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SOCIAL AND EMOTIONAL LEARNING WITH A ROBOT DOG: TECHNOLOGY, EMPATHY AND PLAYFUL LEARNING IN KINDERGARTEN

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Social and Emotional Learning with a Robot Dog: Technology, Empathy and Playful Learning in Kindergarten

Synopsis

Robotic 'pets,' technological emulations of companion animals, have become increasingly complex and broadly disseminated to teaching empathy. They are part of a trend toward anthropomorphized social robots, computer technology embedded within forms that emulate biological entities (Melson et al. 2009). The goal of this study is to investigate potential links between empathy development and social and emotional learning when using a robot dog (Golden Pup) as an educational tool in the Kindergarten context.

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Abstract

When you think of empathy, it is a part of what makes us human and humane, and it has become a core component of the Social Awareness competency of Social and Emotional Learning (SEL) (CASEL, 2019). SEL fosters the understanding of others' emotions, which is the basis of Theory of Mind skills and frames the development of empathy (Walker & Wedenbenner, 2019). The purpose of this study is to trace potential links between empathy development and social and emotional learning when using a robot dog as a learning tool as part of preschool-aged children's education in kindergarten. The robot dog under scrutiny, namely *Golden Pup* by company Joy for All, has 'all the love in the world to give'. According to its marketing materials, thanks to built-in sensors and speakers the robot dog can recreate some of the more 'delightful moments of owning a dog including being a best friend for aging loved ones' (RobotShop, Golden Pup 2019). In the study at hand, the Golden Pup robot dog was observed while being first used by preschool-aged children during free-play. Social robots like robot toy dogs bring new opportunities for designers to rethink areas of change concerned with how children relate to their peers (nurturing), learning (empathy), and play (social interaction). In the paper at hand, the Golden Pup is seen as an educational instrument in assessing and teaching socio-emotional skills. Our tentative results show how child-robot toy interaction may facilitate emphatic responses and playful learning of empathy skills when used as part of guided play.

Keywords: Emotional Learning, Social Learning, Robot Dog, Social Robots, Empathy, Early Education

Figure 1. Preschool children play with the robot dog *Golden Pup* in a Finnish early education environment.

1. Introduction

Children are eager explorers, when using objects like the one employed in our case study—a robot dog—to play while learning about how the world works (Piaget 2013, Smith 2017, Vygotsky 1967). Researchers present that the usage of toys during play have shown to contribute to healthy cognitive development (Singer & Singer 2009). New generations are born into a world in which technological objects merge increasingly with toys, including smartphones, tablets, coding toys, smart toys and connected playthings—the Internet of Toys. This means that the emergence of technologies for children has led to changes in both play objects and related play patterns, as more digital and interactive smart toys and environments enter the market. One example of such toys are social robots employed in the context of learning.

Educational robots are of importance as the creation of new teaching methods and tools remains a highly relevant, active and growing research field in both academic and industry fields (Wu et al. 2018). Research has shown that children are willing to use and interact with technology (Becker 2000, McKenney & Voogt 2010, Plowman & McPake 2013), and that new technologically-enhanced playthings such as the Internet of Toys (IoToys), smart toys and social robot toys can have positive benefits in children's learning (Billard 2003, Heljakka & Ihamäki 2018, Heljakka & Ihamäki 2019a, Heljakka & Ihamäki 2019b, Ihamäki & Heljakka 2018a, Ihamäki & Heljakka 2018b, Ihamäki & Heljakka 2018c).

Several researchers have conducted studies on children interacting with educational robots, and the Internet of Toys in a learning environment (Alves-Oliveira et al. 2017, Westlund et al. 2017). On many occasions, educational robots have an assisting role in teaching. For example, Breazeal et al. (2016) present studies in which children have treated robots as interlocutors. Hall et al. (2016) present results on map reading with an empathic robot tutor, and showed this scenario with the Nao robot interacting with students reading a map.

This paper takes an interest in the potential of a robot toy to be employed as a part of early education with a specific interest in social and emotional learning. What guides our interest in particular is to focus on empathy mediated by a robot dog, Golden Pup.

