	-0.015	(0.015)
Beneficiary of cash transfers	170	0.700	0.460	227	0.634	0.483	397	0.066	(0.048)
Mother responds questionnaire	170	0.935	0.247	227	0.916	0.278	397	0.019	(0.026)
Only child	163	0.337	0.474	220	0.414	0.494	383	-0.076	(0.050)
Mother completed middle school	167	0.317	0.467	226	0.332	0.472	393	-0.014	(0.048)
Mother completed high school	167	0.281	0.451	226	0.305	0.462	393	-0.024	(0.046)
Mother works full time	165	0.388	0.489	217	0.401	0.491	382	-0.013	(0.051)
Mother works part time	165	0.194	0.397	217	0.194	0.396	382	0.000	(0.041)
Father works full time	151	0.808	0.395	215	0.767	0.423	366	0.041	(0.043)
Family had ≥ 2 neg. shocks 12m	74	0.311	0.466	104	0.327	0.471	178	-0.016	(0.071)
High discount rate	138	0.399	0.491	194	0.366	0.483	332	0.033	(0.054)
Low sense of parental competence	74	0.527	0.503	94	0.447	0.500	168	0.080	(0.078)

* p<0.1; **p<0.05; ***p<0.01.

The last two columns in Table 4 show the differences in baseline covariates between treatment and control subjects that responded to the follow-up questionnaire. Out of 23 covariates analyzed, only mother's age is statistically different at 1% across treatment and control subjects (mothers in the treatment group are almost two years older than mothers in the control group). Two other variables are statistically different at 10%, the number of other children in the household (which is larger for treated families), and the number of other adults in the household (which is smaller for treated families). We adjust for these three covariates in the regression analysis.

Table 5 shows descriptive statistics of outcomes assessed at follow-up. Each family of outcomes is identified by a heading in italics. The parental investment subscales indicate the frequency with which parents engage in different parenting activities, with 1 indicating "Never" and 6 "All or most days of the week". Because almost all parents report taking care of the child all or most days of the week, we exclude this outcome from the analysis. The Parental Time Investment Index is a summation of the physical games, didactic and social activities scales. Father's involvement in childrearing is a continuous index from 0 to 1 constructed as the average of 10 items describing whether the father collaborated with different childrearing activities. The average is 0.77. Stimulating material resources include "toy diversity", given by the number of different toys that the caregiver reports to be available in the household, and an indicator of availability of at least 5 children books in the household. 84% of families have at least 5 children books in the household.

The Positive Parenting Scale, the Parental Stress Index, and the Parental Sense of Competence, as well as their subscales, are averages (or summation in the PSI) of the degree to which parents agree with each of the items included in the scale or subscale. Note that the Positive Parenting Scale is not the original scale in Gomez and Muñoz (2015), but a subscale constructed on a subset of items included in the questionnaire. The percentage of families reporting some kind of "disciplinary" violent behavior was 39%. The CES-D depression scale is a count weighting the number and frequency of depression symptoms experienced by the respondent in the past 7 days (it ranges between 0 and 45); depression risk is given by a count of at least 16 in this index. In the sample, 12% of respondents are at risk of depression.

Parenting knowledge is the summation of different true-false items indicating knowledge of positive parenting competences. On average, parents had 11 out of 13 questions right. Finally, the time discount rate (the rate at which parents discount the future) averages 0.08 in the sample, with a minimum of 0 and a maximum of 0.249.

Table 5: Descriptive statistics of outcomes at follow-up

	N	Mean	Std. Dev	Min	Max
	(1)	(2)	(3)	(4)	(5)
Parental investment (quantity)					
Time					
Parental time investment index	272	12.971	1.932	6.9	17.7
Involvement in physical games	338	4.191	0.785	1.9	6
Involvement in physical games every day	338	0.353	0.261	0	1
Involvement in didactic activities	358	4.825	0.989	1.8	6
Involvement in didactic activities every day	358	0.452	0.351	0	1
Involvement in socialization activities	318	3.879	0.875	1.8	6
Involvement in socialization activities every day	318	0.252	0.251	0	1
Father's involvement in childrearing	388	0.769	0.352	0	1
Material resources					
Toys	374	0.851	0.140	0.4	1
More than 5 children books	389	0.843	0.364	0	1
Parental investment (quality)					
Positive Parenting subscale (E2P)	346	4.053	0.437	2.1	5
Attachment	374	4.340	0.585	1.1	5
Routines	378	3.820	0.917	1	5
Social support	378	3.755	0.998	1	5
Parental Reflection	369	3.570	0.741	1	5
Violent disciplinary approach	382	0.390	0.488	0	1
Parental Stress					
Parental Stress Index (PSI)	260	73.019	17.755	37	147
PSI: Parental discomfort	348	26.949	8.362	12	56
PSI: Dysfunctional Interaction	333	20.619	6.305	12	50
PSI: Difficult child	308	25.971	7.030	12	52
Parental Sense of Competence					
Parental Sense of Competence Scale (PSOC)	332	4.119	0.528	2.5	5.7
PSOC: effectiveness	354	4.129	0.806	1.2	6
PSOC: controllability	368	3.862	1.094	1	6
Parental mental health					
CES Depression Scale (# symptoms)	318	7.170	7.835	0	45
CESD: At risk of depression	318	0.116	0.321	0	1
Knowledge					
Index of True/False questions	386	10.808	1.914	1	13
Time preferences					
Discount rate	332	0.081	0.089	0.0	0.25

4.7 Estimation method

To estimate the Intention To Treat (ITT) effect, we run OLS regressions of each outcome on the ITT indicator, adjusting subsequently for a set of covariates. These covariates include: (i) the variable used to stratify the randomization at the CAIF center level (a dummy equal to 1 if the average level of education of mothers participating in Crianza Positiva at the center was at least middle school); (ii) covariates that were unbalanced

after attrition (the mother's age, whether the child lived with other adults aside from mother and/or father, the number of other children in the household, and being an only child); and (iii) other covariates that could help improve the precision of the estimation (the child's age and gender, mother's age and education, whether the child lived with both biological parents, and a baseline measure of the outcome, when available).

