

StoryFaces: Pretend-Play with Ebooks to Support Social-Emotional Storytelling

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ABSTRACT

We introduce StoryFaces, a new composition and storytelling tool for children to explore the role of emotional expressions in children's narrative. StoryFaces invites children to record emotional expressions that become part of storybook illustrations. As children watch the story being told, they see their faces bring the story to life; then they can "go backstage" to play with the story by rearranging the videos and altering the story text. More experienced children can build an interactive ebook from the ground up, creating scenes, characters and expressive faces to craft personalized narratives. Our design rationale focuses on supporting children's exploration of emotional expression through their narrative play. Results with eighteen children ages 4-10 indicate that emotional expressions are inviting and motivating for children across this broad age range to engage in both reading and creating narrative. StoryFaces gave children's ephemeral facial expressions concrete forms with which they could manipulate, discuss, and think about the role of emotion in narratives. Our goal is to provoke new ideas about how pretend play with digital tools can empower young children in social-emotional narrative activities.

Categories and Subject Descriptors

H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems—artificial, augmented, and virtual realities

General Terms

Design

Keywords

Storytelling, children, social-emotional development, facial expressions, video recording, communication tools

1. INTRODUCTION

Facial expression is one of the strong non-verbal communication cues we humans use in understanding one another. For young children, understanding facial expressions seems to play a role in their cognitive, social, and language development [[3]]. While it is

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assumed that children naturally develop these capabilities in interaction with other people in their environment, research suggests benefits in fostering these skills, and these skills seem to be teachable [[9]]. Activities that support children to play with facial expressions but also do so in social and emotional activities are foundational in many preschool curriculums, such as story telling, story-plays and other dramatic activities.

There is a clear opportunity for open-ended play with digital tools today. Outside the classroom, children are increasingly engaging in self-guided learning with digital devices like smartphones and tablet computers, but children's digital activities are dominated by passive entertainment and games. While games can teach explicit knowledge like math or spelling, they do not usually encourage children's creativity or social play and learning. But games keep children engaged; can open-ended digital play engage children as well? In this paper, we argue that children's natural interest in pretend play and emotional expression can provide an appealing point of entry for children to engage in self-guided play and learning with digital tools. Open-ended pretend play and storytelling are important because they nurture children's social-emotional growth and bigger-picture thinking [[1], [21], [8]]. Pretend play, coupled with social-emotional narrative, may expand the tool chest that interaction designers can use to engage children in open-ended and self-guided learning with today's technologies.

We introduce the concept of playing and composing stories with one's own video-recorded facial expressions. StoryFaces invites children to record emotional expressions and then automatically composes these recordings in storybook illustrations. After children watch their faces bring a story to life, they can "go backstage" to play with the story by rearranging the videos and altering the story text, or compose entirely new stories from scratch. StoryFaces combines acting (performative play) with story boarding, story composition, and story telling.

2. BACKGROUND

2.1 Benefits of Playing with Faces

Literature in developmental psychology suggests that growth of social skills is influenced by the child's ability to decipher facial expressions [[1], [26]], especially expressions in the eye region [[4]]. Studies also suggest that people who are better at identifying fearful facial expressions are more kind and generous towards others [[13]]. While it is generally assumed that children naturally develop these skills in a complex social matrix of people around them, some studies have shown that there is a slow development of sensitivity to the expression of all basic emotions except happiness [[15], [27]]. This development may be correlated with children's social and cognitive development.

Research has also suggested that these skills are teachable. In one study, researchers gave elementary school children training in the identification and self-production of facial expression cues. After only 6 half-hour sessions, children improved their ability to read emotions compared with controls [[9]].

In HCI and developmental psychology, a great deal of effort has been made on design and evaluation of technologies that deal with emotions to support children with autistic spectrum disorder (ASD); e.g., playing with avatars that express emotions seems to help children with ASD [[22]]. Results suggest that games that are based on playing with and exploring facial expressions may be beneficial not only for special needs children, but also for typically developing children [[4], [13], [27]]. The challenge has been so far to motivate children to engage in such activities by themselves.

2.2 Pretend Play and Storytelling

Children naturally engage in pretend play and storytelling, and these are great opportunities for children to effortlessly experiment and play with emotions. Storytelling offers a unique place where children can pretend that they are going through different scenarios and associated emotions from the perspective of the story characters. E.g., “Then the girl saw a monster and she got scared...” In storytelling, the children know it is only pretend. Therefore, storytelling is a safe place where children can explore various emotional states without the risk of experiencing the actual emotions [[20]].

