# Calling All Parents: Leveraging Behavioral Insights to Boost Early Childhood Outcomes in the Developing World

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Summary

Early childhood in developing countries faces a greater prevalence of risk factors and limited resources, underscoring the need for effective, scalable support models. We develop and experimentally evaluate a multi-component approach to enhance family well-being over the phone. Our program combines scalable outreaches including calls by a teleoperator, messages, a chatbot, and an AI tool. Targeted at highly vulnerable families with children aged 0 to 3 years in Uruguay, the intervention promotes positive parenting practices at home, fosters language development, and provides personalized assistance to help families access government benefits. The intervention was implemented with 1360 families eligible for support from the government agency Uruguay Crece Contigo over an eight-month period. We find that the program increases weekly frequency of parental engagement in stimulating activities, increases parental knowledge and reduces parental stress. Effects are in the order of 0.20 standard deviations. In addition, we find that the intervention significantly increases parents' knowledge of language stimulation and improves their linguistic interactions with their children in terms of higher average word rate of the mother and pitch range (by 0.37 standard deviations). Treated families made greater use of social benefits (by 0.30 standard deviations) including cash transfers and employment support programs. (JEL: J13, I10, I20, H43)

Data availability
The datasets generated and/or analyzed during the current study are not publicly available due to the presence of protected information, but all de-identified datasets will be made available upon request from the corresponding author to replicate the results.

Code availability
All codes used to generate the results presented in this paper are available from the corresponding author on request.

Ethical Approval
For all the studies involved in the analysis, we received approval from the Universidad de Montevideo Institutional Review Board. The experiments complied with all relevant ethical regulations for work with human participants and involved informed consent of the parents, who were able to ask any questions they might have to a trained Research Assistant.

Previous registration

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The full protocol is registered on the AEA RCT Registry, reference (AEARCTR-0008702).

## I. Introduction

Early environments are crucial in shaping children's health, cognitive development, and socio-emotional well-being. Children living in poverty are especially vulnerable, facing heightened environmental stressors that result in diverging developmental trajectories from an early age (Heckman and Mosso, 2014). This issue is even more pronounced in developing countries, where households encounter a higher prevalence of risk factors and limited access to resources (Grantham-McGregor et al., 2007). Parenting practices and the quality of the home environment are critical during these sensitive early childhood years (Cunha and Heckman, 2008; Todd and Wolpin, 2007; Cunha et al., 2010).

The existing research literature highlights the potential of early childhood interventions, such as educational programs and parenting support, to improve children's developmental outcomes and the quality of early environments (Heckman, 2006). Most existing evidence focuses on intensive programs, either directly engaging children in child-care centers (Campbell and Ramey, 1994; Heckman et al., 2010; Currie, 2001; Garces et al., 2002) or using home-visiting models that work with both parents and children (Gertler et al., 2014; Attanasio et al., 2014; Attanasio et al., 2022).[2] Recent systematic reviews further underscore the effectiveness of parenting interventions in improving early childhood development outcomes and parenting practices, particularly in the first three years of life (Jeong et al., 2021). Although effective (Britto et al., 2017; Dadisman et al., 2024), these programs face significant scalability challenges due to the intensive need for trained facilitators and high levels of oversight (Leer et al., 2016).

In this paper, we demonstrate that an over-the-phone parenting intervention offers a cost-effective and scalable approach to strengthening parental competencies and improving early child-rearing environments. The program operates on a theory of change that highlights the importance of combining multiple activities to achieve meaningful improvements in family environments. It provides personalized guidance and support to parents, helps access to government services and resources, and focuses strongly on enhancing child-caregiver language interactions. The program is structured into two thematic modules, each lasting four months. The first module focuses on general positive parenting practices, addressing areas such as health, nutrition, protection, stimulation, and caregiver self-care. It also places significant emphasis on connecting families with government benefits and services. The second module centers on language stimulation. The intervention is targeted at vulnerable families with children aged 0 to 3 years who qualify for

[2] Evidence from parenting programs indicates positive effects on children's development, with average gains of 0.3 to 0.5 standard deviations, and improvements in parental skills (Bakermans-Kranenburg et al., 2003).

support from Uruguay Crece Contigo (UCC)—the Uruguayan government agency responsible for early childhood protection—and spans 8 months.

The program employs a multi-component approach to enhance family well-being by combining scalable outreaches including calls by a teleoperator, messages, a chatbot, and an AI tool. This design ensures that if one outreach method is less effective for a particular family, others may resonate better. It also allows for a combination of general interventions with adaptable outreach strategies, offering personalized support. The program emphasizes the synergy among its components, which work together to amplify their combined impact rather than focusing on the effectiveness of individual elements in isolation.

The program combines human and technological scalability to deliver its intervention effectively. Weekly telephone sessions with facilitators provide sustained support and ensure that families access eligible government benefits.[3] This is reinforced by weekly text and audio messages, informed by behavioral economics, designed to encourage positive parenting practices and promote self-care. Messages address behavioral biases such as present bias, parental cognitive fatigue, and negative identity influences, all of which can undermine caregiver-child attachment, parental investment, and child development.

Combining the scalable technological approach with human-based intervention sets this program apart from other messaging early childhood interventions. There is growing evidence on the role of technology in scaling early childhood programs.[4] Interventions such as Ready4K (York et al., 2019) and curiosity-driven parenting interventions (Kalil et al., 2022), demonstrate the power of text-based strategies to improve parental engagement using a scalable approach. Similarly, Bloomfield et al. (2022) and Balsa et al. (2021, 2023b), show that an e-messaging program following a parenting workshop significantly improved parenting practices in a developing country. However, emerging research underscores the importance of incorporating human interaction to maximize program effectiveness. For example, in Balsa et al. (2022), when the

[3] Research shows that vulnerable families usually fail to take up benefits they are eligible for due to barriers such as information costs, application complexities, stigma, or psychological frictions like procrastination and inattention (Aizer, 2003; Currie, 2004; Bhargava and Manoli, 2015).

[4] Recent text-messaging interventions have reported favorable outcomes, including increased parental involvement, improved child literacy (York et al., 2019; Doss et al., 2017; Meuwissen et al., 2017; Mayer et al., 2018; Hurwitz et al., 2015), reductions in alcohol consumption during pregnancy (Evans et al., 2012), and enhanced preschool attendance (Ajzenman et al., 2022). Other approaches use automated calls, providing caregivers with short, recorded messages. For instance, in Guatemala, a two-month automated call intervention for caregivers of young children increased caregiver-child interactions (by 0.11 SDs) and vocabulary (by 0.22 SDs) without impacting maternal anxiety or child development overall (Arteaga and Trias, 2023). Similar programs in Jamaica and Jordan showed increases in caregiver interactions but varied effects on stress and self-efficacy (Smith et al., 2023; Rafla et al., 2024). In India, however, an automated call program unexpectedly raised caregiver anxiety and reduced self-efficacy, likely due to limited pacing, lack of age-specific activities, and insufficient child-focused content (Arteaga et al., 2024).

workshop component was removed and the program relied solely on e-messaging, its impact diminished significantly.[5] By integrating scalable technological tools with human-based interventions, the program evaluated in this paper aims to create a more effective approach to improving early environments.

Another innovative aspect of the program is the integration of advanced AI tools that provide new ways of fostering parental engagement. A chatbot provides 24/7 support by simulating interactive conversations and delivering information on past messages, local resources, and transfers, including cash benefits, early childhood centers, ID card issuance, healthcare resources, and domestic violence support.

Additionally, an AI-driven feedback tool allows parents to receive biweekly updates on their language interactions with their children. Parents can upload conversational interactions in the form of WhatsApp audio recordings to the chatbot. These recordings are automatically analyzed to extract vocalizations, conversational turns, and voice pitch range. Feedback is automatically generated when parents upload conversational interactions to the chatbot. The tool recognizes progress and suggests targeted activities to improve specific areas. By focusing on iterative improvement, the tool encourages parents to continually enhance their language interactions.

This feedback mechanism simulates a LENA-type intervention, aiming to stimulate language development in a scalable way. For example, in Suskind et al. (2016), parents were required to collect weekly LENA recordings and received concrete feedback about their home language environment during home visits. While Suskind's experiment was conducted with 37 families, our approach retains the core principles of Suskind et al.'s model while achieving scalability and broader impact using the AI-driven tool.

We evaluate the program through a randomized controlled trial. A total of 1360 families were assigned to either a treatment group or a control group. The treatment group received calls and text and audio messages for eight months, with free access to the chatbot and feedback tool. The control group did not receive any teleassistance or messaging but had access to a restricted version of the chatbot containing information on local resources. Our evaluation includes two follow-up surveys: one four months after the intervention launch and another after eight months. This allows us to assess the impact of the intervention both mid-way and at completion. Surveys were applied

[5] This finding aligns with Gallego et al. (2023), which emphasizes that while low-touch nudges can initiate short-term behavioral changes, sustained and impactful transformation often requires personal support.

by external social workers that do not know the treatment group of the families. We compare the treatment and control groups using an intention-to-treat analysis.

We evaluate families using a telephone survey and language metrics derived from WhatsApp audios of parent-child conversations submitted after the intervention. From the survey, we consider four outcome categories: (i) access to government benefits and programs, (ii) parental involvement and knowledge, (iii) parental well-being and stress, and (iv) child anthropometry.

In the first follow-up, we find that the intervention increased families' access to government benefits (by 0.30 standard deviations (SDs)) and to labor programs promoted by the government. At this point, we observe no effects on the frequency of reported parental involvement with the child. The response rate in the first follow-up was 75% of the sample, and the treated and control groups are balanced.

In the second follow-up, conducted after 8 months, we observe that treated families increased the frequency of parental involvement in cognitive stimulation by 0.19 SDs and parental knowledge of language development by 0.15 SDs. Treated families also show higher well-being (by 0.16 SDs) and lower stress (by 0.2 SDs), along with greater access to government transfers. The second follow-up achieved a 59% response rate, with balanced representation across the treatment and control groups.

Additionally, we analyzed language patterns from WhatsApp audio recordings of conversations between caregivers and children using automated techniques. Audio recordings provide complementary measures on caregiver-child interactions to those collected in the survey. From WhatsApp audios, we extract metrics including the number of adult and child vocalizations, duration of vocalizations, number of conversational turns, and adult voice pitch range. These audio-based outcomes are available for 24% of the sample and have a balanced representation across treatment and control groups. Our analysis reveals that mothers in the treated group have a higher average word rate per minute (by 0.37 SDs) and a greater voice pitch range (by 0.36 SDs) compared to the control group.

We further explore possible mechanisms behind these results. Families who had no prior exposure to one of the main government cash transfers, the Uruguay Social Card, show larger responses to the intervention in terms of parental stress, well-being, and access to government benefits. The intervention also appears to increase parental involvement more effectively among families facing greater economic challenges at baseline. Finally, we observe heterogeneous effects by educational level, with stronger effects on parental stimulation quality and stress for families with higher baseline education levels, who also engaged with the program more intensively.

The remaining of this paper is organized as follows. Section II provides details on the program. Section III describes the impact evaluation methodology. Section IV explains the estimation method. Section V presents the results, and Section VI concludes.

## II. The Program: Teleassistance in Early Childhood and Positive Parenting text and audio messages

### A. Background

Following the height of the SARS-Cov-2 pandemic, the demand for assistance and referrals to the main home visiting program administered by the Uruguayan government was larger than the program's capacity.[6] [7] In response to this situation, the government designed a teleassistance program for families who were on the waiting list for the home visiting program but could not be visited at their homes.

Building on the teleassistance intervention that UCC was designing and exploiting the universal access to smartphones – and the extended use of WhatsApp – in Uruguay, even among poor households, our program added a text and audio e-messaging component that had already been found to be effective in Uruguay (Bloomfield et al., 2022; Balsa et al., 2021). Our program also included a chatbot and an AI feedback device. The design of the program involved developmental psychologists, social communicators, speech therapists and behavioral economists, among others, in coordination with the government team in charge of implementing the intervention.

### B. Intervention contents

The program is separated into two thematic modules with a duration of four months each. The first module covers general positive parenting guidelines including: health, nutrition, protection, stimulation and caregiver's self-care. The program addresses four parental competencies defined by Gomez and Muñoz (2014): affective (parental sensitivity and good treatment), protective (safe environment, routines, and feeding), stimulating (playing and reading) and reflective (self-assessment of parenting and self-care). In Appendix A, Table A1 shows the parenting guidelines in module 1 and Table A2 shows some examples of the messages sent.

The first module also has a strong emphasis on providing families with access to government benefits and services. This is an important feature given that disadvantaged people do not always

[6] The *Programa de Acompañamiento Familiar* (PAF) or Family Support Program is administered by *Uruguay Crece Contigo*, the government agency in Uruguay in charge of early childhood protection, and part of the Ministry of Social Development.

[7] See for example Balsa et al. 2023a for evidence of the effect of the COVID-19 pandemic on household's stressors and wellbeing in Uruguay

take up the benefits for which they are eligible, and this may have detrimental consequences (Aizer, 2003; Currie, 2004). If the costs of gathering information (Bhargava and Manoli, 2015), completing an application process (Bettinger et al. 2012), or the stigma perceptions due to program participation (Currie, 2004) are too high, individuals will not apply, or there may be psychological frictions such as procrastination, inattention and aversion to the program complexity (Bhargava and Manoli, 2015) explaining the failure to take up a government support program. In this sense, helping families remove program application barriers can have significant effects on program participation.

The second module covers language stimulation. The importance of language development during early childhood is well known. It predicts outcomes during youth, such as literacy skills and school success (Zimmerman et al., 2009; Rowe, 2012), as well as outcomes in adulthood, such as mental health and unemployment (Law et al., 2009). The calls and messages in our program encourage parents to engage in supportive, age-appropiate behaviors such as: to pay attention to infant's non-verbal cues, to describe the environment and initiate conversations, and as children age, to wait for the child to respond and engage in two-way conversations, to tell them stories and to sing and read to them (see Tables A3 and A4 in Appendix A).

C. Components of the intervention

a. Telephone calls

Through the first four months of the program, teleoperators are expected to make weekly voice calls to each family, although the frequency is adjusted to the uniqueness of each family. During the following four months, teleoperators make biweekly calls. The teleoperator is always the same for each family and tries reaching five times each family before considering it as an unreachable case.

Teleoperators articulate the different local resources to which families have access and provide families with advice and guidance on parenting, health and nutrition practices. The duration of the calls has an average of 12 minutes.

b. Messages

Each module includes 48 messages that are sent via WhatsApp in text and in audio. Messages are sent three times a week and are personalized according to the child's name, age, and gender, and caregiver's name and gender. In module 1 we personalize messages of the following topics: feeding, limits/safe sleep, play and reading. We adjust messages to two age groups: children younger than 12 months and older children. In module 2, messages are tailored to four age groups

based on the child's stage of development: 6 to 12 months, 12 to 24 months, 24 to 36 months and more than 36 months.