Because our experimental design involved a clustered randomization (we first randomly assigned CAIF centers to treatment and then assigned families to treatment within assigned centers), we needed to adjust standard errors for the clustered design (Abadie et al. 2017). The usual approach when the number of clusters is large is to estimate standard errors using the Zeger and Liang (1986) covariance estimator. Unfortunately, the number of clusters in our data is only 24, a number too low to apply asymptotic theory. As recommended by Cameron, Gelbach and Miller (2008) we use a wild bootstrap with null imposed to enable more accurate cluster-robust inference. Moreover, we conducted randomization inference for 2000 replications. We report the associated p-values.

For each family of outcomes, we adjust standard errors to account for multiple hypotheses testing using the approach suggested by List, Shaik and Xu (2016).[21] We exclude summary indices from each calculation.

We also report the power of the sample to detect an effect of 0.2 standard deviations in the case of continuous outcomes and an effect of 10% in the case of discrete outcomes. The power calculations account for the experimental design (randomization at two levels) and for intra-cluster (intra-CAIF center) correlation of the outcome.

The second level of randomization (of families within treated CAIF centers) was conducted to assess the degree of spillovers of the messaging intervention on CAIF families that were not receiving messages, but that attended an early childhood center in which other families were receiving messages. To account for spillovers, we regressed outcomes on two variables: an indicator of ITT=1 and an indicator of being in the "spillover" sample (equal to 1 if the family belonged to a center randomized into

[21] The authors propose a procedure that asymptotically controls the probability of even one false rejection. The testing procedure is asymptotically balanced in the sense that all marginal probabilities of rejecting any true null hypothesis are approximately equal. The methodology incorporates information about the joint dependence structure of the test statistics when determining which null hypotheses to reject. Hence, this increases power and results in p-values that are always weakly smaller than those obtained from classical multiple testing procedures, such as Bonferroni and Holm.

treatment but, within that center, they were assigned not to receive messages). We begin by analyzing the results on families that were randomized into treatment and focus on spillovers afterwards.

5 Impact Evaluation: Results

5.1 Raw differences across ITT arms

Tables 6a and 6b report the results of regressions of each outcome on an Intent to Treat (ITT) indicator and an indicator for whether the subject belongs to the spillover sample (subjects randomized to the control arm within CAIF centers randomized to treatment). First we report results on parental quantity of investment (Table 6a) with respect to time and material resources and second we report results on Parental stress, sense of competence and mental health (Table 6b).

The first column shows the raw treatment-control differences and the coefficient's unadjusted standard error. In columns two and three we report the p-values corresponding to the outcome difference between ITT=1 And ITT=0 when adjusting for clustering and MHT respectively. In the fourth column we report the p-value that results from randomization inference. The fifth columns shows ITT effects after adjusting for the stratum used for randomizing CAIF centers (average maternal education above middle school), child's gender and age in months, and maternal education. The sixth column adds to the former the mother's age, the time elapsed since the messaging intervention begun, whether the family had a negative shock in the months prior to the intervention, the number of other children in the household, whether the child lived with other adults in addition to father and mother, and whether the child lived with her biological father and mother (intact family). The seventh column adds a control for the outcome at baseline, if available. To avoid losing observations due to missing values in the covariates, we generated, for each covariate, a dummy equal to 1 if the observation was missing and imputed the missing value with the average of the covariate in the sample.

We also report the standard deviation of each outcome for the control sample and the sample power to detect the observed difference. The power calculations consider an effect size of 0.2 standard deviations in the case of continuous outcomes and of 10% in the case of dichotomous outcomes. The calculations account for the experimental design (randomization at two levels) and for intra-cluster (intra-CAIF center) correlation of the outcome.

Parental quantity of investment: time and material resources

In Table 6a, we report the results on parental quantity of investment in terms of time and material resources. Regarding parental time investment, the aggregate index of parental time investment shows an ITT effect of 0.24 (0.488/2.020) standard deviations. This effect is statistically significant when adjusted by the clustered design and by multiple hypotheses testing (MHT). Moreover, the p-value obtained from randomization inference is also significant at conventional significance levels. Also, we find that the intervention increases the average frequency of parental engagement in didactic activities with the child by 0.230 (0.22 standard deviations). The effect is significant at a 5% level when considering unadjusted p-values, and at the 10% level when adjusting for MHT and clustering and when considering randomization inference. Results show that the ITT effects on the parental investment index and the frequency of parental involvement in didactic activities are robust to adjustments for pretreatment covariates, and in particular to adjustments for covariates that were unbalanced in the comparison across treatment arms after accounting for differential attrition. We find that the messaging intervention increases the frequency of parental involvement in physical games with the child in a magnitude of 0.22 standard deviations. This estimate is significant at a level of 10% when considering unadjusted p-values, clustering, and when conducting randomization inference, but slightly crosses the 10% significance level when considering p-values adjusted for MHT. Although significant when controlling for different covariates, the ITT effects on the frequency of parental involvement in social activities with the child is not significant when we do not include controls. However, in the case of frequency of involvement in social activities and physical games, we find a significant effect when we dichotomize the outcome and place value 1 to being involved every day in that activity and 0 otherwise (See Table A2 in Appendix C). We find no statistically significant ITT effects on father's involvement in childrearing nor on availability of books in the household. The power to detect an effect of 0.2 standard deviations is 0.7 for the parental investment index, 0.5 for the measure of engagement in physical games, and 0.7 and 0.8 for engagement in didactic activities and social activities respectively.