Storytelling is also a central component to children’s literacy development. Literacy involves learning to both read and write stories and narratives to convey meaning. Children usually begin pre-literacy learning through dramatic and pretend play, and then solidify this learning through story reading and writing. The “whole language” approach to literacy development argues that children learn these skills best when they understand the whole context of language and how it is used to convey meaning [[21], [8]]. From this perspective, tools that more seamlessly combine dramatic play and written words can help scaffold [[25]] children towards greater mastery of language.

2.3 Multiple Intelligences and Multi-Modal Expressions

The notion of “self-guided learning” is based on the premise that children are motivated to learn. Leveraging children’s internal motivations is a complex task since children are different and have different interests. Gardner’s theory of multiple intelligences [[7]] provides a framework to achieve this goal. It argues that there are a wide variety of cognitive abilities and that different children have different specific cognitive strengths. By designing for children’s various strengths, we can provide more salient points of entry for a wider variety of children.

For example, Gardner calls the ages between five and seven the “golden age of drawing.” The child may sing as she draws, dance as she sings, and tell stories while at play with her toys. Rather than allowing each art form to progress in relative isolation from the others, children move readily from one form to another, combining the forms, and playing them off against one another. This could be called the age of “synesthesia,” a time when, more than any other, the child engages in easy translations across sensory systems: “when colors can readily evoke sounds and sounds can readily evoke colors; when motions of the hand suggest lines of poetry or lines of verse stimulate a dance or a song” (Gardner, 1982, p.128).

Drawing, making faces, singing, narrating, and pretending are all interrelated activities that can be synthesized in children’s digital tools. They may all be part of children’s expressions and performative play, and can help scaffold their play and learning with digital media. By embracing multiple modalities, our tools can provide multiple points of entry to scaffold children’s self-guided learning.

2.4 Creative Tools for Multiple Ages

The preschooler’s paint and brush are nearly identical to the master painter’s. How can digital tools be universally accessible to the young and old, the novice and the master? One must not only appeal to children with different interests; one must also reach children of different age and cognitive abilities. A theory of co-evolution of children and digital materials provides a framework to develop tools with which children can grow: tools provide multiple points of entry for learners to engage, and reveal complexity as children mature and expand their knowledge. Co-evolution does not mean that tools need to evolve in the sense of AI. It means tools should be able to grow with the child over time. This can be achieved by designing layers of complexity into the tools, and is evidenced by a tool’s appeal to learners of a wide age range and cognitive ability [18]. This theory is relevant for self-guided learning with digital tools because it implies that children do not have to abandon the tools and techniques they have already mastered, but rather can continue to build on their existing knowledge and skills.

3. RELATED WORK

Researchers of HCI and interaction design for children have investigated new digital tools to support children to create original compositions, reflect on those creations and learn through the creative process. *KidPad* [[10]] offers a collaborative storytelling canvas where children can create hyperlinked stories in a two-dimensional zoomable space. *Jabberstamp* [[19]] is a tool for children to embed audio recordings into their drawings created on paper. *Picture This!* [[23]] is a video editing and capturing device designed for young children to craft movies with physical toys and artifacts.

Several games and tools use facial expressions as a play element. *Emotion Faces* [[11]] construct faces to represent 5 basic emotions through the manipulation of individual face parts. *Facial Expression Wonderland* [[22]] was a prototype for children with autism spectrum disorder to play with emotional expressions on other people’s faces. Our approach differs in that children use their own faces, pretending to feel those expressions themselves. *Learning Companion* [[12]] analyzed children’s eye gaze and eyebrow behavioral patterns to better support children’s math learning activities on the computer screen.

Various projects in our research community have looked at how interactive agents can facilitate children’s learning. The interaction design of our character in the video booth was inspired by the puppet in *Family Story Play*, which was a video conference based system mediated by an animated Elmo character that invites grandparents to read books together with their grandchildren [[16]]. *Pop Goes The Cell Phone* offers another example of how a character can scaffold children and adults in pretend play with video recording [[17]]. While these projects focus on dialogic reading and family communication, *StoryFaces* focuses on children exploring emotions and creating stories with their playful expressions.

Animated online greeting card services such as *Elf Yourself* [[5]] allow children and adults alike to insert photos of themselves into animated e-cards. Such greeting cards do not generally elicit a variety of emotional expressions from the users, nor do they support narrative creation or editing. *People in Books* [[6]] inserts live video of the story readers into the digital book to encourage active readings. This work however, works only with pre-selected books and does not allow children's original story composition.

