Supporting Sociodramatic Play at the Individual Level

Flannery Hope Currin[1], Kyle Diederich[1], Kaitlyn Blasi[2], Kerry Peterman[2], Juan Pablo Hourcade[1]
[1]Computer Science, [2]Informatics
The University of Iowa
Iowa City, Iowa, USA
[flannery-currin, kyle-diederich, kaitlyn-blasi, kerry-peterman, juanpablo-hourcade]@uiowa.edu

ABSTRACT

High-quality sociodramatic play helps children develop executive function skills which bolster their performance in school. Technology supports can scaffold social play for children who struggle to engage otherwise. This case study examines the impact of a specific system, *StoryCarnival*, on one 3-year-old child's engagement in sociodramatic play with his peers. Comparing this child's participation in sessions using either *StoryCarnival* or a traditional intervention over eight weeks, *StoryCarnival* appeared to lower barriers to this child's physical and verbal engagement in social play. Future research could identify whether this pattern may hold for other children who have trouble entering social play with peers.

CCS CONCEPTS

• Human-centered computing → Field studies; • Social and professional topics → Children.

KEYWORDS

Preschool; Social Play; Executive Function; Inclusive Play

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1 Introduction

The executive function (EF) and self-regulation skills children develop by the time they begin elementary school impact their achievement in reading, math, and communication [7, 9, 10, 24, 26, 44]. Empirical evidence (e.g., [5, 6, 12–14, 28]) supports the use of the *Tools of the Mind* (*ToM*) curriculum, which centers around collaborative sociodramatic play, to improve EF in preschool children. The main barrier to implementing *ToM* programming is the amount of training required for adult facilitators [7]. Addressing this barrier, Pantoja et al. developed a system called *StoryCarnival* to provide scaffolding for caregivers and teachers who want to implement *ToM* [30, 31]. Pantoja et al. developed *StoryCarnival* with groups of 3-5-year-old children and evaluated how the groups interacted with the system, without focusing on specific children's reactions [30, 31].

Another potential barrier to the effectiveness of *ToM*-style interventions could be the difficulty some children have entering and engaging in social play with their peers. Literature on inclusive play within the HCI community largely focuses on children with formal diagnoses of autism or related disabilities [2, 11, 18, 27, 29, 33, 38, 39, 41]. When designing with and for preschool children, however, we must recognize the mean age at which children receive a diagnosis of autism is approximately five years old, and socioeconomic status, I.Q., and symptom presentation are associated with delays in formal diagnosis [25]. Additionally, the social dynamics of preschool classes can lead typically-developing children to engage in social play at varying levels depending on the context of the play environment [32]. Paying attention to how technological scaffolding supports the inclusion of a young child who exhibits difficulty engaging in social play, regardless of disability status, could point to elements of the technology that support inclusion for a broad group of children.

This case study seeks to understand how *StoryCarnival* supported a specific 3-year-old child, referred to in this paper as Lucas, who exhibited difficulties entering and engaging in *ToM*-style play without technology scaffolds. Lucas participated as one of five 3-year-olds in a study comparing the effectiveness of *ToM*-style sociodramatic play with and without *StoryCarnival* over 16 sessions. The goal of this work is to explore why *StoryCarnival* appeared to work especially well for Lucas and whether the system may be helpful for other children who find engaging in social play difficult. Specifically, this study seeks to answer the questions: 1.) Did Lucas verbally and physically engage more with *StoryCarnival* than traditional *ToM*-style activities? 2.) How did the pattern of Lucas' verbal exchanges change when he was engaging with *StoryCarnival*? and 3.) How did the content of Lucas' speech change when he was engaging with *StoryCarnival*?

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2 Related Work

2.1 Significance of EF Development

Executive functions (EF) are a collection of cognitive and affective processes that contribute to self-regulation and allow people to engage in goal-directed behaviors [1]. Goal-directed behavior is critical to school success, and the development of EF skills is associated with achievement in math [7, 9, 26, 44], reading [26, 44], and social skills [10, 24, 26].