Table 6a: Intent to Treat (ITT) effects on Parental Investment.

	ITT=1-ITT=0	p-value adjusting for clustering	p-value adjusting for MHT	p-value from randomization inference	ITT=1-ITT=0			ITT=0 Std. dev.	Power
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Parental time investment									
Time investment index	**0.488****	0.027	0.048	0.092	0.510**	0.667***	0.605**	2.020	0.700
	(0.246)				(0.247)	(0.247)	(0.233)		
Physical games	0.172*	0.094	0.128	0.098	0.175*	0.217**	0.234***	0.794	0.492
	(0.093)				(0.093)	(0.093)	(0.088)		
Didactic Activites	**0.230****	0.074	0.098	0.076	0.274**	0.299***	0.260***	1.024	0.731
	(0.107)				(0.108)	(0.109)	(0.097)		
Social Activities	0.169	0.077	0.102	0.085	0.183*	0.229**	0.164*	0.851	0.756
	(0.103)				(0.104)	(0.103)	(0.098)		
Father's involvement	-0.022	0.563	0.569	0.627	-0.015	-0.029	-0.033	0.341	0.643
	(0.038)				(0.038)	(0.026)	(0.023)		
Material resources									
Toys	-0.026*	0.197	0.179	0.226	-0.024*	-0.021		0.128	0.822
	(0.015)				(0.014)	(0.014)			
More than 5 children books	0.001	0.986	0.976	0.978	0.003	0.001		0.360	0.781
	(0.039)				(0.039)	(0.039)			
Parental quality of investment									
Positive Parenting Scale (E2P subset of items)[#]	**0.098***	0.083	0.051	0.013	0.106**	0.122**		0.395	0.718
	(0.050)				(0.050)	(0.049)			
E2P: Attachment	0.062	0.390	0.341	0.346	0.102*	0.058		0.558	0.620
	(0.065)				(0.052)	(0.051)			
E2P: Routines	0.116	0.329	0.395	0.244	0.131	0.093		0.925	0.801
	(0.098)				(0.096)	(0.093)			
E2P: Social support	**0.222****	0.057	0.099	0.024	0.225**	0.239**		0.954	0.619
	(0.106)				(0.104)	(0.103)			
E2P: Parental Reflection	**0.195****	0.063	0.064	0.015	0.215**	0.243***		0.727	0.711
	(0.082)				(0.083)	(0.084)			
Violent disciplinary approach	-0.011	0.876	0.823	0.869	-0.012	-0.032		0.486	0.160
	(0.053)				(0.054)	(0.054)			
Controls									
None	X								
Strata, child's age & gender, mother's education					X	X	X		
+ mother's age, time elapsed since 1st message, negative shocks, other children in household, other adults in household, intact family						X	X		
+ outcome at baseline if available							X		

Notes: * p<0.1; **p<0.05; ***p<0.01. Rows depict different outcomes. Families of outcomes are identified by a heading in italics. Column (1) reports the ITT coefficient (outcome difference between ITT=1 and ITT=0) and the coefficient's unadjusted robust standard error in parentheses. Column (2) reports the coefficient's p-value adjusted for clustering, the coefficient's p-value adjusted for multiple hypotheses testing and the coefficient's p-value corresponding to the randomization inference. Columns (5)-(7) report the ITT coefficient of specificacions that include controls. Column (8) reports the standard deviation of the outcome in the control sample and Column (9) indicates the sample power to detect the observed difference in Column (1). The estimations control for an indicator of whether the subject was randomized to control within treated CAIF centers (the "spillover" sample). # The E2P index and subscales do not include the full set of E2P items in the original scale. The power calculations consider an effect size of 0.2 standard deviations in the case of continuous outcomes and of 10% in the case of dichotomous outcomes. The calculations account for the experimental design (randomization at two levels) and for intra-cluster (intra-CAIF center) correlation of the outcome.

Regarding parental quality of investment, we find a positive effect of the messaging intervention on the index of positive parenting (the index increases by 0.098 or 0.25 standard deviations) when considering unadjusted p-values and the effect maintains statistical significance at the 5% level once we account for multiple hypotheses testing and at the 10% level once we account for the clustered sample design. Similarly, we find that the intervention has an effect on parental outreach for social support (the magnitude of the effect is 0.23 standard deviations) that is significant at the 5% level when considering unadjusted p-values and at the 10% after adjusting for clustering and after adjusting for MHT. Moreover, we find a statistically significant ITT effect (at the 5% level when considering unadjusted p-values and at the 10% level after adjusting for MHT and after adjusting for clustering) on parental capacity to reflect on parenting. The magnitude of the effect is of 0.27 standard deviations. Power is above 0.61 for all outcomes.

