

Early Communication Indicator: An analysis with three Portuguese toddlers¹

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Abstract. Professionals need efficient tools in early childhood communication development to identify infants and toddlers who are at risk of communication disorders or language delays. In Portugal, this project was carried out to respond to these needs due to a lack of these resources and a high prevalence of children at risk for communication problems at early ages. This paper describes the first steps to adapt the *Early Communication Indicator* (ECI) for the Portuguese population. The ECI is a play-based expressive communication measure for infants and toddlers aged 6 to 42 months. The ECI was originally developed in the U.S. and was designed for use by service providers to provide information about growth in communication, to help in intervention decision making, and to be administered in any language. This paper analyzes the ECI results of three Portuguese children in relation to their communication progression, based on a one-year longitudinal study. The ECI was administered when children were 17, 24, and 30 months of age. The ECI results showed that two of the children follow the typical progression of communication acquisition, with acquisition of earlier prelinguistic skills preceding growth in spoken language. The ECI results for the other child showed a very different and slower progression in the communication skills. The data obtained provided just an initial demonstration of the use of the ECI with Portuguese children. More research is needed into the development of the ECI in the Portuguese context, such as the development of a nationally representative, normative sample. Therefore, a discussion of what is needed in research and practice to advance this project is provided.

Key words: Assessment; Early Communication; communication disorders.

[es] Indicadores de comunicación temprana: Un análisis con tres niños portugueses

Resumen. Los profesionales necesitan herramientas eficaces en el desarrollo de la comunicación en la primera infancia para identificar a los bebés y niños pequeños que corren el riesgo de sufrir trastornos de la comunicación o retrasos en el lenguaje. En Portugal, este estudio se llevó a cabo para responder a estas necesidades debido a la falta de estos recursos y a una alta prevalencia de niños con riesgo de problemas de comunicación a edades tempranas. Este trabajo describe los primeros pasos para adaptar el Indicador de Comunicación Temprana (ECI) a la población portuguesa. El ECI es una medida de comunicación expresiva basada en el juego para bebés y niños pequeños de 6 a 42 meses. El ECI fue desarrollado originalmente en los EE.UU. y fue diseñado para ser utilizado por los proveedores de servicios para proporcionar información sobre el crecimiento en la comunicación, para ayudar en la toma de decisiones de intervención, y para ser administrado en cualquier idioma. Este trabajo analiza los resultados del ECI de tres niños portugueses en relación con su progresión comunicativa, basándose en un estudio longitudinal de un año. La ECI se administró cuando los niños tenían 17, 24 y 30 meses de edad. Los resultados del ECI mostraron que dos de los niños seguían la progresión típica de la adquisición de la comunicación, con la adquisición de habilidades prelingüísticas anteriores al crecimiento del lenguaje hablado. Los resultados de la ECI del otro niño mostraron una progresión muy diferente y más lenta en las habilidades comunicativas. Los datos obtenidos proporcionaron sólo una demostración inicial del uso de la ECI con niños portugueses. Se necesita más investigación sobre el desarrollo de la ECI en el contexto portugués, como el desarrollo de una muestra normativa representativa a nivel nacional. Por lo tanto, se presenta una discusión sobre lo que se necesita en la investigación y en la práctica para avanzar en la línea que marca este estudio.

Palabras clave: Comunicación temprana; Evaluación; Trastornos de la comunicación.

Sumario: Introduction. Method. Overview. Measure. The Early Communication Indicator (ECI). ECI Adaptation for the Portuguese Context. ECI Training and Certification. The multiple case study. Participants. Procedures. Data Collection. ECI Interobserver reliability. Results. Discussion. Limitations and Implications for Future Research. References.

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Introduction

Expressive communication is one of the most important skills a child needs to develop from birth. Communication allows a child to get information, to develop cognitively, and to interact properly with others in their environment (Luze et al., 2001). The first three years of life are particularly important in this process.

Before the first words, much has happened to prepare the infant for the successful acquisition of language. From birth, babies already identify their mothers' voices. Soon, they are able to perceive differences between voices and sounds, respond to the language of others, produce sounds, use eye gaze and vocalize. The early patterns of gaze coupling, turn taking, stimulus-response bonds, routines, and games assume particular importance for later communication (Levey, 2019; Owens, 2016). Later in their first year of life, children are able to use a variety of gestures to communicate their intentions and engage others in communication. Gesture is their primary means of effective communication. A child's first gestures set the stage for the language that is to come. At this point, children do produce gestures along with vocalizations, but they are not always coordinated. Around the time of their first birthday, they begin to use words to accompany or replace gestures. Gesture-plus-word combinations mark the transition to a temporally and semantically integrated gesture-speech system. When using two modalities for two different semantic elements in a systematic way, the child also precedes the onset of two-word speech (Morgenstern & Goldin-Meadow, 2022). Indeed, gesture development is highly correlated with language development. Specifically, gestures are more related to comprehension than production (Bavin et al., 2008; Frank et al., 2021; Morgenstern & Goldin-Meadow, 2022). From here, in a very general way, the early language follows a pattern in which the children "know something", then comprehend the word corresponding to its name, and finally, produce the word (Owens, 2016, p. 184). The first words children produce are essentially names of people and things and words associated with social routines. Children produce new words slowly at first, then this process accelerates over the second year. At 18 months, their expressive vocabulary can be about 50 words, and at 24 months, they can reach an average of 300 words (Frank et al., 2021; Owens, 2016). During this time, they also begin to combine two words in one utterance. By 24 to 36 months, the capacity to produce more complete and complex sentences is acquired. By age 3, speech becomes more intelligible, and vocabulary size grows exponentially. Then they begin to elaborate their use of language to suit a variety of contexts and experiences in the world around them (Levey, 2019; Owens, 2016).

Indeed, the communication process is strongly knitted such that in general terms, children who use more gestures tend to have greater vocabularies, and children who have greater vocabularies also tend to use more compound words (Frank et al., 2021).

Regardless of the resemblances among children and across cultures, in the typical progression of acquisitions, the speed with which children develop language varies a lot in the first years of life (Frank et al., 2021), especially for children with delays or disorders (Walker, 2012). Most children with delays at this age tend to move into the average range of their peers by age 3 years. However, a significant number of children will still be diagnosed with a language disorder later. It is extremely complex to predict accurately who will overcome the delays because of the significant variability of communication and language in the first years (Prelock & Hutchins, 2018). For this reason, there are some specific red-flag indicators that indicate a risk for disorders in children's communication development. Some of these indicators include: vocalizations with few or no consonant sounds until 18 months; lack of first words and lack of consistent communicative gestures until 20 months; lack of word combinations at 24 months; and few or no words or multi-word utterances until 36 months (Crais, 2011; Paul & Roth, 2011; Prelock & Hutchins, 2018). A communication disorder disrupts a child's ability to exchange meanings with others. Thus, even a simple interaction can be very complex for the child. In this way, a communication disorder can create problems and obstacles in terms of learning, self-esteem, attention, thinking, playful activity, and social and emotional functioning, among others (Paul & Roth, 2011; Prelock & Hutchins, 2018; Whitehouse et al., 2011).

It is very difficult to precisely determine the prevalence of communication disorders, because communication disorders are often undiagnosed, diagnosed with different criteria, or are not systematically reported (Fogle, 2017). However, some studies may be used to estimate this. A survey of children with communication disorders in the United States indicates that nearly 8% of children between the ages of 3 and 17 are diagnosed with a communication disorder (Black et al., 2015). There are no formal prevalence studies of communication and language disorders in Portugal. For children up to 3 years old, there aren't any studies. For 3- to 6-years-old children, the existing studies present relatively small samples, very different methodological designs, and very different results. However, they give us some disturbing information (Castro et al., 2019). For example, Lousada, Valente and Mendes (2016) identified 34.16 percent of children with a primary speech and/or language disorder in their study, and Coutinho (2012) found 14.9 percent of children with communication and language difficulties in her research (as cited in Castro et al., 2019).

Unfortunately, communication disorders often are not identified until the preschool years. Thus, in order to prevent or attenuate future disabilities, professionals need efficient early communication screening tools to identify infants and toddlers who are at risk of a communication disorder (Larson, 2016). As a result, there is

a growing acknowledgment of the need to develop or adapt communication assessment tools and procedures to match the necessities of countries and populations where these resources are scarce (Carter et al., 2005).