Finally, technology tools that capture children's dynamic expressions, such as microphones, webcams, and video cameras are becoming increasingly available to children at low cost. Children are fascinated with these capturing devices, actively participating in recording themselves and various things around them with adults' assistance. However, it is still difficult for young children to capture their multimodal and synesthetic expressions using tools that are generally manipulated through GUI menus. Even a multimodal medium like video lacks tools with the kinesthetic affordances that children find in a paintbrush or set of markers, affordances that allow children to actively construct meanings with a medium.

Our approach has been to combine findings from developmental psychology, user interaction and interface design for children and learning to create a new, universally appealing form of narrative play to scaffold children's social-emotional development.

4. STORYFACES

StoryFaces is a multimodal tool for children's expressions that combines acting, performative play with story boarding, story drawing, and story composition. StoryFaces invites children to capture their own facial expressions in a virtual video booth (Figure 1) and create animated stories with their recorded videos and audio, as well as their own drawings.



Figure 1: A child recording expressions in the Video Booth. Recorded expressions are shown as thumbnails at the bottom of the video booth. When clicked, the thumbnails play the video preview.

StoryFaces has three parts: 1) The Video Booth (Figure 1) where the children record their facial and gestural expressions, 2) the Story World (Figures 2, 3, & 10) where the children see the animated story with their recorded videos, and 3) the Backstage (Figures 4, 5, & 6) where the children put all the story elements

together: i.e., to draw backgrounds and costumes for the story characters, as well as to storyboard, compose, and edit the story with the videos, drawings, audio, and text.

4.1 The Video Booth

In StoryFaces, the children first enter the virtual video booth where they are invited to record a variety of emotional expressions. In the video booth, they can record any expressions they wish, but there is an animated character (named "Ema" by the children in our study) who elicits different types of expressions from the children. For example, Ema says, "Let's make a happy face!" or "Let's pretend that you are sad. Can you make a sad face?" (the red character in Figure 1). This is designed to scaffold the story to follow, but Ema also supports those children who may not know what they want to record when they first arrive at the booth. After each recording, the recorded video of the children appears next to the video booth as thumbnails.

4.2 The Story World

Once the children have recorded their facial expressions, they enter the animated story world (Figures 2, 3, & 10). In the Story World, an illustrated story incorporates their recorded facial expressions and animates automatically. Each character's face is brought to life with the children's recorded facial expressions and voices. Ema narrates the text of the story as it proceeds so that the young children who do not yet read can understand the story.

StoryFaces currently includes three pre-made stories designed to involve a variety of emotional expressions. For example, "Expressions with an Alien" involves a curious friendly alien asking a child about human facial expressions (Figure 2). "In the Balloon" is a story that involves two children going on an adventure in the hot air balloon (Figure 3). "Walking in the Woods" is an adaptation of the classic fairy tale "Little Red Riding Hood" with the twist that the child unwittingly acts out the expressions both for the little girl and for the trickster Wolf. Details of these stories are discussed in [[23]].



Figure 2: "Expressions with an Alien" story is played in the Story World with a child's recorded face.



Figure 3: "In the Balloon" story is played in the Story World with two children's recorded faces.

4.3 The Backstage

Once the storytelling finishes, the children may watch the story again or “go backstage” to edit the story by rearranging the order of the recorded videos and changing the story’s text. Backstage reveals each scene in the story like a storyboard (Figure 4) so that children may view and think about the storybook in its entirety. Children can drag the recorded videos from the repository into any of the spaces indicated by the “empty” characters’ faces in each scene. Children can record oral narration for each scene by pressing the voice record button. The text of the story can be edited directly by clicking on the text in each scene. If the children wish to record additional facial expressions, they may go to back to the video booth where they can record as many additional expressions as they wish.