Parental stress, sense of competence, discount rate and knowledge

In Table 6b we report the effect of the messaging intervention on parental stress, sense of competence, discount rate and knowledge. We find no evidence of an effect of the intervention on parental stress, discount rate and parental knowledge. On the other hand, we find a positive and statistically significant effect on the sense of parental effectiveness when considering unadjusted p-values but the effect becomes marginally non-significant once we adjust for MHT and loses significance when adjusting standard errors for the clustering in the sample. The power to detect a 0.2 standard deviation effect size is 51%. The power is lower in the case of the controllability outcomes and parental knowledge. In the latter outcomes, we do not find any statistically significant effects.

Table 6b: Parental stress, sense of competence, discount rate & knowledge.

	ITT=1-ITT=0	p-value from randomization inference	p-value adjusting for MHT	p-value from randomization inference	ITT=1-ITT=0	ITT=1-ITT=0	ITT=1-ITT=0	ITT=0 Std. dev.	Power
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Parental Stress									
Parental Stress Index (PSI)	1.572	0.661	{0.485}	0.606	0.919	0.973	2.702	16.277	0.314
	(2.249)				(2.158)	(2.188)	(2.028)		
PSI: Parental discomfort	1.432				1.360	1.022	1.610*	7.979	0.316
	(0.920)	0.403]	{0.290}	0.410	(0.903)	(0.924)	(0.836)		
PSI: Dysfunctional Interaction	-0.355				-0.444	-0.447	-0.380	5.982	0.415
	(0.739)	0.702]	{0.626}	0.687	(0.735)	(0.730)	(0.712)		
PSI: Difficult child	0.798				0.932	1.059	1.411**	5.905	0.431
	(0.775)	[0.427]	{0.493}	0.421	(0.784)	(0.783)	(0.709)		
Parental Sense of Competence (PSOC)									
PSOC Scale	-0.023	[0.739]	{0.714}	0.755	-0.011	-0.002	-0.017	0.519	0.497
	(0.062)				(0.063)	(0.064)	(0.058)		
PSOC: effectiveness	0.173*	[0.179]	{0.105}	0.165	0.176**	0.157*	0.135	0.795	0.512
	(0.089)				(0.087)	(0.095)	(0.087)		
PSOC: controllability	-0.169				-0.149	-0.145	-0.192*	1.048	0.397
	(0.119)	0.394]	0.147}	0.393	(0.119)	(0.119)	(0.114)		
Information									
Parental knowledge	-0.283	[0.315]	{0.159}	0.352	-0.228	-0.271		1.715	0.508
	(0.201)				(0.187)	(0.193)			
Time preferences									
Discount rate	0.009	[0.520]	{0.365}	0.475	0.010	0.009	0.000	0.088	0.404
	(0.010)				(0.010)	(0.010)	(0.010)		
Controls									
None	X								
Strata, child's age & gender, mother's education					X	X	X		
+ mother's age, time elapsed since 1st message, negative shocks, other children in household, other adults in household, intact family						X	X		
+ outcome at baseline if available							X		

Notes: * p<0.1; **p<0.05; ***p<0.01. Rows depict different outcomes. Families of outcomes are identified by a heading in italics. Column (1) reports the ITT coefficient (outcome difference between ITT=1 and ITT=0) and the coefficient's unadjusted robust standard error in parentheses. Column (2) reports the coefficient's p-value adjusted for clustering, the coefficient's p-value adjusted for multiple hypotheses testing and the coefficient's p-value corresponding to the randomization inference. Columns (5)-(7) report the ITT coefficient of specificacions that include controls. Column (8) reports the standard deviation of the outcome in the control sample and Column (9) indicates the sample power to detect the observed difference in Column (1). The estimations control for an indicator of whether the subject was randomized to control within treated CAIF centers (the "spillover" sample). # The E2P index and subscales do not include the full set of E2P items in the original scale. The power calculations consider an effect size of 0.2 standard deviations in the case of continuous outcomes and of 10% in the case of dichotomous outcomes. The calculations account for the experimental design (randomization at two levels) and for intra-cluster (intra-CAIF center) correlation of the outcome.

5.3 Heterogeneity and mechanisms

To assess whether the messaging program operates through helping parents overcome decision-making biases, we explore program heterogeneity across three dimensions of parental preferences, beliefs and constraints: parental discount rate, negative shocks faced by the household in the previous 12 months, and parental sense of competence.

Results are presented in Table 8. Each pair of columns shows the coefficients and standard errors from an OLS regression of the outcome in each row on the ITT main effect, the interaction between the ITT and a behavioral barrier, the main effect of the behavioral barrier, maternal education, governmental assistance, and randomization strata. Only the ITT and the interaction with the behavioral barrier are shown in the Table. The first two columns explore cognitive fatigue by interacting the ITT with negative shocks faced by the household (Columns (1) and (2)).[22] In general, we find that families with higher cognitive fatigue (higher likelihood of negative shocks) benefit more from the intervention. As we can see from Column (2) the program increased parental investment in social activities, increased the implementation of routines, decreased the use of violent discipline and increased parental sense of competence among parents that suffered two or more shocks in the previous 12 months of the evaluation. On the other hand, we find that the effect of the program on physical games cancels out for those parents that are more exposed to negative shocks.