Portugal has already developed valid, standardized measures to assess infants and toddlers' communication: *The European Portuguese MacArthur-Bates Communicative Development Inventories: Gestures and Words* (PT-CDI:GW) and *Words and Sentences* (PT-CDI:WS), long forms, (Silva et al., 2017; Viana et al., 2017), and short forms (Frota et al., 2016); and *Language Use Inventory – Portuguese Version* (Guimarães et al., 2013; Guimarães, 2016; Guimarães & Cruz-Santos, 2020). The use of parental reports to assess the communicative competence of a child has several advantages. For example, they provide a way to report the interactions of a child across a variety of settings and contexts, are not restricted to an isolated period, and are cost-effective and time-efficient given the large amount of data that can be collected with relative ease and efficiency. Despite the numerous advantages, they have some limitations. The major limitation of parental reports is the possibility of parents differing in their interpretation and understanding of the questionnaires or inventory items, which may not align with the intentions of the researcher. This can be an important concern for people from non-dominant language speaking backgrounds, or for people who have low literacy. Another concern is that in some cases, parents or caregivers may not provide completely accurate information, overestimating or underestimating their child's skills (Bennetts et al., 2016; Hegde & Pomaville, 2017; Levickis et al., 2022). An alternative to conjugating with parental reports are direct observational measures. Direct observational measures serve various purposes. For example, they are appropriate for children from different cultural and linguistic backgrounds, it is possible to define behaviors of interest to assess, they allow for a better monitoring of growth and change, they easily assess post-intervention changes, and they are normally considered more objective than parental reports (Crais, 2011; Levickis et al., 2022; Wolery & Ledford, 2014). Despite the advantages of these measures, they have also some limitations. There are some factors that can influence children's behaviors, and consequently, the accuracy of interpretations, such as the administration setting and instructions, the presence of an observer or recording equipment, caregiver and child factors (for example, being ill, tired, or distracted), and the codification system (Bennetts et al., 2016; Levickis et al., 2022). Each method has its own advantages and offers distinctive information on the child's communication competences, and any method is free from limitations. Thus, a better approach is to integrate the different methods, both for assessment and for monitoring progress, incorporating the major strengths of each method (Bennetts et al., 2016; Crais, 2011; Federico et al., 2021; Hadley et al., 2016; Hegde & Pomaville, 2017).

The advantages of using different methods in a comprehensive assessment of communication and language are evident, as are the considerations of observational instruments to better monitor children's long-term outcomes. Since in Portugal there is a lack of measures that allow the direct observation of the child's communication, a review of instruments developed internationally was consulted (Ferreira & Cruz-Santos, 2021). This review helped to understand *The Early Communication Indicator* (ECI).

The ECI was developed in the U.S. as an expressive communication measure for use in identifying children with communication delays, developing interventions, and monitoring progress of early childhood communication development (Luze et al., 2001). The ECI is one of the *Infant and Toddler Individual Growth and Development Indicators* (IGDIs), developed by the *Juniper Gardens Children's Project*. These are measures developed for use by early educators and practitioners to guide intervention decision making. The ECI is supported by standardized training and administration materials. The ECI analyzes the occurrence and evolution of four key communication skill elements: gestures, vocalizations, single words, and multiple words (Walker & Carta, 2010; Walker et al., 2008). These outcomes characterize the evolution from prelinguistic forms of communication (gestures, vocalizations) to linguistic (words, multiple words) (Brady et al., 2004).

The ECI presents age-based (monthly) growth norms based on the composite score mean for children aged 6 to 42 months (Greenwood et al., 2010). Various studies contribute to the construct validity of ECI, showing that it is sensitive to age differences. The ECI's four communication key skills show dynamic, progressive pattern trajectories over time. These trajectories indicate that gesturing and vocalizing emerge earlier than words, and are followed by the occurrence of single words and then sentences. In general terms, the results showed that children grow in communicative proficiency with age, with children in the third year of life demonstrating more fluent and proficient communication skills than children in their second year, compared to the first year of life (Luze et al., 2001; Greenwood et al., 2006; Greenwood et al., 2010; Greenwood et al., 2013). Greenwood et al. (2020) analyzed the criterion validity of the ECI with the *Preschool Language Scale - 4* (PLS-4), *MacArthur-Bates Communicative Development Inventory* (CDI), *Peabody Picture Vocabulary Tests - 4* (PPVT-4), *Early Literacy - IGDI*, and *Test of Preschool Early Literacy* (TOPEL). Weak to moderately strong patterns of relationship occurred between the ECI Total Weighted Communication and criterion assessments. The strongest positive relationships were found between single words and multiple words, and the criterion assessment at older ages.

Although not projected to be used as a screening tool in isolation, the ECI has been used to accurately identify children at risk of communication and language delays/disorders across children from different racial and ethnic backgrounds, including Spanish-English dual-language learners (Greenwood et al., 2010; King et al., 2022), children from different linguistic realities (Bavin et al., 2020; Buzhardt et al., 2019), and children

with different special needs, such as children with autism spectrum disorder (Buzhardt et al., 2022), and children with cochlear implants (Bavin et al., 2020).

ECI is also supported by a web-based data system (<https://igdi-ds.ku.edu>) that allows for following the communication growth progress of each child, individually or in groups, and helps data-driven decision making. This web-based data system can be used both nationally and internationally (Buzhardt & Walker, 2010; Buzhardt et al., 2018). Between other features, ECI allows for collecting information at multiple points in young children's lives and includes a structure that can be used across countries to compare its results regionally, nationally, or internationally. These are some of the necessary criteria for an international early childhood measurement (Raikes, et al., 2014; Raikes et al., 2017), that make the ECI structure consistent with cross-cultural adaptation. However, Buzhardt et al. (2019) cited the need for additional research in other cultures and languages beyond English.

This study has two main goals. The first goal of this study is to present the first steps and procedures for cultural adaptation of the ECI to the Portuguese context, according to Carter et al. (2005). The second goal of this study is to analyze the ECI results of a multiple case study with three Portuguese children in relation to their communication progression. For that, three Portuguese toddlers of the same age, but with different levels of communicative performance, were assessed with ECI at three different points of their development, and their individual communication progression data were examined.

Method

Overview

The present work is part of a larger project under development in Portugal for the validation of the ECI, for the Portuguese population. The main purpose of this larger project is the development of a normative sample of the ECI for the Portuguese children from 6 to 42 months of age. Ethical approval for this project was granted by the Ethics Committee for Research in Social and Human Sciences of University of Minho in Portugal (CEICSH 091/2019).

Measure

The Early Communication Indicator (ECI)

The ECI is a 6-minute observational measure of a child's expressive communication during a semi-structured play session with a familiar adult. Familiarity of the play partner in the administration of the ECI is very important to avoid interference due to the stranger effect, which is common in very young children (Brooker et al., 2013).

Each session with the ECI involves (Greenwood et al., 2010; Walker & Carta, 2010):

- a) a semi-structured play task centered on either the Fisher-Price® Barn or House. These two toy sets must be alternated in each session along the entire age range of the test (6–42 months);
- b) a play partner to play with the child for six minutes, in a convenient and comfortable setting with limited distractions present. The play partner should motivate the child's communication by following their lead with constant interactive play, commenting and describing about what child is doing, interacting in non-directive, friendly manner, and minimizing questions that elicit one-word responses;
- c) an assessor for scoring during a live session or from a video recording the frequency of the occurrence of four key skill elements of communication (gestures, vocalizations, single words, and multiple words), on a score sheet designed for this purpose (ECI Score Sheet). Gestures are coded when any physical movement is made by the child in order to communicate with the play partner (e.g., showing, handing or giving an object or toy, rejecting or reaching for a toy, pointing toward a person or object, nodding or shaking the head to indicate "yes" or "no", shrugging shoulders). Vocalizations are coded when any non-word or unintelligible utterances are made by the child to the play partner. It may occur alone or accompanied with gestures (e.g., laughing, making animal sounds, babbling, cooing, sounds that appear to be unintelligible words such as "mm" or "huh"). Single words are single voiced or signed words (e.g., sign language), or an intelligible utterance used in isolation by the child that is readily understood by the coder (e.g., labelling objects, repeating words, saying compound words, using ritualized duplications such as "bye-bye", or two-part proper names). Multiple-word utterances are defined as intelligible utterances of two or more voiced or signed words fitting together in a meaningful way, used by the child that are recognized by the observer (e.g., grammatically correct or incorrect word combinations) (Walker & Carta, 2010).

