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## **On-screen children's stories: The good, the bad and the ugly**

Takacs, Z.K.

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**Author:** Takacs, Zsofia Katalin

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# CHAPTER 1

GENERAL INTRODUCTION

Narrative stories like picture storybooks have an important role in the lives of young children, they are a source of cognitive, social and emotional development. Stories support language development by exposing children to sophisticated words and expressions in addition to teaching literacy skills like print and letter knowledge (Bus, van IJzendoorn, & Pellegrini, 1995; Mol & Bus, 2011). According to the book reading paradigm young children are read print storybooks by an adult. However, with the rapid spread of technology, children's stories are going digital.

Technology is massively present in the lives of young children in Western societies. According to a representative survey in the United States (Common Sense Media, 2013), children up to 8 years of age spend almost two hours a day with screen media. While children, although decreasingly, still use older screen technology like television, DVDs, computers and video games, mobile media devices such as smartphones and tablets grow in popularity. In fact, it was found that 75% of American children in the age of 8 or under had access to a mobile media device in the fall of 2013 (Common Sense Media, 2013). Additionally, 58% of the parents reported downloading apps specifically for their child in the same study. Similarly, 86% of Dutch children up to age 7 watch television regularly and 70% use tablets often, as found in an online survey in 2014 (Iene Miene Media, 2014).

Narrative stories for young children are also widely available on different platforms and devices like television (e.g., *Mijn Mooiste Prentenboek*, KRO), CD-ROMs (e.g., *Hennie de Heks* by Bombilla) and DVDs (e.g., *Hoe Tem Je een Draak* movie by DreamWorks Animation), educational websites (e.g., [www.kenny.nl/koekoeksklok](http://www.kenny.nl/koekoeksklok) or [www.bereslim.nl](http://www.bereslim.nl)), but more recently also on mobile media devices (e.g., *Mama Kwijt* app by Gottmer Uitgevers Groep B.V.), and video game consoles (e.g., *Freddi Fish en het Verhaal van de Verdwenen Zeewierzaadjes* for the Wii by Majesco). This transformation to digital stories fundamentally changes the experience of sharing a storybook with an adult and results in a wide variety of electronic storybooks. For example, many print children's storybooks that have been adapted to DVDs and apps include animated illustrations, music and sound effects. To illustrate, in the multimedia app *Roodkapje* by Chocolapps SAS the illustrations are animated featuring movements like the Little Red Riding Hood skipping away in addition to zooming in on specific parts of the illustration such as the wolf knocking on grandma's door, sound effects as Little Red Riding Hood screaming and a background music demonstrating the story like when grandma is surprised and afraid when the wolf comes to her house. Similarly, children's educational television programs like *Dora* by Nickelodeon present narrative stories with the addition of such film effects. However, educational television programs like *Dora* can be quite different from

multimedia storybooks because they often include dialogues instead of narrations, making the language of the story more colloquial.

On the other hand, some electronic stories utilizing the possibilities of interactive devices like mobiles, tablets and video game consoles aim to involve the child actively in the story. They include interactive features that do not play automatically but children need to activate them. The app *Noa's Sterren* by Hanneke van der Meer, for example, includes 'hotspots', areas in the illustrations that can be activated upon touching them. For instance, Noa starts humming, the frog jumps and the plants rock when touched. In the same app, and in many storybook apps, children need to swipe the screen in order to "turn the page" giving them control over the pace of the story and allowing them to spend time with the hotspots on each page. Similarly, in the app *Finn's Hoedje van Papier* by Tizio B.V. children can activate sound effects on each page by touching details in the illustration like the sound of a seal. The app *De Drie Kleine Biggetjes* by Johnny Balassis includes hotspots; after touching the 'sun' or the 'flowers' the narrator names those. As this function is also available during the oral narration there may be some verbal overlap. The English-spoken app *Oh, the Things You Can Do That Are Good For You!* by Oceanhouse Media includes a vocabulary function in the form of highlights: upon touching a bolded word in the written text like 'exercise' a written definition of the word appears in addition to the narrator reading the definition.