Columns (3) and (4) explore whether parents with lower initial parental sense of competence benefit more from an intervention geared towards providing encouragement and constructing positive identities. Parents with low initial self-esteem are more likely to increase the number of toys at follow-up, and have better scores in several measures of quality of investment, i.e. implementing routines, and reflecting on parenthood.

[22] Treatment and control families do not differ in the mean values for these variables. We also confirmed that other baseline socioeconomic variables were balanced within the samples defined by the dichotomous variables used in the heterogeneity analysis (balance analysis is available upon request).

Table 8: Heterogeneity by behavioral barriers. OLS regressions.

	Cognitive fatigue		Negative identity		Present bias	
	ITT	ITT * Negative Shocks	ITT	ITT * Low parental efficacy	ITT	ITT * High discount rate
	(1)	(2)	(3)	(4)	(5)	(6)
A) Parental investment						
Time investment index	0.557*	-0.117	0.557*	0.463	0.614*	-0.332
	(0.307)	(0.513)	(0.307)	(0.671)	(0.324)	(0.554)
Physical games	0.257**	-0.271	0.257**	0.334	0.148	0.098
	(0.115)	(0.184)	(0.115)	(0.256)	(0.118)	(0.195)
Didactic activities	0.266**	-0.005	0.266**	0.305	0.266*	0.062
	(0.135)	(0.221)	(0.135)	(0.288)	(0.146)	(0.237)
Social Activities	0.183	0.048	0.183	-0.150	0.309**	-0.233
	(0.131)	(0.210)	(0.131)	(0.312)	(0.134)	(0.227)
Father's involvement	0.002	-0.036	0.002	-0.079	0.005	-0.055
	(0.043)	(0.080)	(0.043)	(0.102)	(0.050)	(0.079)
Material Resources						
Toys	-0.018	0.005	-0.018	0.083**	-0.024	0.031
	(0.017)	(0.030)	(0.017)	(0.040)	(0.017)	(0.033)
Books >5	-0.010	0.029	-0.010	-0.099	-0.049	0.091
	(0.046)	(0.079)	(0.046)	(0.113)	(0.050)	(0.087)
Investment Quality						
Positive parenting index	0.089	0.064	0.089	0.290*	0.101*	-0.028
	(0.060)	(0.101)	(0.060)	(0.147)	(0.061)	(0.114)
Attachment	0.067	0.044	0.067	0.210	0.061	0.014
	(0.055)	(0.098)	(0.055)	(0.183)	(0.058)	(0.110)
Routines	-0.021	0.411**	-0.021	0.487*	0.119	-0.103
	(0.117)	(0.191)	(0.117)	(0.272)	(0.120)	(0.206)
Social support	0.188	0.124	0.188	0.476	0.224*	0.045
	(0.132)	(0.206)	(0.132)	(0.313)	(0.130)	(0.231)
Reflection	0.187*	0.051	0.187*	0.458*	0.195*	0.037
	(0.103)	(0.162)	(0.103)	(0.247)	(0.104)	(0.176)
Violent discipline	0.053	-0.234**	0.053	-0.175	-0.072	0.184
	(0.065)	(0.104)	(0.065)	(0.148)	(0.070)	(0.114)
B) Mechanisms						
Parental stress	0.464	1.006	2.363	-0.202	1.693	-0.096
	(2.610)	(4.351)	(4.487)	(5.911)	(2.874)	(4.389)
Stress: Personal discomfort	1.822*	-1.111	2.280	-0.063	0.980	1.656
	(1.068)	(1.795)	(1.761)	(2.486)	(1.184)	(1.868)
Stress: Difficult interaction	-0.822	0.621	-1.193	2.376	-0.765	0.619
	(0.806)	(1.562)	(1.350)	(1.955)	(0.953)	(1.410)
Stress: Difficult child	0.601	-0.082	1.366	-0.138	1.658	-0.952
	(0.929)	(1.561)	(1.677)	(2.218)	(1.040)	(1.594)
Parental sense of competence	-0.121	0.294**	0.051	-0.099	-0.086	0.196
	(0.079)	(0.119)	(0.142)	(0.187)	(0.080)	(0.133)
Competence: Effectiveness	0.015	0.347**	0.226	-0.034	0.070	0.222
	(0.111)	(0.169)	(0.179)	(0.264)	(0.114)	(0.186)
Competence: Collaboration	-0.349**	0.489**	-0.059	-0.111	-0.185	0.014
	(0.141)	(0.236)	(0.257)	(0.337)	(0.155)	(0.257)
Parental knowledge	-0.073	-0.258	0.067	-0.169	-0.116	0.210
	(0.227)	(0.399)	(0.361)	(0.502)	(0.213)	(0.369)

Notes: * p<0.1; **p<0.05; ***p<0.01. Each pair of columns denotes a specific model in which the ITT is interacted with a behavioral barrier measured at baseline. Columns (1) and (2) correspond to cognitive fatigue. The variable that measures the latter behavioral barrier is an indicator that takes value of 1 if the family was exposed to 2 or more negative shocks in the previous 12 months to the survey. Columns (3) and (4) correspond to negative identities. The variable that measures the latter behavioral barrier is an indicator that takes the value 1 if the parental efficacy at baseline is less or equal than 4 (ranges from 1 to 6). Columns (5) and (6) correspond to present bias. The variable that proxies the latter behavioral barrier is the discount rate. Each row denotes a different outcome. For each outcome, we show the coefficient and standard error for the ITT main effect, and the coefficient and standard error for the interaction between ITT and the behavioral barrier analyzed. All regressions adjust, in addition, for randomization strata, maternal education, and governmental assistance. Families in the spillovers sample are excluded from the regressions.

