Characterizing Parent-Child Communication, Affect, and Collaboration During Multi-User Digital Tabletop Gameplay

Michala Cox, University of Iowa, michala-brand@uiowa.edu
Benjamin DeVane, University of Iowa, benjamin-devane@uiowa.edu
Jeremy Dietmeier, University of Iowa, jeremy-dietmeier@uiowa.edu
Kristen Missall, University of Washington, kmissall@uw.edu
Salloni Nanda, University of Washington, salloni@uw.edu

Abstract: Multi-user tabletops can support parent-child STEM learning experiences. This paper presents pilot data from seven parent-child dyad play sessions, with two example case studies of individual dyads, examining parent-child (age 4 to 8) communicative acts, affect, and collaboration during digital tabletop gameplay. Overall, more collaborative than parallel or individual play was observed. Across dyads, results emphasize the prevalence of joint gameplay in these interactions. Two highlighted case studies illustrate the unique roles that parents take on during gameplay based upon their interactive patterns. Implications for encouraging parent-child collaboration and communication during collaborative digital tabletop gameplay for STEM learning are discussed.

Importance of study

Collaborative play between parents and children in informal environments (such as museums, science centers or zoos) has been linked with children's engagement with science and scientific thinking (Callanan, Crowley, Jipson, & Shrager, 2001). Multi-user interactive tabletops can engage children in problem-solving activities and facilitate productive collaboration and creativity between parents and children (Horn, Leon, & Block, 2012; MacDonald & Maurer, 2015). Using a skatepark physics game to examine how parent-child dyads play collaboratively on an interactive tabletop, this preliminary study investigates the relationship between the *social positioning* (see Harré & van Langenhove, 1991) of parent-child dyads and our coding of *the affect of their communicative acts*.

Supportive parent communication includes asking questions that produce: meaningful discussion, warmth and a positive tone, immediate positive feedback to expand knowledge, and interactions to build on previous knowledge (Jant, Haden, Uttal, & Babcock, 2014). Children's conceptual understanding is bolstered when parents: offer explanations, ask questions, engage in collaborative discussions, teach concepts, show relations between concepts, focus on abstract knowledge, and provide immediate feedback to facilitate associations between children's prior knowledge and new learning (Horn et al., 2012; Jant et al., 2014).

Users are instructed to build a digital skatepark from modular park elements (i.e., ramps, rails) and test their skatepark design by customizing a skater avatar (i.e., users can modify avatar mass) and manipulating their avatar's movements with options such as jump or push. The game was designed for use in a children's museum to encourage young children's interest and engagement with physics-related activities, as well as intergenerational learning and collaborative problem-solving. This preliminary study employs qualitative methods (positioning analysis) and mixed-methods (quantification of qualitative codes) to examine adult-child communication, affect, and collaborative engagement during gameplay in dyads with a child between age 4 and 8.

Method

Parent-child dyads were recruited to engage with the tabletop as part of user software and hardware testing prior to installation in a children's museum exhibit. Dyads played for approximately 15 minutes, designing and building a skatepark of various ramps and watching their avatar navigate their skatepark (see Figure 1).

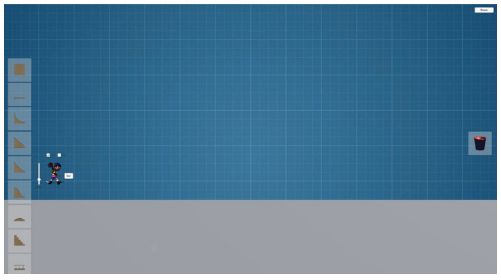

Figure 1. Skatepark prototype tested by parent-child dyads.

Seven parent-child dyads participated with children between the ages of 4-8 (M_{age} = 6 years, 4 months), including 5 boys and 3 mothers. All parents identified English as the primary home language. Of the parent-child dyads, 2 were father-daughter, 2 were father-son, 2 were mother-son, and 1 was mother-daughter.

Study and analysis: Coding affect in communication and positioning in discourse

Gameplay sessions were videotaped, transcribed, then coded using project-developed observation codes for verbal and nonverbal communication. Modified parent-child interaction code sets (see Eyberg et al., 2009) were used to develop observation codes for communicative acts, levels of affect, and collaborative engagement.