2.2 Evidence for *ToM*

The *Tools of the Mind* (*ToM*) curriculum is based on Vygotsky's theories emphasizing the role of social play in children's early development [8]. Vygotsky proposed that by planning and engaging with peers in sociodramatic play, children practice setting and working toward shared goals and develop self-regulation skills by behaving in ways that fit within an agreed-upon make-believe context [42]. Vygotsky also believed playing with generic props (e.g., blocks) that can represent multiple objects helps children develop abstract reasoning skills [42]. *ToM* combines these ideas of sociodramatic roleplay based on familiar stories and using generic props [8]. Prior work validates the positive impact of *ToM* on a broad set of EF skills [5, 6, 12–14, 28].

2.3 Related HCI Research

Most technology-supported games researchers developed to help children develop EF skills (e.g., [21, 34, 40, 43, 46]) focus on training a specific task or skill. Successful transfer of skills developed with these types of training programs appears limited [14, 15]. Pantoja et al.'s *StoryCarnival* supports *ToM*-style play which encourages the development of a broad range of EF skills [30, 31]. *StoryCarnival*'s broad focus and built-in scaffolding may make it more conducive to tailoring for specific children's needs than other technology-supported approaches to improving EF skills.

Growing efforts to increase the inclusion of people with disabilities in HCI research led to the development of design and evaluation frameworks to support inclusive play [3, 4, 22, 23, 38, 39, 45]. Tangible devices are among the most common technologies designed to support inclusion (e.g., [11, 16–18, 20]). These efforts lay the groundwork for broadening our understanding of how to support inclusive play.

3 Methods

3.1 Participants

Five 3-year-old children were recruited from a local preschool as part of a study evaluating the effectiveness of *StoryCarnival*. This case study focuses on one of those participants, who we call Lucas. We chose to look at Lucas specifically because we observed him shift from a timid observer to a more active participant over the course of the study, while the other children in the group appeared to have an easier time engaging with the activities from the beginning.

We sent recruitment packages to participants' parents through their teachers. We obtained informed consent from parents, and children could interrupt their participation at any time if they wanted.

3.2 Materials and Procedure

The University of Iowa's IRB approved this procedure.

3.2.1 Session Materials and Procedure. The evaluation study lasted eight weeks. Each week aligned with a two-session A phase (traditional *ToM*) or B phase *(StoryCarnival*). Phase order was randomized (A, B, B, A, B, A, A, B). All sessions took place at the preschool between October and December 2019. A teacher or aide stayed in the room during sessions. Sessions lasted 20-25 minutes and were all videotaped. Lucas was present for seven A-phase sessions and six B-phase sessions.

All sessions began with the children listening to a story. During A phases, a researcher read the children stories from the *Detective Dinosaur* series: "The Case of the Missing Hat" and "Night Patrol" from [35], "Lost" and "Found" from [36], and "Under the Weather" from [37]. During B phases, a researcher showed the children stories from the *StoryCarnival* app on a 4th generation iPad. Regardless of phase, the researcher asked the children questions during the story (e.g., "How do you think [a character] is feeling?").

Each child then selected a character to play, prompted by a researcher. During A phases, a researcher individually asked children which character they wanted to be, verbally reminding them of the options. During B phases, we used the play-planning portion of the *StoryCarnival* app which gave the children visual and auditory reminders of the options.

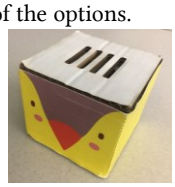

Figure 1: Minibird, the voice agent used in B sessions.

After selecting roles, the children played together using generic foam props, pretending to be characters in the story. Two researchers supported children as they played. In A phases, the researchers interacted directly with children, guiding them to play together and stay within the make-believe context, sometimes joining in play. In B phases, one researcher played the same role as in A phases, while the other controlled the speech of the *StoryCarnival* voice agent, Minibird with a web application using Amazon Polly's speech synthesizer. Minibird is constructed with a Bluetooth speaker, cardboard, and paper and measures 8.57cm x 8.57cm x 7.62cm, making it easy for children to hold and incorporate him into their play (see Figure 1).

3.2.2 Analysis Materials and Procedure. One researcher coded videos to identify the percentage of time Lucas spent physically engaged in each session and the number of times a facilitator

directed speech toward Lucas using the BORIS coding software [19]. BORIS allows researchers to define a set of behavioral codes and log events any time one of those behaviors is observed to start or stop in a video. The researcher also transcribed the videos.