To generate a total early communication composite score capable of reflecting growth in communication proficiency, a weighting system was created. The Weighted Total Communication score is the weighted combination of each key skill that occurred during the session, weighted as follows: Gestures and Vocalizations (1 × each occurrence), Single Words (2 × each occurrence), and Multiple Words (3 × each occurrence), divided by the total administration time (6 minutes). Thus, during the session, if the coder counted 5 gestures, 3 vocalizations, 5 single words and 4 multiple word utterance, the Weighted Total Communication score is $(5 + 3 + [5 \times 2] + [4 \times 3])/6 = 5.0$ communications per minute. The occurrences entered into the IGDI website are automatically weighted and divided by the total administration time (Greenwood et al., 2010; Walker & Carta, 2010).

ECI Adaptation for the Portuguese Context

Based on the literature and in works developed in countries with limited resources, Carter et al. (2005) identified and illustrated the major issues in the development and adaptation of culturally unbiased measures of language and communication. These issues suggest that: the adapted tools should be developed with professionals that are primary-language speakers of the assessment language, familiar with the culture, and trained to carry out the assessment procedures; the materials used in the assessment should be familiar to the children assessed; children should be assessed in their own homes or in familiar spaces; the developers should consider the cultural view of speed and performance, and whether the tool will measure the intended construct; all aspects of the adapted tools should be piloted (instructions, response formats, prompt and setting, etc.); and the developers should analyze comparisons of normative data.

The first step in the adaptation of the ECI for the Portuguese context was its development with Portuguese professionals, as recommended by Carter et al. (2005). Initially, the ECI was translated from the source language (English) into the target language (Portuguese). Two Portuguese professionals fluent in English made two independent translations of all ECI documentation (e.g., ECI Score Sheet, and the ECI Administration Fidelity Checklist). Then, the two versions of the translated ECI were synthesized into a single version. This final version of the translated ECI was analyzed by a committee of experts in the area of communication and childhood, namely speech-language pathologists, kindergarten teachers, and early interventionists.

After these procedures, the first European Portuguese version of ECI followed the majority of the remaining procedures suggested by Carter et al. (2005), e.g. the training of Portuguese professionals to carry out the assessment procedures; testing of materials, spaces, speed, and performance with Portuguese children; testing whether the tool will measure the intended construct; testing of instructions, response formats, prompt and setting with Portuguese professionals and children's relatives. These issues will be addressed during the study.

ECI Training and Certification

For certification in administering and scoring the ECI, future assessors must successfully complete the standard ECI training protocol for assessors (Buzhardt & Walker, 2010). The training takes about one day to complete, and can be divided into two parts. The first part assures the trainees a broad understanding of the ECI in terms of purpose, administration guidelines (with accommodations for children with disabilities), and explanation of online data systems and data interpretation. In the second part, trainees must watch and score two certification videos of ECI administrations. Then the certified assessors estimate the reliability between trainees' scores and master scores, and provide feedback on discrepancies. Trainees must repeat scoring the videos until they reach 85% reliability with a master scoring of each video.

The training also provides some time to analyze the administration fidelity, in order to ensure consistent administration procedures. Fidelity is defined as 13 out of 16 correct administration steps completed in a 16-item Administration Fidelity Checklist (Buzhardt & Walker, 2010). This checklist includes procedures for preparing ECI administration, with guidelines for the preparation of materials and positioning; preparing the ECI assessment administration, with guidelines for how the play partner should interact during the play; and ending the ECI session. If less than 13 steps were correctly followed, the session must be repeated.

The Portuguese research team trained in the ECI administration protocol consists of 3 elements, receiving online training of the IGDI by the *Juniper Gardens Children's Project*.

The multiple case study

Participants

Three monolingual Portuguese toddlers (all boys), from the northern region of Portugal, participated in this study: L – Child 1, G – Child 2, and S – Child 3. They were 17 months of age at the beginning of the study.

L is part of an upper-middle-class Portuguese family consisting of four members: two parents and two children. He is the youngest child, and has a sister that is seven years old. His mother is 36 and his father is 40.

Both parents have a master's degree. No family member has a history of communication disorders or learning difficulties. He was a full-term baby, and had an average birth weight. L is generally in good health, and he has not had any history of hearing problems or any other health problems. L never attended nursery school, as during the day he stays with his grandparents. He always showed a very good communicative performance, with first words at 11 months, and first combination of words at 15 months. At 30 months of age, he was evaluated with the PT-CDI:WS - long forms (Viana et al., 2017), and he scored between the 70th and 90th percentile in all parts of the inventories.

G is part of a middle-class Portuguese family, consisting of himself and his parents (only child). His mother is 35 and his father is 34. Both parents completed high school. There are no known histories of communication disorders or learning difficulties in the family. He was a full-term baby, and had an average birth weight. G is in good health, and he has not had any history of hearing problems or any other health problems. G attended nursery school at five months of age. He showed a typical communicative performance, with first words at 15 months, and first combination of words at 20 months. At 30 months of age, he was evaluated with the PT-CDI:WS - long forms (Viana et al., 2017), and he scored between the 30th and 70th percentile in all parts of the inventories.

S is part of a middle-class Portuguese family. His family is composed of himself and his parents (only child). His mother is 38 and his father is 37. Both parents completed high school. No family member has a history of communication disorders or learning difficulties. He was a full-term baby, and he had an average birth weight. He attended nursery school at five months of age. S is generally in good health, and he has not had any history of hearing problems or any other health problems. However, he began to reveal evidence of delays in communicative development, because at 24 months he still did not say words or combinations of words. Thus, at 28 months of age, he underwent a formal assessment and was referred for speech and language therapy services. At 30 months of age, he was evaluated with the PT-CDI:WS - long forms (Viana et al., 2017), and he scored between the 0th and 20th percentile in all parts of the inventories.

These three participants were chosen because of their approximate characteristics in terms of residence, age, gender, and other biological characteristics, and because of the evidence of different communicative performance between them.

Procedures

Data Collection

The ECI was administered and scored by trained researchers when children were 17, 24, and 30 months of age. These age cutoffs were specially selected because at 17 months, it is expected that children typically have already produced their first words, at 24 months, it is expected that children typically have already produced their first combination of words, and at 30 months, it is expected that children typically use more and longer utterances (Levey, 2019; Owens, 2016).

L and G were assessed in their home. S was assessed in his nursery school. L's play partner during the session was his father. G's play partner was his mother. S's play partner was his kindergarten teacher. In the first session, the Fisher-Price® Barn was used, in the second session the Fisher-Price® House was used, and in the third session the Fisher-Price® Barn was used again. No accommodations were needed in the administration. All the sessions were videotaped. All parents provided written informed consent.

At the beginning of the study, parents completed a sociodemographic survey developed by the researchers, to obtain information about the child and the family. For each child, the following data was collected: birthdate, age, gender, birth weight, prematurity, disability status, nursery attendance, health history, and communication development description. For the family, the following data was collected: family members, age, the caregivers' relationship to the children, communication disorders, learning disability history, language spoken at home, parents' level of education, jobs, family income, and the self-classification of their social class.

At 30 months of age, children were assessed with *The European Portuguese MacArthur-Bates Communicative Development Inventories, Words and Sentences* (PT-CDI:WS)- long forms (Viana et al., 2017), to capture a comprehensive view of children's communication development through an instrument validated for the Portuguese population, and also because some international works showed moderate positive correlations between the ECI and CDI (Bennetts et al., 2016; Greenwood et al., 2020). The PT-CDI:WS forms are used to obtain information on productive vocabulary and early grammatical development, and comprises two main sections: (1) first words; (2) morphology and syntax. The first section is comprised of two parts: (a) vocabulary production; (b) use and understanding of language. The second section is comprised of five parts: (a) regular morphology, auxiliaries and copula verbs; (b) difficult verbs; (c) over-regularizations and non-standard forms; (d) sentence length: MLUw (mean length of utterances measured in words); (e) sentence complexity (Silva et al., 2017).

At the end of the study, all the data were entered into the IGDI website, to analyse the communication development of those three children compared with the international norms of ECI.