Messages include information about the benefits of improving parenting practices, tips for carrying out practical activities at home, as well as motivational nudges.[8] The contents of the messages seek to mitigate suboptimal decisions caused by present bias, parental cognitive fatigue, and the influence of negative identities.[9] These biases threaten the caregiver-child attachment, prevent parents from investing optimally, and ultimately affect child development.

Based on behavioral economics theory, our messages: (i) remind parents about the benefits of engaging in positive parenting behavior in order to make these benefits more salient and tangible, especially for those inclined towards immediate rewards, and improve investment through activation and recall of prior knowledge; (ii) provide parents with suggestions of simple and concrete activities to help address inattention and decision fatigue by decomposing the complexity of parenting into simpler tasks; (iii) provide parents with self-care suggestions and techniques to help address inattention and decision fatigue by improving parental self-control and emotional regulation; (iv) encourage parents to continue trying, to rely on their own resources and on the support of others, to help parents overcome negative identities and strengthen parental self-efficacy.

The sequence of messages in module 1 is as follows:

> Message 1 (Tuesday). Message with information on a parenting topic.
> Message 2 (Wednesday). Proposal for an activity to do at home.
> Message 3 (Saturday). Reflection on the topic and motivation to continue practicing at home.

The sequence of messages in module 2 is as follows:

Odd week:

> Message 1 (Tuesday). Message with information on a parenting topic.
> Message 2 (Wednesday). Proposal for an activity to do at home.

[8] The average message length across all modules is 433 characters. For module 1, informative messages average 501 characters, activity proposals average 446 characters, and reflection messages average 422 characters. In module 2, informative messages have an average length of 399 characters, activity proposals average 313 characters, and reflection messages average 465 characters.

[9] In the area of early childhood development, behavioral economics has identified the following key barriers to parental investment: a) present-bias – families with large discount rates are less likely to invest in activities that provide benefits only in the future; b) inattention and cognitive fatigue – vulnerability of poor families may reduce the idle cognitive capacity to make accurate decisions; c) Negative identities – the absence of self-esteem and self-confidence prevent parents' motivation to undertake child rearing.

Message 3 (Saturday). Audio request.

Even week:

Message 1 (24 hours after sending audio). Feedback to the audio.
Message 2 (Saturday). Reflection and motivational message.
Message 3 (Sunday). Reflection.

Messages include text, images and emojis, and are also sent in audio format. Figure A1 in Appendix A shows how a message is displayed in WhatsApp.

c. Chatbot

In addition to calls and messages, a specific WhatsApp chatbot was designed for the intervention. This tool allows for a two-way flow of communication between the service provides paid by the research team and families. Families get access to a drop-down menu with information on the messages they previously received, the local resources available to them, and the possibility to notify changes to their mobile phone or to register the phone number of a family member.

Control families have access to a restricted version of the chatbot that only includes information on local resources. Figure A2 in Appendix A shows how the drop-down menu is displayed in WhatsApp for treated families.

d. AI feedback tool

In module 2, we incorporate an artificial intelligence tool that allows to automatically decode WhatsApp audio messages and generate feedback messages for families. The literature on early language interventions in Developmental Psychology (Ferjan Ramírez et al. 2019, 2020; Leech et al. 2018, 2021; Leung et al., 2020; McGillion et al., 2017; Suskind et al., 2016) show that providing parents with feedback, or coaching, regarding their linguistic inputs can enhance parent-child interactions.

The tool was created specifically for this project with the aim of decoding communication and language patterns between the caregiver and the child. It is an innovative and easily scalable device useful for monitoring the child's language development and encouraging language stimulating practices on the side of the caregiver.

The tool can store, decode and respond automatically to WhatsApp audio messages (see Peurey et al., 2023, for a description of the tool). Every two weeks the family is asked to send an audio-recording of a language interaction between the caregiver and the child. Families send these recordings through the WhatsApp chatbot and the recordings are automatically stored and

decoded by an AI software[10] that identifies the number of vocalizations of the caregiver and the child, the duration of vocalizations, the number of conversational turns, and the caregiver's voice pitch frequency and range. Those metrics are compared to the latest audio sent by the family and are used to prepare a personalized feedback message, that congratulates the caregiver on the areas that have improved and suggests activities to work on for areas that have not improved. The feedback message is sent 24 hours after the family sends the audio.

For example, after sending an audio in which the child's vocalizations increased but the number of conversational turns decreased, families received the following feedback: "Great job! (Child's name) spoke more than in the previous audio. Next time, try to encourage more back-and-forth interaction by asking (child's name) open questions."

## III. Impact evaluation: Methodology

### A. Experimental design

#### a) Sample and randomization

Participants were recruited from a list of families waiting to get support from the UCC Family Support Program (PAF), of the Ministry of Social Development (MIDES).[11] The total sample size is 1360 families (See Appendix B for details of the recruitment process).

Participating households were randomized in a stratified manner according to the child's age and mother's education into a treatment group and a control group.[12] The treatment group receives teleassistance and messages for a period of 8 months, access to a chatbot with parenting information and local resources, and access to a language feedback AI tool. The control group only receives access to a chatbot with local resources.

The result of the randomization is shown in Table 1. We implemented the intervention in three batches.[13] Intervention batch 1 has 600 households, of which 399 are from the treatment group

[10] We use the DiviMe software. We previously used this software in Balsa et al. (2022) to obtain language interaction metrics from videos. In this project we embedded DiviMe within an algorithm that stores audios, runs the software and provides automatic feedback to users.

[11] The experiment was approved by the ethics committee of Universidad de Montevideo. The ethics protocol number is: CE 2021/2.

[12] Initially, we intended to have two treatment groups—one with teleassistance only for 4 months and the other one with teleassistance during the full 8-month program. However, the Ministry of Health considered that 4 months were not sufficient to support the families, and we extended teleassistance to all families for the full 8 months. This resulted in a 2/3 to 1/3 distribution between treated and control groups.

[13] When the start date of the program arrived, UCC did not have the operational capacity to assist all treatment families through teleassistance at the same time, so we decided to randomly define three batches of implementation. At the beginning of batch 1, the teleassistance team consisted of 18 teleoperators, 1 supervisor and 1 administrative assistant. As of December 31, 2023, the teleassistance team was composed of: 16 operators, 1 administrative, 2 supervisors and 1 coordinator.

and 201 are from the control group. Intervention batch 2 has 426 households, of which 285 are from the treatment group. Intervention batch 3 has 334 households, of which 167 are from the treatment group.

Table 1: Sample size in each treatment group and intervention batch

| Batch | Control | Treatment | Total |
|---|---|---|---|
| 1 | 201 | 399 | 600 |
| 2 | 141 | 285 | 426 |
| 3 | 167 | 167 | 334 |
| Total | 509 | 851 | 1360 |

b) Implementation

Telephone calls were carried out by MIDES teleoperators with the official telephone number of the Ministry. Out of the 851 treated households, throughout all three batches, 672 were reached by teleoperators in at least one occasion, constituting 79% of all treated households. This can be further decomposed into a 100%, 65% and 67% reach for batches 1, 2 and 3 respectively.

We created and validated a WhatsApp account to send messages. In addition, each of the texts went through a validation process by the WhatsApp service (these validations are mandatory because WhatsApp wants to avoid spam messages). We generated outgoing message campaigns through a web platform that allows personalized messages to each user with the name and gender of the caregiver.

We asked families to provide us with at least one mobile phone where they could be reached. We sent the messages to all the contact numbers we had for each family (mothers, fathers and other caregivers) to maximize the chances that the message would reach the family. For the 399 treated families in batch 1, we sent messages to 528 mobile phones. For the 285 treated families in batch 2, we sent messages to 373 mobile phone contacts. And for the 167 treated families in batch 3, we sent messages to 232 mobile phone contacts. Ninety-one percent of the mobiles that received messages belonged to a woman and 9% belonged to a man. In 77% of households only one female caregiver received messages, in 1% of households only one male caregiver received messages, and in 22% of households both male and female caregivers received messages.

The control group received a welcome message to the chatbot. This message was sent to 201 families with 243 mobile phones in batch 1, and to 141 families with 168 mobile phones in batch 2, and to 167 families with 232 phones in batch 3.

Each intervention module is made up of 50 messages in total: a welcome message, 48 messages sent three times a week for 16 weeks, and a farewell message. For batch 1, the implementation of module 1 began on May 2022, the implementation of batch 2 began on November 2022 and the implementation of batch 3 began on June 2023.[14]

c) Compliance

During the implementation, the *Uruguay Crece Contigo* team asked us to exclude certain families from the program due to their complex situations, which required more intensive interventions, such as home visits, rather than support over the phone. From the 851 treated families, 6% of families were excluded both from calls and messages.[15] Families also had the possibility of opting out from the treatment. 7% of treated families opted out from the program.[16] In Appendix C, Tables C1 and C2 describe families that either were excluded by *Uruguay Crece Contigo* or voluntarily opted out from the program. Families that opt out have less children, are more likely to have only one child, and have less risk of depression. Families that were excluded from the program have younger children, are less likely to receive government assistance, less likely to live in the capital city of Montevideo, have older mothers. In addition, in families that were excluded, it is less likely that the baseline survey was answered by the mother of the child.

During the 32 weeks of program, in which the theoretical maximum calls is 24, the average number of answered calls is 16 on average. When splitting the sample by maternal education, the number of answered calls is 17 for families in which the mother completed middle school and 16 for families with less maternal education. The number of answered calls among families with and without economic shocks, as defined by incurring in large debts, significant income loss or job loss in the previous 12 months of the survey, is 16 in both cases.

[14] In batch 2, between week 6 and 7 of the program, there was a pause in the outgoing campaigns of messages. This was a specific request from the *Uruguay Crece Contigo* team because they understood that the dates between 12/24/22 and 1/10/23 (around Christmas and New Year celebrations) were sensitive for the families receiving the messages and it was best to stop the flow of messages during that period. Teleassistance calls were also stopped during this period. This is a measure that is also applied to home visits carried out by the *Uruguay Crece Contigo* team ("home visiting" is another program of UCC: no household in the teleassistance program nor in the control group participate in the "home visiting" program).

[15] 12% of families were excluded from the calls but kept receiving messages.

[16] 8% of families opted out from the calls, but kept receiving messages, while 9% opted out from the messages, but kept receiving calls.

Approximately 76% of the dispatched messages were successfully received or viewed on the intended mobile phones. Additionally, within households where at least one member received the messages, this proportion increases to 82%. We received 489 audios to be processed with the AI-tool, 49 were received in batch 1, 253 were received in batch 2, and 187 were received in batch 3.

Furthermore, surveys were distributed to gauge treated families' satisfaction with the messages. Nearly all respondents (98%) expressed a positive perception of the messages, and 93% found the weekly frequency to be suitable. The response rate of the satisfaction survey was 40% in module 1 and 17% in module 2. All families where then asked about their satisfaction with the chatbot in the follow-up surveys, where we have higher response rates. In the first and second follow-ups, 80% and 73% of treated families, respectively, reported that the chatbot was helpful in providing information about local resources. Additionally, in the second follow-up, 91% of families indicated that the chatbot was valuable for learning about language stimulation.

B. Evaluation Scales

We analyze data from two follow-up surveys conducted at 4 and 8 months after initiating the intervention, along with baseline survey data. All surveys were administered by telephone, and participants received 300 Uruguayan pesos (8 US dollars[17]) as incentive, in the form of a mobile phone recharge upon survey completion. The collected socioeconomic data encompasses information about: (i) access to government transfers and programs, (ii) parental investment and knowledge, (iii) parental wellbeing and stress and (iv) child's anthropometry. In addition, we asked participants to send us a WhatsApp audio with a conversation between the caregiver and the child. Families received the suggestion of recording the audio during mealtime or reading time. The minimum extension required was 2 minutes.

Table D1 (in Appendix D) provides a summary of the various scales employed in each follow-up and batch. Within access to government benefits, we have information on access to cash transfers such as Uruguay Social Card[18] and the *Bono Crianza* (Parenting Bonus). We also consider access to food baskets in the previous 30 days of the survey and an indicator for receiving free early childhood care vouchers for household with no access to early education in their neighborhoods.

[17] This amount is small relative to a family's total budget (as a comparison, the official minimum wage in Uruguay is 550 USD).

[18] The Uruguay Social Card (TUS) is the means of payment for different monetary transfer benefits granted by the Ministry of Social Development to households and people in situations of extreme socio-economic vulnerability. The amount of the transfer varies (approx. from 30 to 200 USD) depending on the composition of the household.

Finally, we consider access to home improvement benefits. We group all the latter outcomes in a single index that we construct using the first component of a principal component analysis.

We also have information on access to government programs such as labor market programs that have a 6-month duration.

Within parental investment we employ the StimQ index (Dreyer et al., 1996) that assesses frequency and quality of parental involvement in stimulating activities. We construct an index of parental knowledge in childrearing as the total score in four parental knowledge general questions that are answered using a dichotomous measure (YES/NO). We also construct a parental knowledge in language stimulation index, using three specific questions in this topic that are answered in a dichotomous manner.

Regarding parental wellbeing, we use different instruments that we group in a single index using the first component of a principal component analysis. In particular, we group the risk from depression from the CESD-10 scale, the score in the WHO-5 instrument, and questions of the well-being scale of McConkey (2000). We also consider parental stress as measured by the Parenting Stress Index and child's anthropometric measures including weight-for-age and height-for-age.

Finally, we include metrics from WhatsApp audios including number of vocalizations, vocalizations' durations, number of conversational turns, voice pitch and pitch range. These metrics are measured for the mother and for the child.

C. Attrition

Of the 1360 participant families (600 in batch 1, 426 in batch 2 and 334 in batch 3), 942 were surveyed (450 in batch 1, 272 in batch 2 and 220 in batch 3) in follow-up 1 and 753 (362 from batch 1, 236 from batch 2 and 155 from batch 3) at follow-up 2. 312 families (133 from batch 1, 104 from batch 2 and 75 from batch 3) sent the WhatsApp audio during the second follow-up. Sample attrition was very similar among treatment and control families in both follow-up surveys and the small difference that exists is not significant. The response rate differences among treatment and control groups, separated by batch, are not significant either.

D. Balance and Descriptive Statistics

Table 2 shows the mean, standard deviation, and number of observations for a series of sociodemographic variables of the child (Panel A), the caregiver (Panel B), and the household (Panel C) at baseline. In Tables E1, E2 and E3 in Appendix E we show, respectively, descriptive statistics at baseline for respondents of the first follow-up, second follow-up and those that sent the audio. The first three columns correspond to control observations, the second three columns

correspond to treatment observations, and the last three columns show the difference between treated and controls. The children participating in the study are on average 26 months old, 51% of them are boys and 48% are the first child in the family. Less than 0.40% of the sample corresponds to cases of twins. 50% of children attend an educational center.

Almost all the respondents are women (99%). In 95% of the cases, the respondent is the mother and on average she is 28 years old. 25% of caregivers worked in the week prior to the survey. 31% of the sample completed basic secondary education (grades 7, 8 and 9). 28% of caregivers run out of internet on their phone every 15 days.

