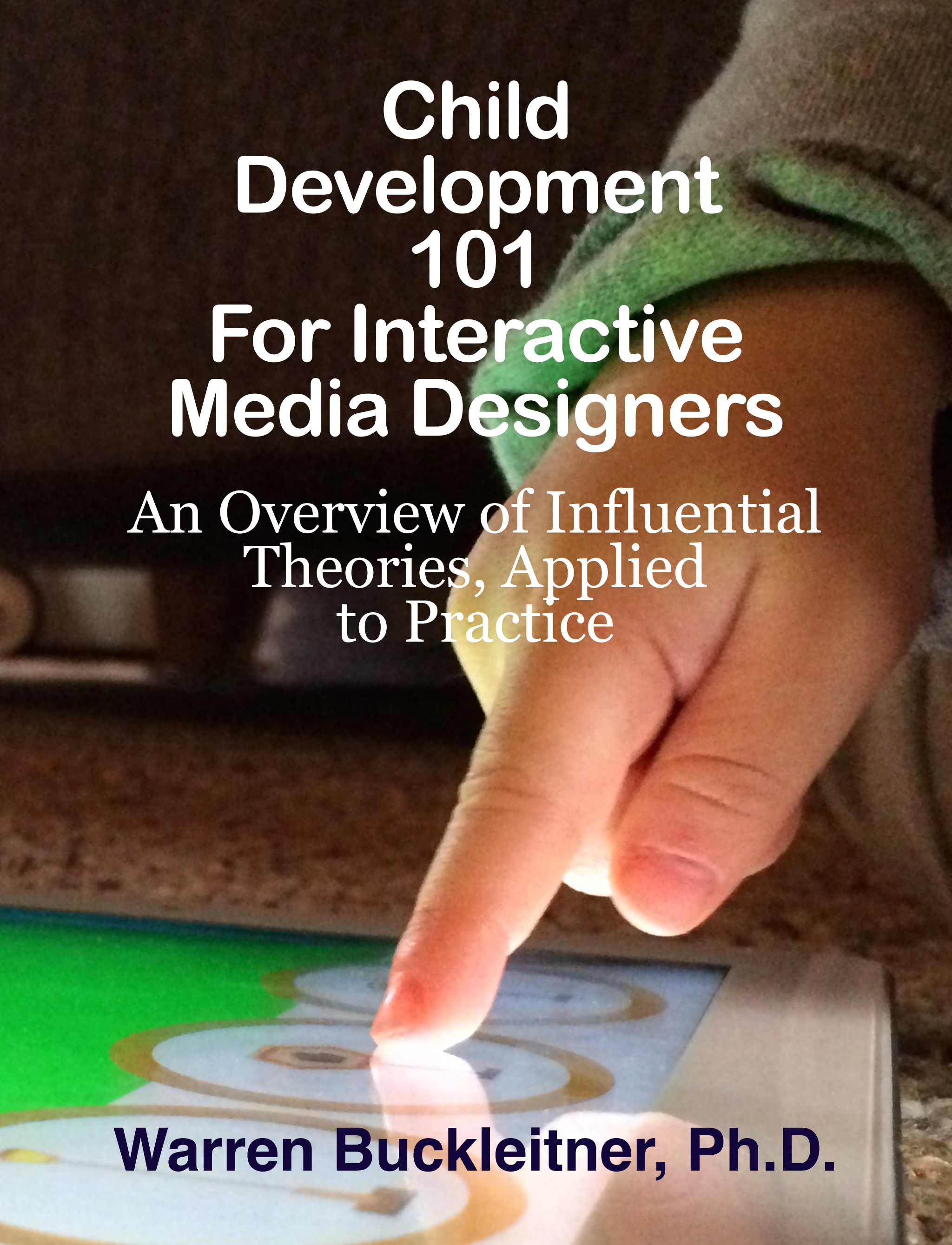
Child Development 101 For Interactive Media Designers

An Overview of Influential Theories, Applied to Practice



Warren Buckleitner, Ph.D.

Child Development 101 For Interactive Media Designers

An Overview of Influential Theories, Applied to Practice

This booklet was designed for the designers of children's interactive media (IM) for use during the Dust or Magic Institute. Designing children's IM that is successful depends on many factors, including a solid knowledge of the capabilities and learning patterns of children.

Keeping in mind some key child development trends early in the software conceptualization process can increase the likelihood of a child wanting to spend time with your product.

This packet provides an overview of what children can do at each age, along with brief summaries of major child development and learning theories. Also included are essays on what makes one particular IM product better than another. We have attempted to write concisely, in a style free of jargon.

The Story of Dust or Magic

From left to right, Daren Carstens, Keli Winters, Mark Schlichting and Warren Buckleitner, on the way to Dust or Magic

Welcome to the official, continually changing handbook of Dust or Magic

Once upon a time (1996), the world's oldest and largest children's book fair wanted to start a prize initiative for "new media." They asked my publication, then called *Children's Software Revue,* if we would create it for them. We accepted on the condition that they would host a juried competition that included a face-to-face meeting of editors, in a setting where each juror could demonstrate a variety of products.

Early in the spring of 1997, a group of reviewers were flown from Europe, Asia and the United States to participate in three days of debate and product demonstrations.

Participants included some of the top minds in the interactive space -- people like Judy Salpeter from Technology & Learning; Dr. Ann Orr and Dr. Ellen Wolock from CSR (who helped write the first versions of this book); James Op-

penheim; Peter Scisco (former editor of Compute!); Dr. Kyung Woo Lee from Korea; Thomas Feibel from Germany; and Caterina Cangià and Gigi Tagliapietra from Italy. From France, repeat jurors were Georgia Leguem and Claude Combet; and from the UK came Pam Turnbull and Jon Smith (then the editor of CD-ROM Today, today a producer for Travelers Tales and the LEGO video game series).

In 2001, when the market for CD-ROM based software slowed, the Bologna New Media Prize ended. In an effort to keep the spirited conversation growing, we decided to start an annual meeting to be financed by participant tuition. We also wanted to consider the expanding range of children's technology products, and to personally get to know others who where working in this space. Rather than coming up with a prize, we decided to review the year.