Finally, the last two columns assess whether the intervention was more effective among parents experiencing more present bias. We find no differential effects among parents with high and low discount rates.

In sum, we find no evidence that the intervention works by mitigating the behavioral bias derived from time inconsistency. We do not find any effect on information either. But we do find some evidence that the program mitigates cognitive fatigue and negative identities. By suggesting simple activities to carry out at home, parents are more able to establish routines, they need to rely less on the use of violent discipline and their sense of parental competence increases. The encouragement provided to parents through the messages seems to improve their reflection capacity, their ability to organize their routines, and material investments.

5.4 Spillovers

In this subsection we compare the effects of non-treated families within treated centers with non-treated families within non-treated centers. Table 9 shows the coefficients on an indicator equal to 1 if the family was assigned to the control in a CAIF center assigned to treatment, and 0 if the family belongs to a CAIF center assigned to control. Each row corresponds to a different outcome. Any positive effect of the intervention on this indicator would suggest spillover effects. There are few statistically significant effects. Although those few are robust to familywise multiple hypothesis testing adjustment, the statistical power is quite low in all cases. Moreover, the effects also run in the opposite way than hypothesized. Families in this group are more likely to report violent discipline than families in the pure control or in the treatment groups, are more likely to report personal discomfort with their parenting roles and show lower levels of knowledge of positive parenting competences. In sum, we do not find spillover effects in the sense we were looking for (positive spillovers) but do find that the group of families not receiving messages when their peers were receiving them was somehow negatively affected by this fact. The results could express frustration among the untreated parents in treated centers in the sense that they observe that other children are gaining in terms of development but do not know how to achieve this with their own children.

Table 9: Spillover effects. Coefficient on a dummy indicating that the family was assigned to the control group in a center assigned to treatment.

	Coeff. and s.e.	Mht adjusted p-value	Power
Parental time investment	0.136		0.754
	(0.420)		
Physical games	0.148		0.847
	(0.121)		
Didactic Activites	-0.071		0.429
	(0.208)		
Social Activities	0.103		0.683
	(0.175)		
Father's involvement	-0.037		0.375

	(0.058)		
Toy diversity	-0.032)		0.228
	(0.025)		
More than 5 children books	-0.048		0.781
	(0.066)		
Positive Parenting Scale (E2P)	-0.037		0.694
	(0.078)		
E2P: Attachment	0.062		0.412
	(0.090)		
E2P: Routines	0.220		0.722
	(0.166)		
E2P: Social support	-0.260		0.703
	(0.180)		
E2P: Parental Reflection	0.013		0.781
	(0.121)		
Violent discipline	0.170**	0.049	0.159
	(0.084)		
Parental Stress Index (PSI)	6.062		0.308
	(3.964)		
PSI: Parental discomfort	3.805**	0.082	0.350
	(1.637)		
PSI: Dysfunctional Interaction	-0.283		0.320
	(1.162)		
PSI: Difficult child	2.000		0.400
	(1.405)		
Parental Sense of Competence Scale (PSOC)	-0.083		0.745
	(0.097)		
PSOC: effectiveness	0.104		0.458
	(0.153)		
PSOC: controllability	-0.209		0.272
	(0.198)		
CES Depression Scale (# symptoms)	-0.980		0.050
	(1.508)		
CESD: At risk of depression	-0.025		0.059
	(0.057)		
Parenting knowledge	-0.971***	0.013	0.186
	(0.364)		
Time discount rate	0.020		0.460
	(0.017)		

Notes: * p<0.1; **p<0.05; ***p<0.01.

6 Discussion and Conclusions

In this paper we used a randomized control trial to evaluate the impact of one of the components of Crianza Positiva, a text and audio messaging program aimed at helping parents develop and sustain parenting competences over time. Rooted on behavioral economics, the program reminds parents about the benefits of engaging in positive parenting practices, provides them with suggestions of simple and concrete positive parenting activities, reinforces positive parental identities, and encourages parents to seek resources within their families and community to improve their parenting behavior and attitudes. Unlike other parenting programs using technology, our messaging program covers a comprehensive range of parenting areas, including sensitive observation and response, the importance of a safe and nurturing environment, the importance of speaking and reading to the child, the key role of free play, and the value of self-caring and of having a reflective parenting attitude.

The program complemented a prior workshop attended by families at local early childhood centers, and included text and voice messages that were delivered to the caregivers' cellphones through SMS and WhatsApp, respectively. Families received both types of messages three times a week during 24 weeks between January and June 2018.

The program was well-received by families. Among families assigned to treatment, 95% said that the messages had been either very useful (61%) or somehow useful (34%), and only one family opted out of the audio messages. Furthermore, the program had a positive effect on parental investment, parental competences and parenting attitudes. Our findings show that messages had an impact of 0.24 standard deviations on a parental time investment index and on parental engagement in social, physical, and didactic activities with the child. They also increased parents' quality of investment as measured by a positive parenting index and by an index of outreach for social support (by 0.25 and 0.23 standard deviations respectively). Moreover, the messages improved parental capacity to reflect on parenting by 0.27 standard deviations. On the other hand, we did not find evidence of effects on parental engagement in physical games and didactic activities, the availability of stimulating material resources in the household, on father's involvement in childrearing, on parental stress or mental health, nor on parental knowledge about positive parenting. For many of the outcomes, however, the statistical power was relatively low, so we are unable to be conclusive about the lack of findings.

