# Can Video Games Improve Phonological Awareness and Reading Skills?

## One experience with Spanish-speaking children with dyslexia

by Juan E Jiménez

One of the most common problems of children with dyslexia is that they have difficulty identifying the phonemes, or sounds, that make up words. In this article, we consider video games as a learning tool to help students develop this phonemic awareness and improve their word reading. To better focus this analysis, we have examined the experiences of Spanish-speaking children, the potential for them to benefit from this type of training, and how teachers and parents can help.

The use of video games by children and adolescents has been a matter of concern for both parents and teachers because of the amount of time spent and the negative effect these games could have on the values and behaviors of the players. But what if the same features that concern parents and teachers about these games could actually be useful tools for struggling readers? Consider the following:

Video games

- attract and hold the interest of the player;
- encourage interaction with the game, giving the player the opportunity to take charge of the situation and become the true protagonist of the story;
- can be played alone or with others;
- recreate fantasy environments and lifelike action that weave text, video, sound, graphics, and animation into one learning environment; and
- introduce original and creative scripts.

Given these features of video games, could it be that they might actually benefit struggling readers? To explore this question, we designed a videogame called *Tradislexia*[1] and assessed its effects of on phonological awareness (PA) and word reading skills in Spanish children with dyslexia.

### Multimedia Learning and Video Games

Videogames, such as *Tradislexia*, can be designed to have an educational and remedial purpose. The theory of multimedia learning can be useful in determining relevant issues for multimedia instructional design in these types of games. For example, Mayer (1999) has noted the following principles that should guide the presentation of information in multimedia format:

- multimedia principle: students learn best when they receive words with corresponding pictures rather than words presented in isolation.
- spatial contiguity principle: students learn best when the distance between words and pictures is closer because both representations can be held in working memory simultaneously, thus freeing up cognitive resources.
- consistency principle: more learning occurs when extraneous words and pictures are excluded.
- modality principle: learning is more successful when words are presented to both visual and auditory channels.
- temporal contiguity principle: learning is improved when words and pictures are presented simultaneously rather than successively.

Another important aspect of multimedia design that can have an impact on instruction is the multimedia agent (MA). MAs are the lifelike characters in multimedia software and online applications that pop up on the screen to explain rules, provide hints, or prompt the user to use the program's features. They can be human or nonhuman, animated or static. They are potentially an important element in the instructional value of these games because they assume the role of tutor or mentor, increasing the learning value of these applications. Researchers and designers have found that when an MA is programmed to demonstrate emotion and to speak in a personalized tone, students' learning rates and interaction is higher, and students also report that the content is more interesting and less difficult (Lester, Stone, & Stelling, 1999). MAs can provide opportunities to practice new skills and knowledge with the support and feedback that is so crucial to learning.

These multimedia principles could also be used to instruct struggling readers such as those with dyslexia. But first, it is helpful to understand the difficulties faced by students with dyslexia and the instructional techniques that have helped them become successful readers.

### Multimedia and PA Training

Studies conducted in different languages have provided empirical evidence that there is a phonological processing deficit in dyslexia. In the Spanish language, some studies have shown that the problem is phonological decoding skills (see for example, Jiménez & Hernández-Valle, 2000) caused by a deficit in the development of PA. There is empirical evidence that the difficulty in solving tasks measuring PA is related to the complexity or syllabic structure of the words used

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(Yopp, 1988). That is, the task performance may be mediated by the complexity of the syllabic structure of the word. If the syllable has a consonant-vowel structure (CV), then it requires an analysis of onset and rhyme; while for syllables with consonant-vowel-consonant (CVC) structure, operation is focused on the analysis of the vowel and coda constitute the rhyme. Finally, if the syllable is structurally consonant-vowel-consonant (CVC), then one must analyze the different phonemes that constitute the syllable.

A study of Spanish-speaking dyslexic children (Jiménez et al., 2005), showed that the complexity of syllable structure is less significant in explaining the difficulties in reading in Spanish than it is in reading English (Goswami, 2002). Empirical evidence shows that children who learn to read in languages with transparent orthography (i.e., there is a regular correspondence between graphemes and phonemes) PA develops faster than children learning to read when the correspondences between graphemes and phonemes are not consistent, such as in English (Goswami, 2002). The educational implications of these findings may be that PA training should include practice exercises where children have to identify phonemes for different types of syllable structures (i.e., CV, CCV, etc.) but it would not be so necessary to manipulate phonemes across different tasks (i.e., isolating the sounds within words, segmentation, blending sounds, and deletion of a sound within words). However, we have no studies that have investigated whether training in PA from different tasks or focused on different types of syllabic structure improves word decoding.

In a recent review of phonological instruction in learning to read in a multimedia context, it was found that systematic phonological training has proven effective and may be part of programs to acquire the skills necessary when students are first learning to read (Blok, Oostdam, Otter, & Overmaat, 2002). Phonological instruction in a multimedia context has also to help those with learning disabilities in reading. Specific programs have been designed for training PA tasks in a multimedia context (e.g., DaisyQuest I and II) that improves PA. In addition, the effects are longer lasting than with the instruction provided by the teacher (Foster, Erickson, Foster, Brinkman, & Torgesen, 1994). However, these studies are in English and it is important to study this instruction in other languages as well.