The title "Dust or Magic" came with the blessing of Bob Hughes, author of the book, *Dust or Magic: Secrets of Successful Multimedia Design*. In the forward of his book, Bob referenced a poem, "An idea can turn from dust to magic, depending on the talent that rubs against it" by Matsuo Basho (1644-1694). The first Dust or Magic was planned for September 23, 2001, and the event sold out weeks in advance. But the September 11 disaster in New York City forced us to reschedule. So, the first Dust or Magic event actually was held in January of 2002. Right away, it was clear that we had not only captured the essence of those early juror's meetings, but we'd improved upon it. We, the media, could learn much more about the thinking behind each product without feeling bribed or manipulated. The spirited debates have continued and the quest for the magic has become a celebration.

There are many people to thank for making this book possible, especially Ann C. Orr and Ellen Wolock.

Dust or Magic has been shaped by many individuals who are passionate about children and technology.

From the start, this has been a collaborative effort; the real "magic" has always been the people in the room.

See the thanks page for further credits.

“An idea can be Dust or Magic depending on the talent that rubs against it.”

Matsuo Bashō (松尾 芭蕉), from the forward of the book by Bob Hughes, with slight modifications.

I am thankful to everyone who has helped make these events possible, and we hope it continues to influence the quality of children’s interactive media products for many more years to come.

Warren Buckleitner, Editor
Children’s Technology Review

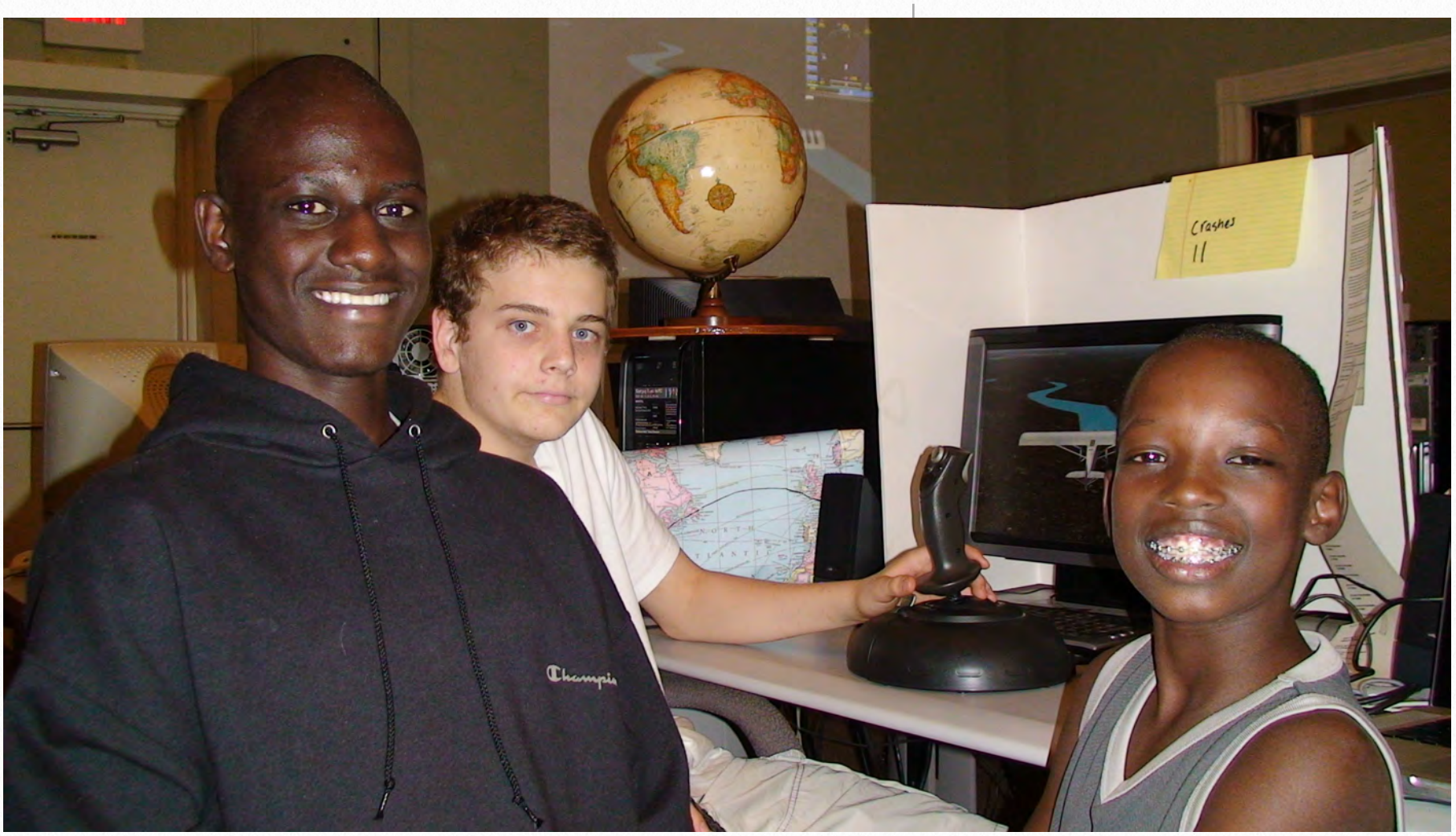
Dynamic Resources

- Twitter http://twitter.com/dustormagic (maintained by CTR Editorial Staff) Hashtag: #dustormagic
- Facebook https://www.facebook.com/groups/dustormagic/ (maintained by alumni)
- YouTube http://www.youtube.com/dustormagic (maintained by CTR Editorial Staff)
- Wiki http://dustormagic.wikispaces.com (maintained by alumni)
- Web http://dustormagic.com (maintained by CTR)
- LinkedIn http://linkd.in/WJ4ZjD (maintained by old timers)
- Read CTR reviews: www.ctrex.us

Make this book better. Did you notice errors or omissions? Let me know warren@childrenstech.com

Section 1. How Children Learn

Tapping the power of intrinsic motivation



These three boys stayed awake for 34 hours (with naps and pizza) with Microsoft Flight Simulator: The History of Flight*, because they wanted to replicate The Spirit of St. Louis crossing of the Atlantic in real-time weather conditions. They provide evidence that interactive media can instantly fascinate children after they discover that it fosters feelings of empowerment and control. A good designer learns how to avoid extinguishing these feelings. They landed successfully, despite two crashes.*

The efficiency of children's learning is increased when they have a stake in the task. It is theorized that intrinsic motivation plays a critical role in the degree to which a child will become engaged with an activity. Several factors have been identified by motivation theorists (Weiner, 1986; White, 1959; Maehr, 1983; Stipek, 1986; and Lepper, 1973, to name a few) as being central to the development of intrinsic motivation attributes in a learner's behavior. These factors can be used as a framework for understanding a child's actions when he or she is using interactive media (IM) or for assessing the overall quality of the IM experience.

