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The *Emotion Detectives* game: Supporting the socio-emotional competence of young children

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Abstract

The potential of digital games to enhance learning in different areas of child development has drawn increasing interest amid growing concern about children's emotional well-being, social-emotional difficulties, and problem behaviors alongside diminishing economic resources for intervention and habilitation. However, digital games designed to promote social-emotional competence are surprisingly scarce. In this chapter, we explore children's use of the digital game *Emotion Detectives (ED)*, designed to promote children's acquisition of emotional knowledge skills (e.g., recognizing, appreciating, and understanding emotions and their expressions), prosocial behaviors (e.g., helping, sharing, comforting, and showing concern for others), and problem-solving abilities. Analyzing children's gameplay sessions in two Finnish day care centers improved understanding of children's gameplay experiences, social-emotional knowledge, and collaborative learning. From the double effect of practicing social-emotional skills simultaneously in the game and in peer interactions, *ED* has the potential to be an effective learning environment for children. The game's humorous features, creative opportunities, and possibilities to make progress while playing clearly motivated children to learn.

Keywords: social-emotional competence; digital games; learning; interaction, game-based intervention

Introduction

Two main trends have motivated the application of digital game-based learning devices to enhance social-emotional learning in young children. First is the belief and, to some extent, the evidence that game-based learning solutions motivate and improve the effectiveness of learning (Robertson & Howells, 2008). Second, even as concern about children's emotional well-being, social-emotional difficulties, and problem behaviors has increased, diminishing econom-

ic resources are available for affordable intervention services in many societies. Digital learning environments offer an easily accessible, widely usable, and cost-effective means to deliver services and aid in the learning of various contents and skills. However, not all digital games lend themselves to curricula, and ensuring whether a particular digital game can enhance learning is critical. Some games, for instance, have little educational value not simply because they are games but because they lack pedagogical design and game-based learning principles. Many researchers are not interested in examining whether the content of a digital game is relevant to educational purposes but, instead, assess whether the structural characteristics of the game could benefit the educational and social processes surrounding the educational experience (Hong et al., 2009).

In this chapter, we critically reflect on both the content and the structural characteristics of *Emotion Detectives (ED)* (Emotion Detectives, 2016; Huttunen et al., 2015), a new digital game based on research findings concerning the key factors in social and emotional development (see e.g., Denham, 2006) and funded by the Finnish National Board of Education. In a theoretical sense, *ED* can be considered a research- or evidence-based intervention tool. However, empirical evidence is needed to evaluate its impact on children's social, emotional, and behavioral development. This research focuses on 5–6-year-old children's gameplay interactions while playing *ED* in pairs. The research goal was to gain understanding of children's gameplay experiences, socio-emotional knowledge building, and collaborative learning through exploring their interactions, decision making, and expression of opinions during gameplay.

The use of game-based learning in early childhood is increasing rapidly (Peirce, 2013; Stephen & Plowman, 2014), but the scientific discussion on the use of digital technologies in early childhood education appears polarized: digital technologies are considered either a problem and threat to children (Blum & Parette, 2015; Nolan & McBride, 2013; Stephen & Plowman 2014) or a possibility and resource (McClure & Sweeny, 2015; Mustola et al., 2016). In order to overcome the unnecessary polarization of these phenomena research-based evidence on the potential of digital games to enhance learning in different areas of child's development is needed.

With the advances in computer technologies over the past 30 years, a flood of new ways to communicate, provide, and deliver psychological treatments has emerged. Among psychobehavioral treatments, various Web-based interventions have grown in importance because they have proven to be both feasible and powerful at delivering various forms of behavioral interventions (Spence et al., 2016). With young children, these interventions typically occur through the employment of digital games. There exists a great need for such interventions independent of geographical location, family socio-economic status, or children's special needs for support. Moreover, Web-based interventions offer one solution to a lack of sufficient local clinical services and frequently long waiting lists (Spence et al., 2016).

Importance of digital games as intervention tools

Typically, interventions in socio-emotional development have been comprehensive, large-scale, curriculum-based programs implemented in day care centers or school settings. Various Web-based interventions for children have also been developed (Spence et al., 2016). Most are games which appear to be highly attractive to children (Holloway et al., 2013). Digital games for young children are being developed at an exceptionally fast rate. According to Marsh (2010), more than 150 virtual worlds targeted at children and young people were available in 2010, and new products for the youngest children were being released every week (see also Holloway et al., 2013). However, there are few developmentally appropriate games for the youngest children and, furthermore, a general lack of research in this area (Peirce, 2013; Sung, Chang & Lee, 2008). In particular, studies on the impact and effectiveness of games are rare, and only a fraction of the research on games is targeted at early childhood learning (Peirce, 2013). This is a serious deficiency because research shows that new media, in addition to providing entertainment, influences young players' attitudes, social behaviors, and information processing in many ways (Wartella, Richert, & Robb, 2010).

Digital games can be considered effective tools for early intervention for a number of reasons: 1) They are effective vehicles for learning because they offer tireless opponents and enable endless

repetition, drilling, and feedback (Bradshaw, 2010); 2) children are intrinsically motivated to navigate the playful or fantasy contexts of digital games (Koivula & Mustola, 2015); 3) they offer a cost-effective tool because children can engage in the exercise or habilitation at any place and time, without expensive and often difficult-to-access clinical treatment (Peirce, 2013); and 4) games serve as a dynamic assessment tool for evaluation and diagnostic purposes because they provide information on children's skills development and difficulties and a means for remedying or improving skills (Ifenthaler, Eseryel, & Ge, 2012; Shute & Ke, 2012). However, few digital games focus on socio-emotional learning despite their inherent potential to evoke emotions, influence social behaviors, and generate a high level of positive emotional engagement (Conati, 2002; Habgood & Ainsworth, 2011).