Empathy is a uniquely human emotion facilitated by abstract thinking and language (Walker & Weidenbenner 2019). Preschool environments offer opportunities to observe the relationship between social and emotional learning, the balance between learner-centered and adult-directed activities, and the benefits of using a robot toy in studying preschool-aged children's firsthand empathic responses. The study presented in the paper explores links between empathy development and social and emotional learning with a robot dog as a learning tool in kindergarten. Our investigation begins with the presumption that motion-based play is a way of teaching prosocial behavior by using robot dogs as a learning tool. We hypothesize that the recognition of emotions, such as empathy and other socio-communication skills children learn at a very young age through child-robot communication and playful learning can be a venue for adding on to the understanding of empathy development for preschool-aged children.

Introducing the Robot Dog – Golden Pup

The Golden Pup is a low cost interactive robotic pet originally developed by toy company Hasbro, and later marketed by Joy for All, called "Joy for All Companion Pets", first made available in 2016. Robotic pets in the companion pets line include three different cats and one dog robot toy—Golden Pup. The battery-operated robot pets respond to nursing and hugging with motion sensors responding to motion and touch. The fur and weight of the robot dog feels like a real dog. Movements and sounds the robot makes simulate a real animal, especially purring, barks and head turning (McBride et al. 2017).

"This pup looks, feels, and sounds like a real dog. Its thumping heartbeat enhances its life-like qualities. This beautiful, soft dog responds to petting, hugging, and motion much like the dogs you know and love, without the care issues." (Golden Pup marketing texts, Amazon.com). According to the toy marketer, the envisioned play patterns of the chosen dog toy robot represent *mobile play*: The Golden Pup reacts to touch "with puppy-like movements and sounds"; *haptic/object play*: The Golden Pup features a "realistic coat"; and *auditive play*: The Golden Pup comes with a "simulated heartbeat, and authentic sounds and "responds to sounds with 'Bark Back' technology".

2. Related work

In this section, we contextualize the robot toy Golden Pup within the general field of Human-Robot Interaction and Child-Robot Interaction, especially with the educational context in mind. We frame the development of robot toy technology with the possibilities of playful learning including learner-centered techniques, and theories about child empathy development, personality and creativity.

2.1. Human-Robot Interaction

Human-robot interaction is a research field dedicated to the design and evaluation of robotic systems that interact with humans (Goodrich and Schultz 2007). These robots have been designed with the ability to "communicate and interact with us, understand and even relate to us, in a personal way" (Breazeal 2004).

An earlier study shows how human-robot interaction demonstrates different embodiments, using a rich taxonomy of expressive behaviors (Fong et al. 2003) and operate in an application field (Ben-Ari & Mondada 2018). Human-robot interaction modalities range from emotional expression (Paiva et al. 2018) including empathy (Paiva et al. 2017), body gestures (Salem et al. 2012, Salem et al. 2013), and expressive lights (Baraka & Veloso 2018) to color, motion and sound (Löffler et al. 2018, Heljakka & Ihamäki 2019a/b). Research has shown that highly successful interactions with humans tend to occur when the interactive and expressive modalities of robots match their physical embodiment (Mori 1970). There are studies according to which a robot's embodiments express human-like appearance (Kanda & Ishiguro 2016, Matsui et al. 2018) to non-humanlike shapes (Bretan et al. 2015, Zaga et al. 2017, Cha et al. 2018). According to Nocentini et al. (2019), when a social robot interacts with human users, empathy represents one of the key factors to increase natural Human Robot Interaction. Emotional models are fundamental for social abilities to reach empathy with users. For example, previous work demonstrated that combining the robot's empathy with the user's state contributed to a better appreciation of a personal assistant (Liu & Picard 2005). Looije et al. (2010) have conducted experiments with the I-Cat robot, where they have provided a computer-based assistant that could persuade and guide elderly people to behave in a healthy way. The I-Cat features an emotional model that makes it able to smile and express sadness. Authors implemented natural cues such as understanding, listening, and looking, to perform different roles for the robot—educator, buddy and motivator.