Four Factors of Intrinsic Motivation

Enjoyment — Children choose activities that they like to do, and avoid activities that are frustrating, static or boring.

Implications for interactive media design:

When designing an activity, make sure the child finds initial success within the first 3 to 10 seconds. Sign-in screens should be intuitive; the first activities easy and fun. Nothing kills enjoyment faster than a talking adult. Next, don't underestimate a child's ability to "find the fun." Some designers think that children don't pay attention to details because they are too young ("don't worry ... these are just little kids"). Put yourself in the child's shoes— would you want to play the activity you are designing? Walt Disney understood that the process of creating a successful children's film is just as difficult as that of creating a film for adults. Disney's films appeal to all ages, stand the test of time and are watched over and over again. Similarly, the early success of Club Penguin, Pokemon, Minecraft or The Living Books can be tied in part to their clever use of animation and humor, which aren't used randomly or without purpose. When interactive media is easy to use and respectful of children, kids are more likely to enjoy it and use it.

Control — Children avoid activities in which they have no control. Good interactive media increases children's feelings of control by providing an environment where their actions have impact.

Implications for interactive media design:

Well designed interactive media sends instant, snappy control messages (such as an action or audio cue) with each mouse click. A crisp, responsive interface increases feelings of control. Avoid trying so hard to grab the child's attention with music, video or animation that the program's responsiveness suffers. Good interactive media allows many opportunities for child input. Every action the child makes results in something happening on screen (see My Very Hungry Caterpillar, for example). The child is leading the way, not the interactive media. Good interactive media also always leaves an intuitive "back door" or "go back" icon that is in a consistent place on every screen. Once a child understands that he or she can reverse a choice or decision, they are more likely to explore further or try a harder challenge.

Interest — Children are more likely to engage in an activity when their interest has been sparked.

Implications for interactive media design:

"Variety is the spice of life" holds true for interactive media design. Make sure that each serving of your experience offers something novel or incorporates open-ended elements. We all love surprises. So there's rarely an excuse to make a "one time through and we're done" app. Get to know as many real live kids as you can. What are they interested in? Fads come and go, but kids always like characters they understand, good story lines, quality music, humor, and familiar items and themes. Apps about animals are always busy. Likewise, adventures are always appealing.

Feelings of Competence — Children develop feelings of competence if they think they have a reasonable chance of success.

Implications for interactive media design:

It is the developer's responsibility to provide children with materials and activities that are at or near their developmental level. This, of course, refers to program content, but also to its design as well. Make sure you understand the notion of MUC or "minimum user competency." In other words, the challenge should be in the activity itself, not in the physical operation of the program (non-intuitive icons, reading required when the target audience is preschool, etc.) Another important concept to understand is that of "motivation inertia." In other words, make sure your interactive media includes elements that build on previous success, allowing greater challenge that is tailored to the child's abilities. Appropriate pacing and leveling of activities is critical— too fast, and the child builds a failure bank rather than competence bank. Too slow, and the intrinsic motivation wanes. Regarding the latter scenario, if extrinsic reinforcers are used such as "nice job" or "try again," make sure they don't slow the pace of the activity (especially when there is a timed element). Teachers have learned that one of the most effective punishments is "time out", because children hate to wait, yet that's exactly what some interactive media design does.

See Carolyn Handler Miller's "Seven Kisses of Death" and you'll see a lot of overlap with these four factors.

See also High/Scope Foundation's Five Ingredients of Active Learning (as a PDF).

Jean Piaget

Constructivism, and his Theory of Cognitive Development

The research and writings of **Jean Piaget** (1896-1980) have had an enormous impact on the field of cognitive development, and children's interactive media design. Piaget's ideas can help you understand the way children think and learn. I like to think of Piaget's theories in two general clusters: Stage Theory (his description of a set of discrete stages through which children proceed over time); and Processes (his explanation of a set of processes that help move a child from one stage to the next). A basic understanding of Piaget's theories can help the interactive media designer create more developmentally appropriate interactive media.

Learn more about Piaget, his life and his work at www.piaget.org. A good book on Piaget for novice readers is **The Piaget Primer: Thinking, Learning, Teaching** by Ed Labinowicz (Menlo Park, CA: Addison-Wesley Publishing Co., 1980).

THE FOUR STAGES

Sensorimotor, birth to 2 1/2 years. (a period of sensory input and physical actions)

Piaget described the ages of 0 to 2 years as the Sensorimotor Stage. All learning is done via physical exploration of the environment. As the child interacts with people and things, pleasing reactions are eventually noted, making the action more likely to be repeated. In the later portion of this period, the child begins to actively experiment, trying out various actions and reactions in a more purposeful manner. By the end of this period, the child has acquired an initial set of concepts dealing with space, objects and causality.

Sensorimotor children think like a flashlight—where the beam shines is where they think. The rest of the world doesn't exist.

✓ Babies initially think that objects out of sight aren't there, but later understand that the object doesn't really disappear (like in peek-a-boo).

✓ Children learn through the direct manipulation of objects, using all senses. Don't forget the importance of touch and sound).

✓ Children learn through the repetition of actions and imitation.

✓ Children understand simple cause and effect.