Contemporary approaches to game-based learning consider an appropriate match among game design, learning content, and players' developmental stage to be highly important (Peirce, 2013). Designing and creating the pedagogy of games for young children demands careful consideration of children's needs for imagination, creativity, play, participation, and social interaction, among others (Habgood & Ainsworth, 2011; Mustola & Thompson, 2016; Peirce, 2013). To understand the possibilities and affordances of digital games as fruitful, supportive learning environments, it is important to evaluate not only the effectiveness of the game through the outcomes in children's skill development but, even more so, the processes through which these outcomes are achieved. We also need to explore the spaces for learning, interaction, and participation which games provide for children. Early childhood pedagogies have generally shifted away from highly structured approaches to more child-centered approaches which encourage children's participation and agency. Therefore, it is important to explore how a learning game which is based on research-based knowledge of emotion recognition and on clinical experience in the habilitation of children's communication and which targets increasing children's socio-emotional competence can motivate children and provide possibilities for their agency.

Promoting the development of children's socio-emotional competence through the *Emotion Detectives* game

Socio-emotional difficulties are among the most severe and growing concerns in young children's development (Prinz & Sanders, 2007). Preschool-aged children already exhibit socio-emotional difficulties, with the prevalence estimated from 10%–15% to 25–30% (Carter et al., 2004; Prinz & Sanders, 2007). Certain constitutionally based problems (e.g., low inhibition), behavioral issues (e.g., impulsivity, overactivity), and difficulties in language development (Van Agt et al., 2011) are considered critical neurobiological factors which increase children's risk for various socio-emotional difficulties. Children's socio-emotional competence has been found to affect not only their peer relations (Denham et al., 2002; Fabes et al., 2001) but also their academic success and later employment (Denham et al., 2002). Theoretical and empirical research has shown that children with positive social and emotional skills demonstrate resilience when confronted with stressful situations (Greenberg et al., 2003; Masten & Motti-Stefanidi, 2009). Research has also pointed to a positive correlation between measures of children's social and emotional skills, including emotion regulation and measures of later psychological health (Greenberg et al., 2001). Therefore, it is important to support children's social and emotional skills as early as possible before difficulties emerge and become prevalent and cumulative.

Previous research has suggested that children's social and emotional skills are partly linked to emotions and partly to socially responsible behavior. However, these two areas are deeply interconnected and usually are present simultaneously (Denham et al. 2002). Children have the innate ability to feel emotions, but the cognitive processes needed for emotion regulation only begin to develop after the first year of life. Moreover, the ability to combine emotional and cognitive information and, for instance, use different strategies to analyze one's own emotional experiences and emotionally arousing social situations emerges only around age 6 (Izard et al., 2002). This process of development suggests that children need adults' support and guidance in dealing with emotions and in learning emotion recognition and regulation strategies (about the development of

emotions, see, for example, Widen & Russell, 2010c). The development of emotional skills requires that children become aware of their emotions and those of others (Harris, 2010). Naming, discussing, and gaining an overall understanding of what emotions feel like is central to learning to recognize emotions.

ED is a game-based intervention tool for supporting the above mentioned behaviors and skills. This freeware is grounded in and follows the socio-cognitive approach to social development and adjustment, particularly Crick and Dodge's (1994) model of social information-processing mechanisms. The core theoretical assumption underlying *ED* is the strong interrelationship among emotions, thoughts, and behavior. By increasing players' emotional knowledge and understanding and influencing their thinking, the game can promote their emotional and self-regulation skills and constructive behavior. Curriculum-based socio-emotional programs, such as Second Step, also use this approach.

Unlike the few existing intervention tools focused on only one dimension of socio-emotional competences (Bölte et al., 2002; Golan et al., 2010; Tanaka et al., 2010; Tseng & Ye-Luen, 2011), *ED* is designed to support and enhance young children's acquisition of emotional knowledge skills (e.g., recognizing, appreciating, and understanding emotions and their expressions), prosocial behaviors (e.g., helping, sharing, comforting, and showing concern for others), and problem-solving abilities (e.g., social problem-solving behaviors, negotiating social conflicts) (Denham, 2006; Eisenberg, 2000). Like digital games in general, *ED* offers good opportunities for experiencing and rehearsing intense emotions due to its powerful audiovisual effects, emotional nature, and invitation to identify with the featured characters (see Ceranoglu, 2010).

It is of the utmost importance that games, especially those of an educational nature, meet the needs of children with very different skill levels. *ED* is designed for ages 5–12 and allows players to select the desired difficulty level. The player (or an adult) can set the difficulty of the office tasks (explained in detail later) by selecting a fixed level of easy, moderate, or difficult. The adaptive game setting uses a stepwise progress as the player proceeds from levels requiring basic skills to more challenging ones. In this setting, players start at the moderate level and are given easier or more difficult tasks based

on their success in playing. The aim of the adaptive game setting is to keep players' motivation as high as possible.

Storyline and structure of the game. In the game, the player sets up an Emotion Detective office and attempts to solve various social and social-emotional problems with the character Aksu, a virtual assistant. Players compete against similar enterprises in town and have to increase the reputation of their newly founded office. Players collect fame points by devising solutions and practicing their skills in the tasks presented. When the Emotion Detective and Aksu have earned enough points, they receive new tools (e.g., Emotion Radar, Magnifying Glass, and Emotion Glove), with which they can proceed to the next level in the game. Exercises in *ED* are divided into two main modules: office and field tasks.

