

# Parent-EMBRACE: An Adaptive Dialogic Reading Intervention

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**Abstract.** Dialogic reading is a practice where adults and children engage in a dialogue as they read together to improve children's language strategies and comprehension. These dialogues are often initiated by parent questioning behaviors, but parents do not always engage in this behavior spontaneously. In this paper, we describe an adaptive intervention for dialogic reading, Parent-EMBRACE, built into an iPad application that uses an embodied cognition approach and is designed specifically for Latino dual language learners in the US. The intervention: 1) Models parent question asking, 2) Provides parents with on-demand hints on questions that can be asked at particular moments during the story, 3) Prompts parents to ask questions at appropriate times, 4) Includes a dashboard that presents parents with data on their question-asking behaviors, 5) Provides all support in both English and Spanish. We discuss the implications of this intervention as an intelligent tutoring system for parent-child interactions, plans to extend and evaluate the system.

**Keywords:** dialogic reading, embodied cognition, parent-child interactions, intelligent tutoring systems

## 1 Introduction and Related Work

Dialogic reading (DR) is a practice where adults and children engage in dialogue as they read together. It has been demonstrated to improve children's language skills, such as vocabulary and syntax development, and inference-making skills [1,2]. Parents can be trained dialogic reading strategies (e.g., asking questions or recasting children's verbal contributions) to facilitate these outcomes [3]. For example, Schwanenflugel and colleagues [4] used a DR model with three types of questions, denoted using the acronym CAR. C stands for competence questions such as, "What are the ingredients in the bowl?". A stands for abstract questions such as, "Why do they need

the bowl of chilis?”. R stands for questions that relate to the child such as, “Have you seen a bowl of chilis in our kitchen?”. In a recent parent-child question-asking study [5], Parents were trained in CAR questions asked an increased number of questions while reading with their child, even five weeks later.

However, there are some limitations to this approach. First, training is expensive in terms of cost and person-hours. Therefore, it does not scale well beyond a handful of families. Second, parents must implement the training after it is over. But, parent implementation of the target practices not only varies with existing family literacy practices and family income, but also with cultural background and possibly the language of training (e.g., [6, 7, 8]). Often programs assume parental literacy skills that parents from low-income homes may not have [7, 9, 10, 11]. In contrast, Mesa and Restrepo [12] found that modeling and coaching in the native language changed parents’ practices and attitudes towards reading with their children, while also affecting the children’s language use. There may be promise in embedding this type of training into digital environments, and, in fact Troseth and colleagues [13] modelled a good question-asking within an e-book by embedding a character that presented example DR prompts on each page of a story. This approach led to strong gains in both parent and child book-related talk, although there was no improvement in story comprehension compared to a condition without DR.

This paper describes Parent-EMBRACE (Enhanced Moved By Reading to Accelerate Comprehension in English), an adaptive system for scaffolding parents in dialogic reading practices as they read an interactive storybook with their children. Parent-EMBRACE extends an iPad application that uses an embodied cognition approach to reading and is designed specifically for parents from Latino communities in the US with children between the ages of 5-10 [14]. Beyond this, our intervention builds on the literature described above by adapting question prompts to parent behaviors, including a dashboard that presents parents with data on their question-asking behaviors, and providing all support in both English and Spanish. There are a limited number of intelligent systems that support parent-child learning, and thus Parent-EMBRACE provides one blueprint for such systems.

## 2 Parent-EMBRACE System

**EMBRACE.** In previous work, we developed EMBRACE, an app that leverages theories of embodied cognition, dual language learning, and intelligent tutoring systems to promote reading comprehension in Latino dual language learners [14]. The app follows principles of embodied cognition by engaging the reader in physical and cognitive simulation. The reader uses an iPad that presents texts and pictures much like in a child’s picture book. However, after reading key sentences, the app prompts the reader to move the pictures to correspond to the sentence, an approach that yields improved reading comprehension outcomes over typical reading practice [15]. This system was developed specifically for Latino populations, and consistent with research on bilingual education, provides support in Spanish (e.g., vocabulary help is presented in English and Spanish; [16]). In addition, the system functions as an intel-



**Fig. 1.** Main interface to Parent-EMBRACE. Parents indicate the type of question they ask and to receive example questions in the large pane at the bottom of the

lignant tutor by using how children move the pictures within the application to make inferences about the child's vocabulary and syntactic knowledge. This information is then used to provide the child with tailored feedback and vocabulary practice. The system is implemented in Objective-C, with storybooks and related metadata for the ITS encoded in xml.

**Assessment of Question-Asking.** Parent-EMBRACE currently defines a few basic rules for how questions should be asked: Parents should not go more than 3 pages of the story without asking a question, and parents should ask roughly equal numbers of C, A, and R questions. The app includes a parent-facing interface, shown in Figure 1, asks parents to indicate when they are asking their child questions and whether they are asking a Concrete (competence), Abstract, or Relational question by clicking on the "C", the "A", or the "R". When they click on the relevant button, the question counter below the button increments, and we maintain a simple parent model by storing the total number of C, A, and R questions asked per book.

**On-Demand Hints and Adaptive Prompts.** There are two mechanisms built into the application to adaptively encourage parents to engage in DR, following principles of ITS design [17]. First, they can use the parent interface to request a hint from the application. Hints consist of three example questions that can be asked. Examples are



**Fig. 2.** Both sides of a book card in the parent dashboard for a book. One side (left) indicates information about who has read and in what language. The other side (right) indicates information related to number of questions asked and time spent

presented one at a time, and parents can view the next example by swiping right or left. Second, if parents have not asked a question after they have read 3 story pages, an example question is revealed in the interface without any hint request being necessary. Examples are drawn from a stored question bank and are always relevant to the current page. The questions are ordered based on question type, where the types that parents have asked the least are put first. Assistance is faded as parents and children reread the books, where on the third reading of the same text, the system only indicates a good time to ask a question of a particular type but does not provide examples, and on the fourth reading there is no support given. Across all readings, this approach depends on parents' accuracy in indicating and labeling the questions they are asking.

**Parent Dashboard.** A dashboard for parents in Parent-EMBRACE with two-sided book cards (see Figure 2) encourages them to ask questions and reflect on their progress. The dashboard displays the number of times a book has been read, the language of the reading (Spanish or English), the reader (Parent or Child), the total number of questions asked by the Parent along with a chart that displays that number by question types and the time spent reading the book.

**Language.** All aspects of our application are implemented in both Spanish and English to facilitate dual language learning. For example, parents can toggle the question interface between Spanish (ES) and English (EN). This allows a parent who may not be comfortable enough in one language to switch to the other available language. Low reading proficiency in the second language is not a barrier to use this application.

### 3 Discussion and Future Work

We present an implementation of Parent-EMBRACE, which has several complementary features that support parent-child dialogic reading, including a parent interface that adaptively displays example questions and a dashboard that displays parent progress. Our next step is to test Parent-EMBRACE in a controlled study to determine its effects on interaction during DR and children's reading comprehension. In addition, there are many ways to extend the current implementation. While we cannot currently ensure that the parents accurately self-label the questions they ask, as future work, using Automated Speech Recognition (ASR), we can build a model for dynamic classification of parent-child dialogue into questions and question types. We can extend the model of parent reading to include questions and question types that are particularly appropriate for certain parts of the book or phases of reading, and even use question generation methods to automatically generate example questions for each page. Currently, the original ITS and parent-ITS operate separately from each other, but in the future, we could use information provided by the original ITS to inform the questions suggested by the parent ITS. Overall, this project represents a framework for supporting parent-child interactions using ITS-based approaches.

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