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# Boosting Children’s Creativity through Creative Interactions with Social Robots

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**Abstract**—Creativity is one of the most important and pervasive of all human abilities. However, it seems to decline during school age years, in a phenomenon entitled “creative crisis”. As developed societies are shifting from an *industrialized economy* to a *creative economy*, there is a need to support creative abilities through life. With this work, we aim to use social robots as boosters for creative-driven behaviors with children.

## I. INTRODUCTION

Creativity has been defined as the “*interaction among aptitude, process, and environment, by which an individual or a group produces a perceptible product that is both novel and useful, within the social context*” [1], and has mainly been studied within human-human interactions. Technological advances however, have gained attention in the past years and the development of futuristic technologies - such as robots - is at full speed. Although nowadays robots are being developed as tools for educational, entertainment, and assistive settings, this type of technology holds promise to be included in broader situations, namely as tools to boost creative-driven behaviors. In this research, we aim to study if this type of technology can have positive effects on children’s creativity.

Creative abilities seem to benefit children’s thinking styles, problem solving, and perseverance when facing obstacles. Although schools are potentially rich environments to foster children’s creativity, research suggests that creativity tends to decline during school-age years - starting at elementary school a phenomenon entitled as “*creativity crisis*” [2]. As most of the developed countries have shifted from an *industrial economy* to a *creative* or *knowledge economy* [3], there is a clear requirement from schools to meet this need. However, most of the current systems of education are still driven by an economic imperative built upon the design of factory lines and standardization, somehow daunting children’s creativity [4]. Our research envisions social robots as a type of technology that goes beyond responding to human needs, to become a tool that can be used to boost creativity.

## II. PRIOR WORK

Creativity seems to portray benefits in cognitive abilities and well-being. Moreover, the controversies on how to develop and nurture creativity has lead to the distinction of many creative techniques (e.g., divergent thinking and problem solving [5]). Thus, research has applied these techniques in activities with

children, using, e.g., storyline and associations pyramid as didactic methods to enhance their creative abilities [6]. In Human-Robot Interaction (HRI) field, it has been studied if children can catch curiosity (an essential creative trait) from a robot [7]. Also, designing and creating robots that can integrate artistic-creative settings has been incorporated in HRI studies from early on. Hence, knowledge from acting theater has been a source of inspiration for the creation of natural behaviors between humans and robots [8], [9]. While there are robots that were developed to become actor performers on stage [10], others have been developed to perform jazz improvisation, leading to novel music outcomes [11]. In our research we aim to extended this line of research by leveraging on the notion of *social creativity* (rather than individual creativity) to develop child-robot interactions (cHRI) aligned to influence creative-driven behaviors.

## III. METHODOLOGY DESIGN

To meet the proposed goals for the study of creativity in cHRI, a *three-stage methodology* was designed as follows:

### A. Research Stage I: Initial User Studies

In the first stage we will conduct initial user studies to analyze what encompasses the holistic experience of interacting with a robot to achieve creative outcomes. Firstly, we performed an initial study with children to analyze how their creative process develops (see section IV.A.). Secondly, we conducted interviews with professional artists targeting social creations techniques included in their work (see section IV.B.). We then intend to create a set of activities that are technically feasible to perform with a robot and afterwards, evaluate how children interact in the proposed task, what are the outcomes, and what should be redesigned in the activity. The goal will be to have an open-ended activity, i.e., an activity that will have an unknown final product to accommodate the emergence of the creative process of children.

### B. Research Stage II: Main Studies

After the iterative process of developing the robot and the activity, we will evaluate how creativity develops in cHRI. The intervention will be performed in schools during a period of 2 months in which groups of children will have weekly sessions with an autonomous social robot. During the time they

spend together, they will work on the creative project and the role of the robot will be to introduce elements that influence creativity (e.g., divergent thinking [12]). The goals of this study is two-fold: 1) analyze if children's cognitive abilities and motivation can be predictors of their creativity. For this, we will measure children's cognitive abilities, intrinsic motivation, and creativity, with validated measures from psychology (e.g., Torrance Test of Creative Thinking [13]); 2) explore the robot's behaviors and interaction styles that foster children's creativity. For this, we will show the creative products made by different groups of children while interacting with the robot to a panel of external judges that will evaluate them using the Consensual Assessment Technique [14]. The study will be a between-subjects design and will include conditions that enable to compare the outcomes (creative products) of the cHRI. We will also evaluate the creative process of cHRI using qualitative methods, such as behavior observation and analysis.

### C. Research Stage III: Initial Framework for Creative cHRI

The last stage of this work aims at delivering the requirements for the behavior and interaction style of the robot that boost creativity in children. We will do this by combining established theoretical knowledge on creativity - such as the framework of social creativity [14] - with knowledge gathered from the performed studies. As such, our goal is to deliver an initial framework that conveys understandings on the social creative process that emerges between humans and robots.

## IV. INITIAL USER STUDIES

The user studies conducted so far are summarized below.

### A. Puppeteering Study

The goal of this study was to understand the creative stages that children undergo when performing a creative project with a puppet (aimed to inspire the creation of the robot in the future). Thus, four children (age 8) interacted with a puppet controlled by an adult and were instructed by the researcher to create a theatre piece together. The study took place in a classroom of a primary school in Portugal and there was two children per session. During the interaction, children underwent several creative stages and the puppet supported their creations by guiding children with elements that are usually present in a theatre piece (e.g., characters, action, and environment). We concluded that sometimes children require assistance (e.g., when they lack of imagination), and other times they have the autonomy to proceed with the task without the support from the puppet.

### B. Interviews to Professional Artists

The goal of the interviews was to gather insights from professional artists that work with children and that use improvisation techniques as part of their socially-creative work. For this, two professionals from different artistic schools were chosen: one is a professional ballerina and the other a drama teacher and theater performer. During the individual interviews the two artists expressed some of the underlying

mechanisms of collaborative creations, emphasizing the importance of group cohesion as an enabler of the creative flow. They also mentioned the importance of *technique as structure* for creative-driven behaviors. As such, one needs to detain technical knowledge (rules and limits) to understand where lies the "open space" for creations.

## V. CONTRIBUTION AND IMPACT

This research introduces a novel application for robots as boosters in creative activities with children. To research this we rely on established theories of creativity and initial studies. This topic constitutes a novel application for HRI with impact in many different fields. As such, our work will contribute to a theoretical framework for creative cHRI and it aims to have impact on several communities, namely the educational community, by bridging the needs of a creative society in the core place where minds start to grow: the schools.

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