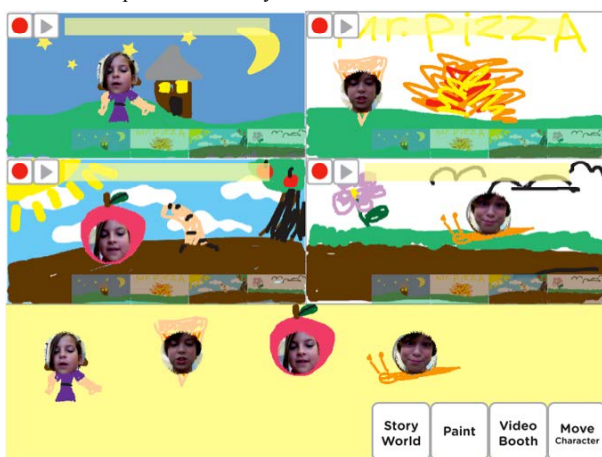


Figure 4: Backstage shows different parts of the story. Children can drag and drop story characters, animate the characters, arrange backgrounds, and record oral narrative or text for each scene.

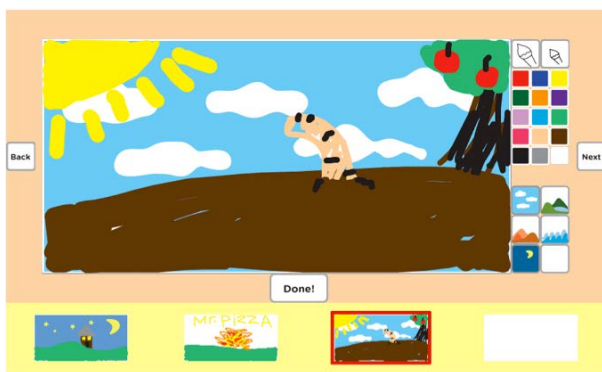


Figure 5: Children can draw their own story backgrounds. The original backgrounds can be inserted into any of the story scenes.

4.4 Free Style: Creating a Story from Scratch

Combining the videos and drawings. Children can also create their own stories from scratch. Once they recorded their video faces, they can draw costumes and backgrounds for their video recorded faces (Figure 6a, b). In the “Character” drawing room, children can dress up their video faces by selecting one of the premade costumes, drawing a costume from scratch, or combining the

premade costume and their own drawings. In the “Background” drawing room (Figure 5), children can select one of the premade backgrounds, draw their own background, or combine the premade and their own backgrounds.



Figure 6a: Character drawing room allows children to create their original story characters by combining their video faces with their drawings.

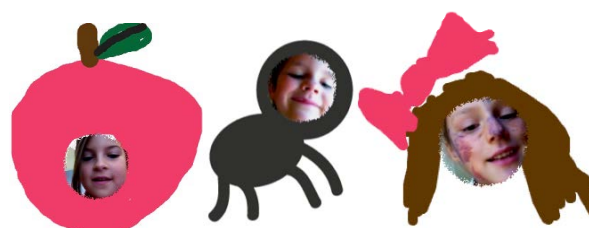


Figure 6b: A variety of story characters created by the children.

Crafting the story. In the backstage, children have several tools to create their dynamic stories. The main backstage is broken into four parts for storyboarding (Figure 4). To add the story characters or background, the child simply drags the desired elements to the part of the story they like. Thumbnails of the characters and backgrounds are shown at the bottom of the screen and they can choose these elements as many times as they like. When the “Move Character” option is chosen, the story characters may be animated by selecting the desired start and endpoint of the movement path directly on the story stage. They can record and preview the scene narrations and edit the text.

4.5 Technical Implementation

StoryFaces is written in ActionScript 3, which provides access to video and audio hardware as well as an animation framework. Within the video booth, all visual and audible input is recorded from the webcam/microphone before the data is processed. In contrast to the rest of the application, recording is done in portrait mode to avoid possible confusions, based on parallax effects, since the front facing camera of the tablet is positioned for vertical use. As soon as the recording is finished, all images are masked into circular frame shapes to fit the round animated faces in the story. Finally, a scene handler component is responsible for displaying story text and backgrounds, playing the voice narration and animating children’s recorded videos and character animations at the right time and place. StoryFaces can be used on a tablet computer with a built-in camera, or on a desktop computer with a webcam.

4.6 User Study

We are interested in studying which kinds of expressions and stories children at various stages of development can successfully

engage in with StoryFaces. The styles of storytelling in a natural setting can vary greatly among children [14, 7, 20]. The primary goal of our study was not to quantify children's performance with StoryFaces in an empirical setting, but rather to observe the kinds of expressive activities children were able to engage in with the tool. We investigated qualitatively: 1) types of facial expressions children created with the tool, 2) how children played with and manipulated the recorded faces in their own stories, and 3) what kind of complexity the tool was able to support in the children's creation of multimodal stories.