Office tasks. *ED* consists of many kinds of emotion-related tasks which fall into four main categories: 1) identification of faces and recognition and naming of facial expressions; 2) recognition and naming of tones of voice; 3) matching of tones with facial expressions; and 4) categorization and matching of emotion words, or identification of synonyms and the valence of emotion words. The game comprises 23 office task types which each have three difficulty levels. The hierarchical model of face processing developed by Tanaka, Lincoln, and Hegg (2003) provides the basic structure of the facial expression tasks. Developmental data from the research literature were used to select the emotions in the game, especially for the different difficulty levels and the various alternatives for the multiple-choice tasks (Castelli, 2005; Golarai, Grill-Spector, & Reiss, 2006; Harris, 2010; Hopyan-Misakyan et al., 2009; Leppänen & Hietanen, 2001; Sauter, Panattoni, & Happé, 2013; Widen & Russell, 2010c).

The game tasks demand holistic face processing and part-based facial recognition, along with recognition of facial identity and expressions. In several tasks, players match facial expressions of either one person (e.g., in memory games) or across different people (see Figure 1). Faces of altogether 12 persons appear in the material expressing up to eight different emotions each, and the game randomizes the faces for maximal variability and learning.

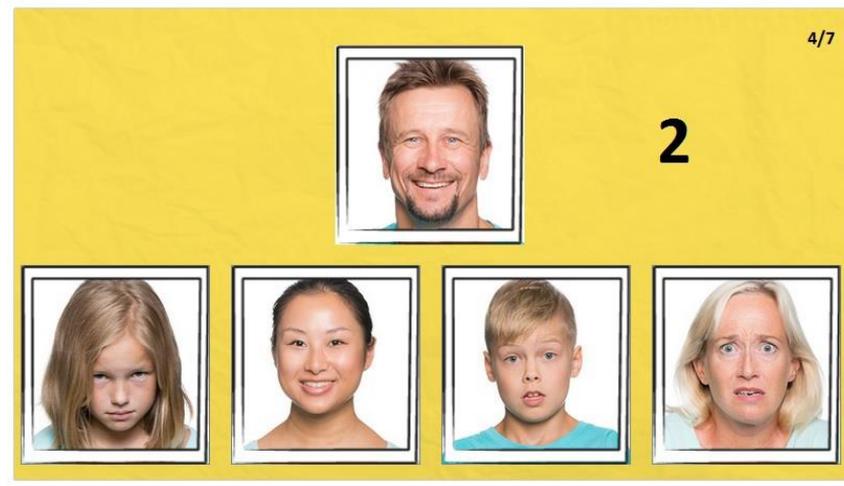


Figure 1. Office task in *ED* requiring the player to match two identical facial expressions.

A more difficult level of facial processing is involved when the player is asked to identify emotions based on an image of a face showing only the eyes and eyebrows (Wolf et al., 2008; Sadr, Jarudi, & Sinha, 2003). In addition to identification of faces and expressions, visual and auditory memory skills are practiced in the *ED* game. For example, visual short-term memory plays a central role when players need to store the order of three successive images of facial expressions in memory. In addition to the 10 face processing tasks, *ED* has three tasks on the recognition of tone of voice. Whereas other office tasks focus on one modality, some office tasks require combining visual and auditory information to reflect on everyday communication situations. The game also supports the development of children's emotional knowledge. In seven tasks ordered by difficulty level, players produce emotion labels, in other words, name emotions (Widen & Russell, 2010b). Players thereby enlarge their emotion vocabulary through these tasks which require, for instance, identifying and learning new synonyms of emotion words.

Field tasks. In field tasks, players receive an alert and leave the office to solve social or social-emotional problems for various char-

acters. Thirteen field tasks are presented through social stories shown in cartoons with speech bubbles. The recorded lines are spoken by children and adults, the latter who are mostly professional actors. All field tasks have the same basic structure. Players first *recognize emotions* using the Emotion Radar, then *identify the reason for the emotions* using the Magnifying Glass, and finally, *select the best solution to the conflict* and resolve it in both thoughts and concrete action using the Emotion Glove. All the solutions require thinking about other characters' viewpoints, knowledge, and feelings and negotiating conflict resolution accordingly. The topics of the social stories follow developmental trajectory, and the facial expressions and tones of voice used in the tasks must be interpreted and understood in social settings. The tasks also give practical tips, such as how to control strong affective states. One such tool is Robin, Schneider, and Dolnick's (1976) *turtle technique*, in which one takes a few deep breaths to reduce tension.

The themes of the field tasks cover a wide range of social situations including both conflicts and prosocial behavior: approaching others; belonging to a group; fair play; lying and betrayal; helping others; peer competition; aggression (direct, relational, and indirect); self-regulation; self-efficiency; discrimination (due to clothing, skills, and physical appearance); feelings of being lonely, isolated, or different; shame; fears; and shyness. The social stories in the field tasks provide training in many fundamental social skills: initiating interactions, approaching others, politely making requests, expressing positive or negative emotions, taking turns, thanking others, asking for help, and expressing empathy (Figure 2).



Figure 2. *ED* field task in which a boy is mocked for misunderstanding a metaphor (the dialogue is translated from Finnish).

The game is designed to engage children through active, reciprocal interaction with the character Aksu, the Emotion Detective's virtual assistant. Players receive feedback on their selections in multiple-choice tasks from Aksu, and the Emotion Radar (the robot) (Figure 3). Aksu, in particular, simulates normal language-acquisition processes in which adults use positive emotion talk and mental state language. The feedback includes simulation of natural techniques used by skilled parents (Brownell et al., 2013): 1) use of emotion labels; 2) elicitation of emotion labels from the child ("How does x feel?"); 3) explanations of emotions ("He was unhappy because ..."); 4) descriptions of desires ("What does x want to do?"); 5) internal talk ("What does x think about?"); 6) other mental state talk (vocabulary, metaphors and idioms); and 7) provision of empathy inductions. The aim is to support players' self-reflection, increase their ability to recognize different forms of rejection, and thereby prevent later aggression in children who do not find easy acceptance in peer groups. Children's social information-processing patterns have been found to partially mediate the effects of peer group rejection on later aggression (Dodge et al., 2003). Accepting other children in peer groups provides all children with opportunities for social growth and the development of social skills.