ECI Interobserver reliability

The videos of each session were scored by two certified ECI assessors. Both scores were registered in an interobserver sheet. Intraclass Correlation Coefficient (ICC) has been used to calculate the ECI interobserver reliability. ICC results and their 95% confidence intervals were calculated using SPSS software version 28, based on a single-rating, absolute-agreement and two-way mixed-effects model. The results for Weighted Total Communication were ICC=0.988, with 95% confidence interval=0.951-0.997. The results for Gestures were ICC=0.966, with 95% confidence interval=0.842-0.992. The results for Vocalizations were ICC=0.977, with 95% confidence interval=0.910-0.995. The results for Words were ICC=0.993, with 95% confidence interval=0.972-0.998. The results for Multiple Words were ICC=0.985, with 95% confidence interval=0.941-0.997. Based on ICC results and their 95% confidence intervals for all the ECI communication elements, according to Koo & Li (2016), the level of reliability is “excellent”.

Results

Figure 1 presents the three children’s communication rates for weighted communication, gestures, vocalizations, single words and multiple words at different ages. Figure 2 shows the ECI report progress of the three children developed and downloaded from the IGDI’s website.

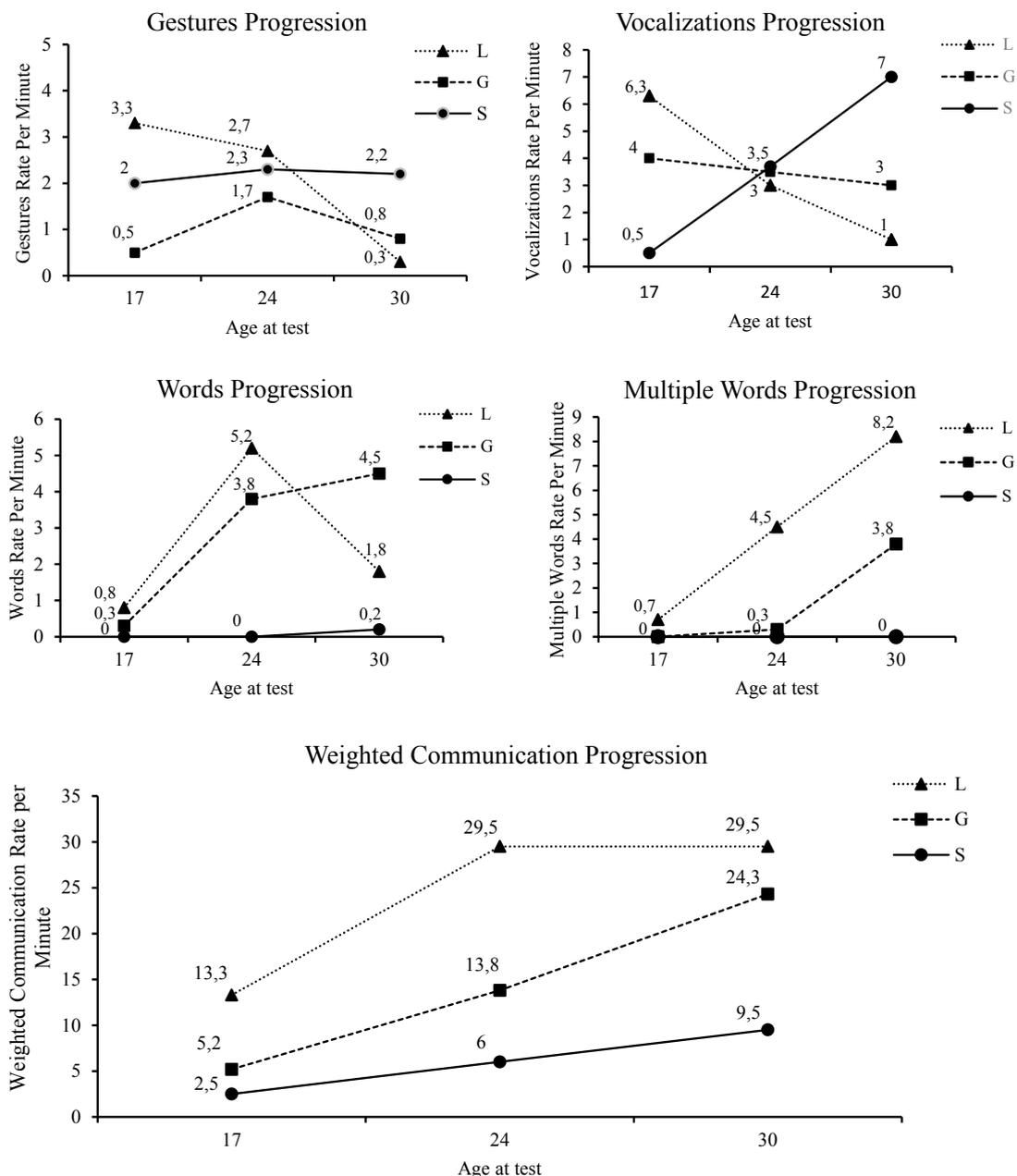
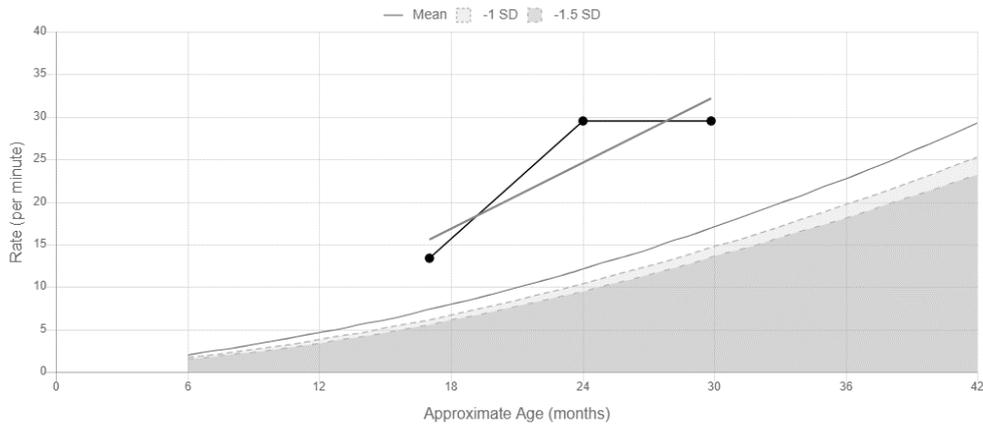
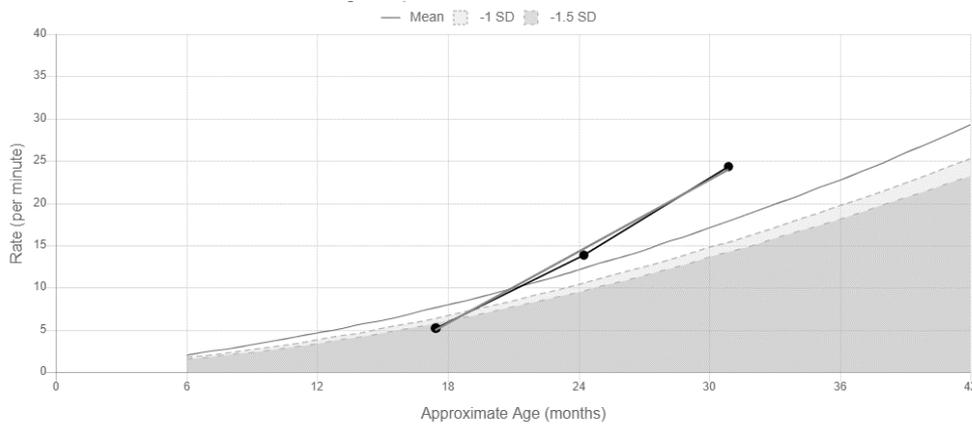


Figure 1. Children’s Communication Rates for Weighted Communication, Gestures, Vocalizations, Single Words and Multiple Words at 17, 24 and 30 Months of Age