Coded data were analyzed for parent-child dyads to produce two unique case studies. The evaluative stances that parents and children assumed relative to their partners can be understood through the framework of positioning theory. Positioning is "a discursive process whereby selves are located in conversations as observably and subjectively coherent positions in jointly produced story lines" (Davies & Harré, 1990, p. 48). One particular form of positioning is *first order positioning*, which "refers to the way persons locate themselves and others within an essentially moral space by using several categories and story lines" (Harré & van Langenhove, 1991, p. 396).

This paper adopts a modified version of Gail Jefferson's (2004) system of transcribing talk and behavior that is prevalent in conversation analysis. Jefferson's system of conventions was created to transcribe vocal conduct in talk-in-interaction. We used these conventions to describe the parent-child interactions gameplay.

Results

Observations across dyads illustrated high levels of joint gameplay (i.e., times when parent and child were working toward the same goal, jointly at the same time, as evidenced by verbal communication or physical movement on the tabletop). Six of the seven dyads engaged in coordinated parallel gameplay (parent and child have different roles that are articulated and agreed upon), while four of the seven dyads engaged in non-coordinated parallel gameplay (parent and child worked independently with tabletop gameplay) (see Table 1). Three of the seven dyads engaged in one player interaction where the child was actively playing the game while the parent watched passively with no indication of active engagement.

Table 1: Dyad gameplay

Dyad	Joint Gameplay	Coordinated Parallel	Non-Coord. Parallel	One Player *Child*	One Player *Parent*
1	55	3	7	0	0
2	23	1	1	47	0
3	62	8	3	0	0
4 (K&M)	72	2	1	0	0
5	61	0	0	1	0
6 (P&N)	62	1	0	0	0
7	48	1	0	2	0

Across dyads, parents used verbal communication more often than children (see Table 2). On average, parents asked roughly 5 questions to every 1 question from children over approximately 2 minutes. Parents asked an average of 2.45 total questions per minute of play, compared to children at an average of 0.47 per minute. Most often, questions were positive in tone. Parents also gave more total commands than children, an average of 2.72 per minute of play. Most often, commands were in a positive tone, with four parents giving few commands in a negative tone. Two of the participating children gave commands in a negative tone.

Table 2: Questions and Commands with Affect/Tone

Dyad	Parent Questions			Child Questions			Parent Commands			Child Commands	
	Pos.	Neu.	Neg.	Pos.	Neu.	Neg.	Pos.	Neu.	Neg.	Pos.	Neg.
1	43	2	5	0	0	0	50	13	2	0	1
2	7	13	0	2	4	6	9	4	0	0	3
3	63	3	0	5	5	0	64	10	1	9	0
4 (K&M)	68	0	0	9	1	0	19	1	0	6	1
5	21	4	1	0	1	0	34	15	2	21	3

6 (P&N)	21	0	0	4	0	0	55	0	1	1	0
7	23	1	0	12	2	0	23	0	0	1	0

Parental roles shape parent-child communication

Parents' distinct stances toward collaboration, game play, and physics were evidenced in their unique patterns of interaction with their children and the affect they adopted. Some parents guided their children's play, some offered quite a bit of direction, and yet another mostly spectated as his daughter played. We present two cases of interactions that illustrate distinct parent roles we observed in dyads with high joint gameplay – we describe these two roles as *The Guide* and *The Conductor*.

The guide

Kate, a therapist who often worked with young children, was highly engaged throughout gameplay with her son Matt, age 5, (both names are pseudonyms) and their interactions demonstrated high joint gameplay (see Table 1). Kate shaped her child's activities with guiding questions and gestures as they worked together to pursue Matt's interests and goals. Nearly half of her questions and high positive affect received a verbal response from Matt.

> K: Do you think that you would go faster? (.) do you think (.) the motion we want him to do is to do this? Watch my finger.
>
> M: Yeah.
>
> K: Whoosh. Up here, right?
>
> K: Do you think that this shape would create that motion better? Or something like this shape would create that whoosh motion better? I'm just curious.
>
> M: Oh yeah, that's what we need.
>
> K: Do you think that would work better? M: Yeah.
>
> K: I don't know that it will. I'm just curious about it. M: Let's go.
>
> K: Are we gonna try it that way?

Kate asked many questions to which Matt did not always have an opportunity to respond, but he seemed to use them to guide his decisions after appraising her questions and his goals. Despite dominating most of the conversation, she rarely touched the tabletop interface, but used gesture to demonstrate what she thought may happen when they tested their design. Her guidance was met with positive affective responses from Matt and led them to test out his predictions.