2.2. Child-Robot Interaction

A wide range of research in new technology development used in play by children, especially social robots, coding robots, and playthings in the category of the Internet of Toys, has been developed, with associated benefits for education (Belpaeme et al. 2018, Heljakka & Ihamäki 2019a, Heljakka & Ihamäki 2019b, Ihamäki & Heljakka 2018b, Ihamäki & Heljakka 2018c) and social play (Tarpley 2001, Ihamäki & Heljakka 2018a). When robots are skillfully used by the teachers and aligned with the students' educational needs (Benitti 2012) benefits include positive achievement, as an increase in motivation for learning and improvement in collaborative learning (Spolaôr & Benitti 2017). Benefits for learning with robots have been reported to support of learning styles through play (Turkle 1990), especially when robots are applied to foster creative thinking and creative expression (Resnick 2006). As researchers have shown, robots are used as a learning tool in a variety of different school subjects. Successful examples of social robots that engage children and increase learning acquisitions are the Logo Turtle (Papert 1980), Curlybot (Frei et al. 2000), Robota (Billard 2003), Sphero (Rafferty et al. 2015), KIBO (Elkin et al. 2016), Shybo (Lupetti et al. 2017), Fisher-Price's Smart Toy Bear (Ihamäki & Heljakka 2018b), and Dash by Wonder Workshop (Heljakka & Ihamäki 2019b). These novel learning robot toys (that in many cases represent Internet of Toys, IoToys) have been supported by emerging theoretical frameworks, such as the *Digital Playful Learning Framework*, that intends to guide future social and emotional learning in association with technological objects that help in developing empathy skills. The area of study of Child-Robot Interaction has emerged, with an emphasis on understanding the types of characteristics that children find important in robots (Sciutti et al. 2014), and whether robots can serve as tutors, helping children learn classroom material (e.g. Wit et al. 2018, Kennedy et al. 2016).

Social robots are part of a trend toward personal embodied agents, computer technology embedded within forms that emulate biological entities like robotic pets Sony's AIBO, the seal robot Paro etc. Technology innovation and diffusion are making robotic animals more accessible to children. Social robots bring new opportunities for designers to rethink how children For example, in Japan, "robot-assisted activities" (RAA) and "robot- assisted therapy" (RAT) are used in pediatric hospitals and child clinical interventions (Yokoyama 2001). Social robots bring new opportunities for designers to rethink how children play socially and simultaneously, learn. The combination of play and learning demonstrates the potential of social robots in influencing scientific domains of knowledge – such as mathematics and languages – approachable for children (see e.g. Ihamäki & Heljakka 2018, Heljakka & Ihamäki 2019a, Heljakka & Ihamäki 2019b). With our studies, we contribute to this emerging field of Child-Robot Interaction by exploring preschool children's social and emotional learning, the balance between learner-centered and adult-directed activities, and the benefits of using a robot toy in studying preschool-aged children's firsthand emphatic responses.