4.7 Method

Previous research has shown that children's understanding of facial expressions and situations associated with emotion improve with age. The period between preschool and elementary school seems to mark the time when children expand and gain more control over their expressive capabilities [[15], [26], [27]]. For example, by around age 5, children can describe situations that evoke basic emotions [[2]], and by age 7, children can describe more complex emotions such as pride and guilt [[9]]. In our study, we focused on this age group to observe how StoryFaces supported these emergent expressive skills in pretend play and storytelling. Eighteen children participated in the study: 8 children were enrolled in a preschool (age 4-5), and 10 children were enrolled in an elementary school (age 6-10).

All children played with StoryFaces in a pair with another playmate within the same age group. One of the premade stories, "Walking in the Woods" was used as a practice story with some assistance from a researcher. After the practice story, children were invited to play with StoryFaces by themselves. The children were told that they were free to play with it as long as they wished. Children's sessions were video recorded for later analyses.

4.8 Results

All children worked with all 3 premade stories, but all children spent most of their time working on the "free style" story, where they created their own story from scratch. Each session lasted approximately 45 minutes.

4.8.1 Younger Children (4-5)

Faces. The younger children (age 4-5) tended to focus on production of "happy" faces in the video booth. When prompted for their face recording in the video booth, e.g., the children smiled as they sang parts of a song, or smiled as they made funny noises. Only a quarter of the children (2 out of 8) produced expressions other than happy to neutral (not making any expressions). Even when Ema, the character, prompted the children to make a sad or angry face by "pretending to be" sad or angry, 6 out of 8 children in the younger group made a neutral face or even smiled at the camera. Table 1 shows different types of faces created by the children in our study. As suggested by developmental psychology literature [1, 2, 15, 26, 27], for younger children, expressions other than happy seemed to be more difficult to produce. This finding suggests that stronger cues may be needed to expand younger children's exploration of expressions other than happy. Nevertheless, the younger children enjoyed recording many types of positive expressions and personalizing the characters' by combining drawings onto their video recorded faces.

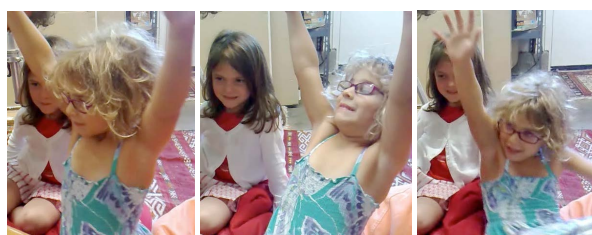


Figure 7: Younger children working on their stories.

The children felt strong ownership over their recorded faces. When they saw their own face on the stage, they told each other, "That's me! (pointing at the recorded video proudly) My turn to paint my character!" In selecting characters for their story, they carefully negotiated their characters to appear in the story equally as often as their partner's. The ability to see and directly manipulate the instances of their video recorded faces in StoryFaces seemed to help in this turn-taking behavior and collaborative storytelling activity.

Story Composition. The younger children crafted their stories "backstage," placing the characters on different backgrounds that they had created earlier, and adding narrations about them. Although the researcher introduced the backstage to the children as having "four parts of a story, like having different pages of one story," the younger children tended to consider the four areas of the backstage to represent four entirely different stories. For example, John said to his partner, "I want to do these stories [pointing at the first two scenes] and you do these stories [pointing at the last two scenes]!" The following is a narration by John (5 years old), which illustrates the type of storytelling play this age group engaged in with StoryFaces:

[John is recording the narration for the first scene in the backstage.]

John: "Once upon a time, there were two kids called Mike and John. Mike said, 'I want to go to the hills.' So they both went to the hills, and played, but then Mike said 'I want to go back home.' So they both went back home. But when they went back home, daddy wasn't there. Cause daddy was at the airport! The end!"

John: And that's number one. [Pointing to the first scene on StoryFaces backstage.]

Then John moved on to the next scene, and recorded an entirely different story about the two friends going to the desert, playing with rattlesnakes, and going home, also marked with "Once upon a time..." and "The end!" The younger children, therefore, often ended up with shorter but more stories than the older children who created fewer stories but with more complexity.

Table 1: Facial expressions produced by younger (age 4-5) and older (age 6-10) children. The numbers in parentheses indicate the number of occurrences.

