From Parents to Mentors: Parent-Child Interaction in Co-Making Activities

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Abstract
Making activities for children often take place at informal learning environments. In this context parents may join their children for co-making activity. It has been shown that this type of activity can be facilitated by educators that serve as mentors. In this paper we aim to explore parent-child interaction in the context of a co-making activity at home. Towards that end, we developed a dedicated kit that couples Automata-building with paper circuits. We also designed five activity cards as scaffolding for parents, to raise their awareness to mentoring principles. We present our design process, evaluation, and findings from eight parent-child co-making activities. Our qualitative analysis indicates the challenges and opportunities for parents as mentors in a co-making activity. We propose a two-dimensional scale that can help designers and maker-space practitioners better understand the different parental roles during a parent-child co-making activities, and the need for better tools and support materials for parents in that context.

Author Keywords
Children; Parents; Making; Scaffolding

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K.3.1 [Computers and Education]: Computer Uses in Education-Collaborative learning

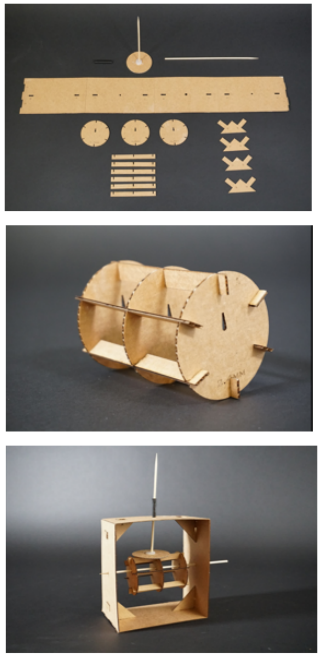

Figure 1: Top: Automata template. Middle: cylinder. Bottom: Automata.

Introduction

Maker spaces and the maker revolution in general are on the rise, with focused attention on children in both formal and informal learning environments. Mentoring is a common practice in these activities, particularly within informal learning contexts [7]. Bar-El et al. [1], reported on the Maketec maker space for children, in which teens serve as mentors who guide children in various making activities. In the Maketec, the mentors' responsibility is not to teach, but rather to support children's intrinsic motivation to create, and offer assistance when the kids encounter hurdles in the making process. By providing teen-mentors a set of skills to help them overcome upcoming challenges during the mentoring role, they showed how valuable and meaningful a good mentor can be [1]. We believe that parents have the potential to fulfill this important role in a family activity context.

In recent years, traditional family roles as expert-novice have shifted, since children are commonly exposed to various technologies and develop expertise that their parents do not master. Roque [8, 9] and Correa [4], noted that these shifts may leave parents wondering what role they can play in supporting their child's learning process. Parent-child co-making activities hold a unique opportunity for parents to find a role in supporting their childs' learning process.

Our goal is to create an intervention that would assist parents in defining their role during a co-making activity at home. Parent-child co-making activities have great potential for both parents and children in two aspects: (1) both parties are introduced to computational thinking skills, which is a creative process that includes iteration, deconstructing, debugging, and generalizations through patterns [7]; (2) the activity may serve as a platform for strengthening parent-child connection. Hence, in this preliminary work we set out to explore the parent-child interaction in the context of a co-making activity at home. We wish to generate insights that can inform researchers, designers, and educators regarding the factors that influence parent-child interaction, as a starting point for design and implementation of relevant technologies. We present our design research based on co-making activity and a set of activity cards intended to increase parents' awareness to the mentor's guiding principles. We report on our findings of parent-child interaction patterns in co-making activities at home, and propose a two-dimensional scale based on three emerging themes we identified, that can help describe the parent's role in the interaction.

Related Work

Our work is influenced by three domains: parent-child co-making activities, activity cards as an empowering tool for awareness, and scaffolding.

Parent-child co-making activities:
Roque [8] [9] et al., reported that mutual making activities are promising for parent-child interaction. They showed that this type of activity was as much about building relationships as it was about building projects [8] [9]. However, it has been noted that explicit reminders regarding the goal of the activity are required during parent-child interaction [9, 12]. A possible implementation may be designing environments that invite parents to learn their diverse potential roles and integrate explicit reminders of these roles during mutual parent-child activities [9, 10].