### *Tradislexia*: A Videogame for Training PA and Reading Skills in Spanish

*Tradislexia* was designed to determine if some of these same findings are applicable to Spanish-speaking children. *Tradislexia* is a video adventure game specifically designed for Spanish-speaking children that takes into account principles derived from cognitive theory and multimedia learning. In Tradislexia, the player is required to unravel a mystery or situation about which little is known to complete the assigned quest. This game has a clear educational and remedial purpose in that it was designed to improve phonological processes and word recognition, based on 3D (Torque Game Engine; *www.ocideidi.net*). This game also trains the user in different cognitive processes associated with dyslexia: perceptual processes, phonological, orthographic, syntactic, semantic, and comprehension. Training activities for each of these processes are presented in different scenarios as part of video game history.

The PA component of the video game consists of four types of exercise games (i.e., isolating, segmentation, deletion, and blending): 1) to practice *isolating* phonemes, the player listens to a word (e.g., *sol* (sun)), and is required to say its first sound (/s/). Then, he or she has to point to the picture (with the computer mouse) that begins with that same sound (in this example, *silla* (chair)). The words for isolating activities are structured CV and CCV to isolate the initial sound and CVC for the final sound; 2) in the *segmentation* exercises the child listens to a word (e.g., *mesa* (table)) and then says its constituent sounds, phoneme by phoneme (i.e., m/e/s/a). Either pronouncing the sounds or saying the names of letters constitutes a correct response; 3) in the *deletion* exercises, children listen to a word (e.g., *blusa* (blouse)) and then are required to delete its first sound. The child responds by using the mouse to select the correct choice from three available options (in this case, *lusa* from /lusa/, /tusa/, and /musa/); 4) *blending* requires that the child listen to a sequence of phonemes (e.g., l/a/p/i/z) and is asked to say the whole word (*lápiz* (pencil)). Three pictures are presented on the computer screen (e.g., pencil, donkey, and bed) and the child is required to select the correct one with the mouse.

In the game the player takes an active role in activities to improve reading processes such as PA. The game goes through different scenarios (e.g., Boulevard, Old House, Desert Island, and Lunar Landscape). Each follows the same instructional sequence provided by an MA. The MA is the video game character that helps the player perform activities and provides the feedback (both positive reinforcement and corrective). The sequence has the following steps: a) the MA explains how to perform the exercise b) the MA does the exercise (as it is the first time and serves to model the correct way of doing it), c) the MA invites the player to do the same example, d) the player completes the exercise sample, e) once he or she has performed the exercise, the MA explains the right choice, regardless of the outcome, f) when the MA has finished explaining the task, it invites the user to perform the exercises, g) then the MA gives positive reinforcement if the user hits or says, "your retry failed," giving a new opportunity to respond; h) finally, if a new user attempt succeeds, it gives positive reinforcement. But if he or she misses, the MA gives the correct alternative (corrective feedback).

An example of instructional sequencing would be: 1) the MA explains and demonstrates how the exercise is done; 2) the MA waits for the child to repeat the exercise sample and provides feedback; 3) once the exercise is conducted, the MA shows the correct solution and gives the explanation; and 4) the child performs the exercises. The computer records the hits-errors and the number of attempts to complete the exercise correctly.

### *Tradislexia* Is a Success

We analyzed the effects of *Tradislexia* in PA and word recognition in children with dyslexia (Jiménez & Rojas, 2008). Studies of PA training in multimedia context in children with dyslexia have not analyzed the effect of type of task (i.e., segmentation, blending, deletion, or isolation) and type of syllable structure (i.e., CV, CVC, or CCV). We wanted to test whether PA multimedia training should focus on different syllabic structures regardless of the type of task. When we analyzed whether the gains in phonological processes were related to training based on type of task or type of syllable structure, the results showed that the multimedia treatment in segmentation and blending with words that include CV syllables is the best predictor of improvement in word decoding processes.***

These results support the effectiveness of the systems through the computer instruction in PA training. In fact, research shows that well-designed MAs have a positive impact of learning (Moreno, 2005).

One of the main hypotheses concerning dyslexia postulates the existence of a deficit in PA that affects the development of decoding skills. The analysis of differences in pre- and posttest reading measurements revealed that the experimental group had improved word reading compared to control group.

There was also a transfer of learning tasks of PA to reading pseudowords in the multimedia context trained group. Moreover, the changes also affected orthographic processing strategies in reading because children with dyslexia had high training scores in a homophone comprehension task. In this task we showed each child a picture, two homophone words that are pronounced the same but are spelled differently (e.g., *hola-ola /hello-wave*) and a spoken question (e.g., "*What word indicates greeting*?"). The child had to choose one of the written words. The correct response was the word that matched the picture and the question.

What we have discovered is that training with the video game improved the performance of children who participated in the games and that their word recognition skills improved also, compared to the control group. In turn, the results showed that by training in tasks requiring all phonemes (synthesis-segment) in CV structure words, phonological representations were improved, which resulted in children having better performance in reading pseudowords. Thus, our findings do not support the hypothesis that PA multimedia training should focus on different syllabic structures regardless of the type of task. Rather, the findings suggest that intervention in the treatment of dyslexia should focus on tasks (e.g., segmentation and blending) that require the manipulation of phonemes in words that contain syllables with CV structure that are the most frequent in transparent languages, such as Spanish, but more studies are necessary to substantiate this conclusion.

Overall, the findings described here have implications for education in school and at home. Special education teachers primarily require access to learning resources that can support cognitive process development for children with learning disabilities in a variety of ways to meet individual learning needs. Enabling teachers to have access to multimedia learning resources, which support phonological and reading skills development, allows the teacher to focus more on being a facilitator of learning while working with individual students. At the same time, the development of multimedia technologies for learning disabilities offers new ways in which learning can take place— in schools and at home.

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