Poverty is linked to unstable income and expenses, leading to stress and unpredictability, which can negatively impact mental health (Ridley et al. 2024). According to the score obtained on the CESD-10 scale, the depression risk index (CESD-10>=10) is around 38% in the sample.[19] The risk of depression increases if the household is single parent.

With respect to household variables, the number of members is around 5. The number of children in the home on average is 2. 96% of households receive assistance from the government. 55% receive the Uruguay Social Card (TUS) and 79% receive Family Allowances from the Equity Plan – monthly monetary transfer (from 25 to 300 USD) for vulnerable households with pregnant women, children, or individuals with disabilities. 68% of households are overcrowded and 84% of them faced a negative shock such as the death of a family member, large debts or legal problems in the 12 months prior to the survey. On average, the number of negative shocks received was 2. 33% of the households are from Montevideo (the capital city of Uruguay – half of the population of the country lives in Montevideo).

The last three columns of Table 2 show the difference between treated and controls on each covariate at baseline. We report the coefficient, standard error and sample size, of a regression of each covariate on the treatment assignment dummy, taking 1 if the household is treated and 0 if it is not. Of the 28 variables analyzed, first child is significant (it is higher for treated families). The difference is statistically significant at the 5% level. In a set of 28 variables, we should expect a statistical difference at the 5% between treated and controls in 1.4 of them. We found only one, which reflects a good balance.

[19] This figure is consistent with the findings from Balsa et al. (2024), which shows that the prevalence of depressive symptoms among a sample of pregnant who attend public health care providers in Uruguay is 36%.

Table 2: Descriptive statistics at baseline

| | Control | | | Treatment | | | Difference | |
|---|---|---|---|---|---|---|---|---|
| | N | Mean | s.d. | N | Mean | s.d. | N | Coefficient | s.e. |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| *Panel A: Child* | | | | | | | | | |
| Age (months) | 509 | 25.105 | 13.012 | 851 | 27.127 | 12.086 | 1360 | -0.102 | (0.578) |
| Male | 509 | 0.505 | 0.500 | 851 | 0.516 | 0.500 | 1360 | 0.011 | (0.028) |
| First son | 509 | 0.456 | 0.498 | 851 | 0.504 | 0.499 | 1360 | 0.058** | (0.028) |
| Twin | 509 | 0.033 | 0.180 | 851 | 0.039 | 0.193 | 1360 | 0.000 | (0.011) |
| Attends an early childhood center | 509 | 0.517 | 0.500 | 851 | 0.485 | 0.499 | 1360 | -0.018 | (0.028) |
| Lives with mother | 509 | 0.976 | 0.152 | 851 | 0.980 | 0.140 | 1360 | 0.003 | (0.008) |
| Father or male caregiver in household | 509 | 0.607 | 0.489 | 851 | 0.618 | 0.486 | 1360 | 0.006 | (0.028) |
| *Panel B: Caregiver* | | | | | | | | | |
| Woman | 509 | 0.994 | 0.077 | 851 | 0.988 | 0.108 | 1360 | -0.007 | (0.006) |
| Age (years) | 509 | 27.179 | 7.526 | 851 | 28.381 | 35.150 | 1360 | 1.267 | (1.598) |
| Works | 509 | 0.254 | 0.435 | 851 | 0.247 | 0.430 | 1360 | -0.009 | (0.024) |
| Relationship=mother | 509 | 0.953 | 0.212 | 851 | 0.951 | 0.217 | 1360 | -0.001 | (0.012) |
| Completed middle school | 509 | 0.306 | 0.461 | 851 | 0.323 | 0.468 | 1360 | 0.020 | (0.026) |
| Completed high school | 509 | 0.071 | 0.257 | 851 | 0.051 | 0.219 | 1360 | -0.021 | (0.013) |
| Risk of depression | 509 | 0.394 | 0.489 | 851 | 0.366 | 0.482 | 1360 | -0.030 | (0.027) |
| Frequency with no internet access = every week | 509 | 0.327 | 0.410 | 851 | 0.326 | 0.405 | 1360 | -0.000 | (0.023) |
| Frequency with no internet access = once a month | 509 | 0.151 | 0.318 | 851 | 0.149 | 0.314 | 1360 | 0.010 | (0.018) |
| Frequency with no internet access = every 15 days | 509 | 0.266 | 0.385 | 851 | 0.267 | 0.380 | 1360 | -0.005 | (0.022) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency with no internet access = every week | 509 | 0.256 | 0.380 | 851 | 0.258 | 0.376 | 1360 | -0.005 | (0.021) |
| *Panel C: Household* | | | | | | | | | |
| Number of members | 509 | 4.786 | 1.957 | 851 | 4.708 | 2.206 | 1360 | 0.041 | (0.118) |
| Number of children | 509 | 2.177 | 1.375 | 851 | 2.041 | 1.205 | 1360 | -0.096 | (0.072) |
| Overcrowding | 509 | 0.689 | 0.463 | 851 | 0.678 | 0.467 | 1360 | -0.007 | (0.026) |
| Government assistance | 509 | 0.964 | 0.185 | 851 | 0.953 | 0.212 | 1360 | -0.007 | (0.011) |
| Receives TUS | 509 | 0.578 | 0.492 | 851 | 0.534 | 0.498 | 1360 | -0.029 | (0.028) |
| Receives AFAM-PE | 509 | 0.794 | 0.403 | 851 | 0.783 | 0.412 | 1360 | 0.018 | (0.023) |
| Experienced negative shock | 509 | 0.848 | 0.356 | 851 | 0.842 | 0.363 | 1360 | 0.000 | (0.020) |
| Number of negative shocks | 509 | 2.177 | 1.570 | 851 | 2.083 | 1.489 | 1360 | -0.052 | (0.086) |
| Montevideo | 509 | 0.472 | 0.499 | 851 | 0.442 | 0.497 | 1360 | -0.047 | (0.028) |

Notes: * p<.1, ** p<.05, *** p<.01. We impute missing observations with the mean for each variable.

## IV. Estimation Method

We used ordinary least squares to estimate the effect of being assigned to the treatment ($ITT_i$ = dummy that takes on the value of 1 if the family $i$ was randomly assigned to treatment and 0 otherwise) on the outcome variable of interest, $Y_i$, and $B_i$ which is a batch fixed effect.

$$Y_i = \beta_0 + \beta_1 \, ITT_i + B_i'\beta_2 + S_i'\beta_3 + X_i'\beta_4 + e_i \qquad (1)$$

We also adjust Equation (1) subsequently for the following set of covariates: (i) stratum fixed effects ($S_i$ includes 4 strata, given by the combinations of two age groups of the child and two groups of mother's education[20]), (ii) a set of covariates $X_i$ that were unbalanced at baseline and (iii) a baseline measure of the outcome variable if available.[21]

In the estimates we use robust standard errors. For each family of outcomes, we adjust standard errors to account for multiple hypothesis testing using the Romano-Wolf correction (Clarke et al., 2020). Families of outcomes are marked with a heading in bold.

## V. Results

In this section we present the main results of the program. We first show results for the outcome variables obtained from the questionnaire including (i) access to government benefits, (ii) parental inputs, (iii) parental wellbeing and stress, and (iv) child's anthropometry. Following, we present results for language metrics obtained from WhatsApp audios. Finally, we assess heterogeneous effects by: maternal socioeconomic level, whether the household received economic shocks, whether the family received TUS at baseline and whether the child is the first of his or her family.

### A. Main results

Table 3 shows estimates of intervention effects on several outcome variables.[22] Estimates were obtained from a regression of each dependent variable on an indicator of treatment intention that takes on the value of 1 if the household is treated and 0 if it is a control. The first four columns correspond to the results of the first follow-up and columns (5)-(8) correspond to the results of the second follow-up. Columns (1) and (5) show the raw treatment-control differences and the

[20] We defined a stratum according to whether the mother completed middle school or not. We define another stratum according to whether the child's age was greater or less than 18 months as of March 10, 2022.

[21] We also estimated a variation of the specification of equation (1) with control variables that have been selected based on the method described in Belloni et at. (2014). The method consists of selecting the variables that best predict the treatment status with a LASSO regression, and then selecting the variables that best predict the outcome, with a LASSO regression as well. Our results are robust to this alternative specification.

[22] This table contains main results of the intervention using summary índices. Results of the full set of outcomes assessed are reported in Appendix F.

coefficient's unadjusted standard error. Columns (2) and (6) show ITT effects after adjusting for stratum used in the randomization, and the first child dummy. Columns (3) and (7) add a control for the outcome at baseline, if available. In columns (4) and (8) we report the p-values corresponding to the outcome difference by ITT status reported in columns (1) and (5) when adjusting for multiple hypothesis testing. Families of outcomes are marked with a heading in bold and italics. We report the number of observations for each regression in straight parentheses. In Appendix G we report power calculations to detect an effect of 0.2 SDs in continuous outcomes and of 20% in dichotomous outcomes. In Appendix H we show results for the panel of families that answered both follow-ups.

We find that in the first and second follow-up, treated families report having accessed more government transfers than control families. The magnitude of the effect is of 0.30 SDs (standard deviations of each outcome are reported in Table D1 in the Appendix) and is significant at the 1% level. After the first four months of intervention, there is also an increase in access to labor programs sponsored by the government in 0.23 SDs. In the second follow-up, the program increased the frequency of parental involvement in stimulating activities as measured by the Stim-Q. The effect is of 0.19 SDs. We also find an effect on parental knowledge in language stimulation of 0.15 SDs. We find no impact on parental investment quality and on parental knowledge in general childrearing topics. Regarding parental wellbeing, we find a decrease in parental stress, which is significant in the second follow-up. The reduction is of 0.19 SDs. Finally, results on child's anthropometry are non-significant, but power to detect an effect on these outcomes is less than 50% (see Appendix G).

Table 3: Effects of the intervention on access to government transfers and programs, parental involvement, caregiver well-being and child's anthropometry. Coefficients in standard deviations.

| | 1st follow-up | | | | 2nd follow-up | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A: Government transfers and programs** | | | | | | | | |
| Government transfers | 0.296*** | 0.306*** | 0.300*** | 0.010 | 0.301*** | 0.329*** | 0.337*** | 0.010 |
| | (0.068) | (0.066) | (0.059) | | (0.076) | (0.074) | (0.069) | |
| | [873] | [871] | [866] | | [705] | [704] | [700] | |
| Labor programs | 0.230*** | 0.232*** | | 0.010 | 0.074 | 0.068 | | 0.594 |
| | (0.071) | (0.072) | | | (0.079) | (0.079) | | |
| | [939] | [937] | | | [747] | [746] | | |
| **Panel B: Parental investment and knowledge** | | | | | | | | |
| Parental Knowledge – Childrearing | 0.097 | 0.099 | | | 0.029 | 0.015 | | 0.713 |
| | (0.068) | (0.067) | | | (0.079) | (0.078) | | |
| | [932] | [930] | | | [733] | [732] | | |
| Parental Knowledge – Language | | | | | 0.150** | 0.145* | | 0.099 |
| | | | | | (0.075) | (0.075) | | |
| | | | | | [730] | [729] | | |
| StimQ - Frequency | | | | | 0.187** | 0.181** | | 0.059 |
| | | | | | (0.077) | (0.076) | | |
| | | | | | [740] | [739] | | |
| StimQ - Quality | | | | | -0.082 | -0.069 | | 0.891 |
| | | | | | (0.071) | (0.071) | | |
| | | | | | [740] | [739] | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Panel C: Parental Wellbeing and Stress** | | | | | | | | |
| Wellbeing Index | 0.006 | 0.013 | | 0.307 | 0.156** | 0.156** | | 0.079 |
| | (0.094) | (0.094) | | | (0.079) | (0.079) | | |
| | [467] | [466] | | | [697] | [696] | | |
| Parental Stress Index | -0.066 | -0.061 | | 0.723 | -0.193** | -0.193** | | 0.079 |
| | (0.091) | (0.092) | | | (0.078) | (0.078) | | |
| | [479] | [478] | | | [697] | [696] | | |
| **Panel D: Child's anthropometry** | | | | | | | | |
| Weight for age | 0.186 | 0.185 | -0.152 | 0.673 | 0.116 | 0.109 | 0.029 | 0.228 |
| | (0.121) | (0.123) | (0.155) | | (0.107) | (0.108) | (0.113) | |
| | [329] | [328] | [155] | | [389] | [388] | [269] | |
| Height for age | -0.107 | -0.108 | -0.107 | 0.663 | -0.070 | -0.080 | -0.162 | 0.762 |
| | (0.128) | (0.130) | (0.166) | | (0.106) | (0.106) | (0.127) | |
| | [309] | [308] | [133] | | [354] | [353] | [217] | |
| Controls | | | | | | | | |
| Strata and unbalanced vars | N | Y | Y | | N | Y | Y | |
| Variable in baseline if available | N | N | Y | | N | N | Y | |

Notes: * p<.1, ** p<.05, *** p<.01. Rows depict different outcomes. Families of outcomes are identified by a heading in italics. Columns (1)-(4) and (5)-(8) report the ITT coefficient (outcome difference between ITT=1 and ITT=0) in the first and second follow-up respectively. Columns (2)-(3) and (5)-(7) report the ITT coefficient of specifications that include controls. We adjust for multiple hypothesis testing the p-values of the coefficients in columns (2) and (6) and report these in columns (4) and (8) respectively. Families of outcomes are marked with a heading in bold. Number of observations are reported in straight parentheses.

Table 4 shows results obtained from short conversations uploaded as WhatsApp audio messages. We consider outcomes of the mother, of the child and of both of them together. We normalize audio recording length in Columns (1), (2), (5) and (6). The average word rate per minute of the mother increases and is significant at the 10% level. In addition, the pitch range of mothers also increases, and the effect has a magnitude of 0.762.

Table 4: Effects of the intervention on language outcomes. Coefficients in standard deviations.

| | Mother's average word rate per minute | Mother's number of vocalizations per hour | Mother's pitch range | Mother's pitch | Child's number of vocalizations per hour | Number of turn transitions between the child and the adult per hour |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Coefficient | 0.369* | 0.114 | -0.152 | 0.355* | 0.036 | -0.064 |
| | (0.216) | (0.149) | (0.176) | (0.185) | (0.171) | (0.162) |
| N | 123 | 123 | 123 | 123 | 123 | 123 |

Notes: * p<.1, ** p<.05, *** p<.01. Columns depict different outcomes. The table reports the ITT coefficient (outcome difference between ITT=1 and ITT=0) in the second follow-up for each outcome. We control for strata and for a dummy that indicates whether the child is the first of his or her family. We also control for the outcome at baseline. Number of observations are reported below each coefficient.