Activity cards as an empowering tool for awareness:
Many previous researchers have used physical cards as tools to assist learning and design processes, or as a source of inspiration. Deng, Antle and Neustaedter presented

Mentoring Principles
The Silent Attentive Expert: do not directly solve problems but patiently listen and strive to help children solve challenges by themselves, with gentle suggestions that hint at the solution indirectly.

Pleasantly Frustrating: guide children how do deconstruct complex challenges into small manageable steps, striving to transform frustration into a pleasant challenge.

The Empathic Partner: show empathy to the child, use positive feedback and encouragements along the way, especially when the child faces or completes a challenge.

An Active Passive Presence: create an atmosphere that empowers the child to ask for support when needed, rather than the mentor initiating it.

Meaningful Inspirations: encourage children to let their personal interests and hobbies influence their work.

TANGO cards [5], a design tool facilitating communication and shared understanding. Friedman and Hendry designed the Envisioning Cards [6], a toolkit for inducing human values during a design process.

Scaffolding:
Scaffolding is defined as adjusting the learning process, progress, and its content to a child's specific needs, abilities, and interests. This is a major difficulty educators face, since it requires previous acquaintance and personal attention to every individual child [10]. Scaffolding is based on Vygotsky's [11] classic Zone of Proximal Development ("ZPD"), defined as the greater achievement a learner can achieve with the help of another person that he would otherwise be unable to achieve by himself [11].

Design research

In this section, we present our design research process including the kit we created for the parent-child activity as well as the Parent Mentoring Cards (PMC) that were designed as a physical reminder to raise parents' awareness to the mentoring role.

The kit
We designed a step-by-step co-making activity focusing on entry-level making that includes mechanisms and electronics. Each domain has its specific instruction cards - Kit Building Cards (KBC). The mechanical kit is the Automata, a three-dimensional structure that exhibits motion or behavior [2]. We designed an Automata that integrates movement on two different axes: horizontal and vertical (see Figure 1). The electronic kit is paper circuit, made of a 3-Volt battery, LED, and a copper coil with a sticky side to glue onto surfaces.

The Parent Mentoring Cards (PMC):
We were inspired by prior work of Friedman et al. [6] and Deng et al. [5] and adopted some design principles from both. From Friedman's Envisioning Cards [6] we adopted the use of images related to the content of the cards. The images seek to evoke the diversity, complexity, and subtlety of human affairs. In particular, we chose pictures that might evoke relatedness between the content of the card and the image. From Deng's Tango Cards [5] we adopted four elements: title, rationale, design consideration, and textual example (See Figure 2). We focused on five mentoring principles used successfully in the Maketec maker-space [1]. Some principles have ambiguous titles, as they aim to describe the ambiguous and challenging role a mentor has during co-making activities (See side bar).

Method and procedure

Eight families with children 8-12 year old (5 males, 3 females) participated in the study. Participants were recruited through personal acquaintance. The sessions were held for approximately 90 minutes in the participant's home, usually in the living room. In each session, the researcher observed the parent-child interaction by sitting behind them and taking notes. The activity was introduced to the participants as a mutual activity around two domains: mechanics and electronics.

When handing the PMC, we aimed at finding the balance between controlling PMC order between families, PMC relevance to the interaction and having the smallest impact on the natural parent-child interaction. However, in order to avoid order influences, greater weight was given to handing specific PMC in constant stages of the activity. Apart from that, the researcher's decision when to hand the next PMC within the specific stage was guided by one factor: to minimize distraction to the natural dynamics between par-