Preoperational, ages 2 1/2-7. (a period of representational, prelogical thought)

From approximately age 2 to age 7, Piaget described the child as being in the Preoperational Stage. Language acquisition is a major goal, as is "object permanence" or the idea that objects continue to exist even when they are out of sight. This is the first building block of memory and higher order thinking skills. Piaget also believed that children at this age fail to understand that the mass of an object is unchanged even when something is done to it. For example, if you take a short glass of milk and pour it into a taller, narrower glass, children in the Preoperational Stage will think that the taller glass contains more milk.

Preoperational children think like a slide projector. They can typically hold distinct thoughts in mind, but have trouble mixing them, or understanding that they can affect one another.

✓ Children begin to represent experiences through play and communications.

✓ Children are generally egocentric, less able to take another's perspective.

✓ Children consider the current condition of what they see. For instance, a small banana cut into lots of little pieces is “more” than a big banana cut into just a few pieces.
✓ In the early period of this stage, expressions may be taken literally (e.g. keep an eye on the ball).

Concrete-Operational Stage, ages 7-12.
(a period of focused logical thought)

From about 7 to 12 years, the child is described as being in the Concrete-Operational Stage, a period characterized by a more mature understanding of the world and objects around them. They understand that you can do things that change the appearance of an object, without changing the essence of the object. For instance, children at this age understand that a certain amount of liquid has the same volume regardless of how it looks, or a ball of clay has the same mass even after you smash it into a patty. This kind of thinking forms the basis for scientific exploration and thought (kids at this age love science), but they still rely upon concrete objects and experiments to form their ideas.

Concrete operational kids think like a motion picture projector, a step up from distinct “slide by slide” processing. But they still have trouble jumping, or mentally juggling different ideas. This is why they rely on concrete materials.

✓ Children are tied to their direct experiences, but can consider and coordinate more than one dimension.
✓ Children understand time, space and number. Children can conserve, understanding that objects are the same if their original state was equal, (e.g. a small banana is smaller than a large banana, no matter how it is sliced).
✓ Children can take another’s perspective.
✓ Children in this period still learn best through concrete experiences.

The Formal-Operational Stage, ages 12-17
(a period of unlimited, logical thought)

Formal-Operational thinking is said to begin around age 12. Here, the adolescent begins to use abstract logic and no longer relies on concrete objects to form his thinking. Learning can occur through verbal reasoning and by taking the perspective of others. Pre-teens/teens in this period formulate their own hypotheses about causes and solutions. They are now able to rely on abstract symbols to learn.

Like a computer controlled DVD player, formal operational thinking children can quickly skip from one idea to another, hold multiple contrasting ideas in memory, and evaluate the relevance of different ideas.

✓ Preteens/teens can rely on symbols to understand and learn.
✓ Preteens/teens understand complex concepts like density.
✓ Egocentrism may disappear completely with the capacity to think and reason beyond own beliefs.
✓ A sense of fairness and equality supersedes adult authority.

Piaget was incredibly prolific over his 84 years, as indicated by the multiple pens in his pocket. Source: The 1967 issue of the Michiganensian yearbook.

The Art of Confusion: Equilibration vs. Disequilibration

Your job as an interactive designer is to confuse children.
But in the right way, and not in a way that has unintended consequences.

How do children move from one stage to the next? You can't. The movement happens from within. Piaget argued that children "build" knowledge via a cycle of repeated and expanded interactions with their environment. Piaget described this process as having two mechanisms. One, he referred to as **assimilation**. When encountering something new in our environment (which is the prerequisite to learning), humans first try to incorporate that new thing into our existing mental framework. **Accommodation** is the complement to assimilation. Accommodation occurs when we have to adjust our existing mental framework in order to make room for that new "thing." Piaget said that these two processes are occurring all the time, back and forth as we experience (learn) new things in our environment.

When children encounter something new, they are slightly off balance, experiencing what Piaget called **disequilibration**. The child naturally seeks equilibration, or a balance between interacting factors inside and outside the child.

Real world examples are easy to find. Speaking in front of an audience, learning a difficult sport such as golf (trying to sink a putt, or hit a drive down a fairway), water skiing or snow boarding all have definable moments of assimilation, accommodation and equilibration.

Interactive media developers gently nudge the child from equilibration to disequilibration to equilibration, and so on.

When it comes to abstract things, we're all sensorimotor learners. This has implications for all types of interface designers. Things that get used foster feelings of instant success.

Both clippers are identical, but one has rubber grips that give it a feeling of "enhanced" usability.

While the function is the same, it it feels easier to use.

The same is true for a children's app interface.

How to Create Feelings of Control in a Children's Interface

DO

- Use rollovers and other "tangible" techniques to foster feelings of empowerment. Balloons pop, eyeballs follow, letters sing.
- Make the stuff on the screen that catches your eye have a function. The biggest resource you have is a child's immediate attention (or the first slide, using the preoperational metaphor).
- Provide pointers to the hot spot.
- Use audio to amplify a child's smallest action.
- Use "hot spice" (surprises) related to the task at hand.
- Provide status indicator metaphors that have meaning to a child (e.g., climbing a set of stairs, getting higher in a tree to get to the treehouse, helping a dog get to a bone).
- Make it clear when it is "your turn." The moving start button on Toca Boca apps is easy to find, for example.
- Let a child interrupt the narration or animation. Always.

DON'T

- Clutter the screen with nonfunctional "dead" art or instructions. Save the frosting for the movie.
- Underestimate the role of sound in the design.
- Let your narrator talk for more than a sentence or two.
- Parrot back instructions.
- Let decisions about licensed characters get in the way, or diminish child control.
- Use reinforcements that have no relation to the task. With IM design for children, it is easy to kill two birds with one stone.