We find no evidence that the program worked through helping parents overcome present bias. But we do find that the program had stronger effects over parents more constrained initially by a negative identity (i.e., a low sense of parental competence) and over parents that suffered from a negative shock.

Overall, our results suggest that messages are a promising and cost-effective tool to enhance parental behaviors, competences and attitudes. A back-of-the-envelope estimate of the cost per family of implementing this program again is 10 USD. While our intervention was implemented in CAIF centers in Uruguay, which tend to assist families of lower socioeconomic status, the program was designed for any socioeconomic setting and would need little adaptation to be delivered in other contexts. We believe the contents of the program have high external validity. Moreover, the intervention was embedded directly in a governmental-provided program which makes the implementation and results closer to a "real-life" intervention. Because not all families ended up receiving the

messages, the Intent to Treat effect we analyze is a lower bound on the impact of receiving the treatment. This lower bound is, however, the effect we are interested in when considering external validity, since message failure would be an important aspect when scaling up this intervention.

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Appendix A: Behavioral Biases and tools to overcome them

a) Present bias

Behavioral economics proposes that individuals often exhibit inconsistent preferences when faced with intertemporal decisions. People have an order of preferences when planning decisions in the long term, but when the time comes to make the decision, that order is reverted (usually giving up future benefits in order to obtain immediate rewards).[23] Known as present-bias (Thaler, 2015), the phenomenon is modeled assuming an additional discount factor applied to any future benefit (Laibson, 1997). Present bias generates impatience and can affect many areas of choice such as financial decisions (see for example Meier and Sprenger 2010; Eckel, Johnson, and Montmarquette, 2005), decisions related to health -nutrition, exercise, or the decision to smoke- (Chabris et al., 2008), and decisions related to investments in human capital (Sutter et al., 2013; Castillo et al., 2011).

Parental investments involve making intertemporal decisions, since returns are often perceived to be realized in the long term while costs are immediate. The evidence shows that most people tend to do less than the optimal in a specific activity when the reward for that activity is received some time later (Thaler and Sunstein, 2008). Parents can fail to internalize the future benefits derived from their parental investments and consequently make short-sighted investment decisions in their children.

In addition to the inconsistent preference problem, the literature establishes that people from disadvantaged contexts discount the future at higher rates (Lawrance 1991) and invest less time in their children (Agee and Crocker, 1996; Pabilonia and Song, 2013). Differences in discount rates can arise because parents from lower socio-economic backgrounds face stressors in their daily lives that demand their attention at the moment of making a decision, consume their cognitive resources and impede them from thinking about the future (Gennetian et al., 2017).The behavioral economics literature has proposed the use of commitments, reminders, and immediate incentives to overcome present bias. Commitments involve a promise to perform certain behavior or meet a certain goal. Commitments motivate people to be consistent with their objectives and

[23] This happens even in cases in which the short run benefits of waiting are quite large, a phenomenon documented by Mischel, Ebbesen, and Raskoff Zeiss (1972) in a famous experiment. The authors showed that a group of children could not resist the temptation of taking a sweet for a few minutes, despite getting great benefits for waiting.

increase the likelihood that this behavior will finally be carried out by imposing a psychological cost in case of non-compliance. The evidence shows that only by regularly writing down a promise that has been made in the past, the probability of complying with that behavior increases (Giné, Karlan and Zinman 2010). This happens because the commitment focuses the attention of the individual on the actions necessary to meet that objective. In the context of parental interventions, the commitment to short-term parental goals, combined with a follow-up of the progress made (Mayer et al., 2018) can contribute to overcome the barrier of present bias.

Reminders increase the salience of the benefits of certain behaviors. Text messages (York, Loeb and Doss, 2018) are the most common and proven way to send reminders. They have been used in the health area, for example, to support smokers to quit smoking (Rodgers et al., 2005) and to promote weight loss (Patrick et al., 2009).

Obtaining immediate benefits from actions that will have a benefit in the future increases the present value of that behavior. Both monetary and non-monetary incentives are effective in generating behavioral changes. In the context of interventions with parents, Fryer, Levitt and List (2015) show that providing monetary incentives for attendance and fulfillment of tasks in a parental program has positive effects on cognitive and non-cognitive test scores of children.

b) Complexity of the parental role, inattention and cognitive fatigue

The complexity of parenting may overwhelm and inhibit parents when making parental investments. Also, the fast pace of current life generates distractions that can hinder the achievement of parenting goals. The stress that arises from financial problems, social isolation and poverty can reduce self-control and consume cognitive resources and, hence, prevent the dedication of parental time to the exercise of good parenting.

Mullainathan and coauthors (Schilbach et al., 2016; Mani et al., 2013; Shah et al., 2012) argue that in poverty, cognitive resources are scarce. The preoccupations that appear due to the scarcity of economic resources reduce the idle capacity of cognitive resources and shorten the "bandwidth" available to make more accurate decisions and behavior (Mani et al., 2013). This results in decisions that are made quickly, intuitively and automatically, and, hence, that are more likely to fall into biases and errors. Therefore, poverty changes the way people assign their cognitive resources and focus their attention, making them

worry about certain problems that seem to be more important than others, because they are more pressing in the present. The authors also state that there are indications that the effects of a diminished "bandwidth" are greater in poverty, as the same mistake can be more expensive for someone poor and the options available to counteract a decreased bandwidth are lower.