Figure 3. Virtual characters Aksu and the Emotion Radar urge the Emotion Detective to identify emotions in the *ED* game.

Support of players' creativity. The game design aims to allow room for children's creativity to increase the attractiveness of the game. According to the player statistics embedded in the game, one of the most popular mini-games has been The Mannequins of Mr. Eagle Owl the Dressmaker (in Finnish, *Herra Huuhkajan mallinuket*). In this mini-game, the player can design the faces of mannequins by selecting eyes, eyebrows, and mouths which express different emotions and can dress the mannequins by selecting their hair, clothes, and shoes. After completing a mannequin, the child is asked to select the emotion on its face (Figure 4). Additionally, the player can choose to save and print the dressed dummy. Children can also create their own cartoons in StoryTube (*Tarinatuubi*), a cartoon construction program which is an extension to *ED*. StoryTube can be launched by clicking a link embedded in *ED*. For the cartoons, which can be saved and printed, players can select various scenes, characters, and objects featured in the game and add speech bubbles to create narratives.

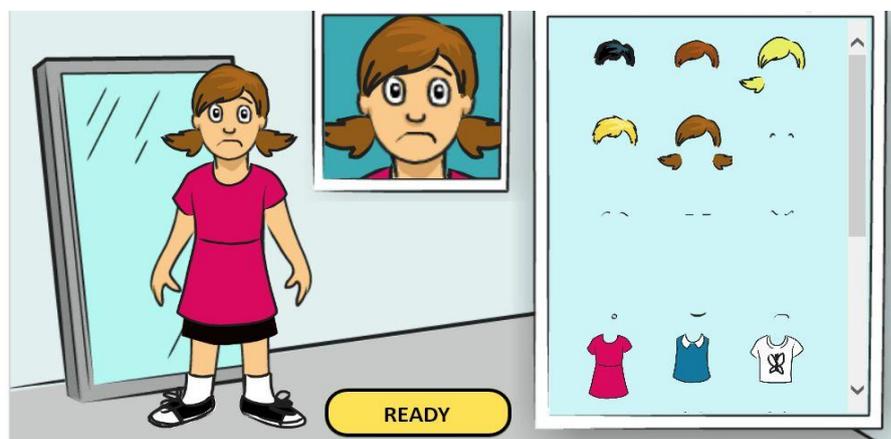


Figure 4. Mannequin of Mr. Eagle Owl the Dressmaker with a sad face.

The usability of the game has been increased by providing mini-games. The 23 office tasks can be selected individually on the webpage (<http://emo.oph.oodles.fi/minipelit.html>) if the player does not have the time or interest to play the entire *ED* game with all the field tasks and progressive accumulation of points. This mini-game option is especially helpful for parents, teachers, and therapists who want to select the needed office tasks and to plan how long playing them will take.

Adults' and peers' role in supporting the child's play

Human-machine interaction (HMI) is not necessarily adequate for digital games to support children's socio-emotional development at an optimal level. According to previous research (Erhel & Jamet, 2013), feedback from others is important for good learning results. The child, therefore, needs another person, whether an adult or another child, to create a human-human-machine triad which enriches the contents of the intervention through the interaction of the child-

adult or child–child pair. When *exploiting scaffolding* or, as Vygotsky (1978, p. 90) called it, *the zone of proximal development*, a child who cannot accomplish a task alone can succeed and learn with the help and encouragement of a knowledgeable adult or a more competent peer.

In *ED*, adults are urged to support children in playing because adult–child interactions and communication support learning. Parents' encouragement of their children's active participation in discussing others' emotions has been found to be beneficial in children's emotional development (Brownell et al., 2013). *ED* exploits the features of parent–child interaction effective in supporting children's recognition of emotions and social-emotional development. Adults who support children in playing the game are urged to give feedback on the children's playing, to use emotion words in conversations with the players, and to expand the themes introduced in the game by discussing emotions related to children's experiences in everyday life. The game provides instruction materials for adults on how to support children in playing, topics to discuss, and how to promote children's self-reflection ability.

ED is also designed to promote peer learning. The gameplay setup allows two (or more) children to play while seated side-by-side and sharing the screen. This seating arrangement precludes direct engagement but places participants in an intimate position. The averted gazes might allow children to more easily chat or start conversations about their gameplay and the themes in the game. The multiple options and solutions in the game offer players possibilities for joint discussions and reasoning. Players receive direct feedback on their responses. Aksu, the virtual assistant, comments on players' actions and uses gestures, vivid tones of voice, and abundant emotion state talk and mental vocabulary. Such feedback, when used in parental talk, has been shown to support children's language skills and social emotional development and to be associated with fewer behavior problems (Brownell et al., 2013; Curenton & Craig, 2011).

Empirical observations on children's gameplay interactions

This section presents observations of children's learning dispositions and possibilities for shared thinking (Mercer & Littleton, 2007; Wegerif, Littleton, & Jones, 2003) and (emotional) engagement (Schoenau-Fog, 2011) during the *ED* gameplay. The aim was to identify what game-playing processes and qualities sustain engagement and learning in the target domain of socio-emotional competence. To understand the possibilities, affordances, and limitations of digital games as learning environments, it is important to evaluate not only a game's effectiveness in achieving children's experienced motivation or skills development but more so the processes through which sustained motivation and positive learning outcomes are attained.