L's Weighted Total Early Communication



G's Weighted Total Early Communication



S's Weighted Total Early Communication

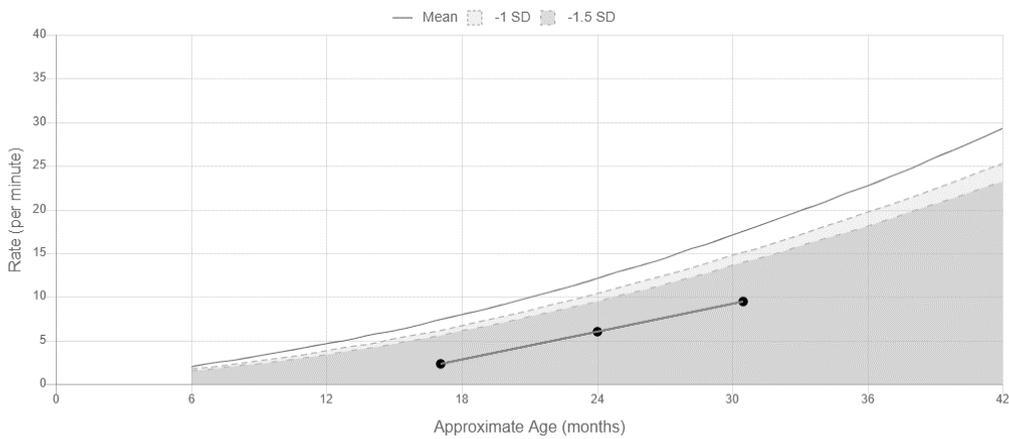


Figure 2. ECI report progress of the three children in relation to the norms, at IGDI's website. (© Juniper Gardens Children's Project; reprinted by permission.)

The data in Figure 1 indicates that at 17 months of age, L was the child who produced the most gestures during the ECI sessions. L produced gestures like shrugging shoulders, showing a toy to the play partner, reaching toward a toy the play partner was holding, and pointing. G was the child who produced the fewest gestures. G produced gestures like handing a toy to the play partner and reaching toward the play partner's hand to get help. S produced gestures such as showing a toy to the play partner, reaching toward a toy the play partner was holding, and pointing. In terms of vocalizations, L was also the child who produced the most vocalizations. L produced some fillers, such as "mmm" and "huh," animal sounds, and vowel-consonant combinations. G produced vocalizations such as sounds of wonder, animal sounds, and vowel-vowel and vowel-consonant combinations. S was the child who produced the fewest vocalizations, producing only fewer vowel-vowel combinations. Regarding

single words, L was the child who produced the most words per minute, words such as “avó” (grandma), “ovos” (eggs), “cavalo” (horse), and “aqui” (here). G produced the same word two times: “está” (is). S didn’t produce any words. Relative to multiple words, L was the only child to produce a word combination: “já está” (it’s done). G and S did not produce any multiple-word utterances during the ECI session. Thus, at 17 months of age, according to the ECI results, the children communicated mainly using gestures and vocalizations, but at different rates. L and G already used a small number of single words. L was the only child who used multiple words.

At 24 months of age, with regard to gestures, L produced the same kind of gestures he used in the first ECI session. G produced gestures such as waving goodbye, shrugging shoulders, giving a toy to the play partner, and pointing. S only reached toward toys the play partner was holding. In terms of vocalizations, L produced transportation/motor sounds and animal sounds. G produced wonder sounds, transportation/motor sounds, and vowel-consonant combinations. S produced equal numbers of vowel-vowel and vowel-consonant combinations. In the matter of single words, L produced the most words, mainly the names of the toys with which he was playing, and action words such as “olha” (look). G also produced names of the toys with which he was playing, words such “não” (no), and “aqui” (here), and he said “bye-bye” at the same time he was waving his hand. S didn’t produce any words. In terms of multiple words, L produced a significant number of expressions with more than two words, in affirmative form “olha o bebé aqui” (look, the baby is here), in negative form “não está aqui” (it’s not here), and in interrogative form “onde está o cão?” (where is the dog?). G produced a small number of simple multiple words combinations, “a vovó” (the grandma), “onde está?” (where is?). S didn’t produce any multiple-word utterances during the ECI session. Therefore, at 24 months of age, according to the ECI results, the three children still communicated using gestures and vocalizations, showing approximated rates, but they demonstrated a different variety of these skills among them. L increased his use and variety of single and multiple words. G increased his use and variety of single words, and he had started to use multiple words. S still did not use any single or multiple words.

At 30 months of age, in terms of gestures, L produced a small number of gestures. L only nodded his head to indicate “yes” one time, and he pointed to an object another time. G also produced a small number of gestures, only pointing a couple of times. S still produced a significant number of gestures per minute, which were based only on reaching toward toys the play partner was holding. With regard to vocalizations, L produced a small number of vocalizations, fillers and animal and object sounds. G produced mostly sounds of enthusiasm and animal sounds. S still produced a significant number of vocalizations (this being the session where he produced more vocalizations per minute), few vowel-vowel combinations and a lot of vowel-consonant combinations. Regarding single words, L produced mainly action words, words like “come” (eat), “apanha” (catch), and “caiu” (fall). G produced a significant number of words, words such as colors, “sim” (yes), “olha” (look), “aqui” (here). S produced only one word during the ECI session: “dois” (two). Relative to multiple words, L produced a significant number of multiple words, as in the previous session in varied forms, and mainly with more than two words, evidencing greater length of utterances compared to previous sessions, for example “este é o bebé e esta é a mamã galinha” (this is the baby and this is the mommy chicken). G produced also a significant number of multiple-word utterances per minute: “não sei” (don’t know), “já está” (it’s done), “a galinha é gigante” (the chicken is huge), “isto é branco” (this is white). S didn’t produce any multiple-word utterances during the ECI session. In general terms, at 30 months of age, according to ECI’s results, L used a very small number of vocalizations and gestures, and also used some words but fewer than in the session before. L increased the use and the length of multiple-word utterances, and mainly used this element to communicate. G used a very small number of gestures and still used some vocalizations, but he increased the use and variety of single and multiple words. S still used a large number of gestures and vocalizations to communicate. S had started to use words, but he was still not using multiple words to communicate at this age.

In terms of the weighted total communication progression trend, the slopes indicated that the children are growing in communication outcomes, but at different rates (see Figure 1, bottom panel). L showed a higher rate of weighted total communication (with evident stabilization of the trend in the later sessions), followed by G (with evident growth trend), and S who showed a lower rate (with a moderated growth trend).

In Figure 2, it is possible to analyze the performance of the children in terms of Weighted Total Communication compared with international norms of ECI, as generated on the IGDI’s website. The figures show that L was always at a higher level than the norm, G was below the norm in the first assessment, but in the last assessment he was slightly above the norm, and S was always below the norm.

Discussion

Appropriate measures designed to screen and monitor young children’s progress in reaching early communication proficiency are lacking in Portugal. The ECI is one promising measure with strong technical, conceptual, and practical implications. Taking these aspects into account, this work was developed around two goals. The first goal was to discuss the first procedures for culturally adapting the ECI in pursuit of the Portuguese context. The second goal was to analyze the results of the ECI assessments in three Portuguese children.

In terms of the first goal of this study, the adaptation of the ECI for the Portuguese context, most of the suggestions by Carter et al. (2005), in the development and adaptation of culturally unbiased measures of communication, were already followed.

The ECI was already translated and adapted with Portuguese professionals, who were trained to carry out the ECI procedures and administration, and completed the standard ECI training protocol for assessors (Buzhardt & Walker, 2010).

The materials used in the assessment encourage natural play and allow children to engage in typical, age-appropriate behaviors with their caregivers (Luze et al., 2001). Anecdotal observations indicated that none of the children included in this work refused to participate, and on the contrary, they wanted to continue playing with the materials even after the time needed for the assessment. This aspect also indicates that the time used for each assessment is appropriate.

This assessment allows children to be assessed in their own homes or in familiar spaces, as was done for the three children included in this work (L and G were assessed in their homes, and L in his kindergarten).

The construct assessed by the ECI, the growth in early communication, and the communication skills (gestures, vocalizations, single and multiple words), are components that practitioners involved in this work, as well as caregivers, agree are important to understanding the early communication development of a child, and were easily analyzed in these assessments.

Finally, data obtained shows that in the case of the three children involved in this work, the instructions, response formats, prompt and setting achieved the expected results. The resulting data were clear and easy to understand, and allow parents and early childhood professionals to analyze a child's performance in comparison to other children, as well as how the child is progressing over time.