Mani et al., (2013) complement their theory with evidence. On the one hand, the authors perform an experiment where a group of individuals must think about financial situations. They find that this framework decreases the cognitive performance of the poor participants, but not of the participants who have a better economic situation. On the other hand, they examine the cognitive performance of rural producers during the harvest of plantations and find that producers have a reduced cognitive performance before planting, when they are poor, compared to after the harvest when they are in a better economic position. This is not explained by differences in food intake, work effort or stress.

To overcome the complexity of the parental role, the lack of attention, and deviation of the cognitive resources, Bryan et al. (2010) propose the use of reminder messages that make more salient the commitment to the desired objective, while Mayer et al. (2018), and York, Loeb and Doss (2018), propose designing solutions that facilitate parenting practices by decomposing complex tasks into simpler ones.

c) Negative identities

Self-esteem and self-confidence are key factors to build intrinsic motivation. The first theoretical model in economics on self-confidence was proposed by Benabou and Tirole (2002). This model suggests that, since skill and effort are complementary factors, an over-optimistic view of one's abilities can be a great motivational factor. In the context of parenthood, trust is essential for parents to feel that they are capable of influencing the trajectory of their children and that their efforts are worthwhile. This reinforces their motivation to exercise good parenting.

On the other hand, identities are closely related to the social group to which the individual belongs. Knowing what other parents in similar situations are doing can be useful as a reference point for deciding how to act. The utility of parental investments can come not only from personal benefits, but also from how consistent that investment is in relation to that of members of the social group the individual belongs to.

Positive feedback, motivational testimonies and peer support can help to promote positive identities (Lavecchia, Liu and Oreopoulos, 2016). Increasing the salience of a positive identity can change both the way in which individuals evaluate their options and their performance (Gennetian et al., 2017).

d) Status quo bias

Adopting new parenting practices requires changing behaviors that are performed routinely or, in other words, breaking the status quo (Samuelson and Zeckhauser, 1988). Even knowing that changing parenting practices could be beneficial for their children's development, parents might find it costly to change their habits. Many of these habits reproduce the parenting patterns of their parents. Establishing options by default can be an effective strategy to overcome this barrier (Madrian and Shea, 2000).

Appendix B: Exploratory assessment of behavioral economics predictions at baseline

Table A1: Regressions of parental investment outcomes on the discount rate, parental stress, and sense of competence

	Physical games	Stimulating activities	Social activities
Discount rate	0.133	-1.539**	0.017
	(0.568)	(0.729)	(0.670)
PSI: Dysfunctional interaction	-0.021**	-0.028**	-0.014
	(0.009)	(0.011)	(0.010)
PSOC	0.275**	0.232	0.257*
	(0.117)	(0.150)	(0.138)
Constant	3.311***	4.311***	3.127***
	(0.555)	(0.712)	(0.655)
N	289	289	289
r2	0.054	0.059	0.025
F	0.001	0.001	0.065

Notes: * p<0.1; **p<0.05; ***p<0.01. Table shows results of regressing each parental investment outcome on the discount rate, parental stress and the sense of competence. PSI= Parenting Stress Index. PSOC= Parental Sense of Competence. Standard errors in parentheses.

Appendix C: Intent to Treat (ITT) effects on every-day parental time investment

Table A2: Intent to Treat (ITT) effects on every-day parental time investment

	ITT=1-ITT=0	p-value adjusting for clustering	p-value adjusting for MHT	p-value from randomization inference	ITT=1-ITT=0			ITT=0 Std. dev.	Power
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Physical games every day	0.071**	0.078	0.051	0.053	0.067**	0.074**	0.076**	0.251	0.396
	(0.030)				(0.031)	(0.031)	(0.030)		
Didactic Activites every day	0.090**	0.109	0.043	0.082	0.093**	0.104**	0.076**	0.356	0.484
	(0.039)				(0.040)	(0.041)	(0.038)		

Social Activities every day	0.067** (0.030)	0.050	0.025	0.042	0.068** (0.030)	0.073** (0.032)	0.050* (0.029)	0.245	0.632
Controls									
None	X								
Strata, child's age & gender, mother's education					X	X	X		
+ mother's age, time elapsed since 1st message, negative shocks, other children in household, other adults in household, intact family						X	X		
+ outcome at baseline if available							X		

Notes: * p<0.1; **p<0.05; ***p<0.01. Rows depict different outcomes. Families of outcomes are identified by a heading in italics. Column (1) reports the ITT coefficient (outcome difference between ITT=1 and ITT=0) and the coefficient's unadjusted robust standard error in parentheses. Column (2) reports the coefficient's p-value adjusted for clustering, the coefficient's p-value adjusted for multiple hypotheses testing and the coefficient's p-value corresponding to the randomization inference. Columns (5)-(7) report the ITT coefficient of specifications that include controls. Column (8) reports the standard deviation of the outcome in the control sample and Column (9) indicates the sample power to detect the observed difference in Column (1). The estimations control for an indicator of whether the subject was randomized to control within treated CAIF centers (the "spillover" sample). # The E2P index and subscales do not include the full set of E2P items in the original scale. The power calculations consider an effect size of 0.2 standard deviations in the case of continuous outcomes and of 10% in the case of dichotomous outcomes. The calculations account for the experimental design (randomization at two levels) and for intra-cluster (intra-CAIF center) correlation of the outcome.