B. Heterogeneous impacts

To assess the mechanisms by which the intervention operates, we explore program heterogeneity across three dimensions: (i) mother's education level, (ii) presence of economic shocks in the household, (iii) recipient status of the main cash transfer (TUS) at baseline, and (iv) first child.[23] Results are presented in Tables 7, 8, 9 and 10. The first three columns correspond to the first follow-up and the last three columns correspond to the second follow-up. Columns (1), (2), (4) and (5) shows the coefficients and standard errors from an Ordinary Least Squares (OLS) regression of the outcome in each row on the ITT main effect, the interaction between ITT status and the variable capturing the mechanism, the main effect of the mechanism, maternal education, a dummy for whether the household received an economic shock, and a dummy for whether the household received TUS at baseline and randomization strata. The table displays only the ITT main effect and the interaction of ITT with the mechanism. Table 5 shows that families in which

[23] Due to the limited number of observations in the language outcomes, we do not consider these in the heterogeneity analysis.

the mother has completed middle school derive some additional benefits from the intervention in terms of access to government transfers (see Column (2)), parental involvement in stimulating activities and parental stress index (see Column (5)). These results are in line with the fact that families in which the mother completed middle school have less issues of connectivity, change phone numbers less often and are therefore easier to contact and to provide the intervention.

Table 5: Heterogeneous impacts by mother's education level. Coefficients in standard deviations.

| | 1st follow-up | | | 2nd follow-up | | |
|---|---|---|---|---|---|---|
| | ITT | ITT x completed middle school | N | ITT | ITT x completed middle school | N |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Government transfers | 0.209*** | 0.267* | 873 | 0.263*** | 0.143 | 705 |
| | (0.079) | (0.146) | | (0.090) | (0.164) | |
| Labor programs | 0.210** | 0.049 | 939 | 0.125 | -0.149 | 747 |
| | (0.085) | (0.156) | | (0.096) | (0.169) | |
| Parental Knowledge - Childrearing | 0.120 | -0.055 | 932 | -0.056 | 0.247 | 733 |
| | (0.082) | (0.136) | | (0.097) | (0.165) | |
| Parental Knowledge - Language | | | | 0.161* | -0.027 | 730 |
| | | | | (0.091) | (0.158) | |
| StimQ - Frequency | | | | 0.136 | 0.147 | 740 |
| | | | | (0.097) | (0.152) | |
| StimQ – Quality | | | | -0.148 | 0.247* | 740 |
| | | | | (0.092) | (0.138) | |
| Wellbeing Index | 0.007 | 0.009 | 467 | 0.187** | -0.075 | 697 |
| | (0.114) | (0.195) | | (0.092) | (0.173) | |
| Parental Stress Index | -0.010 | -0.173 | 479 | -0.090 | -0.317** | 697 |
| | (0.115) | (0.179) | | (0.099) | (0.160) | |
| Weight for age | 0.232 | -0.125 | 329 | 0.134 | -0.126 | 389 |
| | (0.156) | (0.257) | | (0.137) | (0.224) | |
| Height for age | -0.111 | 0.019 | 309 | -0.080 | -0.012 | 354 |
| | (0.164) | (0.267) | | (0.134) | (0.217) | |

Note: Columns (1), (2), (4) and (5) denote a specific model in which the ITT is interacted with a dummy that takes value of 1 if the mother completed middle school. The first three columns correspond to the first follow-up and the second three correspond to the second follow-up. 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. Standard errors are reported in parentheses. All regressions adjust for randomization strata, maternal education, a dummy for whether the household received an economic shock and a dummy for whether the household received TUS at baseline. N corresponds to number of observations. *p<.1, **p<.05, ***p<.01.

Table 6 shows that families that experienced an economic shock at baseline, as defined by incurring in large debts, significant income loss or job loss in the previous 12 months of the survey, are more likely to increase the frequency of parental involvement in stimulating activities and the wellbeing index in the second follow-up (see Column (5)). In Bloomfield et al. (2022) we show that families with more negative shocks in the past have stronger behavioral barriers and engage less frequency with their children. Because the intervention, and particularly the messaging component, was designed to address these barriers, the results from Table 6 suggest that the intervention triggered the right channels. The heterogeneous effects for these families seem to appear after 8 months of intervention, but not earlier. In fact, there is a negative effect on the interaction coefficient for parental knowledge when considering the first follow-up.

Table 6: Heterogeneous impacts by economic shocks. Coefficients in standard deviations.

| | 1st follow-up | | | 2nd follow-up | | |
|---|---|---|---|---|---|---|
| | ITT | ITT x shocks | N | ITT | ITT x shocks | N |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Government transfers | 0.494* | -0.196 | 205 | 0.354** | -0.063 | 705 |
| | (0.271) | (0.308) | | (0.148) | (0.172) | |
| Labor programs | -0.207 | 0.537 | 219 | 0.195 | -0.161 | 747 |
| | (0.321) | (0.368) | | (0.133) | (0.163) | |
| Parental Knowledge - Childrearing | 0.309 | -0.576* | 218 | -0.088 | 0.155 | 733 |
| | (0.250) | (0.293) | | (0.158) | (0.180) | |
| Parental Knowledge - Language | | | | 0.242* | -0.123 | 730 |
| | | | | (0.133) | (0.160) | |
| StimQ - Frequency | | | | -0.120 | 0.419** | 740 |
| | | | | (0.154) | (0.176) | |
| StimQ - Quality | | | | 0.010 | -0.109 | 740 |
| | | | | (0.134) | (0.159) | |
| Wellbeing Index | -0.065 | -0.090 | 208 | -0.051 | 0.293* | 697 |
| | (0.282) | (0.319) | | (0.141) | (0.169) | |
| Parental Stress Index | 0.032 | 0.183 | 215 | -0.176 | -0.025 | 697 |
| | (0.293) | (0.331) | | (0.137) | (0.166) | |
| Weight for age | 0.415 | 0.030 | 167 | -0.074 | 0.227 | 389 |
| | (0.352) | (0.413) | | (0.189) | (0.231) | |
| Height for age | 0.296 | -0.505 | 154 | -0.258 | 0.244 | 354 |
| | (0.404) | (0.455) | | (0.190) | (0.232) | |

Note: Columns (1), (2), (4) and (5) denote a specific model in which the ITT is interacted with a dummy that takes value of 1 if the family received an economic shock at baseline. The first three columns correspond to the first follow-up and the second three correspond to the second follow-up. 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. Standard errors are reported in parentheses. All regressions adjust for randomization strata, maternal education, a dummy for whether the household received an economic shock and a dummy for whether the household received TUS at baseline. N corresponds to number of observations. *p<.1, **p<.05, ***p<.01.

In Table 7, we interact the ITT dummy with a dummy that takes value of 1 if the family did not have TUS at baseline. As expected, we find that families that did not receive Uruguay Social Card before the intervention are more likely to receive government transfers during the intervention. The effect is persistent both in the first and the second follow-up. In addition, we find that having no transfers at baseline, and therefore receiving them during the intervention, increases the effect of the program on the wellbeing index and on parental stress. We find no heterogeneous effects on parental involvement. Taken together, this evidence suggests that the monetary component of the intervention seems to be the mechanism behind the effect on parental stress.

Table 7: Heterogeneous effects by no-TUS at baseline. Coefficients in standard deviations.

| | 1st follow-up | | | 2nd follow-up | | |
|---|---|---|---|---|---|---|
| | ITT | ITT x no TUS | N | ITT | ITT x no TUS | N |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Government transfers | 0.086 | 0.473*** | 868 | 0.122 | 0.453*** | 701 |
| | (0.068) | (0.121) | | (0.083) | (0.140) | |
| Labor programs | 0.156 | 0.155 | 934 | 0.173 | -0.209 | 743 |
| | (0.098) | (0.143) | | (0.109) | (0.158) | |
| Parental Knowledge - Childrearing | 0.119 | -0.047 | 927 | 0.002 | 0.050 | 729 |
| | (0.091) | (0.132) | | (0.105) | (0.156) | |
| Parental Knowledge - Language | | | | 0.087 | 0.124 | 726 |
| | | | | (0.100) | (0.151) | |
| StimQ - Frequency | | | | 0.075 | 0.245 | 736 |
| | | | | (0.102) | (0.151) | |
| StimQ - Quality | | | | -0.090 | 0.055 | 736 |
| | | | | (0.093) | (0.145) | |
| Wellbeing Index | -0.149 | 0.333* | 464 | 0.085 | 0.164 | 693 |
| | (0.123) | (0.188) | | (0.105) | (0.158) | |
| Parental Stress Index | 0.090 | -0.333* | 476 | -0.033 | -0.368** | 693 |
| | (0.127) | (0.181) | | (0.106) | (0.159) | |
| Weight for age | 0.286 | -0.201 | 328 | 0.107 | -0.035 | 387 |
| | (0.175) | (0.252) | | (0.139) | (0.221) | |
| Height for age | 0.076 | -0.358 | 308 | 0.062 | -0.321 | 353 |
| | (0.168) | (0.263) | | (0.141) | (0.214) | |

Note: Columns (1), (2), (4) and (5) denote a specific model in which the ITT is interacted with a dummy that takes value of 1 if the family did not receive TUS at baseline. The first three columns correspond to the first follow-up and the second three correspond to the second follow-up. 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. Standard errors are reported in parentheses. All regressions adjust for randomization strata, maternal education, a dummy for whether the household received an economic shock and a dummy for whether the household received TUS at baseline. N corresponds to number of observations. *p<.1, **p<.05, ***p<.01.

Table 8 shows heterogeneous effects by a dummy that indicates whether the child is the first of his or her family. Firstborns show larger effects on government transfers, but smaller effects on parental knowledge in childrearing in the first follow-up. In the second follow-up there are differential effects on the wellbeing index, suggesting that families that received the intervention for their first child, have a higher wellbeing that those that have older children also.

Table 8: Heterogeneous effects by first child. Coefficients in standard deviations.

| | 1st follow-up | | | 2nd follow-up | | |
|---|---|---|---|---|---|---|
| | ITT | ITT x first child | N | ITT | ITT x first child | N |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Government transfers | 0.192** | 0.244* | 871 | 0.227** | 0.211 | 704 |
| | (0.085) | (0.134) | | (0.097) | (0.149) | |
| Labor programs | 0.289*** | -0.147 | 937 | 0.182* | -0.247 | 746 |
| | (0.096) | (0.143) | | (0.104) | (0.158) | |
| Parental Knowledge - Childrearing | 0.247*** | -0.317** | 930 | 0.075 | -0.123 | 732 |
| | (0.088) | (0.134) | | (0.110) | (0.155) | |
| Parental Knowledge - Language | | | | 0.059 | 0.206 | 729 |
| | | | | (0.096) | (0.151) | |
| StimQ - Frequency | | | | 0.279*** | -0.211 | 739 |
| | | | | (0.107) | (0.151) | |
| StimQ - Quality | | | | -0.069 | 0.009 | 739 |
| | | | | (0.101) | (0.144) | |
| Wellbeing Index | -0.033 | 0.086 | 466 | -0.056 | 0.478*** | 696 |
| | (0.129) | (0.189) | | (0.103) | (0.156) | |
| Parental Stress Index | 0.052 | -0.252 | 478 | -0.117 | -0.174 | 696 |
| | (0.126) | (0.182) | | (0.106) | (0.157) | |
| Weight for age | 0.091 | 0.183 | 328 | 0.153 | -0.138 | 388 |
| | (0.171) | (0.244) | | (0.150) | (0.218) | |
| Height for age | -0.057 | -0.112 | 308 | 0.034 | -0.269 | 353 |
| | (0.190) | (0.258) | | (0.145) | (0.216) | |

Note: Columns (1), (2), (4) and (5) denote a specific model in which the ITT is interacted with a dummy that takes value of 1 if the child is the first from his or her family. The first three columns correspond to the first follow-up and the second three correspond to the second follow-up. 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. Standard errors are reported in parentheses. All regressions adjust for randomization strata, maternal education, a dummy for whether the household received an economic shock and a dummy for whether the household received TUS at baseline. N corresponds to number of observations. *p<.1, **p<.05, ***p<.01.

## VI. Conclusions

In this work we design, implement, and experimentally evaluate an over-the-phone program which combines calls from a teleoperator with messages, a chatbot and a feedback AI tool. The program is targeted at families with children from 0 to 3 years old and was implemented in Uruguay with 1360 families that qualified to receive support from the government agency *Uruguay Crece Contigo*. The intervention focuses on supporting positive parenting practices at home, fostering language development and offers one-to-one assistance for taking up the government benefits that families are entitled to.

Overall, the program was well-received by treated families: 90% of families report that the chatbot is useful to gather information on parenting practices and language stimulation, and 75% of families report the chatbot is useful to gather information on local resources. In addition, teleoperators value the tool. From qualitative surveys, teleoperators report that messages allow to "break the ice" when calling families and anchor the sequence of calls around topics with which the family has already been in contact during the week. Also in some cases, facilitators prefer to start the conversation "chatting" instead of talking, which allows them to gradually gain the trust of the caregivers. An additional advantage is that with a telephone intervention it is possible to reach rural places, where there are no territory teams that can make home visits.

After 4 months of intervention, we find that treated families have more access to social benefits. The effects are of a magnitude of 0.30 SDs. Treated families have also more access to government sponsored labor programs (in 0.23 SDs).

In the second follow-up, after 8 months of intervention, parental involvement in stimulating activities, measured by questions of the StimQ-Frequency, is 0.19 SDs higher for the treated group. In addition, parental stress is lower, and wellbeing is higher for treated families (by 0.19 and 0.16 SDs respectively) and the treatment group continues to have more access to social benefits.

In line with the findings from the pilot study of Suskind et al. (2016), we find that the intervention significantly increases parents' knowledge of language stimulation and improves their linguistic interactions with their children in terms of higher average word rate of the mother and pitch range. We extend the work of Suskind et al. (2016) by offering a more scalable and cost-effective intervention. Furthermore, we expand upon the set of outcomes analyzed by including an additional metric—pitch range—alongside the previously examined word rate and other linguistic aspects. Overall, while building on the foundational insights of Suskind et al. (2016), our study addresses important limitations by focusing on scalability and broadening the scope of outcomes analyzed.

The results show that providing financial and personal support is effective to smooth economic shocks. Targeting parental stress seems to be key in such vulnerable households where 68% of them are overcrowded and 84% faced negative shocks such as the death of family member, large debts or legal problems in the prior 12 months of the survey (see Table 2). In turn, it is possible that one of the main channels through which the program affects parental involvement is by decreasing parental stress. Studies show that depression and anxiety directly affect the way people think, and thus distort important economic decisions made by individuals during their children's early childhood and therefore parental mental illness can also influence children's development. Cuijpers et al. (2015) find that treating maternal depression improves interaction with their children.

The lower parental stress achieved by the intervention may be the result of the helping hands of teleoperators that encourage the take up of social protection (we find greater access to monetary transfers and public programs). Indeed, we find heterogeneous effects depending on whether the household received or not received the Uruguay Social Card transfer at baseline. Parental stress is lower for those that did not have this transfer before the intervention. The usefulness of the chatbot for parenting issues also seems to be important, as families that were more intensively treated with the intervention (those with higher educational level), and those with more behavioral barriers at baseline have higher impacts on the frequency of parental stimulation.

Since the results come from self-reported surveys, it is not possible to rule out the presence of an experimenter demand effect. However, the possibility of experimenter demand effect is undermined by the fact that questionnaires are not applied by the teleoperator -that may affect the answers of the families in the follow-up- but by external social workers that do not know the treatment group of the families. Finally, it should also be noted that families were instructed during the surveys that their answers would remain anonymous and would only by analyzed in an aggregate manner. This information may have likely mitigated the incentives for parents to offer the desirable answers.