Two researchers analyzed the transcripts and output from Boris. One researcher wrote a python script to count the average number of lines per minute that Lucas spoke each session, the average number of lines per minute in B sessions in which Lucas specifically mentioned Minibird, the percentage of children's speech accounted for by Lucas in each session, and who Lucas was responding to each time he spoke (another child, a facilitator, or Minibird). Another researcher computed the average percentage of session time Lucas spent physically engaged in play and read through the transcripts to identify differences in the content of Lucas' speech in A and B sessions.

Because of the nature of the data collected during this study, we do not draw conclusions about the statistical or clinical significance of these results.

4 Results

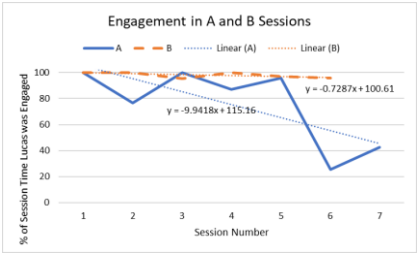

Figure 2: Percentage of session time Lucas spent physically engaged in play during each session.

4.1 Physical Engagement

Lucas' physical engagement in play included instances where Lucas was paying clear attention to others' play, even if he was hesitant to engage more actively. Examples of disengagement include covering his eyes, walking away to talk to the aide in the room, etc. Lucas spent nearly 100% of session time engaged during most sessions, but there was a clear difference between his engagement over time in A sessions vs. B sessions (see Figure 2). In A sessions, Lucas spent a mean of 75.4% of session time engaged (*s.d.*=29.9), compared to 98.1% in B sessions (*s.d.*=2.21). The linear regression reveals a relatively steep drop in engagement over time in the A sessions (-9.94%/session), and a much smaller drop in the B sessions (-0.729%/session). This suggests *StoryCarnival* was more effective at keeping Lucas engaged over time than traditional *ToM*-style activities.

4.2 Instances of Speech

The number of times Lucas spoke during each session was counted and divided by session length (in minutes). In A sessions, Lucas spoke an average of 0.878 times/minute (*s.d.*=0.409), compared to 2.80 times/minute in B sessions (*s.d.*=1.52). The slopes of the regression lines indicate a decrease in speech (-0.160 instances/minute/session) in A sessions and an increase in speech over time (0.633 instances/minute/session) in B sessions (see Figure 3). Lucas' speech accounted for 6.06% of the instances of children's speech in A sessions and 17.9% of children's speech in B sessions. If each of the five children spoke an equal number of times, his speech would account for 20% of children's speech.

The number of times a facilitator (or Minibird) spoke directly to Lucas during each session was counted and divided by session length. In A sessions, facilitators addressed Lucas an average of 1.43 times/minute (*s.d.*=0.739), compared to 3.20 times/minute in B sessions (*s.d.*=1.36). The directions of the slopes of the regression lines for A sessions (-0.212 instances/minute/session) and B sessions (0.348 instances/minute/session) mirror those observed in Lucas' speech, meriting an inspection of the pattern of speech between Lucas and other children, facilitators and Minibird.

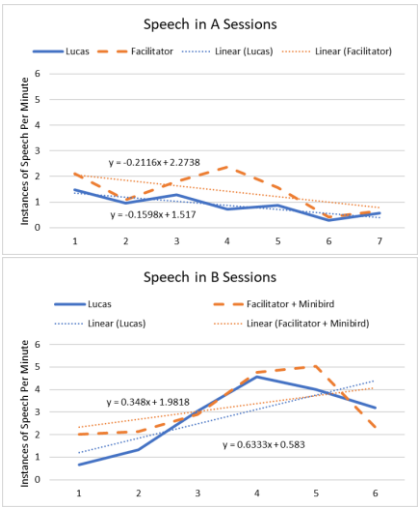

Figure 3: Average number of times per minute Lucas spoke or a facilitator or Minibird directed speech at Lucas during each session.

4.3 Patterns of Speech

Lucas was responding to other children 29.6% of the time he spoke during A sessions, compared to 42.2% of the time in B sessions. This suggests that Lucas engaged more directly with his peers during B sessions, which could account for some of his increase in speech. Another main factor accounting for his increased speech in B sessions was Minibird-specific speech: specific mentions of Minibird made up 31.4% of the difference between the number of times Lucas spoke in B sessions and A sessions.