2.3 Robot toys within Playful Learning

Robot toys are the most likely applications of social robots in the future (Druin 1998). Educational robots are being used extensively in preschools and schools, both in classrooms and in extracurricular activities. Many educational robots are designed as pre-assembled mobile robots, for example the Dash robot by Wonder Workshop (Melson et al. 2009). An earlier study by Friedman et al. (2003) found that among 34- to 74-month old children who had an initial 20 minutes play session with a robotic dog, 46% accorded biological properties, 66% mental sates, 76% social rapport and 63% moral standing. When Japanese and Swiss preschoolers (Yokoyama et al. 2004) interacted with a robotic dog for a 5-minute session weekly over 10 weeks, their behaviors included social bids, greetings, 'conversation' and affectionate touch (Melson et al. 2009). Movellan et al. (2009) present assessment of children's learning from a robot. In their study, toddlers aged 18-24 months interacted with a social robot, RUBI. The RUBI displayed images of four objects on a 12-inch touch screen located on its body and asked the child to touch one of the displayed objects (e.g., "Touch the yellow"). At pre-test, children's choices were little better than chance. Breazeal et al. (2016) studied RUBI over a 2- week period and they showed significant improvement on taught words, but no improvement on control words. These results demonstrate modest learning, but they cast no light on how RUBI was construed by children. Arguably, they conceptualized RUBI simply as a display screen with a recorded voice but not as an informative interlocutor whom they could question and learn from. Furthermore, Breazeal et al. (2016) have investigated how far children display to socially transmitted information when they interact with a robot rather than a human being. Their study shows that children readily treat anthropomorphic robots as social companions, for example, when robots interacted via gestures and utterances with visitors to a science museum, children and adults described them as interesting and friendly. In addition, children expressed an interest in museum exhibits after being led to them or having them explained by the robot (Shiomi et al. 2006). Moreover, Breazeal et al. (2016) discuss how children learned and maintained information from a robot and also whether they were more receptive if the robot display the attentiveness that usually characterized human conversation. With the framework of these studies, play has been brought into the center of the debate about education as a crucial aspect of human learning together with the importance of artefacts (Ackermann 2004). By playing, children have an opportunity to unconsciously learn those habits necessary for their intellectual growth (Bettelheim 1987).

Additionally, play also has the particular function of letting children deal with new objects and situations in a process that Piaget calls assimilation (Piaget 2013). Thus toys, daily life objects and the whole surrounding environment represent an expansion of the individual abilities for building knowledge (Ackermann 1996). Through the play with an artefact has the chance to become an "object-to- think-with", whether they are computers or tablets, robots or non-technological objects (Papert 1980). This practice-based, explorative, and intrinsically motivating (Malone & Lepper 1987), approach to education takes the name of *playful learning*. Following UNESCO, successful education requires new competencies from teachers to: a) structure the learning environment in new ways, b) merge new technology with a new pedagogy; and c) develop socially active classrooms by encouraging collaborative learning and group work (UNESCO, 2011). Again, the successful implementation of playful learning requires from teachers a readiness to improvise and take a playful stance (Nousiainen et al. 2018). According to Fisher et al. (2011) in playful learning, children that approach academic contents through free and guided play acquire greater cognitive and social skills than via traditional and direct instruction practices. Kangas (2017) sees playful learning as a key competence in teaching and learning. Kangas defines the goal of playful learning as follows: It is curriculum-based learning that is enriched with play, games and technological affordances. Playful learning is a mind-on, hands-on and body-on activity that is supposed to promote learners' key competencies for knowledge co-creation and finally, playful learning can be promoted at all school levels, from preschool to university studies (e.g. Hyvönen, 2008; Kangas, 2010; Kangas et al. 2011; Kangas et al. 2017, Kangas, 2017).

Playful learning challenges educators, teachers, researchers and designers to carry out projects and activities able to support playful experiences by enriching the environment with artefacts that provide experiential learning opportunities, and by supporting and guiding children in their exploration (Fisher et al. 2011). These theories demonstrate many opportunities, in which innovative educational activities, as well as artefacts can be explored. Thus, the implications of using a robot toy in facilitation of children's playful learning, were investigated through the empathy development of a novel robot dog Golden Pup. This robot dog gives the possibility of letting children construct their knowledge; the Golden Pup is designed to be used as a pet toy in imaginative playing as well as teaching of abstract concepts, such as identifying emotional intelligence. In fact, to play with the Golden Pup within in a group and in a social learning situation, children have to train social interaction (sharing the robot dog with other children), negotiation skills (through collaborative play) and emotional intelligence (to 'nurture' the robot dog, showing empathy skills both to the robot dog and their peers).

3. Interaction elements

To sustain playful, social and emotional interaction with children, the robot dog under investigation makes use of implicit interaction modalities, such as heartbeat and eye-and-head movements, to communicate with children. In this section, the interactive elements of the robot dog Golden Pup are described in more detail.