Our results are in line with those from Bloomfield et al. (2022) and Balsa et al. (2021) in the sense that we find that the intervention is useful to increase parental involvement and improve language interactions between the parent and the child. In this paper, we additionally show that parental stress and wellbeing can be influenced by including one-to-one telephonic assistance to obtain cash transfers that families are entitled to receive.

This paper highlights that an over-the-phone program can have substantial positive effects on parental competencies and early child-rearing environments. A back-of-the-envelope estimate

places the implementation cost at $350 per family, with 78% of this cost allocated to teleoperator components and 22% to messaging and chatbot services. This figure is notably lower than the average cost of traditional home visiting programs, which can reach up to $10,503 per family (Glazner et al., 2005). The success of this program demonstrates its potential as a cost-effective alternative that could be scaled to benefit a broader population.

Recognizing its impact, the Ministry of Social Development in Uruguay has already established a dedicated team of teleoperators to scale up the program, aiming to extend its benefits to a larger sector of the population. The next version of this paper will include administrative registries to complement the results of this work and, in future research, we will conduct a third follow-up that includes observational data to assess child development and cortisol measures to assess parental stress.

Appendix A: Intervention contents

Table A1: Parenting topics included in intervention module 1.

| Week | Topic | Parental competence |
|---|---|---|
| 1 | Parental sensitivity | Affective |
| 2 | Parental sensitivity | Affective |
| 3 | Good treatment | Affective |
| 4 | Safety at home | Protective |
| 5 | Routines | Protective |
| 6 | Routines | Protective |
| 7 | Feeding | Protective |
| 8 | Feeding | Protective |
| 9 | Limits / Safe sleep | Protective |
| 10 | Play | Stimulating |
| 11 | Play | Stimulating |
| 12 | Reading | Stimulating |
| 13 | Reading | Stimulating |
| 14 | Self-care | Reflective |
| 15 | Self-care | Reflective |
| 16 | Parental involvement | All |

Table A2: Examples of messages sent during module 1, by topic and parental competence addressed

| Topic | Parental Competence | Type of message | Message |
|---|---|---|---|
| Parental Sensitivity | Affective | Informative | When (child's name) is fussy, do you notice that you understand him or her better when you put yourself in his or her place? Their face will give you clues about what they need, so trust your intuition! Try different responses like giving him/her a hug or sitting on your lap. And even if you're wrong sometimes, know that the most important thing for your child to feel safe is to be attentive and always try to respond sensitively. 💞 |
| | | Activity proposal | We all have difficult days, when we are more tired and less patient. On those days, if (child's name) cries or is fussy, try to manage your discomfort and mood so you don't get angry with (her). You can talk to her and express what is happening to you. Try saying, "Mommy is tired today. Or ask her "why are you crying, how can I help you?" Talking to her in a calm and loving tone will help you tune in to (child's name) even on those days when it's hard. 🤗 |
| | | Reflection | These past few weeks we've been seeing that when (child's name) cries or is fussy, he/she may want to tell you a lot of things. It's normal to be worried, upset or upset, especially when she seems inconsolable. She's just trying to tell you what's wrong.<br><br>Keep exercising your watchful eye and when you are overwhelmed, be sure to turn to other adults around you. |
| Good treatment Good treatment | Affective | Informative | Children who feel loved and contained develop and learn better. It is not necessary to set aside long hours, (child's name) will feel your love and containment as long as you are emotionally willing and give yourself in the daily moments of shared enjoyment. That is the sure foundation that will make your (daughter) feel happy and loved. |

| | | | |
|---|---|---|---|
| | | | Also, there's something you need to know: there's never too much cuddling! 💗<br>There's a false belief that cuddling is a habit, but it's not. Don't hesitate to cuddle (child's name) when you see (child's name) looking for it. |
| | | Activity proposal | Children need to be treated with care and kindness. Always avoid sudden movements when dealing with (child's name). Talk softly and never shake (child's name) to stop crying.<br><br>When (child's name) cries, you can soothe him/her by holding him/her or putting him/her very close to you.<br>You'll find it works and it's a way to show your unconditional love - we all like to be treated well! 😊 |
| | | Reflection | Your love is extremely important to your child's development. We know you want the best for (child's name) and (she) feels it.<br><br>Don't worry if some days you feel distant or disconnected from (her). When we feel stressed this can be normal. At those times, find a way to relax and lean on someone else to take over (child's name)'s care. When you are calmer, you will feel connected again.<br><br>Trust the value of hugs and kisses. Never put (child) to bed without first giving him/her a hug.<br>💛 |
| Routines | Protective | Informative | Routines give children security and confidence and also organize family life.<br><br>To generate them, we must organize daily activities (such as feeding, sleeping and bathing) and repeat them. The more we repeat them, the stronger the routine becomes established.<br><br>Toddlers don't understand times or schedules. But (child's name) will gradually understand "what comes next" if you repeat his daily routines of feeding, bathing and sleeping in the order that works best in your home.<br><br>What are (child's name)'s routines? 🗓️ ⏰" |
| | | Activity proposal | Games add a lot on an emotional level and you can include them in the day's activities to help (child's name) anticipate routines.<br><br>Sometimes it helps to repeat the same song at bath time (remember "Al agua pato"?) or look for the same toy before taking (child's name) to the bathroom. 💦<br><br>That way, we are sure that (child's name) will enjoy the bath. Do you have a bedtime song? 🤗<br><br>Here we leave you some ideas:<br>(link to a page with song playlist) |
| | | Reflection | Do you notice changes in (child's name) when you struggle to follow the same routine every day? Routines provide containment, security and lower anxiety - and that helps both (her) and you enjoy it so much more! 😍<br><br>How about incorporating a bedtime story into your sleep routine? |
| Play | Stimulating | Informative | As she gets older, (child's name) is likely to become more fidgety and find it hard to stay with the same toy for long periods of time.<br><br>She'll play with you sometimes, other times she'll choose to play alone, and she'll probably have trouble sharing her things. And she will probably find it hard to share her things, which is normal for her age! |

| | | | |
|---|---|---|---|
| | | | To teach him to share, try telling him that if a friend borrows a toy, he won't take it away. Sharing is learned and you have to help him/her do it. 💛 |
| | | Activity proposal | We know (child's name) is very active at this time. It's age.<br><br>It's normal for her to seek new challenges with her body like jumping, climbing or running. She will always feel safer if you are close by.<br><br>This week we invite you to explore objects and put toys together with him/her. Here's an idea: Find a string you have at home and two or three rolls of toilet paper (without paper). It's a worm! You can paint it or decorate it together. 😊 |
| | | Reflection | At this stage when (child's name) is so wiggly, we want to remind you that screens (TV, cell phone, computer) are not a recommended option for children under 4 years old. They provide a lot of information that (child's name) cannot process yet and, if you think about it, being in front of the screen takes time away from things that do add up, such as playing and communicating with other people.<br><br>But if you need to resort to them at certain times, be sure to control the quality of what she sees and interact with her while she is in front of the screen. The benefits of limiting or even eliminating screen time in these early moments will last a lifetime. 💫 |
| Reading | Stimulating | Informative | Reading and stories, as well as play, also help (child's name) learn and develop.<br><br>Reading gives her vocabulary, helps her imagination and intelligence unfold.<br><br>Stories envelop children in magical worlds full of emotions. Tell stories, change the tone of voice, immerse (her) in that world.<br><br>(Child's name) will play an increasingly active role as you read to her. He/she will ask questions, interrupt your stories. Let him (her) interact with the books, he (she) may want to see only the illustrations or start at the end. Whatever exchange you choose to make with the book, it will allow him/her to get closer to the reading. |
| | | Activity proposal | Reading brings a lot to people. The best thing to do is to include it in the daily routine and, in addition, to enjoy it. We invite you to think about what quiet time would be a good time to read to (child's name).<br><br>We believe that the time before bedtime is, in general, a good time because it helps your child to calm down before going to sleep.<br><br>Sometimes it's not necessary to have a book. You can choose a magazine, show him/her pictures and create simple stories, help him/her to imagine!<br><br>Try asking him questions. For example: "What do you think is going to happen next? How many animals are there? What color are their eyes? Let him/her participate in the stories, changing the names of characters for family names. If he/she gets involved with reading and stories, he/she will develop more his/her language, imagination and intelligence. 📖 ❤️ |
| | | Reflection | Reading time can become a space for connection and daily enjoyment shared by both of us.<br><br>Take advantage of reading to him/her every day. Transform that time into something special for both of you. Because you are also giving him/her the pleasure of reading and that will last a lifetime. |

| | | | |
|---|---|---|---|
| | | | Enjoy every book together, every shared story, celebrate the stories! 📚👏🏻 |
| Self-care | Reflective | Informative | There are emotions such as anger, sadness or fear that, if they accumulate, affect our health. In addition, they influence our relationships.<br><br>That is why it is very important to realize how you feel, to find a good way to manage your emotions when you are not well.<br><br>Breathing, going for a walk or simply leaving the place for a few minutes when you are overwhelmed, are things that serve to regulate emotions. And don't hesitate to ask for help from someone you trust if you need it.<br><br>Parenting is demanding, but it's also beautiful. 💫 |
| | | Activity proposal | If you are stressed, overwhelmed or feel back pain, then we invite you to follow some of these tips.<br><br>Take a deep breath. Take a break from whatever you are doing. Drink a glass of water. Take a minute to drink mate.<br><br>All these practices generally work to lower your blood pressure. You have to find out what works best for you.<br><br>Something that also helps to loosen tensions are gentle movements with the head. First moving it up and down as if saying "yes". Then to the sides as if saying "no". And after that, try moving your shoulders up and down as if saying "I don't know". If you repeat this several times, your neck will be much more relaxed.<br><br>And of course, you can always go to your health center for a consultation if you feel persistently overwhelmed. |
| | | Reflection | Try to express your feelings and emotions by saying "I'm nervous", "I feel exhausted today".<br>Putting emotions into words generates relief.<br><br>Remember that breaks, breathing, walking, or neck and head exercises help improve your mood and stress level when you feel overwhelmed or overwhelmed.<br><br>Have you tried any of these suggestions and how did they go?<br><br>The more relaxed you feel, the more you will enjoy your time with (child's name). 👶🏻💙 |

Table A3: Language stimulation topics included in intervention module 2.

| Week | Topic | Parental competence |
|---|---|---|
| 1-2 | I understand more than I can express | Stimulating |
| 3-4 | Between gestures and words | Stimulating |
| 5-6 | Conversational turns | Stimulating |
| 7-8 | Feeding time | Stimulating |
| 9-10 | Verbal productions | Stimulating |
| 11-12 | Sentences | Stimulating |
| 13-14 | Music time | Stimulating |
| 15-16 | Reading | Stimulating |

Table A4: Examples of messages sent during module 2, by topic and age of the child

| **Topic** | **Child's age** | **Type of message** | **Message** |
|---|---|---|---|
| I understand more than I can express | 12-24 months | Informative | Your child understands much more than he/she can express. At this stage, (CHILD'S NAME) clearly understands simple words and commands (e.g., "(CHILD'S NAME), Can you bring me your shoes, please?").<br><br>It is important for the child's language development that you ask him/her to reach for objects or point to others whenever possible. Also try to give him simple commands and ask him simple questions about things happening around him. 😊 |
| | | Activity proposal | Today we suggest that at some point in your play with (CHILD'S NAME), you pay attention to what he/she understands.<br><br>For example: you can ask her to bring you the toy box; to take the ball out of the box; to give you a book; or to show you where the doll is. 🧩 🧸 |
| | | Reflection | Have you been able to notice the words and commands that (CHILD'S NAME) understands?<br><br>Language is not only what children express, it is also what they understand.<br><br>By challenging him with increasingly complex questions and requests, you encourage (CHILD'S NAME) to continue to develop his understanding and language acquisition.<br><br>Incorporate these challenges into everyday life as if they were games - both you and (CHILD'S NAME) will enjoy it! 🤗 |
| Between gestures and words | 24-36 months | Informative | At this stage of development, (CHILD'S NAME) communicates a lot through his body language, with the gestures of his face, the movement of his shoulders, his hands, arms and postures in general. At this time, it is important that you accompany their body communication by putting into words what you think they are communicating. In this way, you are expanding their language. 💬 💓 |
| | | Activity proposal | Today, while you are feeding (CHILD'S NAME), pay attention to all the ways she uses to communicate.<br><br>Try to put into words what you think he wants to communicate and wait for his response before you speak again.<br><br>For example, (CHILD'S NAME) points to her glass on the table. You can say, "that's your glass, are you thirsty?"; (CHILD'S NAME) says "yes" and you say "here you go. |
| | | Reflection | Were you able to identify what (CHILD'S NAME) was communicating to you in its own way during the week?<br><br>This process doesn't happen overnight, it builds little by little. 💪🏻<br><br>By expressing out loud what you think (CHILD'S NAME) wants to say, you make your child feel recognized and understood, and you help him/her to incorporate the language better. 😊<br><br>Keep looking for these shared moments of communication and discovery with (CHILD'S NAME)! |

| | | | |
|---|---|---|---|
| Conversational turns | 36+ months | Informative | In communication with (CHILD'S NAME) it is important to give space: that you listen and respond to what (CHILD'S NAME) wants to tell you and that you give space for him/her to respond to what you tell him/her. Communication is richer when it happens in turns, like in ping-pong: one serves, the other receives and returns. ✨<br><br>When you manage to keep more turns of conversation with (CHILD'S NAME), you are stimulating their brain development: their intelligence, language acquisition, social and emotional skills. 💡 |
| | | Activity proposal | We propose that today, at some playtime with (CHILD'S NAME), you talk to him/her about what they are playing. 🧩🧸<br><br>Try to put yourself at his/her level, sit on the floor with him/her.<br><br>While you are talking to him/her, try to leave space for him/her to express him/herself in some way and then continue talking to him/her.<br><br>Remember that talking to (CHILD'S NAME) in turns is the best way to promote his/her language. practice it during this week! 🤩 |
| | | Reflection | How did you do this week with the conversational turns between you and (CHILD'S NAME)?<br><br>A good conversation has spaces for listening and moments of response. In order for children to express themselves, it is important to give them space to do so 😉.<br><br>Remember this whenever you're talking to (CHILD'S NAME).<br><br>This way you will be respecting their intention to communicate and promoting their language development. |
| Feeding time | 6-12 months | Informative | Feeding time is the best space for communication. It allows physical, visual and auditory contact between (CHILD'S NAME) and you.<br><br>Take advantage of these moments to interact with (CHILD'S NAME) and share words related to the foods he/she likes, dislikes, colors, sizes, textures, sweet-salty, etc. This way you are filling their world with words. 💛 🔡<br><br>We share a link<br>[LINK] |
| | | Activity proposal | Today, when you are feeding (CHILD'S NAME), tell her who made the food, if it's warm or hot, soft, etc. 🤗 |
| | | Reflection | How did it go this week conversing with (CHILD'S NAME)?<br><br>Conversing with your child at feeding times creates rituals for life. 💞<br><br>In those moments of interaction, avoid distractions such as TV, tablet or cell phones that hinder the face-to-face encounter with your child.<br><br>Conversing with (CHILD'S NAME) makes him/her feel understood and loved. keep looking for these moments! |