To achieve the second goal, the ECI was used in a one-year longitudinal study, involving three boys with differences in communication performance. These boys were assessed with ECI at 17, 24 and 30 months of age, and they presented obvious differences in both weighted total communication and the four key skill elements. L and G increased single- and multiple-word use fluency over time (with L increasing more and faster than G) and also evidently increased in overall communication proficiency over time. S did not progress significantly in terms of the key skill elements over time, and thus his total communication proficiency was lower than L and G. Thus, it is possible to conclude that L demonstrated the highest performance in the progression of the skill elements and communication proficiency, followed by G, and then S with performance well below expectations compared with the other two boys. The same results are evident when their performance is compared to international norms. L always performs higher than the norm, followed by G with performance very close to the norm, and then S, with performance below the norm. These results are entirely in line with their history of communication development and performance, where L already used words and combinations of words before the first assessment with the ECI; G only used words before his first assessment with ECI; and S did not use any words or combinations of words before his first assessment with ECI.

The results obtained with ECI assessments also agreed with the results obtained for the three boys in the PT-CDI: WS - long forms inventories (Silva et al., 2017; Viana et al., 2017). L performs higher than the norm when his performance in ECI assessments is compared to international norms, and in the PT-CDI, he scored between the 70th and 90th percentile in all tasks. When compared with the other two boys, L showed the best performance in the overall progression of the skill elements and communication proficiency in ECI assessments, and he also obtained the highest percentiles in the PT-CDI assessment, specifically in vocabulary production (where he produced 581 words out of 639, corresponding to the 90th percentile); in sentence length (where he obtained a MLUw median of 6 words, corresponding to the 80th percentile); and in sentence complexity (where he used a more complex sentence 19 times out of 26, corresponding to the 70th percentile). G performs very near the norm when compared to ECI international norms, and he scored between the 30th and 70th percentile in all parts of the PT-CDI inventories. When compared with the other two boys in the ECI assessments, G showed better performance than S and lower performance than L, and in the PT-CDI inventories, he also obtained higher percentiles than S and lower percentiles than L, specifically in vocabulary production (where he produced 448 words out of 639, corresponding to the 55th percentile); in sentence length (where he obtained a MLUw median of 2.7 words, corresponding to the 30th percentile); and in sentence complexity (where he used the more complex sentence 5 times out of 26, corresponding to the 30th percentile). S performs lower than the norm when his performance is compared to ECI international norms, and in the PT-CDI inventories, he scored between the 0 and 20th percentile in all tasks. When compared with the other two boys, S demonstrated the lowest performance in the progression of the skill elements and communication proficiency in ECI assessments, and in the same way, he obtained the lowest percentiles in the PT-CDI parts, specifically in vocabulary production (where he produced 33 words out of 639, corresponding to the 5th percentile); in sentence length (where he obtained raw and per-centile scores of zero); and in sentence complexity (where he obtained raw and percentile scores of zero). It's important to note that ECI is a direct observational measure, and PT-CDI: WS is a parental report, which involves different assessment features. Nevertheless, both are relevant instruments to evaluate the expressive communication at these ages (Ferreira & Cruz-Santos, 2021), and an effective assessment of children's communication development requires a combination of information from several sources (Bennetts et al., 2016; Crais, 2011; Federico et al., 2021; Hadley et al., 2016; Hegde & Pomaville, 2017).

Consistent with theory and prior reports related to the ECI, L and G follow the typical progression of language acquisition, with acquisition of earlier prelinguistic skills preceding growth in spoken language. They show a sequential trajectory of acquisition to a peak level, followed by a decline in earlier skills to acquire new, emerging skills (i.e., from gestures and vocalizations to single words, and from single words to multiple words) (Greenwood et al., 2010; Greenwood et al., 2013). However, S shows a very different progression. At 17 months, S produced vocalizations with no consonant sounds. At 24 months, S did not produce any words, still produced many vocalizations in vowel-vowel combinations, and always produced the same kinds of gestures. At 30 months, S produced few words, and he still did not produce any word combinations. S produced mainly vowel-consonant vocalizations, and gestures, although with no variety. Here it is possible to identify many red-flag indicators in communication development that may indicate a communication delay or a risk for communication disorders (Crais, 2011; Paul & Roth, 2011; Prelock & Hutchins, 2018; Walker, 2012).

Given the importance of communication in early childhood, it is expected that the rates of communication skills and total communication will differ, when obtained by a measure to distinguish the performance of children with typical development from those with identified delays (Luze et al., 2001). The significant differences in the ECI trajectories of L and G, who are typically developing children, from S, who is lower-performing in expressive communication, can effectively help to identify S as a child at risk for communication delays or disorders. Indeed, at 28 months of age, S was identified in a comprehensive assessment, as a child with communication delays, and for that reason he was referred for speech and language therapy services.

This paper shows that for these three Portuguese children, ECI is sensitive to changes in key skill elements, and is also sensitive to individual differences in their communication in terms of trajectories and growth rates. ECI also apparently distinguishes between children with and without identified developmental delays.

It is important to reiterate that it is not possible to guarantee that differences found in the performance of the three boys cannot be related to factors of their intrinsic development and interaction contexts (which are distinct), taking these factors into account in studies with this type of methodological design.

One of the factors that can affect language development is socioeconomic status. Lower socioeconomic status places children at risk for later emergence of language (Hammer et al., 2017). However, while the mechanisms to define the socioeconomic status are unclear (Gain, 2014), the literature suggests that factors related to socioeconomic status, such as maternal education, dramatically affect children's very early language competencies (Fernald et al., 2013). Here, the evidence clearly shows that children with more highly educated mothers would show accelerated language trajectories compared to children with less educated mothers (Justice et al., 2020). Since L's mother is more highly educated than the other children's mothers, it could have influenced the higher results shown by L in this study.

Several studies have shown that parents' responsiveness to infants' communicative behaviors plays an important role in early communication acquisition (Bruce et al., 2022; Tamis-LeMonda et al., 2014). In this way, the different capacities for interaction and the responsiveness of caregivers with their children may yield different results in their children's communication performance.

Different assessment settings and contexts can yield different results (Bennetts et al., 2016; Levickis et al., 2022). The home is usually considered the ideal place for direct observation when the objective is to stimulate natural behaviors and interactions (Gardner, 2000, as cited in Levickis et al., 2022). Thus, the place where the sessions occurred may have led L and G to communicate more, since they were assessed in their homes, and S was assessed in his nursery school.

Intelligibility may depend on different aspects, for example, familiarity of listeners, word or discourse level, amount of background noise, knowledge about the communication topic, and extra-linguistic cues. Therefore, intelligibility of words or multiple-word utterances must be interpreted with caution at these ages (Hustad et al. 2020, 2021; McLeod, 2020).

Despite the attempt to select children with similar sociodemographic characteristics, and to standardize the process as much as possible, these variables could have exerted some kind of influence in this particular study. However, these are variables that are difficult to analyze and measure in this type of work and about which concrete conclusions cannot be drawn, except in experimental studies with larger samples, with this specific objective (Levickis et al., 2022).

Regardless of these factors, the findings of this study provide an initial demonstration of the ECI in screening the individual progress of young Portuguese children learning to communicate, and to identify those children who are falling below benchmarks, as compared with other children of the same age.

Limitations and Implications for Future Research

While the data obtained provided a promising initial demonstration of the ECI's applicability to the Portuguese children, the amount of data remains very limited. Future research and development of the ECI for very young children in the Portuguese context is needed.

This paper has addressed some steps of the adaptation of the ECI for the Portuguese context. However, it is necessary to demonstrate more specifically all of the adaptations made; for example, adaptations of the scoring definitions based on nuances of the Portuguese language. For those who want to take even further advantage of the ECI features, its scoring can be adapted by registering all the concrete gestures, vocalizations, words, and multiple-word utterances that the children produce. In this way, it is possible, for example, to determine the number of different words uttered and the average length of these utterances. It is also possible to compile word and multi-word lists in order to assess the type of words produced and the progress in combining words into phrases (Kaiser, 2014). Therefore, it would be very interesting to carry out studies in Portugal using the ECI for this purpose.

The development of a nationally representative, normative sample is essential, as stated by Carter et al. (2005), this is missing from full adaptation of the ECI for the Portuguese context. In addition to this, additional research would be useful in identifying predictive relationships and determining benchmarks between the ECI key skill elements in the Portuguese context.