Examples on this page, from top to bottom: Endless Alphabet, Toca Pet Doctor, Wubbzy's Dance Party, Counting With the Very Hungry Caterpillar

Other Influential Theories

Behaviorism

This theory asserts that behavior can be explained entirely in terms of observable responses to environmental stimuli. Influenced by the conditioned-reflex experiments of Pavlov, behaviorism was introduced in 1913 by J.B. Watson, who, denying both the value of introspection and the concept of consciousness, emphasized stimulus-response laboratory techniques. B.F. Skinner concerned himself exclusively with the relationship of observable responses to stimuli and rewards, and one result was the concept of mastery learning, which was applied in the 1950's as "teaching machines." Edward Thorndike was another important proponent of behaviorism; his work looked at the role of rewards and consequences and the technique of breaking tasks into small parts to be learned. **Interactive media that is very linear and scripted or that relies heavily upon external rewards draws from the behaviorist perspective.**

Constructivism

This school of psychology asserts that children actively construct their own knowledge from prior experiences — a process of fitting together new experiences with old to create a new reality. The theories of Jean Piaget (1896-1980) have been used to support constructivist curricula, which include the open classroom movement, whole language, and others. The idea that the

Lev Semyonovitch Vygotsky was born in 1896 in Byelorussia (Soviet Union). He began his career as a psychologist in 1917 and only pursued this career for 17 years before his death from tuberculosis in 1934.

Focus on these ideas

Intermittent Reinforcement— a type of reinforcement schedule in which the praise or reward is given only once in a while (like a slot machine). Of all the reinforcers, this one is the most powerful when used in software.

Minimum User Competency (MUC)— the lowest level (entry level) skill a child must possess in order to be successful with an activity. A menu that requires reading raises the MUC, for example.

Responsivity— one of the variables considered to be most related to engagement. A "crisp" interface responds instantly to a tap, mouse click or key stroke.

Zone of Proximal Development (ZPD)— an especially useful idea for interactive designers. This "zone" has been defined as the distance between a child's independent abilities and his or her capabilities under the guidance of a more capable peer. The "zone" is where you want instruction to take place; slightly beyond what a user can do by himself.

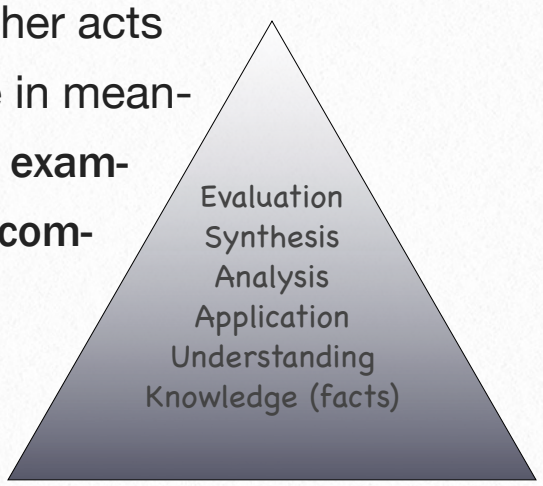
child is an active, not passive, learner is key to this theory. **Interactive media that is child-led using open-ended components or virtual manipulatives draws from the constructivist theory.**

Social Learning Theory

The work of Albert Bandura (b. 1925) gave rise to the social learning theory. Bandura emphasized the social aspects of learning such as the importance of observing and modeling the behaviors, attitudes and reactions of others. In other words, Bandura claims that much of what we learn is attained by watching other people. Bandura sees learning as a continual, reciprocal interaction between cognition, behavior and environmental influences. The learner's attention, memory and motivation are seen as key determinants of learning. **Interactive media that models desired responses or that provides children with opportunities to see other kids learning and doing can be said to draw from social learning theory.**

Social Constructivism

Lev Vygotsky, a Russian psychologist and philosopher in the 1930's, is most often associated with the social constructivist theory. He emphasized the influences of cultural and social contexts in learning and supported a discovery model of learning. Vygotsky believed that learning and development is a social and collaborative activity that cannot be "taught" to anyone. It is up to the student to construct his or her own understanding in his or her own mind, while the teacher acts as a facilitator. Vygotsky maintained that learning should take place in meaningful cultural contexts. **Simulation programs like SimCity are perfect examples of social constructivism, as are online games which facilitate the communication between two or more players.** Vygotsky's concept of the "zone of proximal development" is a useful idea for interactive media developers. This "zone" has been defined as the distance between a child's independent problem solving and his capabilities of problem solving while under adult guidance or the guidance of more capable peers. The "zone" is where you want to be when teaching a child— just slightly beyond what he can already do by himself. The same goes for interactive media activities, you want them to be challenging, but not overwhelming, and you want to give the child enough support while



doing the task that he succeeds at learning something new. **Programs that track a child's past performance and automatically offer slightly more challenging activities are using the concept of "zone of proximal development."**

Information Processing Theory

Based on the work of George Miller and others, the Information Processing theory of learning maintains that children are actively processing, storing and retrieving information (much like a computer) and that teaching involves helping learners to develop information processing skills and apply them systematically to mastering the curriculum. Two major principles of this theory are that short term memory (or attention span) is limited to seven chunks of information and that processing information in sequential steps is a fundamental cognitive process. CAI (computer assisted instruction) interactive media uses these principles. Tasks are broken into sequential steps, connections between new and old information are highlighted, retention strategies are suggested and there is ample opportunity for repetition and review of information. **Developers of interactive media designed to teach memorization of facts, reading, etc., should explore this theory further as its concepts can be easily integrated into learning games and activities.**

This child grew up to become an EMT (Emergency Medical Technician)

Bloom's Taxonomy*

In 1956, a group of educational psychologists led by Benjamin Bloom found that over 95% of the test questions students encounter require them to think only at the lowest possible level—the recall of information. Bloom identified six levels within the cognitive domain, from the simple recall or recognition of facts, at the lowest level, through increasingly more complex and abstract mental levels, to the highest order which is classified as evaluation.

1. Knowledge: define, list, match, order, name, repeat, memorize, recall

2. Comprehension: describe, sort, classify, report, identify, review, translate

3. Application: demonstrate, illustrate, solve, employ, use

4. Analysis: categorize, appraise, calculate, compare, contrast, distinguish, examine, question, test

5. Synthesis: compare, formulate, manage, organize, plan, prepare, propose, set up

6. Evaluation: assess, defend,estimate, judge, predict, support, value, test

Interactive media has much to contribute to "higher order" thinking, through simulations such as **Sim City** or **Oregon Trail**, where children must continually evaluate and synthesize information related to a long-term task.