Many storybook apps include small games all along the story. On several pages in *Noa's Sterren* children need to solve a problem (e.g., collect stars in Noa's lantern) before they can turn the page. In the app *De 5 Hoofden* by Barbara de Wolf children can make the peas fly away from the illustration. In the famous English-spoken app *Alice for the iPad* by Atomic Antelope there are many hotspots with small games like a bottle that can be moved around the screen. The English-spoken "storybook adventure" video game *Sesame Street: Once Upon a Monster* for the Xbox 360 by Double Fine Productions features a plethora of mini-games focusing on dancing and movements utilizing the motion detector of the device. Likewise, in the award-winning English app *Little Red Riding Hood* by Nosy Crow children play a game like collecting flowers or pouring honey in Little Red Riding Hood's basket on every page. Interestingly, the same app allows children to choose from eight possible endings for the story. The story *Robot in Space* in the app *Speakaboos Stories* by Speakaboos also offers choices regarding different elements in the story like the vehicle in which the robot travels. Another feature to involve the children personalizes the story for them, for example, in the English-speaking app *I Imagine* by Bizzibrains users can upload photos and design the characters of the story looking like themselves. The app *Timo*

en *het Toverstokje* by Books2download allows parents to record their own narration of the stories.

In sum, electronic storybooks for children vary hugely in terms of the mix of features they offer. On one end of the spectrum electronic storybooks are very similar to print storybooks. Exemplary are the app *Dikkie Dik* by Gottmer Uitgevers Groep B.V. or the *VerhaaltjesApp* by De Onderwijsstudio. Both present the static illustrations and the written text on the screen while a narrator reads the story without any technological additions. On the other end of the spectrum, there are storybook apps like *De Geweldige Vliegende Boeken van Meneer Morris Lessmore* by Moonbot Studios LA that include automatic animations, music and sound effects in addition to numerous hotspots and games on every page. In between there are electronic stories with mostly multimedia features and no interactive options. The app *Roodkapje*, for instance, plays the story automatically with animated illustrations and background music and there is very little interaction in between. There are also digital stories with many interactive functions but without automatic dynamic visualizations. Exemplary is the app *Woeste Muis* by Tizio B.V. with hotspots in the illustration that, upon touching, result in sound effects and brief animations. Which features are present in an electronic story depends on the device for which they are made. For example, interactive features are very popular in mobile media story apps and such apps are preferred by distributors in order to utilize the possibilities of the device. However, instead of considering the different devices, the present thesis focuses on features that electronic stories have in common: multimedia and interactive features.

### MULTIMEDIA FEATURES

Animations including motion and zooming, sound effects and background music are the characteristic multimedia features in electronic storybooks. In a recent content analysis about half of English-spoken storybook apps were found to include animation, while 60% featured music or sound effects (Guernsey, Levine, Chiong, & Severns, 2012).

These additions may serve story comprehension when they are well matched to the story language. However, multimedia features can also be purely decorative or incidental. In the app *Nijntje op School* by Sanoma Media Netherlands B.V. the only animation on most of the pages is the bunny blinking, which has nothing to do with the story. In the app *Verhaaltjes Verteller, Deel 2* by Fisher-Price the clouds in the background are moving all along the story which is irrelevant for understanding the story. In the English-spoken app *Elmer and Rose* by Oceanhouse Media there are

sound effects of monkeys and lions while the main theme is a conversation between three elephants about a fourth elephant missing. In these cases the motion and sound effects do not match the oral language of the story and are purely for decoration.

### INTERACTIVE FEATURES

Older generations of electronic stories included many interactive features (de Jong & Bus, 2003). With the introduction of mobile media devices like smart phones and tablets variation in interactive features increased. For example, they may include tilting, shaking or turning the device and utilize the gyroscope in the iPad. By tilting the iPad in the English-spoken app *PopOut! The Tale of Peter Rabbit* by Loud Crow Interactive Inc. flowers of the Chinese lantern slide up and down on the bottom of the screen. Scanning the most popular children's apps and their descriptions, it seems that interactivity is a large selling point. In fact, it was found in 2012 that 75% of story apps that were on the market in that year contained hotspots, while 65% included games and activities like coloring (Guernsey et al., 2012).