	Younger Children	Older Children
Story 1 "Walking in the Woods"	Smile (3) Neutral (8) Scary face (1)	Smile (8) Neutral (2) Scary face (6)
Story 2 "Expressions with an Alien"	Smile (9) Neutral (4) Sad (2) Angry (1)	Smile (10) Neutral (2) Sad (6) Angry (6)
Story 3 "In the Balloon"	Smile (8) Neutral (11) Sad (1)	Smile (14) Neutral (5) Sad (7)
Story 4 Free style	Smile (12) Neutral (4)	Smile (8) Sad/Scared (8) Panic (4) Surprised (2) Blow kisses (2) Disgust (2)

After completing their story, the younger children watched their stories in action in the story world. They smiled at each other as they reviewed their performances. They did not however, engage in explicit activities of revising or editing their stories after viewing their stories. The children in this younger age group also did not seem to explicitly make the connection between the facial expressions captured in the video booth and the final story. For example, younger children's stories contained many smiling characters. They sometimes narrated stories involving negative emotions, but they did not go back to the video booth to re-record additional video faces to match their final storyline. The younger children also spent a long time working on the visual aspect of their characters (how they are dressed) but did not play with or animate their character using the "move character" feature. While they did not edit their stories, the younger children moved organically from one story possibility to another, building up their stories based on the opportunity presented in front of them. Overall, the younger children explored all parts of StoryFaces, collaboratively engaged in multimodal storytelling, involving recording their expressions, painting backgrounds and characters, and recording their narration for their stories.

4.8.2 Older Children (ages 6-10)

In contrast to the younger children, the older children (age 6-10) created complex stories that involved interaction between a variety of expressions and story plots. The older children also engaged with the tool and its features in more iterative ways.

Faces. Compared to younger children, older children not only recorded more facial expressions but also a wider variety of expressions (e.g., disgust, scared, surprised, etc.). Some of the older children also practiced their facial expressions before they recorded them. In such cases, they used the viewfinder as a mirror (see Table 1). Table 1 shows the diversity and quantity compared to the younger children.

The older children explicitly talked about what kind of faces they were going to make, why they were making certain types of expressions, and how those expressions related to their stories. For example, one 6-year-old explained to his partner, "I'm panicking [as he point at the panic expression he just recorded] because I'm drowning, okay?" Such metalinguistic and metanarrative activities can support children's language and literacy development [[21]].



Figure 8: Brad recorded a panicked face as he said, "Aggg! Help me! Aggg!" As he made the expression, he also flapped both of his arms. Next, his partner Lucas recorded a frightened face. As he crossed his hands over his chest, he exclaimed, "I'm terrified! That's so terrifying!" Figure 8 above shows Lucas (the boy on the right with a lighter color shirt) recording his frightened expression. The expression of his partner, Brad (the boy on the left) is also affected by watching Lucas' expression through StoryFaces.

Like younger children, the older children felt strong ownership over the characters made with their own video recorded faces. They took turns making creations around their own story elements. "That's my guy (pointing at the character he recorded)! Now it's my turn!"

Planning and Revising. In addition to planning for types of expressions to record in the older children's work with StoryFaces, significant effort went into planning and revising their stories. Before they began, the older children often discussed explicitly what kind of story they were going to create and what kind of characters they would need to develop for the story. As they worked on their drawings, they continued to plan their stories together. Below is a conversation between Brad and Lucas:

[Brad is painting a background with mountains and a lake]

Lucas: [to Brad] I'm gonna fly in the sky, and I'm gonna save you! [pointing and gesturing at the background]

Lucas: [to Brad] You could drown and then you could say [when Lucas' character helps Brad's character] "My best friend saved me!"

Brad: We're gonna say "...from above the lake" so you are gonna pretend that you are drowning above the lake." [to Lucas who's drawing the next scene]

[... the story continues ...]

Brad: [to Lucas] Pick out something for the end of the story!

Lucas: Let's say they live on the mountain?

Brad: How about if we say "Then they ran away to the far by mountain?"

Lucas: Okay.

[They continue to record the narrative]

As part of planning and revising their stories, the older children directed their partner what to record or how they should record it. They also reminded each other what they planned to do and negotiated how their current activity fit or did not fit their original plan. Ephemeral narrative elements such as emotional expressions and oral narrative parts, represented in concrete and manipulable forms, seemed to support children's meta-narrative processes, such as explicitly point at them and talk about these elements with their partners while constructing the story.