Other activities, such as making a spreadsheet or database, programming in Scratch, Java or HTML or making a world in Minecraft, are thick with higher order problem solving opportunities.

** Adapted from: Bloom, B.S. (Ed.) (1956) Taxonomy of educational objectives: The classification of educational goals: Handbook I, cognitive domain. New York; Toronto: Longmans, Green.*

Adults who is design for children learn the skill of "decentering" from an adult point of view. It's like a different language or culture.

Children see the world, and an interface, differently depending on their level of maturation.

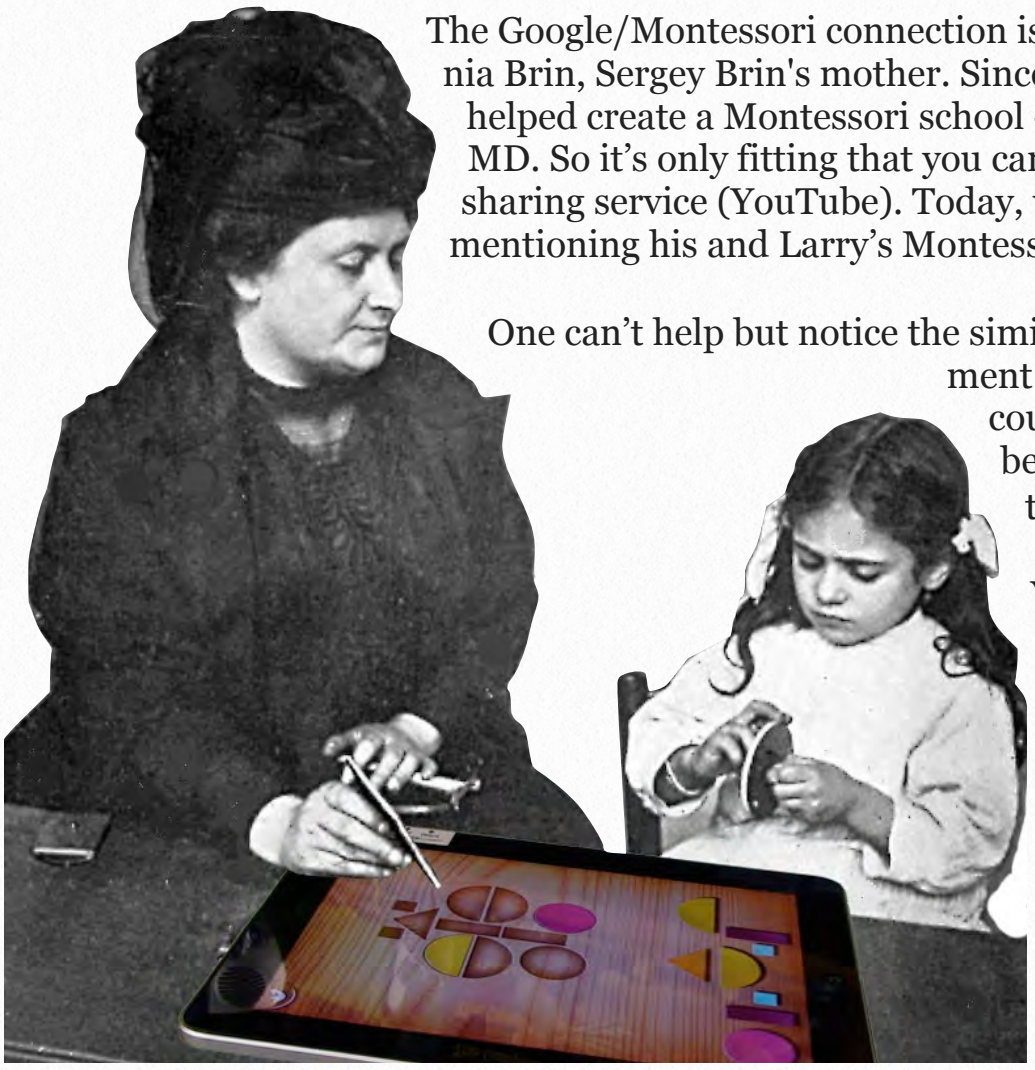
Maria Montessori

Maria Montessori once said: "Never give more to the mind than you give to the hand." So how does the iPad fit into this thinking?

In the fall of 1913, an important visitor from Italy came to the stage at Carnegie Hall. But it wasn't to star in an opera. It was to lecture about education, at the invitation of two of her big fans: Thomas Edison and Alexander Graham Bell. After an introduction by none other than John Dewey (can you imagine that pressure?), Dr. Maria Montessori, the 43-year-old doctor-turned-teacher described her new teaching methods for working with the "idiot" children in the Roman slums.

She apparently struck a chord. According to the media coverage at the time, 1,000 people had to be turned away at the door, all eager to hear her plans for "the eventual perfection of the human race." Maria Montessori died in 1952, but if she were alive today, she would probably be astonished by how her methods have grown and multiplied.

FAMOUS MONTESSORIANS. Graduates of programs bearing the Montessori name include some of the most famous pioneers of the information age: Jeff Bezos of Amazon.com, Sergey Brin and Larry Page of Google, Jimmy Wales of Wikipedia and Will Wright of The Sims. (For a good discussion of Will Wright's Montessori education, see Brian Crecente's article on Kotaku.) All attended Montessori schools and have mentioned the value of the experience. But she'd be shocked by the number of times her name shows up on schools —and, more recently apps— that vary widely in quality.



