The future of interface design, through a child's eyes

Hayes Raffle
Tangible Media Group
MIT Media Lab
77 Massachusetts Ave.
Cambridge, MA 02139, USA
hayes@media.mit.edu

Abstract
One way to try to predict the future of UI design is to look at the new ways children are doing design today. There is strong evidence that education in the 19th century shaped the arts and design of the 20th century, and I believe that today's pedagogy that uses computers will be a cornerstone in future applications of interactive systems. When we consider UI design, we are thinking of the computer as a design tool, and I will approach the future of UI design with a brief overview some trends that present computerized systems and tools to encourage children to be designers.

Introduction
Kindergarten was invented by Frederick Froebel in the 1830's, a crystallographer heavily influenced by Pestalozzi and Goethe. His educational philosophy emphasized unity in the natural world and fostered an understanding of one's role in society and nature. His pedagogy used activities and specialized objects called "gifts and occupations" (figure 2) to explore relationships between divergent natural phenomena [2].

Many of the greatest artists and designers of the 20th century were among the original Kindergartners. Klee, Kandinsky, Mondrian, Braque, Frank Lloyd Wright, Buckminster Fuller, Le Corbusier, Mies van der Rohe and Gropius all either taught kindergarten or were students of kindergarten. We find that some of their mature work was almost identical and untransformed from the exercises, strong evidence that their early learning shaped later aesthetic practices. The Bauhaus and the Modernist movement, cornerstones in 20th century art and design, were directly informed by Kindergarten. These movements later helped inform the development of UI design when researchers sought to make interfaces that lay people and professionals could use for art and design practices.

Our next generation of designers will be influenced by the technologies they have today, and by design-oriented interfaces that are currently being developed in both research and industry.

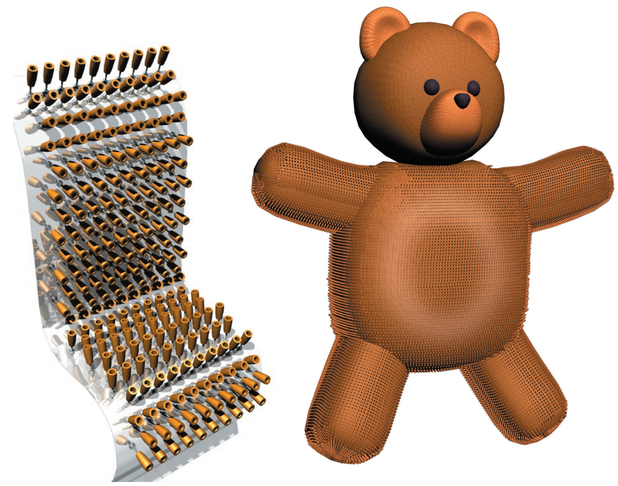

Figure 1. Super Cilia Skin conceptual rendering. A material with kinetic memory could someday be used to design children's toys to engage emotions and support learning.

Child as programmer
In the 1970's Seymour Papert, a student of Piaget, argued that children learned best when they were actively designing things. He viewed the computer as a tool for children to understand how they think and how the world around them works, and invented the LOGO programming language for kids to create computer programs to do things like play music and draw pictures [8]. His work influenced mainstream education at led to the LEGO Mindstorms products, which were based on LEGO/LOGO research at the MIT Media Lab. This work generally used the dominant UI of the day, from command line interfaces to contemporary GUIs with drag and drop iconic programming languages. One goal is to help kids think in terms of systems concepts, and to test ideas through active construction of models. In the case of LEGO/LOGO, physical models are created with LEGO and computational models are created with a GUI and downloaded into the toy [14].

This work was part of a larger effort to create "digital manipulatives" that embed computation into familiar children's toys. The idea is that computers can make ideas about feedback and emergence more salient to kids, and the UI shifted towards making the physical toy a greater part of the "interface" [14].

Tangibles and learning

Tangible Interfaces assume that the physical object should be the primary interface to the program structure and behavior [6]. Where digital manipulative and tangibles intersect we find specialized programming paradigms that are developed to make a specific set of ideas accessible to children. Many of these projects build on classic play patterns, and use interactivity to allow children to design different kinds of dynamic systems.

For example, "flow blocks" and "system blocks" can be physically connected and adjusted to create different dynamic patterns of light and sound. They are somewhere between a marble chute building toy and real dynamic modeling, where kids can explore some of the effects of feedback and cyclic behavior in flow-based systems. Physical models are built, parameters are adjusted and the behavior is observed to change in different ways [17].

Other projects have used organization of blocks to represent program structure. For example, Wyeth's blocks allowed young children to construct logical models and see their models respond to conditional and feedback behaviors [16].

Record and play has been explored in different ways to explore different modalities, including sight, touch, and sound. Since this programming model has been argued to facilitate computational design for young children, I will briefly overview some projects that use record and play.