The empirical evidence was gathered from observations of the *ED* gameplay of 5- and 6-year-old children (6 pairs in the first phase of data collection). A large dataset was collected on the effectiveness of *ED*, including the experiences of children and kindergarten teachers, and their evaluations of the game design using both quantitative (e.g., measuring children's pre- and post-intervention socio-emotional competence) and qualitative methods (e.g., observations, interviews). The *ED* game intervention was conducted over 8 weeks. Each child played *ED* alone for a minimum of 1 and a maximum of 2 hours per week and with another child 15–30 minutes per week in their day care center. Three game-playing sessions with each pair of children were videotaped during the first, fourth, and eighth weeks of data collection. The purpose of this periodic data collection was to detect any changes in children's gameplay. The aim was to analyze children's gameplay interactions and the context provided by *ED* game design. To do so, qualitative analyses, including content analysis and thematic analysis, were performed.

The first step in the analysis was to transcribe all the video recordings. The next task was to develop initial thematic categories and to examine them in detail by coding all the material. The unit of analysis was a meaningful phrase or sentence uttered during an interaction (taking into account the affordances of the game context). The following sections discuss preliminary findings from the children's playing of *ED* concerning: 1) the process of recognizing and naming emotions; 2) player interactions; and 3) players' interactions with the *ED* game. The aim of these analyzes is to understand whether and

how playing *ED* supports children's emotional knowledge, socio-emotional competence, and collaborative learning.

The process of recognizing and naming emotions

To develop an understanding of emotions, a child must be able to identify different emotions (Widen & Russell, 2010a). A child develops the ability to recognize specific emotions from facial expressions during the first half-year of life, and this innate or prepared system forms the basis for later development of emotional scripts (Widen & Russell, 2010a; Widen & Russell, 2010b). In building these scripts, the child learns by, for example, labeling emotion expressions and processing information about the causes and consequences of specific emotions (Widen & Russell, 2010a). As mentioned, various tasks in *ED* target recognizing and naming different emotions.

Example 1 illustrates children's discussions about recognizing emotions. In this task, the player first must identify seven faces from a background scene, and each time a face is identified, the player selects from three alternatives which emotion is expressed on the face. In the examples given here, children are identified with codes: a capital C indicates a child, and a number identifies a specific child.

Example 1:

C2: *Hey, this is nice!* [smiling] *Seven faces. This is nice.*

C1: [nods to the pair and looks at the camera for a while]

(.)

C2: *Hey. (.) So let's see that picture (.)*

C1: *Fun. This is good.*

C2: *Hmm.*

C1: *Shall we do this with [a child's name]?*

C2: *Yeah, I'll be the first one, then it's your turn.*

C1: *Okay.*

C2: *Okay?*

C1: *Yes.*

C2: *I'll click here.*

C1: *Yeeess.*

C2: And then angry (.) I knew it!
Adult: How did you know that it's angry?
C2: Well, because it looked that way.
Adult: But how did you know that it is said "angry" there?
C2: Yes, I can read these.
C1: Then [clicks the mouse]
C2: Eeeh. You have to take the sad one.
C1: Sad is (.) above or below... which one? [asks her partner in a soft voice]
C2: Below.
C1: Okay, I thought that... (.) so, where do I click...there?
C2: There.
C1: [Clicks the mouse]
C2: Yay hehe [smiling, rubbing hands together]

This example illustrates how the two girls played *ED*. They also practiced how to use a computer and mouse because as tablet users, they were not familiar with using a laptop computer. The girls were both interested in playing *ED*. They decided to choose a nice task and found a face recognition task to be rewarding. They felt joy when they correctly labeled the emotion, which they signaled by clapping their hands and praising one another. This example also shows their collaboration in playing the game. C2 was somewhat more competent than C1, who continuously asked for her partner's advice and confirmation as their game continued. C1 seemed to need scaffolding as she functioned in her zone of proximal development. Thus, for this pair, the gameplay promoted learning of emotional knowledge and the social skills needed in collaborative learning.

During the gameplay, the children exhibited some differences. Participants had different skill levels in the *ED* game; some also played it at home, so they were more competent at it than those who played it only in the day care center. In some pairs, the children negotiated taking turns in the gameplay, whereas in other pairs, there were conflicts. In example 2, a boy (C3) and a girl (C4) practice recognizing facial expressions. This kind of discrepancy in skill level between learners can frequently result in peer tutoring and collaborative learning.

Example 2:

C3: *Where is the sad one?*

C4: *Wait ... it is...* [she pushes her partner's hand away from the mouse] *wait* [pushes her partner's hand away from the mouse]. *It is angry. The one below ... below ... yes Then where do you put the next one?*

C3: *Happy.*

C4: *That one* [pointing].

C3: *This is the bad guy.*

C4: *Angry, that is the one below... Wrong, the one below* [shows it on the screen] ... *Then where do you put the next one?*

C3: *This one ... the sun.*

C4: *It's not going there ... it's that one.*

C3: *Angry.*

C4: *Happy. It's the one on the top.*

...

C4: *Is he ... happy, sad or angry?*

C3: [Laughs when he gets the correct answer] *I know them myself ... you don't have to* [help]

...

C4: *Wrong ... Like that ... then ... is she ... happy, sad, or angry? Wrong ... Yes, you did those ... Hey, you have to listen!*

C4: *You have to listen to those!* [her partner just clicks the mouse forward without listening] ... *Click ... Click!* [speaks more emphatically]

C3: *Okay* [talks to the game] *Stupid* [says to the game] ... *Don't you get it.* [repeats what he hears from the game, laughs]

C4: *Hey ...listen to those!* [as her partner keeps on clicking forward without listening]

C3: *I'll listen to this, at least.*

C4: *Click there, click there!* [pointing]

...