Interactive features may be more supportive for story understanding if they are related to the narration. For example, most of the effects in the app *Noa's Sterren* elicited by touching details in the illustration are not mentioned in the narration. Similarly, the English-spoken apps of *PopOut!*, *The Tale of Peter Rabbit* or *Alice for the iPad*, include small details in the illustration like blackberries that children can enlarge and smash or a clock they can spin. None of those have a relation to the story. Actually 90% of the hotspots were found irrelevant to the story in older CD-ROM stories in the Netherlands (de Jong & Bus, 2003). In the same vein, Guernsey and colleagues (2012) found that only 25% of story apps that were available in 2012 included games that foster reading skills. Hotspots including labels for visual elements in the illustration, small animations, sound effects or dictionary functions might be more congruent with and relevant for the story.

With electronic stories that are filled with hotspots and games, one might wonder where storybook reading ends and playing begins. It is questionable whether young children are able to play with the hotspots and games and simultaneously understand the story and learn story language. Actually doing both at the same time requires multitasking, which may put young children at risk of cognitive overload.

### COGNITIVE RESOURCES

Humans have limited working memory capacities, that is, the amount of information that we can hold for a short term is restricted (Baddeley, 2003; Sweller, 2005). If games and hotspots are part of the storybook children need to switch between

playing with the interactive features and listening to the narration. Thus, interactive features might distract children from the story due to their limited working memory capacities. This is especially likely when games and hotspots are available at the same time as the story is read to them.

On the other hand, the multimedia may be helpful in selecting the relevant information from the illustrations that match the story text, and form integrated mental representations. That is, the animated pictures might guide children in making a connection between images and story language by attracting their attention to specific parts of the illustration via motion and zooming. Paivio's dual coding theory (Paivio, 2007) and Baddeley's working memory model (Baddeley, 2003) propose that verbal and nonverbal information are processed by two independent but integrated channels. This suggests that processing nonverbal information at the same time as verbal stimuli does not result in cognitive overload especially when there is a strong match between the non-verbal and verbal information.

Building on these premises instructional theories like the cognitive theory of multimedia learning (Mayer, 2003) assume that pictures in addition to words, as long as they are congruent, may result in deeper learning than words alone. This might apply to storybook reading as well and preschool-aged children may benefit from a multimedia presentation of a narration.

In sum, the story language can be visualized and concretized by means of animated illustrations and thus facilitate story comprehension. This is only possible when there is a strong connection between the verbal and nonverbal information. On the other hand, according to the coherence principle of the multimedia learning theory, extraneous additions might interfere with learning (Mayer, 2003). Information that is not tightly connected to the story might distract children and reduce comprehension of and learning from the story. Incidental motions in the illustrations or small games not closely related to the story can cause overload of children's working memory resources. Multimedia and interactive additions in electronic stories may enhance learning but only as long as they are tightly connected to the content of the story.

## OVERVIEW OF THE THESIS

The present thesis reports the results of research that was part of the PROO project 'Creating and Implementing Technology for Early Literacy'. The thesis focuses on the effects of electronic stories on children's cognitive development. The main issue was whether, and if so why, technology-enhanced stories are more facilitative of children's learning of language and literacy skills than the more traditional print storybooks with static pictures. In case digital stories are found more beneficial, it is important to identify features that contribute to this effect.

**Chapter 2** reviews the empirical evidence for effects of digital stories, making a distinction between multimedia and interactive features. Research findings are explained by referring to cognitive information processing theories including dual coding and cognitive overload.

Based on the conclusions of the narrative review, **Chapter 3** presents a quantitative research synthesis that addresses the hypotheses raised in Chapter 2 regarding the distinct effects of multimedia and interactive features on children's story comprehension and vocabulary development. Additionally, the impact of technological enhancements for children raised in disadvantaged environments is discussed.

Taking the issue one step further, **Chapter 4** reports another meta-analysis comparing the benefits of multimedia elements in digital stories on children's story comprehension and word learning to the benefits of support from an adult when children encounter traditional print stories.

**Chapter 5** zooms in on the advantage of animations in multimedia stories for children's story comprehension. Furthermore, the underlying mechanisms are discussed based on eye-tracking data of children's attention to and processing of animated and static storybook illustrations.

Finally, **Chapter 6** discusses the conclusions of the results presented in the present thesis and formulates guidelines for designing and selecting high-quality electronic stories that support young children's language and literacy development.

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