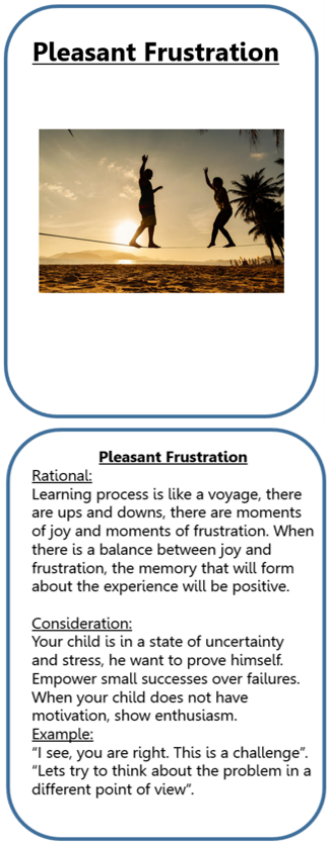

Figure 2: An example for one of the PMC. Top: Image related to the content of the card, highlighting a pleasant experience that inherently involves some frustration. Bottom: Title, rationale, consideration, and textual examples.

ent and child. After the parent-child team completed the Automata and the paper circuit tasks, they were asked to configure the paper circuit on top of the Automata in order to complete a sensor that turns the paper circuit LED on, in sync with the Automata movement.

Findings

We followed Grounded Theory methods [3] and used our observational notes to analyze the qualitative data (parent and child quotes and the various observed behaviors). We conducted a brief analysis of the first session, detected five emerging themes from the parent-child interaction and agreed on a coding scheme for the first four sessions, according to the "initial codes" methodology [3]. The initial codes were: initiative, process management, feedback, attention, and interaction. Following completion of the first four sessions, we identified repeating topics in our themes, and merged the five themes into three leading ones: initiative, attention, and interaction. After forming these three themes we continued with four additional co-making sessions as a theoretical sample to gather more data and verify our consolidated themes, as recommended by Charmaz [3]. We present a sample of our qualitative data below, with four representative "scenes" of parent-child interaction, including our analysis.

Scene 1 - mother is a product manager, has three children, co-making activity with her 9-year-old son:
Mother and child are at the 3rd stage of the Automata building activity when they realize they need to insert the triangle corner to the frame of the Automata. The child struggles to insert the triangle corners to the frame of the Automata.

Child :"Mom, how do I do it?"

Mother: "Look, I'll do it and show you how it's done, and then you will do the rest".

The mother showed **high attention** to the child; she responded to his struggle. She also showed **high initiative**, since she chose to insert the triangle corners herself. She did not ask him any guiding questions or encouraged him to solve the problem by himself. However, she encouraged him to connect the rest of the triangle corners after she showed him how to do it - **positive interaction.**

Scene 2 - mother is a teacher, has three children, co-making activity with her 9-year-old daughter:
Mother and child are at the 5th stage of the Automata building activity as they attempt to glue the triangle corners of the Automata and construct the frame. The child has difficulties in gluing the triangle corners and she realizes that the frame is unstable:

Child: "It's hard, it's almost falling apart". The mother does not respond.

Child: "Oh no, mom, it's not stable". The mother does not respond, she gazes at the instruction cards.

Eventually, the frame is stabled.

Mother: "Very good! You made it".

The mother showed **low attention** to the child, she did not respond in any form, explicit or implicit, to the child's struggles and explicit continuous requests for help.

Scene 3 - mother works in marketing, co-making activity with her 9-year-old son:
Mother and child are at the 12th stage of the Automata building activity as they realize that they need to cut the straw in order to stabilize it on the inner side of the Automata's frame:

Mother: "Go bring the scissors".

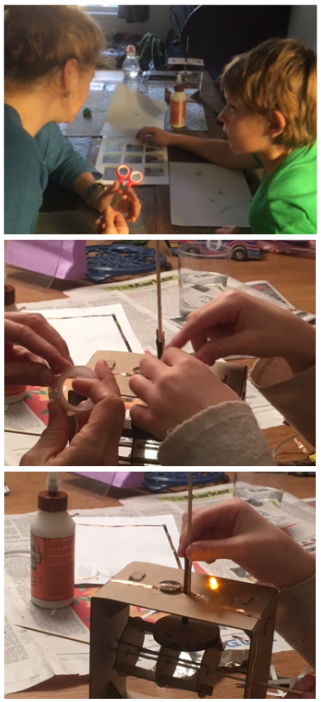

Figure 3: Parent-child co-making activity

Child: ”I’ll cut it with my hands”.