3.1 Shape, movements and sound reminding of real pets as imagination triggers

The robot dog—Golden Pup—has a shape that resembles a Golden retriever and when touching the toy robot, one can feel it is very soft fur, which associates with a real dog. The robot dog looks like a real dog and follows the sound and movements of the real dog (including heartbeat), but does not walk. Sound and movement were chosen as the main interaction modalities between the robot and children as this combination was recognized as one of the most efficient nonverbal multi-modal communication for non-anthropomorphic robots (Löffler et al. 2018). The Golden Pup's sound, moving eyes and head may be seen as an invitation both to interaction and imaginative play. For example, when the robot exhibits an introvert personality, it would use less sound and behaviors with smooth transitions between them; when exhibiting an extrovert personality the sound is more powerful and behavior would happen with more frequency and at faster speeds of transition (Alves-Oliveira et al. 2017). The Golden Pup interacts with children by making use of sound and making eye contact with blinking its eyes and creating different emotional expressions by using sounds that create the impression of so-called emotional intelligence.

3.2 Touch for shared control

Children are usually in full control of their toys. However, this is not the case when they interact with autonomous social robots and robot toys, as interactive technology performs actions that are not controllable by children due to their autonomous nature. During an interaction, this can lead to positive effects, such as engagement due to novelty, but according to previous research, can also create frustration and sometimes even fear in children, possibly leading to interaction breakdowns with robots (Serholt 2016). To address this aspect, Golden Pup moves by itself, but a player can control and turn off the robot dog (by turning a switch), which when played by children, gives the control to them, similarly to what occurs during interactions with their traditional toys. This is made possible by using capacitive touch sensors in the robot's 'skin'. When children touch the robot, the capacitive touch sensor is activated and the robot dog continues to mimic dog behavior. This shared control enables children to have the control they are used to with their traditional toys at certain levels of the interaction, and at the same time enables the robot to perform autonomously (Alves-Oliveira et al. 2017).

3.3 Motion-based play – nurturing

A study by Cooney et al. (2014) proposes that motion-based play with robots combines several ideas: 1) enjoyment can be provided via play, 2) play often involves moving an artifact and obtaining feedback from its motion, 3) people will move a small held humanoid robot, 4) such gestures can be detected by an inertial sensor inside the robot. Fasola and Mataric (2012) described enjoyable motion-based interactions involving a person exercising with an autonomous humanoid robot. Müller et al. (2011) present how flying robots with excellent mobility could provide enjoyment in ball games. Earlier research described several enjoyable motion-based haptic scenarios, but did not indicate how we could provide enjoyment in a playful interaction with a small humanoid robot when a person is free to choose how they wish to play. DiSalvo et al. (2003) have designed a teleoperated robot to transmit affectionate hugs to a remote person. Teh et al. have built a hug conveying system for the case of parents communicating with a child (Teh et al. 2008). In this case study, the robot toy under investigation, Golden Pup, has motion-based haptic features like heartbeat, a moving head, blinking eyes and sounds reminding of a real dog.

These features allow motion-based interaction and play for the children. Previously, motion-based play and learning has been used in “pet therapy”. A study by Chia & Li (2012) describes a Kinect application enabling touchless motion based interaction with virtual dolphins, and proposes a detailed questionnaire to measure the effects on the experience. Based on earlier studies of motion-based play concerning the promotion of engagement and the creation of a stronger affective experience, this type of play also assists in learning of emotional development processes.

4. Empathy Development – Social and Emotional Learning

Social learning includes learning by imitation, that is, learning through the observation of others’ behavior, and social facilitation, where others enhance the learning tasks. In a recent review of studies on social-emotional competence (SEC), the development of children’s social, emotional and behavioral skills have been linked to greater educational success, improvements in behavior, increased inclusions, improved learning, greater social cohesion and improvements in mental health (Weare & Gray 2003, Lancaster et al. 2004).

As Internet-related technologies are still young, we still need to be aware of that children who are raised interacting regularly in virtual worlds and playing with smart toys will develop empathy in a different manner than other generations (Walker & Weidenbenner 2019). Empathy development, from growth to internationalization, is a complex process that begins in early childhood. Empathy describes an individual’s “ability to understand and feel the other” (Dvash and Shamay-Tsoory 2014, 282).