Since there are currently no national prevalence studies of communication and language disorders in Portugal for children up to 3 years old, the adaptation of an instrument such as ECI could be useful to monitor the development of children in early ages, and might give place to the development of high-scale epidemiological studies. This adaptation will allow also to develop experimental studies to assess the influence of potential significant variables in the ECI results, such as different sociodemographic characteristics of the children, different assessment settings, different characteristics of caregivers, etc.

Future research should explore the sensitivity of the ECI to early intervention service results for children in Portugal receiving such services. Future works should analyze the clinical and educational utility of ECI in decision making by Portuguese professionals, to demonstrate the effects that ECI can have in these children's futures. This is because the design and purpose of ECI is to meet the need for early education professionals to have a quick, repeatable, reliable, and valid instrument of children's progress in developing expressive communication. This may help early education professionals to rapidly identify those children who are falling below benchmarks, and use the resulting information to initiate an intervention and to make appropriate intervention decisions for children over time (Walker et al., 2008).

The ultimate goal of any of these studies would be to make measures such as ECI more feasible and accessible to professionals, giving them greater awareness of the differences their interventions make in children's lives.

References

- Bavin, E. L., Prior, M., Reilly, S., Bretherton, L., Williams, J., Eadie, P., Barrett, Y., & Ukoumunne, O. C. (2008). The early language in Victoria Study: Predicting vocabulary at age one and two years from gesture and object use. *Journal of Child Language*, 35(3), 687-701. <https://doi.org/10.1017/S0305000908008726>
- Bavin, E. L., Sarant, J., Hackworth, N. J., Bennetts, S. K., Buzhardt, J., Jia, F., Button, E., Busby, P., Leigh, G., & Peterson, C. (2020). Modelling the early expressive communicative trajectories of infants/toddlers with early cochlear implants. *Journal of Child Language*, 47(4), 796-816. <http://doi.org/10.1017/S0305000919000941>
- Bennetts, S. K., Mensah, F. K., Westrupp, E. M., Hackworth, N. J., & Reilly, S. (2016). The agreement between parent-reported and directly measured child language and parenting behaviors. *Frontiers in Psychology*, 7, 1710. <https://doi.org/10.3389/fpsyg.2016.01710>
- Black, L. I., Vahratian, A., & Hoffman, H. J. (2015). Communication disorders and use of intervention services among children aged 3-17 years: United States, 2012 (Data Brief No. 205). National Center for Health Statistics. <https://www.cdc.gov/nchs/data/databriefs/db205.pdf>
- Brady, N. C., Marquis, J., Fleming, L., & McLean, L. (2004). Prelinguistic predictor of language growth in children with developmental disabilities. *Journal of Speech, Language, and Hearing Research*, 47(3), 663-677. [https://doi.org/10.1044/1092-4388\(2004/051\)](https://doi.org/10.1044/1092-4388(2004/051))
- Brooker, R. J., Buss, K. A., Lemery-Chalfant, K., Aksan, N., Davidson, R. J., & Goldsmith, H. H. (2013). The development of stranger fear in infancy and toddlerhood: Normative development, individual differences, antecedents, and outcomes. *Developmental Science*, 16(6), 864-878. <https://doi.org/10.1111/desc.12058>
- Bruce, M., McFayden, T. C., Ollendick, T. H., & Bell, M. A. (2022). Expressive language in infancy and toddlerhood: The roles of child temperament and maternal parenting behaviors. *Developmental Psychobiology*, 64(6), Article e22287. <https://doi.org/10.1002/dev.22287>
- Buzhardt, J., Greenwood, C., Hackworth, N., Jia, F., Bennetts, S., Walker, D., & Matthews, J. (2019). Cross – cultural exploration of growth in expressive communication of English – speaking infants and toddlers. *Early Childhood Research Quarterly*, 48(2019), 284-294. <https://doi.org/10.1016/j.ecresq.2019.04.002>
- Buzhardt, J., Greenwood, C., Walker, D., Jia, F., Schnitz, A., Higgins, S., Montagna, D., & Muehe, C. (2018). Web-based support for data-based decision making: Effect of intervention implementation on children's communication. *Journal of Early Intervention*, 40(3), 246-267. <https://doi.org/10.1177/1053815118788059>

- Buzhardt, J., & Walker, D. (2010). Web-based support for decision making using IGDIs. In J. J. Carta, C. R. Greenwood, D. Walker, & J. Buzhardt (Eds.), *Using IGDIs: Monitoring progress and improving intervention results for infants and young children* (pp. 127–144). Brookes.
- Buzhardt, J., Wallisch, A., Irvin, D., Boyd, B., Salley, B., & Jia, F. (2022). Exploring growth in expressive communication of infants and toddlers with autism spectrum disorder. *Journal of Early Intervention, 44*(1), 3–22. <https://doi.org/10.1177/1053815121995578>
- Carter, J. A., Lees, J. A., Murira, G. M., Gona, J., Neville, B. G. R., & Newton, C. R. J. C. (2005). Issues in the development of cross-cultural assessments of speech and language for children. *International Journal of Language & Communication Disorders, 40*(4), 385–401. <https://doi.org/10.1080/13682820500057301>
- Castro, A., Alves, D. C., & Departamento de Linguagem na Criança da Sociedade Portuguesa de Terapia da Fala. (2019). Portugal. In J. Law, C. McKean, C.-A. Murphy, & E. Thordardottir (Eds.), *Managing children with developmental language disorder: Theory and practice across Europe and beyond* (pp.374-386). Routledge. <https://doi.org/10.4324/9780429455308>
- Crais, E. R. (2011). Testing and beyond: Strategies and tools for evaluating and assessing infants and toddlers. *Language Speech and Hearing Services in Schools, 42*(3), 341–364. [https://doi.org/10.1044/0161-1461\(2010/09-0061\)](https://doi.org/10.1044/0161-1461(2010/09-0061))
- Federico, A., Shi, D., & Bradshaw, J. (2021). Agreement between parental report and clinician observation of infant developmental skills. *Frontiers in Psychology, 12*, 734341. <https://doi.org/10.3389/fpsyg.2021.734341>
- Fernald, A., Marchman, V. A., & Weisleder, A. (2013). SES differences in language processing skill and vocabulary are evident at 18 months. *Developmental Science, 16*(2), 234–248. <https://doi.org/10.1111/desc.12019>
- Ferreira, S., & Cruz-Santos, A. (2021). A review and analysis of four measures of early childhood communication development. *SN Social Sciences, 1*(100). <https://doi.org/10.1007/s43545-021-00129-2>
- Fogle, P. (2017). *Essentials of communication sciences and disorders* (2nd ed.). Jones & Bartlett Learning.
- Frank, M. C., Braginsky, M., Yurovsky, D., & Marchman, V. A. (2021). *Variability and consistency in early language learning: The Wordbank project*. MIT Press. <https://doi.org/10.7551/mitpress/11577.001.0001>
- Frota, S., Butler, J., Correia, S., Severino, C., Vicente, S., & Vigário, M. (2016). Infant communicative development assessed with the European Portuguese MacArthur–Bates Communicative Development Inventories short forms. *First Language, 36*(5), 524–545. <https://doi.org/10.1177/0142723716648867>
- Gain, K. (2014). What is the impact of low socioeconomic status on the vocabulary development of typically developing children prior to school entry? [Critical Review]. <https://www.uwo.ca/fhs/lwm/teaching/EBP/2013-14/Gain.pdf>
- Greenwood, C., Buzhardt, J., Walker, D., Jia, F., & Carta, J. (2020). Criterion validity of the Early Communication Indicator for infants and toddlers. *Assessment for Effective Intervention, 45*(4), 298–310. <https://doi.org/10.1177/1534508418824154>
- Greenwood, C. R., Carta, J. J., Walker, D., Hughes, K., & Weathers, M. (2006). Preliminary investigations of the application of the Early Communication Indicator (ECI) for infants and toddlers. *Journal of Early Intervention, 28*(3), 178–196. <https://doi.org/10.1177/105381510602800306>
- Greenwood, C. R., Walker, D., & Buzhardt, J. (2010). The Early Communication Indicator (ECI) for infants and toddlers: Early Head Start growth norms from two states. *Journal of Early Intervention, 32*(5), 310–334. <https://doi.org/10.1177/1053815110392335>
- Greenwood, C. R., Walker, D., Buzhardt, J., Howard, W. J., McCune, L., & Anderson, R. (2013). Evidence of a continuum in foundational expressive communication skills. *Early Childhood Research Quarterly, 28*(3), 540–554. <https://doi.org/10.1016/j.ecresq.2013.02.006>
- Guimarães, C. S. (2016). *Avaliação das competências pragmáticas em crianças portuguesas dos 18 aos 47 meses: Aferição do Language Use Inventory*. [Unpublished doctoral dissertation]. University of Minho.
- Guimarães, C., & Cruz-Santos, A. (2020). LUI – Portuguese (Portugal). Knowledge in Development. <https://languageuseinventory.com/Translations/Portuguese>
- Guimarães, C., Cruz-Santos, A., & Almeida, L. (2013). Adaptation of the Parent Report Language Use Inventory for 18- to 47-months-old children to European Portuguese: A pilot study. *Audiology - Communication Research, 18*(4), 332–338. <https://doi.org/10.1590/S2317-64312013000400015>
- Hadley, P. A., Rispoli, M., & Hsu, N. (2016). Toddlers’ verb lexicon diversity and grammatical outcomes. *Language, Speech, and Hearing Services in Schools 47*(1), 44–58. https://doi.org/10.1044/2015_LSHSS-15-0018. PMID: 26803292.
- Hammer, C., Morgan, P., Farkas, G., Hillemeier, M, Bitetti, D., & Maczuga, S. (2017). Late Talkers: A population-based study of risk factors and school readiness consequences. *Journal of Speech, Language, and Hearing Research, 60*(3), 607–626. https://doi.org/10.1044/2016_JSLHR-L-15-0417
- Hegde, M. N., & Pomaville, F. (2017). *Assessment of communication disorders in children: Resources and protocols* (3rd ed.). Plural Publishing, Inc.
- Hustad, K. C., Mahr, T. J., Natzke, P., and Rathouz, P. J. (2021). Speech development between 30 and 119 months in typical children I: Intelligibility growth curves for single-word and multiword productions. *Journal of Speech, Language, and Hearing Research, 64*(10), 3707–3719. https://doi.org/10.1044/2021_JSLHR-21-00142
- Hustad, K. C., Mahr, T., Natzke, P. E. M., & Rathouz, P. J. (2020). Development of speech intelligibility between 30 and 47 months in typically developing children: A cross-sectional study of growth. *Journal of Speech, Language, and Hearing Research 63*(6): 1675–1687. https://doi.org/10.1044/2020_JSLHR-20-00008