Story Complexity. Older children spent longer times backstage than the younger children and crafted complex stories with backgrounds interacting with their characters and storyline. For example, a story by Peter and Meg titled "Pie" involved thematic coordination of background, character design and animation, facial expressions, and narratives. In the video booth, Peter and Meg recorded their faces and dressed their faces by drawing the "Apple" and "Pizza" suits. In the backstage, they painted the background for the corresponding themes. For example, Meg drew a sunny outdoor scene with trees and worms where Mrs. Apple appears from the tree. Meg further programmed Mrs. Apple to move from the tree to the ground and said, "She comes down from the tree and takes a walk!" Peter drew a room with sauce spilled all over. He then arranged the pizza man to move from one corner to the center where the sauce was spilt, and recorded, "Then Mr. Pizza came and exploded!" as the character reached the center with the illustrated splatter of pizza sauce (Figure 10).



Figure 9: Meg and Peter viewing their story creation.

Another example illustrates the complex story crafting the older children engaged in. After recording all parts of their narratives in the backstage, Brad and Lucas animated their story characters on the stage using the "Move Character" feature. As Lucas looked at the scene, he said, "Ok, my turn! All right. Yeah, I am starting to get afraid." [Looking and pointing at the second scene.] Brad suggests to Lucas, "How about if you went zigzag [making zigzag motion on the tablet] because you are afraid?" Then they used

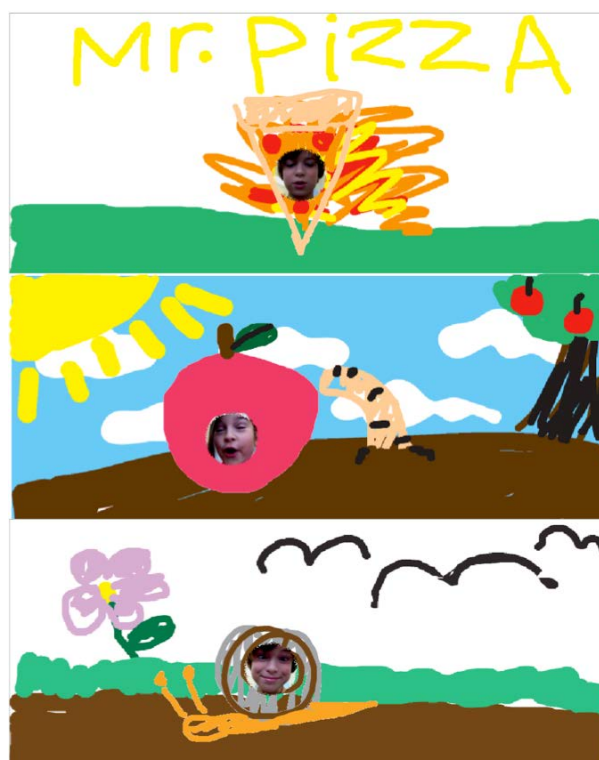


Figure 10: Meg and Peter's story. The two children make an adventure as "Mr. Pizza," "Mrs. Apple," and "Mr. Snail."

"Move" feature to move the character on the screen to appear from the right of the scene and move to the left of the scene. Below is the final story Brad and Lucas created, which illustrates the two children taking turns and collaboratively narrating their story:

Brad: "Once upon a time there were two children who were lost. And they were swimming in the lake."

Lucas: "Ah-oh! It's getting night time! The children were getting afraid. They did not like the dark at all!"

Brad: "And suddenly, it turned pitch black. And they were "Agg!" And they ran. And they were so scared, they ran all the way to the mountains! The end! Oh! Not the end yet! [laughs]"

Lucas: Okay my turn! "Suddenly, one of the children landed on the snow and was about to freeze to death [one of the character in the fourth scene has a snowcapped mountain] but the other person, pushed him off the snow, he tumbled in the air, and he landed on his feet right on top of his house, [making kneeling gesture] jumped down from the house. And he was the championship of the world. The end!"

In the end, Brad and Lucas successfully combined the elements they have pre-planned for their story. Their story involved the synthesis of a variety of media and story elements. In contrast to the younger children, the emotional expressions of the characters in the story matched the ongoing narrative. In doing so, they explicitly engaged in discussions about creating and narrating different expressions. They collaboratively captured their faces in different emotions (happy, panic, terrified, sad), painted

characters' bodies and backgrounds, pre-arranged the characters to appear and move to appropriate locations to fit their ongoing story, and finally, collaboratively narrated the story that connected all these elements.