As we see children grow and observe the world, and learn from interactions with others, caregivers play a critical role in helping children make to understanding others’ distress. Empathy development places significant cognitive demands, when children do not fully develop their perspective-taking abilities until they have the ability to think abstractly (around age 12). In fact, empathy expands on the understanding other’s mental sates, or “mentalizing” (Frith, 1999), encompassing the emotional aspect of other’s experiences (Dvas and Shamay-Tsoory, 2014). Dvas and Shamay-Tsoory (2014) have concluded that “empathy is the link between knowing the thoughts and feelings of others, experiencing them, and responding to others in caring, supportive ways”. More specifically, to understanding self and others’ mental states and is at the root of empathy (Ibid.). Therefore, social and emotional development cannot occur without the development of cognitive skills (Walker & Weidenbenner 2019). During the past 10 years researchers have identified a number of social skills that robots ought to be provided with. These include the ability to recognize others, to interpret gestures and verbal expressions, to recognize and to express emotions (Dautenhahn 1995).

5. Methodology

This tentative study uses a mixed-method approach combining a play-test with focus group interview with preschool-aged children. In our research, we have conducted a play test with a group consisting of preschool aged children (n=7). In Finland, this means age groups: for preschool children ages 5-6 years.

Focus group interview and play test: Guided play with a Robot Dog

We invited preschool children aged 5–6 years to join a play session, in which they were first asked to their own chosen plush toy and later the robot dog Golden Pup. Participants had the possibility to discuss and play together with the Golden Pup, while one researcher acted as facilitator, and the other researcher made observations, and a third person video recorded the session. The observer kept in the background but joined the conversation when it felt natural. While the children interacted with the robot dog, their teachers were supervising the situation, but did not contribute to the collecting of data by asking specific questions or such.

In the play session children were asked to present their plush toys (which they had brought with them to the play-test from their homes) their possible real pets (if they have any) or their most memorable experiences of pets in the home environment in general. Children were later introduced to the Golden Pup, proposed to play with the robot dog and finally, to share their experiences of this toy in a group interview. Before the participants were allowed to play with the Golden Pup, they were asked about their general experiences with domestic animals, both in the past and in the present. Our approach was to interfere as little as possible in these engagements.

The children were given an opportunity to exploratory play with the unfamiliar robot dog, in which all 7 preschool-children first engaged with the robot dog together, then playing with it one by one. Children's opinions of playing with the robot dog were assessed via several different measures. Finally, children's gaze behavior during the interactions with the robots was video-recorded and analyzed.

The study was designed to examine two questions: First, we asked if young children are willing to learn social skills (sharing of the robot toy with other participants and playing together with it) and empathy (negotiate with other preschoolers about nurturing for the robot dog). Second, we asked, how children will play with this robot dog alone or a group with preschool friends. To answer this question, we observed how children were playing with the robot dog and how they shared their experiences with others.

6. Results

Focus play-tests and group interview analysis: *Findings of the test-playing session*

In this study, we introduced 7 preschool-aged children ages 5-6 to a robot dog, Golden Pup. The participants engaged with the toy robot in a focus play-test and group interview situation for 60 minutes in the context of Finnish preschool. This section describes the key findings from the firsthand results of our study.

Before introducing the Golden Pup, the preschoolers were given the possibility to present the plush toy animals they had brought with them; which kind of animals they are, what their names are, and how the children usually play with the toys at home. All of the toys had the appearance of known animals (if extinct, as in the case of a dinosaur), such as a squirrel, dogs and (teddy)bears. Generally, most of the children reported to use the plush toys as companions, which are brought to bed.