- Kaiser, A. P. (2014). Practical assessment of communication in the classroom. In M. E. McLean, M. L. Hemmeter, & P. Snyder (Eds.) *Essential elements for assessing infants and preschoolers with special needs*. Pearson
- King, M., Larson, A. L., & Buzhardt, J. (2022). Exploring the classification accuracy of the Early Communication Indicator (ECI) with dual-language learners from latinx backgrounds. *Assessment for Effective Intervention*, 47(4), 209–219. <https://doi.org/10.1177/15345084211027138>
- Koo, T., & Li, M. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine*, 15(2), 155–163. <https://doi.org/10.1016/j.jcm.2016.02.012>
- Justice, L. M., Jiang, H., Bates, R., & Koury, A. (2020). Language disparities related to maternal education emerge by two years in a low-income sample. *Maternal and Child Health Journal*, 24(11), 1419–1427. <https://doi.org/10.1007/s10995-020-02973-9>
- Larson, A. (2016). Language screening for infants and toddlers: A literature review of four commercially available tools. *Communication Disorders Quarterly*, 38(1), 1–10. <https://doi.org/10.1177/1525740115627420>
- Levey, S. (2019). *Introduction to language development* (2nd ed.). Plural Publishing, Inc.
- Levickis, P., Conway, L., Smith, J., & Bennetts, S. (2022). Parent–child interaction and its impact on language development. In J. Law, S. Reilly, & C. McKean (Eds.), *Language development: Individual differences in a social context* (pp.166–192). Cambridge University Press
- Luze, G., Linebarger, D., Greenwood, C., Carta, J., Walker, D., Leitschuh, C., & Atwater, J. (2001). Developing a general outcome measure of grow in the expressive communication of infants and toddlers. *School Psychology Review*, 30(3), 383–406. <https://doi.org/10.1080/02796015.2001.12086122>
- McLeod, S. (2020). Intelligibility in Context Scale: Cross-linguistic use, validity, and reliability. *Speech, Language and Hearing*, 23(1), 9–16. <https://doi.org/10.1080/2050571X.2020.1718837>
- Morgenstern, A., & Goldin-Meadow, S. (2022). Introduction to gesture in language. In A. Morgenstern & S. Goldin-Meadow (Eds.), *Gesture in language: Development across the lifespan* (pp. 3–17). American Psychological Association; De Gruyter Mouton. <https://doi.org/10.1037/0000269-001>
- Owens, R. (2016). *Language development: An introduction* (9th ed.). Pearson Education.
- Paul, R., & Roth, F. (2011). Characterizing and predicting outcomes of communication delays in infants and toddlers: Implications for clinical practice. *Language, Speech and Hearing Services in Schools*, 42(3), 331–340. [https://doi.org/10.1044/0161-1461\(2010/09-0067\)](https://doi.org/10.1044/0161-1461(2010/09-0067))
- Prelock, P. A., & Hutchins, T. L. (2018). *Clinical guide to assessment and treatment of communication disorders*. Springer International Publishing.
- Raikes, A., Britto, P. R., & Dua, T. (2014). A measurement framework for early childhood: Birth to 8 years of age (NAM Perspectives, Discussion Paper). National Academy of Medicine. <https://doi.org/10.31478/201411a>
- Raikes, A., Yoshikawa, H., Britto, P. R., & Iruka, I. (2017). Children, youth and developmental science in the 2015–2030 Global Sustainable Development Goals. *Social Policy Report*, 30(3), 1–23. <https://doi.org/10.1002/j.2379-3988.2017.tb00088.x>
- Silva, C., Cadime, I., Ribeiro, I., Santos, S., Santos, A., & Viana, F. (2017). Parents’ reports of lexical and grammatical aspects of toddlers’ language in European Portuguese: Developmental trends, age and gender differences. *First Language*, 37(3), 267–284. <https://doi.org/10.1177/0142723716689274>
- Tamis-LeMonda, C. S., Kuchirko, Y., & Song, L. (2014). Why is infant language learning facilitated by parental responsiveness? *Current Directions in Psychological Science*. 23(2), 121–26. <https://doi.org/10.1177/0963721414522813>
- Viana, F. L., Cadime, I., Silva, C., Santos, A. L., Ribeiro, I., Santos, S., Lima, R., Costa, J., Acosta, V., Meira, A., Santos, A. S., Lucas, M. I., & Monteiro, J. (2017). *MacArthur-Bates Inventários de Desenvolvimento Comunicativo: Manual técnico* [The MacArthur-Bates Communicative Development Inventories: Technical Manual]. Lusoinfo Multimédia.
- Walker, D. (2012). *Strategies for promoting communication and language of infants and toddlers*. Juniper Gardens Children’s Project. <http://www.talk.ku.edu/wp-content/uploads/2014/09/PC-Manual-web-site-and-distrib-9-26-141.pdf>
- Walker, D. & Carta, J. (2010). The communication IGDI: Early Communication Indicator (ECI). In J. J. Carta, C. R. Greenwood, D. Walker, & J. Buzhardt (Eds.), *Using IGDIs: Monitoring progress and improving intervention results for infants and young children* (pp. 39–56). Brookes.
- Walker, D., Carta, J. J., Greenwood, C. R., & Buzhardt, J. F. (2008). The use of individual growth and developmental indicators for progress monitoring and intervention decision making in early education. *Exceptionality*, 16(1), 33–47. <https://doi.org/10.1080/09362830701796784>
- Whitehouse, A. J. O., Robinson, M., & Zubrick, S. R. (2011). Late talking and the risk for psychosocial problems during childhood and adolescence. *Pediatrics*, 128(2), 324–33. <https://doi.org/10.1542/peds.2010-2782>
- Wolery, M., & Ledford, J. R. (2014). Monitoring child progress. In M. E. McLean, M. L. Hemmeter, & P. Snyder (Eds.) *Essential elements for assessing infants and preschoolers with special needs*. Pearson