C3: [It is C4's turn to play, followed by C3] *Now I can do it.* [pulling the computer away from C4]

C4: *Wait, no, I can do it!* [pulling the computer back]

C3: *I will do, too!* [pulling the computer]

C4: *No!*

C3: *This is a joint game!*

C4: You actually did have more time for play. [pulling the computer]

C3: Joint game! [tries to pull the computer toward himself]

C4: Wait ... You did have more time for play than I had.

C3: Yes I can ... this is a joint game [The children continue arguing, and finally, C4 gives up to C3, and he takes over the game.]

In this example, C4 (a girl) clearly had more knowledge about the *ED* game and tried to help C3 (a boy) in gameplay. However, her efforts did not succeed: C3 was determined to play the game by himself and appeared to have his own style of gameplay. He did not listen to C4's advice but kept on guessing the answers and clicking on alternatives without thinking about which was the right answer. This frustrated C4 and finally resulted in a conflict between the children, who argued over whose turn it was to play. When it was C4's turn to play, C3 finally seemed to understand the goal of the game and tried to pull the computer away from C4, using the argument "This is a joint game" to justify his actions. In the end, C3 got his way, and C4 gave up the fight and lost her rightful game time.

In this situation, the children had different motivations for gameplay. C3 wanted to play by himself, even though C4 consistently tried to negotiate, give advice, and construct joint gameplay. If C3 had a more responsive mindset, this situation could have resulted in collaborative learning instead of conflict. However, for both children, this social interchange required practicing socio-emotional skills and competence. Previous research (Koivula, 2010) has suggested that this reluctance, as in the case of C3, to receive help and construct a joint, collaborative learning situation occurs more frequently in preschool-aged boys than girls. One explanation for this trend is that boys eagerly desire to emphasize their own gameplay skills and knowledge and so interpret receiving help as incompetence. This example illustrates the significance of player interaction for the construction of joint gameplay and collaboration.

Player interaction during gameplay

A number of studies have found that children's knowledge of their own and others' emotions forms the basis for their actions in specific social contexts. As Harris (2010, p. 329) states, "Children's ability to understand and predict their own emotions likely affects their decision making about what course of action to take." In addition, research has found that emotional communication cannot be separated from its social context (Saarni, 2010). The social context of playing *ED* in pairs resulted in a variety of player interactions, ranging from minimal verbal communication between children to active collaboration and co-construction of knowledge. Here, the examples illustrate the findings concerning two categories of player interactions: 1) rules and negotiations about the gameplay; and 2) children's ways of interacting and co-constructing knowledge.

Rules and negotiations

Most child pairs strictly followed the rules during gameplay. As the children started the game, they negotiated taking turns but had to continue doing so during gameplay, as example 3 shows. Turn-taking was the main cause of conflicts between children.

Example 3:

C7: Shall I click here [a certain picture]?

C8: Don't. Take that one. Again, wrong one. And now one more, and then it is my turn.

C8: Hey! [C7 takes control of the mouse.]

C7: You have had more game time with this!

C8: Huh, no I haven't! I put....! C7 [child's name]! Do you know ... is it okay that everyone plays the game twice, is it okay?

C7: Yes.

In this example, a conflict about game time occurred between the children. These minor conflicts occurred quite frequently in the data. The first strategy children normally used was to take away the other child's finger from the mouse, but in some cases, the child also tried to take control of the entire laptop and move it away from the peer, as in example 2. Only after these physical reactions did the children start verbal negotiations. However, some girls also developed inno-

vative solutions for turn-taking in their gameplay. For example, a pair of girls agreed that one would move the mouse and the cursor while the other did the clicking, and the children collaborated in this way throughout the game.

From the perspective of *ED* game design, it is interesting to explore children's negotiations of the events of the game and their interactions to recognize emotions or resolve social situations in the game. The aim of the *ED* game setup is to support and promote these kinds of interactions. Example 4 illustrates a situation in which two girls attempt to find the correct solution together:

Example 4:

C6: Okay, I think it is this one [the correct one] ... Could it be this? [selects the wrong one] Oh, man! That was ...

C5: I pointed to the other one.

C6: Is it this one?.... Yes, it is this one, isn't it? Are you thinking about this as well?

C5: I tried to point it and then you just picked the other one.

C6: Well, you know what ... I ... well, I ...

C5: I just show like this.

C6: That's the one ... you know what?

C5: Wait!

C6: Well, I just did not see ... I just thought that you pointed to that one. [The girls look at each other.]

C5: What on earth? [The girls try to understand what is happening in the game.]

C6: Okay ... click ...

This example shows a typical gameplay situation as both children actively participated even though it was C6's turn to select the correct answer. C5 pointed to the option on the screen she thought was correct. Although the children followed the rules regarding turn-taking, the member of the pair observing still participated by giving advice and pointing to the correct answers.

Interestingly, there was also some competition between the children. They all wanted to succeed and were glad when they selected the correct answer, but in some occasions, the competition resulted in one child underrating another's performance, saying, for example,

“You did not get it right.” or “You can’t play correctly.” When the children encountered challenging tasks, they turned to each other for help, but some problems also emerged in these situations. An unmotivated member of a pair might not give assistance despite the other child’s request.

Children’s motivation (see Deci & Ryan, 1995) to play the game was a key element in successful peer collaboration, but the most significant contributing factor was the social relationship between the children. Our data showed that, in gameplay, pairs of friends were more likely to succeed in collaboration and learning together, whereas non-friends were more likely to encounter challenges and problems. Koivula (2010) reported similar results: peer collaboration (collaborative learning) among young children was most successful between friends. Friends were more willing to negotiate with each other and quickly resolve conflicts and had motivation to construct shared activities.