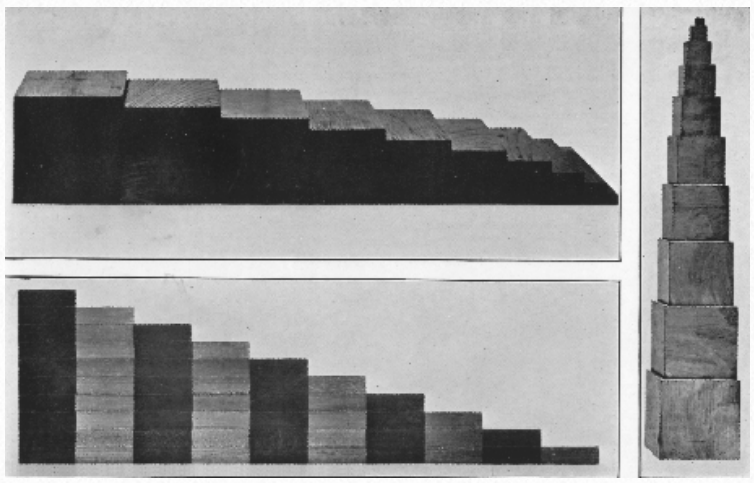
The Google/Montessori connection is particularly interesting, in part because of Genia Brin, Sergey Brin's mother. Since coming to the United States , Mrs. Brin has helped create a Montessori school -- the Alef Bet Montessori school in Rockville MD. So it's only fitting that you can find a tribute to her service on her son's video sharing service (YouTube). Today, when Sergey Brin gives a talk, he seems fond of mentioning his and Larry's Montessori past.

One can't help but notice the similarities between a Montessori learning environment and Google's campus, where employees are encouraged to pursue personal interests like tending bees or planting gardens, and are served a nutritious carrot smoothie during the morning break.

You see a life-sized replica of a T-Rex skeleton, and was inspired by the replica of SpaceShipOne, the first manned aircraft to leave orbit and land safely, hanging in the lobby.
While these cool toys may seem unrelated to search engines, they are very much related to play, and how people learn.

Tapping into the power of play was part of Montessori's magic, but she was hardly unique with the idea. It was central to the theories of Johann Pestalozzi and his student Friedrich

Fröbel (the guy who coined the word "kindergarten"), years before Montessori opened her school.



A HOT BUTTON ISSUE. Among Montessori groups, the use of technology-based materials like the iPad is debated. One important Montessorian who doesn't seem afraid of the iPad is Virginia McHugh Goodwin, the Executive Director of the Association Montessori International/USA. She once said "Montessori would appreciate the deep, intuitive connection the iPad fosters between content and user, taking working with knowledge to another level."

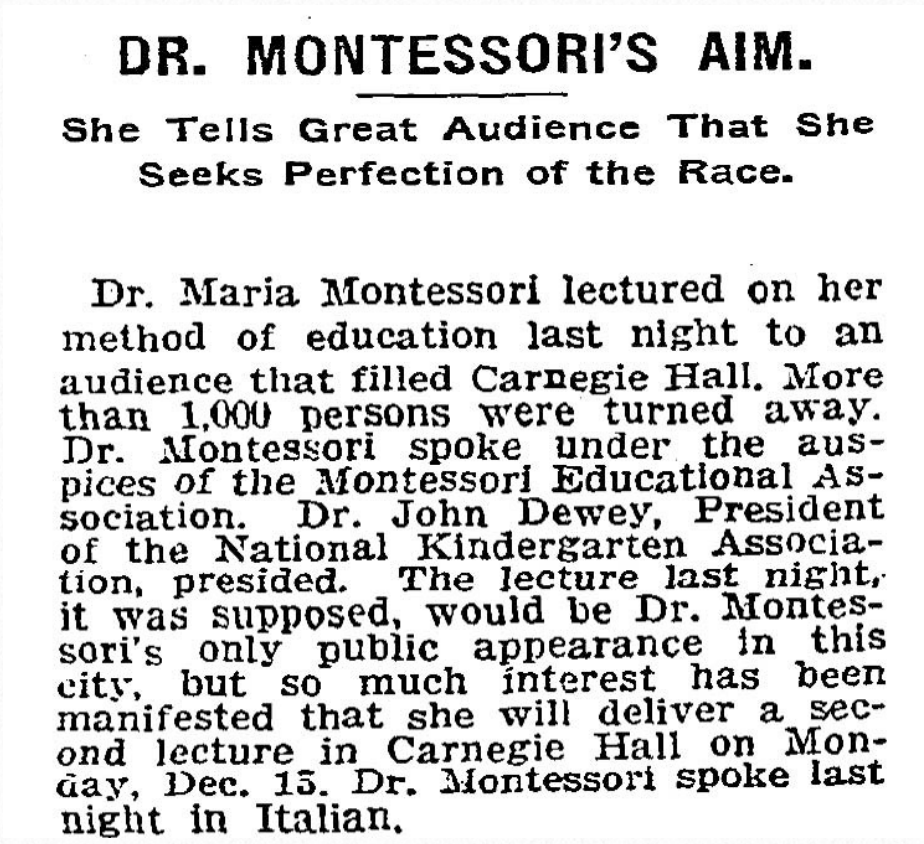
Other clues can be derived from Montessori's book, "The Montessori Method." You'll find plenty of evidence that Montessori was a bit of a geek. She wrote about the promise of Roentgen Rays (later renamed X-rays) in 1912, and accurately predicted "wonderful things from the Marconi Telegraph" (aka, the radio).

She was also a consummate game maker, constantly fiddling with innovative materials like sand paper to perfect a new self-teaching gadget. Because she'd always put a child's interests ahead of any formal curriculum, it's a safe bet that she would've encouraged young Sergey Brin's play with a Commodore 64. Said Goodwin, "Maria Montessori would view the iPad— and devices like it— as a tool for tomorrow's mind."

So when Montessori wrote that education was "seeking the release of human potentialities," it is easy to imagine her including an iPad in her modern arsenal of materials. Let me recap the "pro iPad" reasons:

• Montessori was a scientist who was future-centric. She understood that she was living in a changing time, and that children needed to be exposed to modern materials. She was in the business of preparing children for their future, to live to their full human potential, so she would've wanted them to embrace, and feel empowered, by every element of their environment, including technology.

• She would be discriminating about the types of apps she loaded on her iPads. She'd look for non-commercial apps that promote active learning, are self-correcting, are multi-leveling, don't talk too much and empower children. Another word Montessori used frequently was "didactic" as in "didactic materials," or working toward one right answer; a feature found in many better designed apps.