Sound: Tell Tale was a caterpillar whose body segments could record different audio clips. When arranged in different sequences, a story could be played different ways [1]. Storymat [3] recorded children's spoken stories as dolls were moved around on a special mat that could record their position. When dolls revisited those areas later, the stories would play back. Where one project used physical construction, the other used spatial mapping for recordings.

Figure 2. The original kindergarten "gifts" emphasized design using geometry and craft techniques.

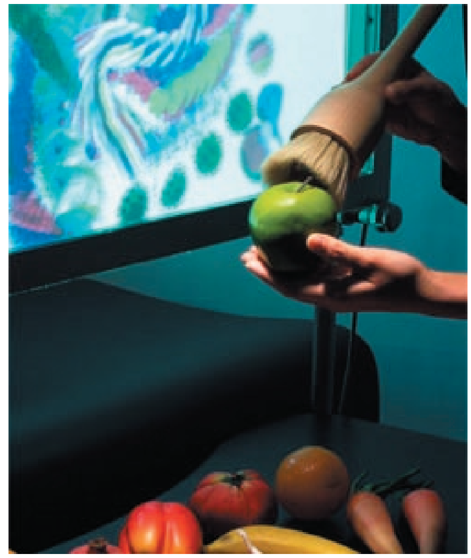

Figure 3. With IO Brush, children can paint with the color and movement of any object.

Light and sound: IO Brush (figure 3) is a paintbrush with an embedded video camera that can record still or video images and sound, and paint the images and sound onto a large plasma display. Children can create paintings with familiar colors from the environment, make animations, or hide stories in a painting that are released when a child touches different parts of the painting [15].

Movement: Curlybot is a small object that can record a playback its movements on a table top. Children used curlybot to tell stories, or explore geometry with the toy's looping playback [5].

Movement and form: Topobo (figure 4) is a constructive assembly system, also with kinetic memory, that children can use to build and animate different kinds of creatures. For instance, a child can make a moose and teach it to walk by twisting its body around. The moose will then walk on its own. The same way kids learn about buildings by playing with blocks, they can learn about animal locomotion by playing with Topobo [12]. The creators of Topobo also developed different tangible interfaces to modulate recordings, as well as to sample and sequence playback motions.

Touch and sight: Super Cilia Skin (figure 1) is a textural interface that can record and playback the movements of an array of hair-like actuators. The designers proposed that a kinesthetic fabric could be used in children's plush toys as an interface to computational behavior. The argument was that the subtle, organic qualities of textiles were the qualities that helped children form personal emotional connections to the objects that are an important part of their development, and that an interface designed to emphasize these qualities could allow young children to form such connections with an interactive system [13].

Sight: Moovl is a web applet that allows children to use a GUI to draw and animate their drawings. Animation uses a record and play paradigm, where drawings are animated based on gestural paths that the user inputs. Moovl was designed to be used with a tablet PC, and although it is not a tangible UI, in this way is more like drawing than "using a computer" (GUI) [9].

While there seems to be a "record and play" trend among some design tools, there may also be potential for this approach to enhance computational sports. Exertion Interfaces argued that UI designs that promote physical activity support social relationships [10]. AR approaches to games like "Can You See Me Now," where people simultaneously play a game either at web terminals, or running around with handhelds and GPS units, also use physical activity as input [4]. Similarly, Dance Dance Revolution requires and promotes dancing as input and play pattern. Although all of these projects have different "interface designs," the trends towards physicality and tangible UIs may lead towards more specialized multi-modal interfaces that blend ideas from gestural, pen, tangible and graphical interfaces.

Consumer electronics and commercial toys

Consumer electronics like cell phones, mp3 players and video game systems present the dominant UIs that children use today. These devices do not generally encourage children to be designers, with the exception of things like text messaging and digital photography. Although the toy industry has not adjusted to this shift in children's play patterns, designers have introduced several educational toys that use less expensive sensing and embedded technologies to build on more traditional play and learning patterns.

Leap Frog is one of the most creative mass-market educational toy companies, who made a name for themselves creating talking toys that could teach young kids phonics. On a talking bus, pressing a letter A on the side of the bus would sound out the letter A, make an animal in the bus sing and dance, and use the letter A in a word. Later, Leap Frog developed a talking book called the Leap Pad with interchangeable paper booklets and ROM cartridges. When a child touches different parts of the printed page (either with a special pen or finger), the book will sing or talk to the user. It can sound out words, identify letters, or teach you geography. Most of their products are display only (i.e. a "touch and hear" paradigm), although the recently introduced the "Fly pen computer" uses Anoto pen technology to encourage children to create their own content. This limited form of pen computing seems most compelling with the pre-scripted games, or in more open-

Figure 4. This walking Topobo moose was designed by two eighth grade girls.

ended writing exercises that encourage creative writing and give some feedback and structure to the activity [7].