Children’s ways of interacting and co-constructing knowledge

As examples 2 and 3 show, some conflicts occurred between children during gameplay. However, the conflicts were typically short and did not result in the breakdown of the shared gameplay activity. Children’s collaborative interactions mostly proceeded without significant problems. The child pairs displayed a range of productive interactions during gameplay. Of particular interest were children’s flexible transitions between solo gameplay and collaborative endeavors. On one hand, it was important for children to succeed by themselves, expressed in such statements as “I knew that!”, “I know what are the right ones.”, “I am good at this.” and “I have done this before. It is that one.” On the other hand, the children were motivated to create the context of shared gameplay and emphasized the collective nature of the gameplay situation. The collaborative interactions during the gameplay were represented in such statements as “Shall we do this one?”, “Let’s take the tablet games again!”, “We guessed that!”, or “We got the Magnifying Glass! Exciting!” This we-talk indicated the commitment of both members of a pair to joint gameplay and created the feeling of togetherness in the gameplay activity, which lay foundation for collaborative learning (Koivula,

2010; Koivula & Hännikäinen, 2016). Example 5 shows a child seeking assistance from and co-constructing knowledge with a peer but refusing help from an adult:

Example 5:

C5: Now, let's take the second one, shall we? [The children listen to the second alternative.]

C6: No, not even close. [They listen to more options.] ... *No ...oops.* [They look at each other.]

Adult: What happened now?... I don't know ...

C5: Let's listen [to options and instructions].

C6: [sighs and makes sounds with her tongue]

C5: Surprised.

Adult: Do you need some help?

C5: Nooo... [does not want help from the adult]

C6: Eeeh ... I don't know right now... Okay, exhilarated comes next.

C5: I know what that one is ...

C6: Mmph [to the game] *Tell...which one of these?*

C5: Wait, let's see ... embarrassed ... no ... Insecure ... no... ashamed

C6: Let's take ... let's see if it is insecure [the correct answer].

C5: But we just took it, just a while ago!

C6: No, we took embarrassed.

C5: Was this supposed to be ... [listens to the option from the game]

C6: That was not exhilaration ... no, that was not embarrassed.

This one is embarrassed, but in there it is ... let's try this one... for real that one. This is so hard! This is so hard! [Finally, they find the correct answer.] *Right!* [C6 smiles and looks at the camera for a while.]

In this example, the girls, C5 and C6, both struggled to find the correct answer. The kindergarten teacher was nearby and offered to help, but they did not want the teacher's assistance. They relied on each other and wanted to succeed by themselves. Their interactions illustrate the construction of joint knowledge through discussion. Together, they recognized and named emotions and tried to find the

correct alternatives. C6 became somewhat frustrated when this turned out to be a challenge. Such interactions were quite typical in the data. Children sought help from each other, and especially when difficulties emerged, they relied on their peers.

Surprisingly, the presence of the kindergarten teacher lessened the amount of interactions between children. Sometimes, children sought help or confirmation from the teacher and often called for the teacher to come and see their improvement, but the more long-term presence of the teacher decreased mutual interactions among children. On one occasion, the researcher observed that a pair involved in gameplay did not talk to each other despite the researcher's guidance. In other observations of *ED* gameplay, these same children had lively conversations with each other. An explanation for this difference might be that the pairs were committed to playing the *ED* game together and relied on each other but did not want to fail or reason together under the eye of the teacher (or researcher), who was an adult authority. In the present data, thus, it seems that, for the children playing the *ED* game in the setting of a day care center, interactions materialized in either peer interaction or adult-child interactions, and these two did not mingle seamlessly.

The design of the *ED* game, as stated, supports adult-child and peer interactions. Children's co-construction of knowledge occurred when they needed assistance or support from their partner, as in example 5, but also when they were committed to making choices and proceeding in the game together. One particular task which resulted in productive interaction was the office task *The Mannequins of Mr. Eagle Owl the Dressmaker*.

Example 6:

[The children have made two mannequins for Mr. Eagle Owl.]

C7: Eh, which one of these? Teacher?

C2: Teacher!!! [shouts for the teacher]

C7: We don't know what this one is.

C2: Surprised, it is surprised.

[The teacher reads the alternatives aloud.]

C7: We don't know.

Teacher: Well, you can choose yourselves what [emotional expression] *you want for the figure you have made.*

C7: This one.

Teacher: It says emotional.

C2: Yeah, emotional.

Teacher: Do you both think it is emotional?

Both children: Yes.

Teacher: Well, then you can choose that one. And then click ready.

C7: Uuuu, now that mannequin. Take that kind of fancy.

C2: I'll make a boy ... a father.

C7: This is our dad! [Both start laughing out loud]...No, choose hair like that.

C2: [laughs]

C7: No, choose black hair [both are laughing again]. This is better.

C2: No, this is better.

C7: Like that. Then take the sad face.

C2: No, the angry one. It is angry. This will soon look angry.

[Both are laughing out loud.]

C7: Then let's dress him with some silly clown clothes!

C2: No, we have forgotten to put this ... this will be on his head.

C7: We cannot put a skirt like that!!

C2: [laughing]

C7: Put this one.

C2: No, these ones. Which? You can decide.

C7: This one [Both are laughing again]. Still, shoes like that ...

Example 6 illustrates joint collaboration in making mannequins for Mr. Eagle Owl. Both children contributed to the choices made and discussed the various options. In this case, the children started to add humor and have fun designing the third mannequin. They decided to make the mannequin a dad, and C7 thought that it illustrated her father. They chose the color of the hair and wanted to put funny clothes on the mannequin. C7, however, did not want the mannequin to have a skirt. The children laughed a lot about the silly mannequin. Such shared fun between children occurred on many occasions throughout the data and served the important functions of motivating the children's gameplay and strengthening their relationships. The

children frequently joked together and commented on the events or feedback given by *ED*.