| | | | |
|---|---|---|---|
| Verbal productions | 24-36 months | Informative | (CHILD'S NAME) is acquiring new words every day. While you may not yet understand everything your child says, his or her everyday vocabulary is growing significantly.<br><br>It is important that you put in your words and add new words to what (CHILD'S NAME) points, looks and/or says. In this way you enrich their vocabulary. 💫 |
| | | Activity proposal | Today we suggest that, at feeding time, you pay attention to the words that (CHILD'S NAME) uses to communicate with you and try, based on them, to add new words to his/her language.<br><br>For example:<br>(CHILD'S NAME) points and says "ota", you say: "Do you want the ball?" ... you wait for an answer from (CHILD'S NAME) and then you add more words to the one he/she has: "Ok, let's go get the ball that is on top of the chair!" ⚽ 🙌🏻 |
| | | Reflection | How did you do this week putting into words what (CHILD'S NAME) communicates to you and adding new words to her vocabulary?<br><br>To accompany the language acquisition process, it is important to put into words what interests (CHILD'S NAME), and repeat what he/she says by adding new words to the conversation.<br><br>Remember that conversations with you are the greatest treasure for (CHILD'S NAME). 😍 |
| Sentences/Voice tone variations | 36+ months | Informative | It is common at this stage of (CHILD'S NAME)'s development to talk to him/her using a higher-pitched, more singsong voice than usual (higher pitched), making each vowel much longer and using short sentences. This way of talking to him/her is good! It helps (CHILD'S NAME) understand the messages you give her better and allows her to identify new words better. 🌟 |
| | | Activity proposal | Today we propose that at the time of bathing (CHILD'S NAME), you tell him/her and ask questions about what is around using variations in the tone of your voice. 🛁 🧼<br><br>For example, "Where is the soap; what are we going to dry ourselves with; what do we wrap our feet with? |
| | | Reflection | How have you felt this week practicing pitch variations in your voice?<br><br>Variations in the pitch of your voice help (CHILD'S NAME) be more attentive to the sounds of language, convey affection and allow your child to locate where each word begins and ends in a sentence.<br><br>It generally comes naturally to us to talk to our children this way - don't hold it back, keep doing it, it's very good! 💪🏻 😻 |
| Music time | 6-12 months | Informative | Children recognize their parents' voices from the time they are in the womb. Parents' singing caresses without touching, soothes without speaking and reassures without being so close.<br><br>When you sing to (CHILD'S NAME), you are helping them develop understanding, use of language and memory. 🎶<br><br>If you opt for rhyming songs, the benefits are even greater: you get (CHILD'S NAME) to identify familiar sounds, and that will help him/her when he/she starts reading and spelling. 😊 |

| | | | |
|---|---|---|---|
| | | | We share some links with songs:<br>[LINK TO SONG PLAYLIST] |
| | | Activity proposal | Today we invite you to choose a song that you and (CHILD'S NAME) like. Sing in a tender and loving way, pause to watch (CHILD'S NAME)'s expression and sing again.<br><br>This can be at any time of the day: when waking up, during playtime, feeding, bath time or before going to sleep. And if your child associates a song to each of these stages, so much the better. The song will allow him/her to anticipate the routine ahead. 😍 |
| | | Reflection | How was this week of singing with your child?<br><br>Music produces substances in the brain that send feelings of well-being to our bodies. When you and your child feel good, communication with each other and with others improves.<br><br>Music strengthens the emotional bond that unites you with (CHILD'S NAME). Look for these moments every day! 🎵 👶 |
| Reading | 24-36 months | Informative | When you tell stories or read stories to (CHILD'S NAME), you are teaching them to listen, to concentrate, to understand language, to memorize and to express themselves. All of these skills are essential to his development. Also, sitting close to him/her while you share the story or pictures, strengthens the bond between (CHILD'S NAME) and you. 📚 💫<br><br>We share a page where you can find some stories:<br>[LINK] |
| | | Activity proposal | Today we invite you to share a moment of reading with (CHILD'S NAME). 📖<br><br>If you don't have a children's book, you can resort to the website we gave you yesterday, tell him/her a story you remember or make one up. Unfold your creativity, and let the moment flow.<br><br>Exaggerate gestures, voice tones and body movements to capture (CHILD'S NAME)'s attention, giving him/her space to participate as well.<br><br>Also try using open-ended questions that arouse his/her curiosity. For example, you can say: "What do you think will happen next?" 💭<br><br>Repeat this reading moment every day as a routine. 💕 |
| | | Reflection | How did you do this week in trying to find story time with your child?<br><br>Each book you read or story you tell is like a brick on which (CHILD'S NAME) will build. The more bricks, the more solid and secure the foundation.<br><br>Try to make time for these moments every day. What you do for your child today will help him/her forever. 💫 |

Note: messages were sent according to the age of the child. In the table we show a selection of messages sent using different age ranges as an example.

Figure A1: Viewing messages in WhatsApp.

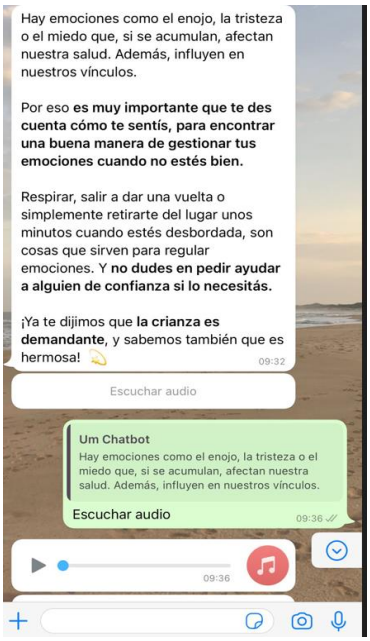
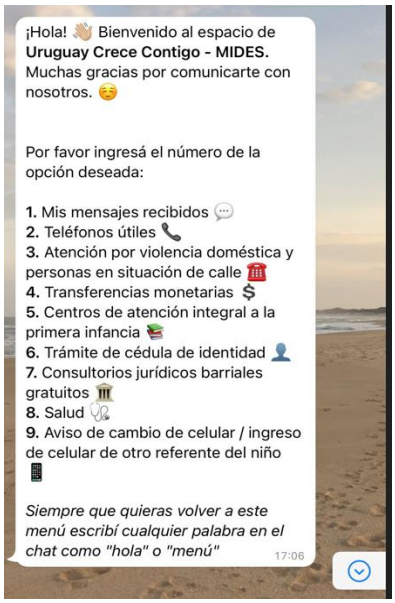



Figure A2: Viewing the chatbot for treated families on WhatsApp.



Apendix B: Recruitment

The initial database contained 4436 records of children.

The recruitment of participating families consisted of two stages:

1. First stage (October-November 2021): a first contact call was made to verify that families had a child under three years of age at home and that they were interested in participating in the program. We could contact 35% of the initial database. From these, 86% showed interest in participating in the program. 256 families did not have a child between ages 0-3 and were excluded from the sample.
2. Second stage (December 2021-January 2022): those families who showed interest in participating in the program and who met the entry requirements were contacted again.[24] A baseline survey was applied, and participation consents were recorded. We could survey 79% of contacted households.

In cases where there was more than one child under 3 years of age in the home, the baseline survey was carried out for the youngest child. In the case of twins, two forms were applied per household, one for each child, although we then randomly selected one twin to participate in the evaluation.

Given that the sample size obtained in the second stage was lower than the objective (N=900), a new period of baseline information collection was planned between February and March 2022. On that occasion, MIDES provided a new list of families with a profile similar to families on the PAF waiting list. In particular, the list included families that, due to their characteristics, met the criteria to receive the Uruguay Social Card (TUS), but were not yet receiving it.[25]

In the new survey period, the surveys were administered by MIDES teleoperators. It was possible to survey 264 households. Adding these surveys, the number of project participants stood at 917 households.

Lastly, in May and July 2022, MIDES provided two additional databases with new families on the waiting list for the PAF. 109 new families were added to the 917 that were already part of the project, bringing the total sample size to 1,026 households.

[24] Children 36 months or younger as of December 6, 2021.
[25] Only very poor families are eligible to receive TUS.

Appendix C: Compliance

Table C1: Descriptive statistics of treated families opted out from the program

| | Treated families that opted out | | | Treated families that did not opt out | | | Difference | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | s.d. | N | Mean | s.d. | N | Coefficient | s.e. |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| *Panel A: Child* | | | | | | | | | |
| Age (months) | 57 | 27413 | 11374 | 794 | 27107 | 12142 | 851 | 0.307 | (1.658) |
| Male | 57 | 0.368 | 0.487 | 794 | 0.525 | 0.500 | 851 | -0.158** | (0.068) |
| First son | 56 | 0.607 | 0.493 | 791 | 0.497 | 0.500 | 847 | 0.110 | (0.069) |
| Twin | 57 | 0.000 | 0.000 | 794 | 0.042 | 0.200 | 851 | -0.042 | (0.026) |
| Attends an early childhood center | 57 | 0.404 | 0.495 | 792 | 0.491 | 0.500 | 849 | -0.088 | (0.069) |
| Lives with mother | 57 | 0.965 | 0.186 | 792 | 0.981 | 0.136 | 849 | -0.016 | (0.019) |
| Father or male caregiver in household | 57 | 0.596 | 0.495 | 794 | 0.620 | 0.486 | 851 | -0.023 | (0.067) |
| *Panel B: Caregiver* | | | | | | | | | |
| Woman | 57 | 1000 | 0.000 | 794 | 0.987 | 0.112 | 851 | 0.013 | (0.015) |
| Age (years) | 57 | 26472 | 9203 | 792 | 28519 | 36351 | 849 | -2.047 | (4.828) |
| Works | 56 | 0.339 | 0.478 | 791 | 0.240 | 0.427 | 847 | 0.099* | (0.060) |
| Relationship=mother | 57 | 0.947 | 0.225 | 794 | 0.951 | 0.216 | 851 | -0.004 | (0.030) |
| Completed middle school | 57 | 0.351 | 0.481 | 794 | 0.321 | 0.467 | 851 | 0.030 | (0.064) |
| Risk of depression | 57 | 0.281 | 0.453 | 793 | 0.372 | 0.484 | 850 | -0.091 | (0.066) |
| Frequency with no internet access = never | 45 | 0.356 | 0.484 | 589 | 0.324 | 0.469 | 634 | 0.031 | (0.073) |
| Frequency with no internet access = once a month | 45 | 0.111 | 0.318 | 589 | 0.160 | 0.367 | 634 | -0.048 | (0.056) |
| Frequency with no internet access = every 15 days | 45 | 0.222 | 0.420 | 589 | 0.267 | 0.443 | 634 | -0.044 | (0.068) |
| Frequency with no internet access = every week | 45 | 0.311 | 0.468 | 589 | 0.250 | 0.433 | 634 | 0.062 | (0.067) |
| *Panel C: Household* | | | | | | | | | |
| Number of members | 57 | 4298 | 1964 | 793 | 4738 | 2222 | 850 | -0.439 | (0.302) |
| Number of children | 57 | 1772 | 1180 | 792 | 2061 | 1206 | 849 | -0.289* | (0.165) |
| Overcrowding | 57 | 0.684 | 0.469 | 793 | 0.677 | 0.468 | 850 | 0.007 | (0.064) |
| Government assistance | 57 | 0.965 | 0.186 | 791 | 0.952 | 0.214 | 848 | 0.013 | (0.029) |
| Receives TUS | 57 | 0.579 | 0.498 | 791 | 0.531 | 0.499 | 848 | 0.048 | (0.068) |
| Receives AFAM-PE | 57 | 0.789 | 0.411 | 791 | 0.783 | 0.413 | 848 | 0.007 | (0.057) |
| Experienced negative shock | 56 | 0.839 | 0.371 | 785 | 0.842 | 0.365 | 841 | -0.003 | (0.051) |
| Number of negative shocks | 56 | 1893 | 1216 | 785 | 2097 | 1515 | 841 | -0.204 | (0.207) |
| Montevideo | 57 | 0.281 | 0.453 | 794 | 0.343 | 0.475 | 851 | -0.062 | (0.065) |

Table C2: Descriptive statistics of treated families that were excluded from the program

| | Treated families that were excluded | | | Treated families that were not excluded | | | Difference | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | s.d. | N | Mean | s.d. | N | Coefficient | s.e. |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| *Panel A: Child* | | | | | | | | | |
| Age (months) | 52 | 23.240 | 11.574 | 799 | 27.380 | 12.082 | 851 | -4.140** | (1.725) |
| Male | 52 | 0.500 | 0.505 | 799 | 0.516 | 0.500 | 851 | -0.017 | (0.072) |
| First son | 51 | 0.471 | 0.504 | 796 | 0.506 | 0.500 | 847 | -0.036 | (0.072) |
| Twin | 52 | 0.000 | 0.000 | 799 | 0.041 | 0.199 | 851 | -0.041 | (0.028) |
| Attends an early childhood center | 52 | 0.365 | 0.486 | 797 | 0.493 | 0.500 | 849 | -0.128* | (0.071) |
| Lives with mother | 52 | 0.962 | 0.194 | 797 | 0.981 | 0.136 | 849 | -0.020 | (0.020) |
| Father or male caregiver in household | 52 | 0.462 | 0.503 | 799 | 0.628 | 0.484 | 851 | -0.167** | (0.069) |
| *Panel B: Caregiver* | 52 | 0.942 | 0.235 | 799 | 0.991 | 0.093 | 851 | -0.049*** | (0.015) |
| Woman | 52 | 30.680 | 13.160 | 797 | 28.232 | 36.165 | 849 | 2.449 | -5.039 |
| Age (years) | 52 | 0.212 | 0.412 | 795 | 0.249 | 0.433 | 847 | -0.038 | (0.062) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Works | 52 | 0.827 | 0.382 | 799 | 0.959 | 0.199 | 851 | -0.132*** | (0.031) |
| Relationship=mother | 52 | 0.288 | 0.457 | 799 | 0.325 | 0.469 | 851 | -0.037 | (0.067) |
| Completed middle school | 51 | 0.373 | 0.488 | 799 | 0.365 | 0.482 | 850 | 0.007 | (0.070) |
| Risk of depression | 38 | 0.263 | 0.446 | 596 | 0.331 | 0.471 | 634 | -0.067 | (0.079) |
| Frequency with no internet access = never | 38 | 0.211 | 0.413 | 596 | 0.153 | 0.360 | 634 | 0.058 | (0.061) |
| Frequency with no internet access = once a month | 38 | 0.342 | 0.481 | 596 | 0.258 | 0.438 | 634 | 0.084 | (0.074) |
| Frequency with no internet access = every 15 days | 38 | 0.184 | 0.393 | 596 | 0.258 | 0.438 | 634 | -0.074 | (0.073) |
| Frequency with no internet access = every week | 52 | 4.731 | 1.931 | 798 | 4.707 | 2.225 | 850 | 0.024 | (0.316) |
| *Panel C: Household* | 52 | 2.173 | 1.248 | 797 | 2.033 | 1.204 | 849 | 0.140 | (0.173) |
| Number of members | 52 | 0.538 | 0.503 | 798 | 0.687 | 0.464 | 850 | -0.148** | (0.067) |
| Number of children | 52 | 0.885 | 0.323 | 796 | 0.957 | 0.202 | 848 | -0.073** | (0.030) |
| Overcrowding | 52 | 0.404 | 0.495 | 796 | 0.543 | 0.498 | 848 | -0.139* | (0.071) |
| Government assistance | 52 | 0.635 | 0.486 | 796 | 0.793 | 0.406 | 848 | -0.158*** | (0.059) |
| Receives TUS | 50 | 0.860 | 0.351 | 791 | 0.841 | 0.366 | 841 | 0.019 | (0.053) |
| Receives AFAM-PE | 50 | 2.360 | 1.687 | 791 | 2.066 | 1.484 | 841 | 0.294 | (0.218) |
| Experienced negative shock | 52 | 0.269 | 0.448 | 799 | 0.343 | 0.475 | 851 | -0.074 | (0.068) |
| Number of negative shocks | 52 | 23.240 | 11.574 | 799 | 27.380 | 12.082 | 851 | -4.140** | (1.725) |
| Montevideo | 52 | 0.500 | 0.505 | 799 | 0.516 | 0.500 | 851 | -0.016 | (0.072) |