4.4 Minibird-Specific Speech

Much of Lucas' B session specific speech centered around Minibird. These comments could be classified as: 1.) repeating comments Minibird made to himself, the facilitator, or the other children; 2.) asking to hold or talk to Minibird; and 3.) expressing

care for Minibird by speculating about Minibird's wants and needs (e.g., "Maybe Minibird is hungry"), attending to those perceived needs (e.g., "I made some breakfast for Minibird"), or showing interest in how Minibird works (e.g., "Why does Minibird talk?"). The percentage of Lucas' speech during each B session that fell into each of these categories is summarized in Figure 4. These comments accounted for approximately 40% of the comments Lucas made during the final B session. The relative frequency of each type of speech is examined in Section 5.1.3.

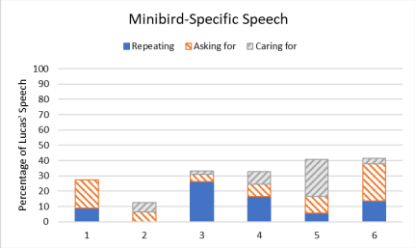

Figure 4: Percentage of Lucas' speech during each B session which repeated, asked for, or expressed care for Minibird.

5 Discussion

5.1 Implications for Research Questions

5.1.1 Did Lucas verbally and physically engage more with StoryCarnival than traditional ToM-style activities? StoryCarnival appeared to motivate Lucas to remain physically engaged in play while more traditional *ToM*-style activities did not always hold his attention (see Section 4.1). Additionally, Lucas' verbal engagement decreased over time in A sessions but increased over time in B sessions (see Section 4.2). Our study design does not allow us to compare these results to a scenario in which Lucas only tried the *ToM*-style activities without technology supports over a longer period. However, it is possible that *StoryCarnival* motivated Lucas to stay engaged in *ToM*-style activities. If *StoryCarnival* can help motivate other children, it may enhance their potential to develop EF skills.

5.1.2 How did the pattern of Lucas' verbal exchanges change when he was engaging with StoryCarnival? Although facilitators directed more speech toward Lucas during B sessions than during A sessions (see section 4.2), Lucas was more likely to respond to other children during B sessions than during A sessions (see section 4.3). This implies that *StoryCarnival* encouraged Lucas to engage with his peers in a way the facilitators failed to in A sessions. Minibird-specific speech accounted for some, but not all, of Lucas' increase in speech (see section 4.3). This means other types of Lucas' speech increased in B sessions compared to A sessions, suggesting that other types of story-related speech may have been more accessible to Lucas in B sessions than in A sessions, although they were present to some degree in both. Overall, *StoryCarnival* appeared to encourage Lucas to engage with his peers more, both through Minibird and independently.

5.1.3 How did the content of Lucas' speech change when he was engaging with StoryCarnival? Lucas' speech during B sessions indicates attachment to Minibird (see Section 4.4). Lucas showed an initial interest in Minibird during the first B session, asking to hold and talk to the voice agent, perhaps due the system's novelty. By B sessions three and four, Lucas seemed to use Minibird's speech to engage with others in the group, repeating Minibird's comments as a means of entry to social play. Lucas' focus on expressing care for Minibird in session five suggests a stronger, more creative attachment to Minibird. His focus on asking for Minibird during the last session appears somewhat regressive but could stem from his attachment to Minibird. Lucas bonded with Minibird which allowed him to participate more fully in play but caused discomfort with sharing Minibird. If feasible, using multiple voice agents with groups might ease tension that comes from such strong attachments to the agent while allowing children who benefit from the support focus on their own agent.

5.2 Limitations and Future Work

This work is limited by the short-term duration of the study and its focus on one participant. We are in the process of qualitatively assessing the differences in the characteristics of play observed between A-sessions and B-sessions for the group of 3-year-olds as a whole, as well as those observed for three groups of 4-5-year-old children. We plan to conduct a longer-term, larger-scale remote evaluation study with parents using *StoryCarnival* at home with their children. We also plan to recruit a group of parents of young children with intellectual or developmental disabilities and look more specifically at measures of inclusive play within mixed-abilities groups of children.

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