Neurosmith [11] has introduced a number of good toys that use a variety of interfaces design approaches including gestural and tangible. Most of their toys encourage physical activity, use music as content and display, and some use tangible manipulations of objects to emphasize sequencing and concepts of parallel/serial organization and nesting. They use sound as a primary display, often coupled with physical organization of toys, or gesture. One thing their toys make clear is that limited interfaces are best for children; when a child cannot be successful if they forget a piece of hidden information, the toy will be frustrating. UI designs are best kept simple and tailored for specific activities and types of design. Although the GUI (with its all-purpose keyboard and mouse) challenges this idea, simplicity and specificity are fundamental in disciplines like product design, may become a dominant design goal in tomorrow's UI designs.

Looking forward:

In today's toys, we find a variety of interfaces, including gestural, graphical, tangible, voice, record and play. They all seem to work well in different situations, and don't conflict when different techniques are used to engage different senses, leading to multi-modal interaction. As computers are reaching out into the environment, balancing multi-modal interactions will become a more common design problem in the future.

I feel there are two important questions regarding the future of children's design tools, and the future of design in general. First, how will currently disparate ideas about designing with interactive systems be contextualized? To a certain extent, different paradigms will work best for different modalities, for example gestural interfaces make sense for certain kinds of physical games and pen computing makes sense for writing exercises. However, there may be potential in relating the world of computational processes to the natural world through carefully designed materials and activities.

In creating Kindergarten, Froebel used the craft and design techniques of his day to help children model and understand the natural world. Today researchers in UI design present new design techniques, and due to the field of interactive material design, are beginning to present new craft materials like color-changing fabrics and materials with gestural memory. With materials, the material itself is a central part of the interface. How can these new craft and design techniques be distilled and organized to help children understand our modern interpretation of nature?

Where Froebel wove clay, ink, colored paper and cloth into a circle of pedagogical pattern and activity, we may soon be able to approach the next design revolution by considering the expressive capabilities of materials. With materials, pre-programmed material behaviors may actually become a dominant part of an interface. Already, our building blocks can come to life, and fabric can replay touch and color. A new pedagogy that relates objects, materials, modalities, and behaviors to nature may give people an intuitive way to create meaning through design in our increasingly technologized culture.

REFERENCES

1. Ananny, M. *Telling Tales: A new way to encourage written literacy through oral language*. PhD Thesis, Media Lab, MIT: available http://web.media.mit.edu/~ananny/thesis.html [28th February, 2003], 2001, 165.
2. Brosterman, N. 1997. *Inventing Kindergarten*. New York, Harry N. Adams, Inc.
3. Cassell, J. and Ryokai, K. 2001. "Making Space for Voice: Technologies to Support Children's Fantasy and Storytelling." *Personal Technologies 5(3)*: 203-224.
4. Crabtree, A, et al. "Orchestrating a mixed reality game 'on the ground'." *Proceedings of CHI 2004*, ACM Press, (2004), 391-398.
5. Frei, P., Su, V., Mikhak, B., and Ishii, H. 2000. "curlybot: Designing a New Class of Computational Toys." *Proceedings of Conference on Human Factors in Computing Systems (CHI) '00*, 129-136. ACM Press.
6. Ishii, H. and Ullmer, B. Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms. *Proceedings of CHI 1997*, ACM Press, (1997), 234-241.
7. Leap Frog toys. http;//www.leapfrog.com.
8. Papert, S. *Mindstorms: Children Computers and Powerful Ideas*. Cambridge, Massachusetts: Perseus Publishing, 1980.
9. Moovl. http://www.moovl.com.
10. Mueller, F et al. Exertion Interfaces: Sports over a Distance for Social Bonding and Fun. *Proceedings of CHI 2003*. ACM Press, (2003), 561-568.
11. Neurosmith toys. http://www.neurosmith.com.
12. Raffle, H. Parkes, A. Ishii, H. Topobo: A Constructive Assembly System with Kinetic Memory. *Proceedings of CHI 04*. ACM Press, (2004), 869-877.
13. Raffle, H., Tichenor, J. and Joachim, M. 2003. "Super Cilia Skin, an Interactive Membrane." *Extended proceedings on Human Factors in Computing Systems (CHI) '03*, 529-530. ACM Press.
14. Resnick, Martin, Berg, et al. Digital Manipulatives: New Toys to Think With. Paper Session, *Proceedings of CHI 1998*, ACM Press, (1998) 281-287.
15. Ryokai, K., Marti, S., Ishii, H. IO Brush: Drawing with Everyday Objects as Ink, in *Proceedings of CHI 04*.
16. Wyeth, P. and Purchase, H. Tangible Programming Elements for Young Children. *Proceedings of CHI 2002*, ACM Press, (2002) 774-775.
17. Zuckerman O., Arida, S., and Resnick M. (2005). Extending Tangible Interfaces for Education: Digital Montessori-inspired Manipulatives. *Proceedings of CHI 2005*.