Children's interaction with the *Emotion Detectives* game

HMI is a new research field even though humans have long operated machines. The concept of HMI is usually broken down into four categories addressing the use of computerized machines: safety, performance, comfort, and aesthetics. These categories are often associated with four human factors: physical, cognitive, social, and emotional (Boy, 2012). When analyzing the interactions between humans and machines, the essential factors are the quality of the interaction and the machine's ability to create a satisfying experience of agency for the human (Murray, 2011). In analyzing the structural characteristics of game design, it is important to consider how the game design supports or enhances the processes and elements considered meaningful for promoting effective learning. These include putting players into simulated real-life situations and enabling shared experiences (collaboration) during gameplay.

As described, two dimensions of social interaction were included in the *ED* game design. First, *ED* introduces children to social situations in which they need to recognize emotions and select appropriate solutions to conflicts. Second, the game setup offers possibilities for joint learning. Prensky (2001) has identified six key structural elements of games: 1) rules; 2) goals and objectives; 3) outcomes and feedback; 4) conflict, competition, challenge, and opposition; 5) interaction; and 6) representation. The examples from the data touch upon game rules and objectives and also conflicts and challenges. Next, the qualities of the interaction and feedback in *ED* are described, focusing on both the game itself and the motivational aspects of the game.

In their interaction with *ED*, children sometimes expressed a lack of motivation to play *ED* and the desire to do something else: "This is a stupid game!" "I don't want to play anymore." This is boring!" In some cases, it was best to stop playing the game and continue doing so at another time when the child felt more motivated to play.

However, these statements of reluctance were quite rare. Children mostly had an enthusiastic outlook toward playing *ED*. In the data, utterances, such as “Hey, this is nice!”, “Yeah!”, “I know this one!”, and “This is easy!”, were more common than negative feedback. Children felt that it was important to move to the next level of the game and make the correct choices. When they succeeded and got rewards, they felt enthusiastic, smiled, clapped their hands, and shared the joy of success with their partners. One girl had invented a sort of short rhyme which she shared with her partner when they got the right answer. The girls scratched each other’s hands and chanted: “Kittens obey what their mommas say!” They repeated this action every time they had success in the game. Example 7 illustrates the importance of rewards:

Example 7:

C6 and C7 have played the ED game for some time but have not received the Magnifying Glass and have started to wonder if there is something wrong. They receive a package in the game and call the kindergarten teacher to come and see that they have finally gotten the Magnifying Glass. The teacher compliments them, and both children are extremely happy and scream for joy. They look at each other, and then they look at the amount of reputation points they have received in the game.

In example 7, the children wanted to receive the Magnifying Glass, which would enable them to proceed to a new task. They felt that they should already have earned the item and wondered if something was wrong with the game. When they finally attained the goal and received the Magnifying Glass, their joy was evident, and they wanted to share their joy with the teacher. The game design motivated children to learn to recognize emotions and practice socio-emotional skills, represented in their desire to earn high scores and to know the right answers and in their annoyance when they chose the incorrect alternative.

When the children did not succeed in the emotion recognition tasks or in resolving socially complex situations, *ED* offered feedback. The feedback usually gave encouragement to try again and think harder but could also include humor, as example 8 shows:

Example 8:

[Children say the feedback from the *ED* out loud.]

C2 and C7: [along with Aksu, the virtual assistant in the game]
“But that did not succeed very well. What do you think? Shall we close our office and move to Timbuktu? Maybe there we can have a job as a wall decoration.”

C2 and C7: [along with the voice of the Emotion Detective]
“Don’t overreact now. Let’s take a little break and play again after a while.”

This repetition of feedback and other statements in the game was common among players. The children anticipated what feedback they would receive and reinforced it by saying it themselves. When the feedback was positive (“We are the best ones!”), children also repeated it. In addition, the game included some humor. For example, saying the phrase “red-butt baboon” made the children laugh and want to hear that comment again. Children also joked about the words they heard in the game and imitated the sounds they heard, such as the metallic, robot-like sound of the Emotion Radar. These exchanges illustrate the interactive nature of children’s gameplay in *ED*. They gave feedback to the game, repeated the feedback that the game gave to them, and, with their partner (and with the game), improved their gameplay.

Discussion

The empirical data collected revealed the diverse gameplay situations the children experienced while playing *ED* in pairs. Based on the empirical extracts presented, it is clear that the children learned socio-emotional skills through playing *ED* and through social interactions with their partner. As stated, social-emotional competencies, broadly understood, consist of various skills, such as recognizing and naming emotions and the ability to behave in a socially responsible way. Through the double effect of practicing these skills in the game while engaging in peer interactions, *ED* has the potential to be an effective learning environment for children.

The gameplay situations presented did not always appear to be ideal, purely positive learning scenes. They also involved conflicts, arguments, submission, and assaults. The game itself did not generate such incidents, but conflicts arose from peer interactions, reflecting the nature of real-life social situations which inevitably are both easy and challenging. Such social difficulties offer an important opportunity for children to practice and enhance their social and emotional skills. The presence of an adult, however, is important to intervene to help children solve their arguments in cases of major conflicts.

The empirical data enabled understanding what qualities of *ED* motivated the children. The game's humorous features (e.g., the possibility to dress a man in a dress) and funny feedback (e.g., Aksu suggesting that the player should give up and move to Timbuktu) fascinated the children. The opportunities to acquire various tools and to progress in the game were also essential. Similarly, the children seemed to enjoy the opportunity to be creative, as in the office task to dress a mannequin in different outfits and select different emotional expressions for its face. The research information gained from observing actual gameplay situations with children provided crucial knowledge about what features of digital environments motivated the children to learn.

In the future, research could be more specifically targeted at the processes and qualities of educational games and gameplay that promote engagement, collaborative learning, and positive learning outcomes. More in-depth theoretical and empirical knowledge of these processes and quality issues regarding digital games could improve understanding of the effectiveness of game-based learning in various areas of children's early development.

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