Once they finished putting the story together, the children viewed their stories together and commented on their performances. They enjoyed seeing their stories come to life in the Story World, but these reflections also led them to edit the parts of the story they did not like and/or plan different elements for their subsequent stories. Being able to easily go to the backstage and select specific parts of story elements seemed to help children with this process of negotiating and editing their story explicitly.

Overall, StoryFaces engaged the older children in creating and playing with the facial expressions, as well as engaging in collaborative storytelling play that involved complex negotiation of narrative elements.

5. DISCUSSION

StoryFaces invited children to capture their own facial expressions and combine them with drawings and animations to create their own dynamic stories. By focusing on faces but encouraging creations around them, StoryFaces enriched children's storytelling in several distinct ways.

5.1 Making Expressions Concrete

StoryFaces supported children's exploration of emotional expressions. By turning children's own facial expressions into digital objects they could directly manipulate (like other illustrated materials in their drawings), StoryFaces gave children concrete ways of exploring emotional expressions, things which are usually abstract and hard to play with (and thus to think about). Having concrete ways of manipulating expressions gave children ways to talk explicitly about the expressions with their partners and how they fit in their ongoing stories. Reviewing their stories, preparing story elements in response, and explicitly talking about emotional expressions with their friends, led them to create complex stories.

5.2 Multiple Modalities

StoryFaces celebrated children's multimodal creations. In working with StoryFaces, children combined a variety of media in their creative effort: recording and reviewing their emotional expressions, drawing and animating their illustrations with the videos, acting out and narrating the story, and storyboarding and re-editing. Some children spent more time on drawing and storyboarding while others spent more time on recording their faces and narrating. They each engaged with StoryFaces focusing on the aspect of the tool they liked most. By embracing multiple modalities, our tools provided multiple points of entry to scaffold children's self-guided storytelling.

5.3 Collaboration & Social Play

Children negotiated these elements of their creations with their partners collaboratively. In creating original story characters with their own faces, the children carefully talked about and reminded each other to take turns ("Now it's your turn!" "Now it's my turn!" pointing at the faces) and crafted the story collaboratively. These embodiments in StoryFaces seemed to serve as concrete reference points of children's conversations while collaboratively engaged in their creations.

5.4 Age Range Findings

While all children explored these aspects of StoryFaces, the older children did so more than the younger children. Our findings

followed the general trend of older children having more control over facial expressions and producing more facial expressions than the younger children.

Younger children did engage playfully and richly with the tools, seeming to enjoy recording themselves and see their recordings bring a story to life in a personal way. However, their ability to perform different expressions was more limited compared to older children. In order to provide additional scaffolding, we could make the video booth more thematic and dramatic. For example, we could provide a sad or scary background, or make "Ema" the character facilitate the video recording in a more dramatic but fun ways to model a wide variety of expressions. We are continuing to explore ways of supporting a rich variety of young children's expressions.

In expressing different types of emotions with StoryFaces, both older and younger children used their bodies in addition to their facial expressions (see Figure 7). Instead of holding the tablet in their hands, they preferred to leave the tablet on the table and have their hands free so that they could move them around. In the future, a "magic mirror" type of setup—upright like an easel with markings on the floor for the ideal location for them to sit or stand—might provide a good solution for full body interaction with the system.

6. CONCLUSION

We have presented StoryFaces, a tool for children to record their own facial expressions and construct stories with them. Emotional expressions were inviting and motivating for young children across a broad age range, and seemed to provide a unique point of entry for the children to engage in both reading and creating narratives. StoryFaces puts a particular focus on children's emotional expressions by turning them into manipulable elements in their own storytelling play.

Through recording and replaying performances, arranging and rearranging those performances, StoryFaces invited the children to explore a variety of emotional expressions and to play with these expressions as part of their story elements. StoryFaces gave concrete form to children's ephemeral facial expressions so children could manipulate, discuss and think about the role of emotion in narratives. While older children crafted more complex stories and performances, the tools appealed even to younger children. Our results show that a digital authoring environment can give young children an opportunity to collaborate, play, and reflect on their pretend emotions, and that when these emotions are cast into the context of a traditional narrative, children can engage with and meaningfully manipulate elements of those stories. This research suggests that multimedia authoring tools can leverage children's performative play and more traditional forms of content like storybooks to support the social-emotional and emergent literacy development of young children.

Looking ahead, we would also like to see how the findings of this research combining narrative and emotion may help children with autism spectrum disorder. Further, as more children are using tablets in their everyday learning, we hope this research can inspire a new generation of software and content designers to use media in ways that engage children's creativity and social-emotional learning.

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