Appendix D: Evaluation scales

Table D1: Description of variables included in follow-up questionnaires.

| Category | Scale | Follow-up | Batch |
|---|---|---|---|
| | **Parental knowledge:** 4 questions that survey parents' knowledge of positive parenting. The questions are True/False. | Follow-up 1, Follow-up 2 | Batches 1 and 2 |
| | **StimQ:** StimQ is a scale developed, reviewed and validated by pediatricians and developmental psychologists at New York University. To measure frequency of involvement in didactic activities, we use four StimQ questions that are answered on a scale from 0 to 7 according to the caregiver's frequency with the child in different activities. To measure quality of interaction in didactic activities, we added questions that are answered dichotomously with Yes/No depending on whether the caregiver performs certain practices that are considered to add quality to language interactions such as describing the environment, putting into words what the adult and child are doing, among others. | Follow-up 2 | Batches 1 and 2 |

| | | | |
|---|---|---|---|
| Depression, Stress, and Wellbeing of caregiver | **CESD-10**: Center for Epidemiologic Studies scale used to measure depression. It consists of 10 questions and uses a 4-option Likert scale, where 1 indicates that the respondent rarely or never experienced the symptoms described, and 4 indicates that the symptom was experienced most days or every day. A depression risk indicator is constructed that takes the value of 1 if the score is equal to or greater than 10. | Follow-up 1, Follow-up 2 | Batches 1 and 2 |
| | **Parental stress**: We applied the dysfunctional parent-child interaction subscale of the Parental Stress Index (PSI). This is a self-reported questionnaire that allows us to identify different sources of stress that emerge during parenting. The subscale we use approximates the degree of satisfaction that the caregiver has with his or her child and with the interactions they have. The respondent must answer how much he/she agrees with certain statements referring to common parenting situations on a five-point Likert scale. Additionally, the PSI scale incorporates a question that seeks to survey how the caregiver perceives him/herself (e.g. "Not a very good caregiver", "A person who has some problems being a caregiver", "A normal caregiver", "A better than average caregiver", "A very good caregiver"). | Follow-up 1, Follow-up 2 | Batch 1 (second follow-up), Batch 2 (first and second follow-up) |
| | **WHO-5**: WHO-5 of the World Health Organization (WHO), a self-reported questionnaire that measures current mental well-being. The WHO-5 has demonstrated adequate validity as a screening instrument for depressive symptoms. It consists of five questions regarding vitality, mood and general interest answered on a six-point scale. The time reference of the instrument is the last two weeks. Based on the score obtained, a risk threshold of depression is established. | Follow-up 1, Follow-up 2 | Batch 1 (second follow-up), Batch 2 (first and second follow-up) |
| | **McConkey Well-Being Scale (2020):** An instrument based on the concept of subjective well-being that seeks to measure how satisfied the person is in various dimensions of his or her life (health, household and care tasks, general quality of life, etc.) on a 10-point scale. | Follow-up 1, Follow-up 2 | Batch 1 (second follow-up), Batch 2 (first and second follow-up) |

| | | | |
|---|---|---|---|
| | We constructed a well-being index by averaging the score on two items from the reduced version of the Burden Scale for Family Caregivers (BSFC) and four items from the Well-Being During Pregnancy (WiP) questionnaire developed by Alderdice et al. (2017) and Kelly et al. (2022) that we adapted to the parenting stage in life. Specifically, we employed the following statements from the BSFC: "Your satisfaction with your life has been negatively affected due to caring for your child" and "Caring for your child has taken quite a bit of your energy." The person should indicate how much he or she agrees or disagrees with the statement on a four-point scale where 1 is strongly disagree and 4 is strongly agree. Lower values indicate less caregiving overload. From the WiP scale we used four items that seek to capture the frequency with which the caregiver feels connected with his/her child, enjoys his/her role as caregiver, has social contact with other people and feels confident in how to care for his/her child. | Follow-up 1, Follow-up 2 | Batch 1 (second follow-up), Batch 2 (first and second follow-up) |

**Appendix E: Baseline descriptive statistics by batch and outcome variables at follow-up**

Table E1: Descriptive statistics for batch 1

| | Control | | | Treatment | | | Difference | |
|---|---|---|---|---|---|---|---|---|
| | N | Mean | s.d. | N | Mean | s.d. | N | Coefficient | s.e. |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| *Panel A: Child* | | | | | | | | | |
| Age (months) | 201 | 32.276 | 9.640 | 399 | 31.932 | 9.406 | 600 | -0.344 | (0.820) |
| Male | 201 | 0.502 | 0.501 | 399 | 0.521 | 0.500 | 600 | 0.019 | (0.043) |
| First son | 201 | 0.418 | 0.494 | 399 | 0.469 | 0.498 | 600 | 0.051 | (0.043) |
| Twin | 201 | 0.050 | 0.218 | 399 | 0.050 | 0.218 | 600 | 0.000 | (0.019) |
| Attends an early childhood center | 201 | 0.542 | 0.499 | 399 | 0.480 | 0.500 | 600 | -0.062 | (0.043) |
| Lives with mother | 201 | 0.980 | 0.140 | 399 | 0.987 | 0.111 | 600 | 0.008 | (0.011) |
| Father or male caregiver in household | 201 | 0.612 | 0.489 | 399 | 0.649 | 0.478 | 600 | 0.037 | (0.042) |
| *Panel B: Caregiver* | | | | | | | | | |
| Woman | 201 | 0.995 | 0.071 | 399 | 0.995 | 0.071 | 600 | 0.000 | (0.006) |
| Age (years) | 201 | 28.881 | 7.856 | 399 | 27.302 | 6.715 | 600 | -1.579** | (0.616) |
| Works | 201 | 0.294 | 0.457 | 399 | 0.271 | 0.445 | 600 | -0.023 | (0.039) |
| Relationship=mother | 201 | 0.950 | 0.218 | 399 | 0.972 | 0.164 | 600 | 0.022 | (0.016) |
| Completed middle school | 201 | 0.328 | 0.471 | 399 | 0.318 | 0.466 | 600 | -0.010 | (0.040) |
| Completed high school | 201 | 0.075 | 0.263 | 399 | 0.040 | 0.196 | 600 | -0.035* | (0.019) |
| Risk of depression | 201 | 0.393 | 0.490 | 399 | 0.406 | 0.492 | 600 | 0.013 | (0.042) |
| Frequency with no internet access = every week | 201 | 0.309 | 0.356 | 399 | 0.301 | 0.365 | 600 | -0.008 | (0.031) |
| Frequency with no internet access = once a month | | | | | | | | | |
| Frequency with no internet access = every 15 days | 201 | 4.612 | 1.881 | 399 | 4.474 | 1.955 | 600 | -0.138 | (0.167) |
| Frequency with no internet access = every week | 201 | 2.075 | 1.149 | 399 | 1.973 | 1.157 | 600 | -0.102 | (0.100) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Panel C: Household* | 201 | 0.692 | 0.463 | 399 | 0.682 | 0.466 | 600 | -0.010 | (0.040) |
| Number of members | 201 | 0.960 | 0.196 | 399 | 0.957 | 0.202 | 600 | -0.003 | (0.017) |
| Number of children | 201 | 0.580 | 0.494 | 399 | 0.518 | 0.500 | 600 | -0.062 | (0.043) |
| Overcrowding | 201 | 0.735 | 0.441 | 399 | 0.731 | 0.443 | 600 | -0.004 | (0.038) |
| Government assistance | 201 | 0.854 | 0.352 | 399 | 0.821 | 0.383 | 600 | -0.033 | (0.032) |
| Receives TUS | 201 | 2.179 | 1.577 | 399 | 2.033 | 1.494 | 600 | -0.147 | (0.132) |
| Receives AFAM-PE | 201 | 32.276 | 9.640 | 399 | 31.932 | 9.406 | 600 | -0.344 | (0.820) |
| Experienced negative shock | 201 | 0.502 | 0.501 | 399 | 0.521 | 0.500 | 600 | 0.019 | (0.043) |
| Number of negative shocks | 201 | 0.418 | 0.494 | 399 | 0.469 | 0.498 | 600 | 0.051 | (0.043) |
| Montevideo | 201 | 0.050 | 0.218 | 399 | 0.050 | 0.218 | 600 | 0.000 | (0.019) |

Table E2: Descriptive statistics for batch 2

| | Control | | | Treatment | | | Difference | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | s.d. | N | Mean | s.d. | N | Coefficient | s.e. |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| *Panel A: Child* | | | | | | | | | |
| Age (months) | 141 | 27.826 | 11.602 | 285 | 28.014 | 10.985 | 426 | 0.188 | (1.152) |
| Male | 141 | 0.482 | 0.501 | 285 | 0.523 | 0.500 | 426 | 0.041 | (0.052) |
| First son | 141 | 0.457 | 0.498 | 285 | 0.517 | 0.500 | 426 | 0.060 | (0.051) |
| Twin | 141 | 0.035 | 0.186 | 285 | 0.046 | 0.209 | 426 | 0.010 | (0.021) |
| Attends an early childhood center | 141 | 0.404 | 0.492 | 285 | 0.444 | 0.497 | 426 | 0.040 | (0.051) |
| Lives with mother | 141 | 0.979 | 0.145 | 285 | 0.968 | 0.175 | 426 | -0.010 | (0.017) |
| Father or male caregiver in household | 141 | 0.631 | 0.484 | 285 | 0.593 | 0.492 | 426 | -0.038 | (0.050) |
| *Panel B: Caregiver* | | | | | | | | | |
| Woman | 141 | 1.000 | 0.000 | 285 | 0.986 | 0.118 | 426 | -0.014 | (0.010) |
| Age (years) | 141 | 27.762 | 7.194 | 285 | 27.970 | 9.618 | 426 | 0.207 | (0.915) |
| Works | 141 | 0.186 | 0.389 | 285 | 0.231 | 0.420 | 426 | 0.045 | (0.042) |
| Relationship=mother | 141 | 0.950 | 0.218 | 285 | 0.919 | 0.273 | 426 | -0.031 | (0.026) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Completed middle school | 141 | 0.255 | 0.438 | 285 | 0.319 | 0.467 | 426 | 0.064 | (0.047) |
| Completed high school | 141 | 0.071 | 0.258 | 285 | 0.067 | 0.250 | 426 | -0.004 | (0.026) |
| Risk of depression | 141 | 0.397 | 0.491 | 285 | 0.324 | 0.468 | 426 | -0.073 | (0.049) |
| Frequency with no internet access = every week | 141 | 0.343 | 0.403 | 285 | 0.364 | 0.417 | 426 | 0.021 | (0.042) |
| Frequency with no internet access = once a month | 141 | 0.116 | 0.265 | 285 | 0.126 | 0.283 | 426 | 0.010 | (0.029) |
| Frequency with no internet access = every 15 days | 141 | 0.286 | 0.384 | 285 | 0.253 | 0.369 | 426 | -0.033 | (0.038) |
| Frequency with no internet access = every week | 141 | 0.255 | 0.366 | 285 | 0.258 | 0.373 | 426 | 0.002 | (0.038) |
| *Panel C: Household* | | | | | | | | | |
| Number of members | 141 | 4.539 | 1.783 | 285 | 4.502 | 1.851 | 426 | -0.037 | (0.188) |
| Number of children | 141 | 2.092 | 1.356 | 285 | 1.992 | 115.671 | 426 | -0.099 | (0.126) |
| Overcrowding | 141 | 0.688 | 0.465 | 285 | 0.646 | 0.479 | 426 | -0.042 | (0.049) |
| Government assistance | 141 | 0.929 | 0.258 | 285 | 0.937 | 0.244 | 426 | 0.008 | (0.026) |
| Receives TUS | 141 | 0.465 | 0.499 | 285 | 0.514 | 0.500 | 426 | 0.049 | (0.051) |
| Receives AFAM-PE | 141 | 0.700 | 0.458 | 285 | 0.757 | 0.429 | 426 | 0.057 | (0.045) |
| Experienced negative shock | 141 | 0.812 | 0.388 | 285 | 0.843 | 0.361 | 426 | 0.031 | (0.038) |
| Number of negative shocks | 141 | 1.951 | 1.504 | 285 | 1.987 | 1.422 | 426 | 0.035 | (0.149) |
| Montevideo | 141 | 0.489 | 0.502 | 285 | 0.470 | 0.500 | 426 | -0.019 | (0.052) |