Mother: ”Ok...try it...”. After several minutes, during which the child failed to cut the straw with his hands or teeth, he brings the scissors.

Mother (while the child is cutting the straw with the scissors): ”You wasted a lot of time because you didn’t bring the scissors”.

The Mother showed **high attention** to the child and the activity, but she also showed **high initiative** by telling the child what to do. The child refused to listen to the mother and insisted to cut the straw with his teeth. After several minutes, when he realized that it is ineffective, he brought scissors and cut the straw with them. While he cut the straw the mother teased him and added an element of time pressure - **negative interaction**.

Scene 4 - mother is an architect, has two children, co-making activity with her 10-year-old son:
Mother and child are at the beginning of the 7th stage of the Automata building activity when the child realizes that he did not glue all the triangle corners to the Automata facing in the same direction, which is not critical:

Child: ”Oh no, I glued it in the wrong direction”.

Mother: ”Do you think it is a problem?”

Child: ”Yes”.

Mother: ”Then what should we do?”

Child: ”Disassemble it and glue it again”.

Mother: ”Do you think it is critical?”

Child: ”Yes”.

Mother: ”OK, then go for it”.

The mother showed **high attention** to the child as she responded to his difficulties by asking guiding questions. She also showed **low initiative** since she let the child disassemble the frame despite knowing that it is not critical and that it might defect the frame and delay the progress of the activity. When she realized that the child is holding his ground, she encouraged him to do what he thought was right, an example of **positive interaction.**

Discussion

We aimed at exploring parent-child interaction during a co-making activity, while increasing parents’ awareness towards mentoring guiding principles. Based on our qualitative findings, we present a two-dimensional scale showing both the challenge and potential in parent-child interaction during a co-making activity (see Figure 4).

As we showed in our findings, attention is a prerequisite for any successful parent-child co-making activity. The parent must be attentive to the child and to the activity. While a parent is attentive in the activity, he or she can take a meaningful role on a spectrum between ‘a peer parent‘ and ‘a mentor parent‘. The main motivation of a peer-parent is to complete the activity successfully and efficiently, by leading the activity or following the child’s lead. Peer interaction can include both negative or positive interactions, according to the team’s personal dynamics. In contrast, a mentor-parent is focused on the child‘s learning process, not the successful completion of the activity. He or she will never lead directly, but will always follow the child’s lead with positive encouragements, promoting exploration and "pleasant frustration". While the shift of the parents role to mentoring is clearly desirable, our analysis suggests that it is important for parents to find the right balance between

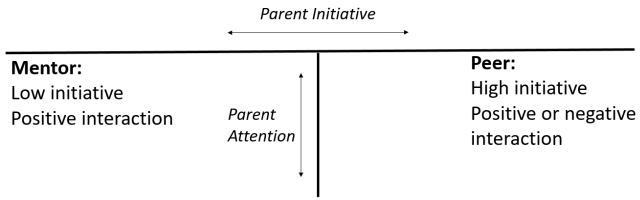

Figure 4: The parent-as-mentor scale

mentor and peer. Shifting roles in the process of an activity enables leveraging the strengths of each role at the right time. Hence, parents can adapt their role according to their child's needs and abilities. Future work should focus on two main question raised in this paper: (1) How to design environments that expose parents to their diverse potential roles? (2) How to assists parents in shifting their roles along the co-making activity, according to their childs' needs?

Our findings and scale can help designers and makerspace practitioners better understand the different parental roles during parent-child co-making activities. Creating opportunities for parents and children to create together is not enough. New technologies, tools, aids, and support materials must be designed and implemented to assist parents in (1) becoming more aware of their natural role vs. their desired role, and (2) learning new tools and strategies to better scaffold their child's learning process.

Limitations

As a Work in Progress paper, our research has several limitations, including the small number of participants and potential bias of the researcher handing the Parent Mentoring Cards.

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