Then we asked the children about their own live-pets and most memorable aspects of their experiences with these domestic animals. Only two of the children reported to have either a dog or cats at their home. In this way, considering the children, the ones who currently have pets as family members, were the minority. The preschool-children reported in generally to have had good relations to their pets, playing with them and treating them as companions. When the group was introduced with the Golden Pup, the preschoolers responded with interest and excitement. First, the preschoolers gathered on the floor to each take their turn to interact with the Golden Pup. The robot dog simulates a real dog's heartbeat, eye movements, head movements and dog voices, which make robot dog very realistic. In our study, one of the child participants even asked: "Is it a real dog?"

Based on the findings of this study, the response of preschoolers aged 5-6 years was as emphathetic to the robot dog: The Golden Pup was considered "cute" and open for playful engagement: All of the participants wished to engage with the robot dog by touching and "petting" it, holding it in their hands and talking to it. According to our findings, then, *there are three facets of interaction that effect the social and emotional learning with a robot dog like Golden Pup*, as demonstrated with earlier research on social robots:

1) The shape, movement and sound as reminding of a real dog trigger the imagination of the players by adding experiences of its 'realness': The preschoolers envisioned, how they would play with the robot dog as if it was a real dog (although it does not walk). Due to sensors, movement and touch of the players engaging with the toy allow shared control of the robot dog, which makes it especially suitable for social play. (*Haptic/object play, social play*)

2) Again, motion-based play gave the players a chance to physically move, and by their own movement, also make contact with the robot dog individually, showing that each individual's interaction with the robot, has an effect on how the robot dog responds, showing the capacity of the toy robot to be used as a part of satisfactory solitary play as well. (*Mobile play, solitary play*)

3) Above all, the realistic appearance, which at the same time was considered "cute" (aesthetics), together with the gentle sounds, seemed to attract the preschoolers the most. (*Auditive play, solitary and social play*)

With these findings in mind, the authors believe that a robot dog like Golden Pup could well be introduced to the early education context as a pet-substitute in (emotional and social learning) situations where caring for a real pet (dog) would not be possible, and where the goal is to learn about empathic responses of others towards a companion robot and other players.

7. Conclusions

Currently, the technological aspect of contemporary toys is becoming a more normalized part of the toy design process as character toys such as animal companions are becoming increasingly digitalized and computerized. Educational robot pets are expected to facilitate children's learning and they may improve their literacy and creativity (Serholt et al. 2016). For example, an educational robot-based playful learning system can improve motivation and interest in learning empathy by expressing simulated emotions. Therefore, it is of crucial importance to investigate the interaction of children with these technologically-enhanced toys, to know how they respond to the toys and, which kind of experiences these toys may offer, for example, in terms of playful learning.

The purpose of the study was to investigate preschool-children's first-hand responses to a dog robot introduced in a setting allowing Child-Robot Interaction. We choose the play test with focus group interview as key action, because play is useful to investigate as people of all ages engage in such behavior (Ellis 1973).

Our investigation began with the presumption that motion-based play is a way of teaching prosocial behavior by using robot dogs as a learning tool. According to our findings, the movement of the robot dog makes it very true compared to a live canine. Therefore, we believe, that the 'liveliness' of the robot dog makes it a great tool in learning of empathy skills related to interaction with living beings. The movements of Golden Pup also made it interesting in terms of social play (sharing of the toy in play)—in a group situation the sensors of the toy directed its 'interest' towards a specific player, and the preschoolers needed to take turns to interact with the robot toy.

The tentative results show, how the key dimensions of the Golden Pup were its welcoming appearance (aesthetics, soundscape and gentle movement) that attracted the children. When asked, preschoolers reported to be mainly interested in interacting with the toy through engagements demonstrating activities that would be carried out with a normal pet—engaging with it in the name of *mobile play*; taking it outdoors, giving it toys, playing 'house' with it and generally, treating the toy robot as a furry friend and companion.

As the results of our firsthand analysis of the play-test conducted illustrate, a robot dog like the Golden Pup is suitable to be used as a part of a guided play session. Furthermore, the robot dog seems to facilitate emotional learning as well: According to the responses shown by the preschoolers who joined our study, it could be a potentially valuable tool to be used in playful learning interested in teaching about the importance of empathy and social sharing as key facets of interaction between actual living beings.

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