Table E3: Descriptive statistics for batch 3

| | Control | | | Treatment | | | Difference | |
|---|---|---|---|---|---|---|---|---|
| | N | Mean | s.d. | N | Mean | s.d. | N | Coefficient | s.e. |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| *Panel A: Child* | | | | | | | | | |
| Age (months) | 167 | 14.178 | 10.194 | 167 | 14.135 | 10.134 | 334 | -0.043 | (1.112) |
| Male | 167 | 0.527 | 0.501 | 167 | 0.491 | 0.501 | 334 | -0.036 | (0.055) |
| First son | 167 | 0.500 | 0.500 | 167 | 0.566 | 0.496 | 334 | 0.066 | (0.054) |
| Twin | 167 | 0.012 | 0.109 | 167 | 0.000 | 0.000 | 334 | -0.012 | (0.008) |
| Attends an early childhood center | 167 | 0.581 | 0.495 | 167 | 0.569 | 0.497 | 334 | -0.012 | (0.054) |
| Lives with mother | 167 | 0.970 | 0.171 | 167 | 0.982 | 0.133 | 334 | 0.012 | (0.017) |
| Father or male caregiver in household | 167 | 0.581 | 0.495 | 167 | 0.587 | 0.494 | 334 | 0.006 | (0.054) |
| *Panel B: Caregiver* | | | | | | | | | |
| Woman | 167 | 0.988 | 0.109 | 167 | 0.976 | 0.153 | 334 | -0.012 | (0.015) |
| Age (years) | 167 | 24.639 | 6.711 | 167 | 31.658 | 77.757 | 334 | 7.019 | (6.039) |
| Works | 167 | 0.263 | 0.442 | 167 | 0.217 | 0.412 | 334 | -0.046 | (0.047) |
| Relationship=mother | 167 | 0.958 | 0.201 | 167 | 0.952 | 0.214 | 334 | -0.006 | (0.023) |
| Completed middle school | 167 | 0.323 | 0.469 | 167 | 0.341 | 0.476 | 334 | 0.018 | (0.052) |
| Completed high school | 167 | 0.066 | 0.249 | 167 | 0.048 | 0.214 | 334 | -0.018 | (0.025) |
| Risk of depression | 167 | 0.391 | 0.488 | 167 | 0.341 | 0.476 | 334 | -0.050 | (0.053) |
| Frequency with no internet access = every week | 167 | 0.335 | 0.474 | 167 | 0.323 | 0.469 | 334 | -0.012 | (0.052) |
| Frequency with no internet access = once a month | 167 | 0.192 | 0.395 | 167 | 0.234 | 0.424 | 334 | 0.042 | (0.045) |
| Frequency with no internet access = every 15 days | 167 | 0.210 | 0.408 | 167 | 0.263 | 0.442 | 334 | 0.054 | (0.047) |
| Frequency with no internet access = every week | 167 | 0.263 | 0.442 | 167 | 0.180 | 0.385 | 334 | -0.084* | (0.045) |
| *Panel C: Household* | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Number of members | 167 | 5.204 | 2.124 | 167 | 5.620 | 2.974 | 334 | 0.416 | (0.283) |
| Number of children | 167 | 2.372 | 1.607 | 167 | 2.287 | 1.363 | 334 | -0.084 | (0.163) |
| Overcrowding | 167 | 0.687 | 0.464 | 167 | 0.723 | 0.448 | 334 | 0.036 | (0.050) |
| Government assistance | 167 | 0.999 | 0.006 | 167 | 0.970 | 0.171 | 334 | -0.030** | (0.013) |
| Receives TUS | 167 | 0.671 | 0.468 | 167 | 0.608 | 0.488 | 334 | -0.063 | (0.052) |
| Receives AFAM-PE | 167 | 0.943 | 0.228 | 167 | 0.951 | 0.215 | 334 | 0.008 | (0.024) |
| Experienced negative shock | 167 | 0.871 | 0.332 | 167 | 0.889 | 0.311 | 334 | 0.018 | (0.035) |
| Number of negative shocks | 167 | 2.366 | 1.599 | 167 | 2.366 | 1.561 | 334 | 0.000 | (0.173) |
| Montevideo | 167 | 0.374 | 0.484 | 167 | 0.359 | 0.481 | 334 | -0.015 | (0.053) |

Table E4 shows descriptive statistics of the outcome variables for the control families on the follow-up questionnaires. 61% and 64% of those surveyed receive the Uruguay Social Card (TUS) in the first and second follow-up respectively. 55% receive the Parenting Bonus[26] in the first follow-up and 49% receive it in the second. 19% and 21% of households obtained information about work programs in the four months prior to the first and second follow-up respectively. 6% of households accessed a program to improve their home in the months prior to the first follow-up and 5% in the months prior to the second.

Regarding food support in the 4 months prior to the first survey, 8% of households received food baskets in the first follow-up and 10% in the second, and 17% and 19% started paperwork to receive food support in the first and second follow-up respectively.

32% of the caregivers reported working during the first follow-up and 38% during the second. 65% of the children attend an early childhood center and 78% do so at the end of the intervention. Children who receive free early childhood vouchers (BIS, for its acronym in Spanish: *Beca de inclusión socio-educativa*) are 3% of the sample in the first follow-up and 4% in the second.

Regarding parental involvement in cognitive stimulation activities, on the Stim-Q scale, families average a value of 4.9 on a scale that goes from 0 to 7. Regarding the quality of language, families score 1.1 with a deviation of 0.18 on a scale that goes from 1 to 1.875. On the parental knowledge scale, the caregivers answered on average 2.5 and 2.6 of 4 questions correctly in the first and second follow-up respectively. On the parental knowledge scale in language topics, parents respond 2.2 out of 3 questions correctly on average.

Regarding the emotional well-being of the caregiver, the risk of depression is 50% in the first follow-up and 54% in the second follow-up. This is consistent with the fact that families that opt out of the program are less likely to present risk of depression at baseline (see Table C1 in Appendix C). Parental stress has a score of 21 points. On the WHO-5 scale, whose score ranges from 0 to 25, the average was 16 points in both follow-ups. On the McConkey's (2000) subjective well-being scale, families scored an average of 62 in the first and second follow-up, out of a total of 80. In the wellbeing index we constructed, that can take values between 2.67 and 6.67, control families have a score of 5 on average in the first follow-up and in the second follow-up.

Regarding anthropometry, height for age and wage for age is below the standarized mean (negative values) in both follow-ups.

[26] The Parenting Bonus is implemented through a monthly monetary transfer that is paid through the Uruguay Social Card (TUS) it is aimed at households in situations of extreme socioeconomic vulnerability in which pregnant women and/or children from 0 to 3 reside. years.

Table E4: Descriptive statistics of the outcome variables for the control families in the follow-up questionnaires

| | First follow-up | | | | | Second follow-up | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variable | N | Mean | s.d. | Min | Max | N | Mean | s.d. | Min | Max |
| **Panel A: Government transfers and programs** | | | | | | | | | | |
| Government transfers | 323 | -0.233 | 1.255 | -2.011 | 2.005 | 256 | -0.258 | 1.244 | -2.011 | 2.302 |
| Uruguay Social Card (TUS) | 351 | 0.613 | 0.488 | 0 | 1 | 268 | 0.642 | 0.480 | 0 | 1 |
| Parenting Bonus | 332 | 0.545 | 0.499 | 0 | 1 | 261 | 0.490 | 0.501 | 0 | 1 |
| Labor Programs | 350 | 0.194 | 0.396 | 0 | 1 | 266 | 0.214 | 0.411 | 0 | 1 |
| Housing Improvement | 350 | 0.060 | 0.238 | 0 | 1 | 268 | 0.049 | 0.215 | 0 | 1 |
| Food baskets | 348 | 0.083 | 0.277 | 0 | 1 | 264 | 0.102 | 0.304 | 0 | 1 |
| Started paperwork for food program | 340 | 0.168 | 0.374 | 0 | 1 | 266 | 0.188 | 0.391 | 0 | 1 |
| Caregiver works | 351 | 0.319 | 0.467 | 0 | 1 | 268 | 0.381 | 0.486 | 0 | 1 |
| Child attends early childhood center | 352 | 0.653 | 0.477 | 0 | 1 | 268 | 0.776 | 0.418 | 0 | 1 |
| Child receives BIS voucher to attend center | 350 | 0.029 | 0.167 | 0 | 1 | 267 | 0.041 | 0.199 | 0 | 1 |
| **Panel B: Parental investment and knowledge** | | | | | | | | | | |
| Stim-Q | | | | | | 265 | 4.870 | 1.346 | 0 | 7 |
| Quality language stimulation | | | | | | 265 | 1.125 | 0.178 | 1 | 1.875 |
| Parental knowledge - childrearing | 350 | 2.517 | 1.056 | 0 | 4 | 262 | 2.649 | 1.005 | 0 | 4 |
| Parental knowledge - language | | | | | | 260 | 2.238 | 0.723 | 0 | 3 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Panel C: Parental Wellbeing and Stress** | | | | | | | | | | |
| Wellbeing PCA | 190 | -0.001 | 1.514 | -3.872 | 2.832 | 246 | -0.142 | 1.501 | -3.815 | 2.976 |
| Risk of depression | 352 | 0.497 | 0.501 | 0 | 1 | 263 | 0.540 | 0.499 | 0 | 1 |
| WHO-5 | 196 | 16.082 | 5.549 | 1 | 25 | 258 | 15.508 | 5.452 | 0 | 25 |
| McConkey Well-being Scale (2000) | 192 | 62.078 | 12.426 | 29 | 80 | 252 | 61.687 | 11.726 | 27 | 80 |
| Wellbeing index | 195 | 5.140 | 0.788 | 2.667 | 6.667 | 255 | 5.114 | 0.842 | 2.667 | 6.667 |
| Parental stress | 197 | 21.355 | 7.016 | 12 | 45 | 252 | 20.647 | 7.444 | 12 | 45 |
| **Panel D: Child's anthropometry** | | | | | | | | | | |
| Height for age | 128 | -1.209 | 1.122 | -3.404 | 2.210 | 139 | -1.118 | 1.459 | -4.973 | 4.136 |
| Weight for age | 138 | -0.321 | 1.043 | -4.156 | 1.960 | 149 | -0.259 | 1.154 | -4.411 | 2.962 |
| **Panel E: Language outcomes** | | | | | | | | | | |
| Mother's average word per minute | 175 | 251.798 | 60.946 | 123.045 | 485.887 | 125 | 246.187 | 53.352 | 168.045 | 464.903 |
| Mother's vocalizations per hour | 176 | 891.107 | 234.985 | 0 | 1622.352 | 126 | 900.203 | 236.203 | 0 | 1651.477 |
| Mother's vocalizations duration | 176 | 1.73e+06 | 6.25e+05 | 0 | 3.34e+06 | 126 | 1.73e+06 | 5.52e+05 | 0 | 2.75e+06 |
| Child's vocalizations per hour | 176 | 672.841 | 306.766 | 0 | 1333.580 | 126 | 752.969 | 258.317 | 83.772 | 1541.379 |
| Child's vocalizations duration | 176 | 8.11e+05 | 4.99e+05 | 0 | 2.99e+06 | 126 | 9.96e+05 | 5.34e+05 | 44255.330 | 3.26e+06 |
| Pitch range | 175 | 23.215 | 3.189 | 12.393 | 31.649 | 125 | 23.074 | 2.777 | 9.828 | 30.019 |
| Mother's average pitch | 175 | 24.082 | 2.370 | 16.882 | 30.053 | 125 | 24.223 | 2.142 | 17.456 | 30.676 |
| Child-adult conversational transitions | 176 | 797.641 | 447.640 | 0 | 2089.671 | 126 | 924.510 | 437.489 | 65.291 | 2862.560 |

**Appendix F: Full set of results**

Table F1 shows results for the full set of outcomes (used to construct summary indices). Regarding the effect of the program on access to monetary transfers, we see that in the first follow-up the treated have greater access to the TUS and the Parenting Bonus. The effects are of a magnitude of 0.26 and 0.2 SDs respectively. In the second follow-up, the effects are of a magnitude of 0.36 SDs for TUS and 0.18 SDs for Parenting Bonus. There are no significant differences between treated and controls in access to the Housing Improvement Program, but the power to detect significant effects in this outcome is very low (see Table G1 in Appendix G).

We find that, on average, those treated have accessed more food baskets than controls in the 30 days prior to the first follow-up survey (Panel C). The magnitude of the effect is of 0.31 SDs. These baskets were awarded punctually and at the discretion of the teleoperator. In the second follow-up, after the implementation of the module exclusively oriented to language development, we did not find significant differences between treated and controls in access to food support.

With respect to attendance at educational centers, we see that in the first follow-up, children from treated families attend early childhood centers to a greater extent than controls, but in the second follow-up this effect disappears. The receipt of BIS scholarships is also higher among treated children.

In terms of parental wellbeing, we find that there is a positive effect on the WHO-5 score and index of wellbeing that is significant in the second follow-up.

Table F1: Effects of the intervention on access to government programs, parental involvement, caregiver well-being and satisfaction with the program.

| | First follow-up (1) | Second follow-up (2) |
|---|---|---|
| Uruguay Social Card | 0.257*** | 0.364*** |
| | (0.066) | (0.072) |
| | 939 | 746 |
| Parenting Bonus | 0.199*** | 0.178** |
| | (0.066) | (0.076) |
| | 897 | 725 |
| Home improvement programs | -0.032 | -0.068 |
| | (0.067) | (0.073) |
| | 938 | 749 |
| Food baskets | 0.305*** | -0.040 |
| | (0.079) | (0.076) |
| | 927 | 739 |
| Paperwork for food basket | 0.101 | -0.137* |
| | (0.071) | (0.074) |
| | 900 | 740 |
| Caregiver works | 0.051 | -0.028 |
| | (0.068) | (0.076) |
| | 939 | 751 |
| Child attends early childhood center | 0.131** | -0.052 |
| | (0.066) | (0.077) |
| | 941 | 752 |
| BIS scholarship | 0.144* | 0.046 |
| | (0.076) | (0.080) |
| | 935 | 745 |
| Risk of depression | 0.004 | -0.097 |
| | (0.068) | (0.077) |
| | 937 | 737 |
| WHO 5 wellbeing | 0.064 | 0.134* |
| | (0.095) | (0.076) |
| | 482 | 726 |
| Wellbeing score | 0.075 | 0.112 |
| | (0.092) | (0.080) |
| | 472 | 707 |
| Index of wellbeing | -0.128 | 0.138* |
| | (0.099) | (0.078) |
| | 476 | 724 |

Notes: * p<.1, ** p<.05, *** p<.01.

## Appendix G: Power calculations

Table G1: Power calculations to detect an effect of 0.2 SDs in continuous variables and of 20 percentage points in dichotomous variables

| | First follow-up | Second follow-up |
|---|---|---|
| | (1) | (2) |
| ***Monetary transfers*** | | |
| Government transfers | 0.838 | 0.753 |
| Uruguay Social Card | 0.973 | 0.960 |
| Parenting Bonus (up to 3 years of age) | 0.898 | 0.722 |
| Food baskets (in the last 30 days) | 0.129 | 0.127 |
| Home improvement program | 0.104 | 0.081 |
| Child receives BIS voucher to attend center | 0.071 | 0.075 |
| Labor programs (duration 6 months) | 0.282 | 0.254 |
| ***Parental inputs*** | | |
| Parental knowledge – Childrearing | 0.842 | 0.724 |
| Parental knowledge – Language | | 0.758 |
| StimQ - Frequency | | 0.754 |
| StimQ - Quality | | 0.784 |
| ***Parental stress and wellbeing*** | | |
| Wellbeing PCA | 0.577 | 0.720 |
| Depression (CESD-10>=10) | 0.844 | 0.819 |
| WHO-5 | 0.581 | 0.742 |
| Caregiver well-being: McConkey (2000) | 0.586 | 0.718 |
| Wellbeing index | 0.533 | 0.731 |
| Parenting Stress Index | 0.574 | 0.734 |
| ***Child's anthropometry*** | | |
| Height for age | 0.369 | 0.471 |
| Weight for age | 0.352 | 0.470 |

Note: The power calculations consider an effect size of 0.20 SDs in the case of continuous outcomes and of 20 percentage points in the case of dichotomous outcomes.

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