Kate's and Matt's unique subject positions resulted from a collaborative strategy. Kate's use of guiding questions positioned Matt as a potentially capable participant who may meaningfully contribute to the successful construction of their skatepark design. This positioning was clearly deliberate and planned – Kate used guiding questions to help Matt create solutions when he struggled with game play. Kate's communicative acts demonstrated significant positive affect and many reflective questions. Matt's activity often resulted from his attempts to engage with Kate's questions and suggestions. Matt did not attempt to shift this leading conversation pattern, which remained within the first order of positioning.

The conductor

Patrick, an engineer with experience using physics to solve problems and build structures, was engaged with his son, Nick, age 8, throughout gameplay. His joint engagement with Nick often took the form of commands that directed how to play the game or declarative statements about the build. Instead of guiding Nick through leading and reflective questions as Kate did with Matt, Patrick sometimes explained what would happen and changed the design himself while Nick watched. When Nick began to offer suggestions on how to improve their skatepark, he was often interrupted or told to "hang on." Nick was relegated to narrating his father's actions as he played the game. On a few occasions, Patrick accepted and acknowledged Nick's suggestions. Although their interactions were mostly positive and they often engaged in joint gameplay, Patrick was clearly the driving force.

> P: --here, let me try this.
>
> N: 'Cause [sic] that's too steep.
>
> P: Let's try this. Hang on. Let's put this over here. Let's put this here. Here we go. N: Yeah.
>
> P: And then we're gonna do another one, we're gonna make it perfect. N: And then we can make it—

P: And then you can—

N: And then we can make him jump real high—

P: Here, let's, uh—

N: --and then he'll land like—

P: Let's put this one in the middle, slide this over 'cause he's gonna come down so fast. N: Yeah, we don't want him flyin, 'cause then he won't reach this part.

Nick and Patrick's communicative acts illustrate a maintenance of first-order positioning in which it was Nick's "moral duty"—his obligation within the interaction—to accept Patrick's requests. Likewise, it is the tacit expectation that Patrick can direct their joint problem-solving endeavors. Over the fifteen-minute period, Patrick's utterances toward Nick showed relatively high numbers of commands and neutral affect compared to other parents in the study (see Table 2). This demonstrates 'first-order' positioning because Nick never substantively challenged this paradigm by saying something like "let me try something" in a bid to be a more influential participant.

Throughout the interaction, this social order—in which Patrick leads and Nick follows—shaped how the duo thought and reasoned about the issues encountered in game play. Patrick led with ideas about how to solve problems in game play and expected Nick to follow his reasoning. The tacit model of parent-child learning in this interaction is one in which the parent demonstrates reasoning for the child, and the child learns by observing the parent. At the same time, the subject positions that Patrick and Nick adopt, as leader and follower, may also be a response to the expediency of game play—of trying to win or accomplish a challenge.

Implications

This observational data indicates that parents were typically highly engaged with their children during tabletop gameplay and dominated conversations with a variety of questions and commands to scaffold their child's learning. This suggests that parents may drive learning in these spaces, which is consistent with previous research demonstrating that parents take on roles as leaders, teachers, and facilitators (Zimmerman, Perin, & Bell, 2013), often giving direct and indirect instructions to guide children's explorations of materials (Crowley et al., 2001). Across dyads, children did not ask many questions or give commands, though children were often physically engaged with the tabletop. When children did ask questions, they indicated a need for clarification and assistance.

In the case of *The Conductor*, Patrick models reasoning for his son, who presumably learns through observation. Conversely, *The Guide* was characterized by positive affect and many questions from Kate which were often met with positive verbal responses. While it was clear that Kate was the more knowledgeable partner, her guiding questions positioned Matt as a capable participant who may have answers to the problems of skatepark design. Kate's approach focused on her son's goals, while Patrick's strategy centered on accomplishing the task.

The highlighted case studies enhance the quantitative codes by illustrating two distinct positions that parents take on during multi-touch gameplay based on their interactive patterns. This work informs designers' approach to these games in children's museum settings, from game design, in-game scaffolds, to physical signage purposed to encourage child-led collaboration. Continued development of a categorization system for parent-child dyads could help museum curators plan exhibits and inform docents in supporting learning.

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