DR. MONTESSORI'S AIM.

She Tells Great Audience That She Seeks Perfection of the Race.

Dr. Maria Montessori lectured on her method of education last night to an audience that filled Carnegie Hall. More than 1,000 persons were turned away. Dr. Montessori spoke under the auspices of the Montessori Educational Association. Dr. John Dewey, President of the National Kindergarten Association, presided. The lecture last night, it was supposed, would be Dr. Montessori's only public appearance in this city, but so much interest has been manifested that she will deliver a second lecture in Carnegie Hall on Monday, Dec. 15. Dr. Montessori spoke last night in Italian.

• In designing apps, she'd compensate for the iPad's sensory limitation of just sight and sound, using apps in concert with real, concrete experiences. She would use the iPad to supplement and extend traditional experiences rather than to replace them. After the trip to the Apple orchard, she'd give each child their own apple, to hold, smell and taste. Only then would she read a story about the apples, or let them "pick" the abstract apples on a multi-touch screen.

SOME WORDS OF CAUTION

Before you rush out and purchase every child an iPad, consider some words of caution, based conversations with Goodwin, a close reading of Montessori's book and a review of hundreds of apps.

• **Keep an open mind about this issue.** iPads are like chameleons— they take the form of the app they are running. Some apps match a child and your learning philosophy; others don't. Like anything new, it must be observed and studied to maximize the strengths and minimize downsides. As a scientist, Montessori was trained to systematically study various techniques, use what works, and discard the rest.

• **Keep things in balance.** She'd urge modern parents not to upset the balance of diet, exercise and the development of the senses through exposure to real wood, sand and water. Technology-based experiences can supplement this mix. For example, the camera on the new iPod Touch is an ideal tool for capturing observations on a field trip.

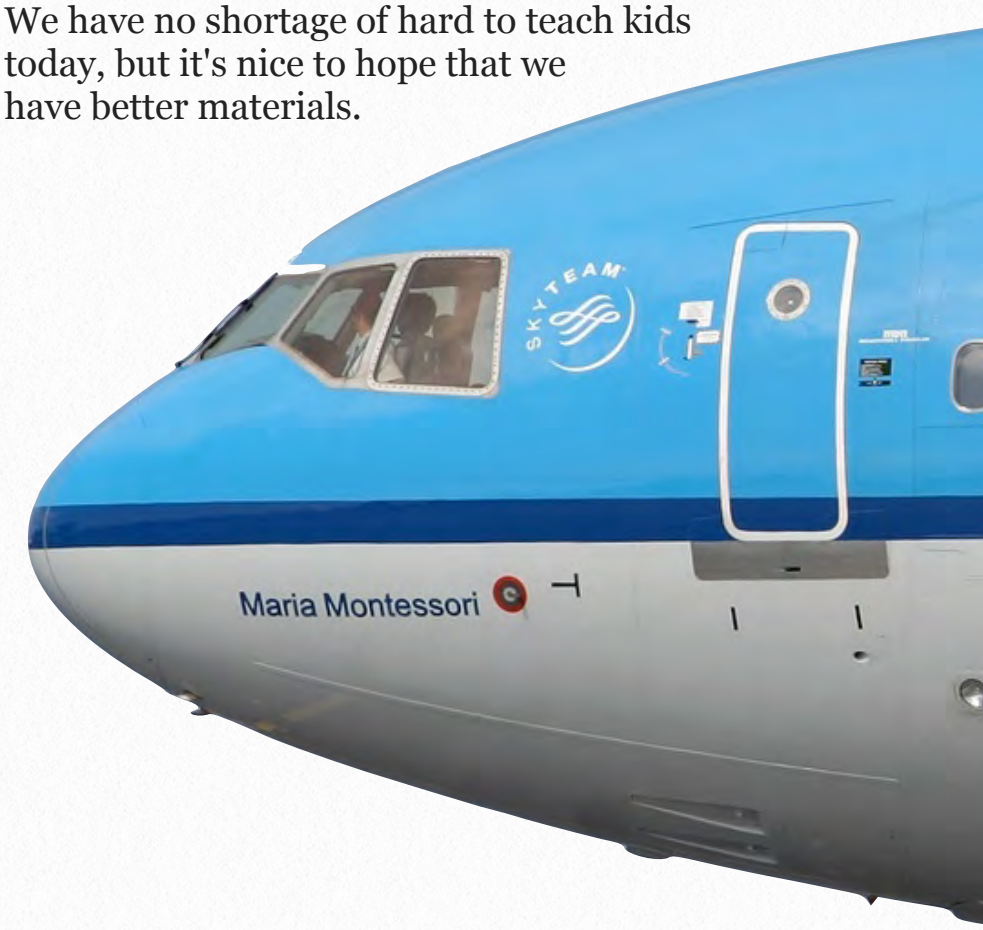
• **Screens are abstract.** Said Goodwin: "She'd (Montessori) remind us that any screen is an abstract, two-dimensional object that is removed from reality." In other words, the movements of a virtual fish in the Koi Pond HD app ($1.99 The Blimp Pilots, LLC) might fool your cat, but one sniff tells you they're not real. What app could replace the smells and sounds of a real pond?

• **Technology tends to be expensive and quickly becomes obsolete.** You can buy a lot of chromatic silk frames and sandpaper letters for $500, and anyone knows that the next iPad will be "newer, better, faster and cheaper."

• **Don't sugar coat the learning.** She'd like apps that are simple and stripped "of all that is not absolute truth," sans licensed characters, long musical introductions, or links that steer a child toward the iTunes store. Because she frowned on the notion of shaping a child's behavior with external prizes and punishments, she'd recommend apps where the process, in itself, is rewarding. She might ask "What type of society exposes its young to manipulative tricks with commercial motives?" Montessori would probably insist that every children's app should have a "no candy lane" mode, that perhaps costs a few lire/EU more.

It's been 97 years since Maria Montessori gave her famous Carnegie Hall address on how to teach hard-to-reach children.

We have no shortage of hard to teach kids today, but it's nice to hope that we have better materials.



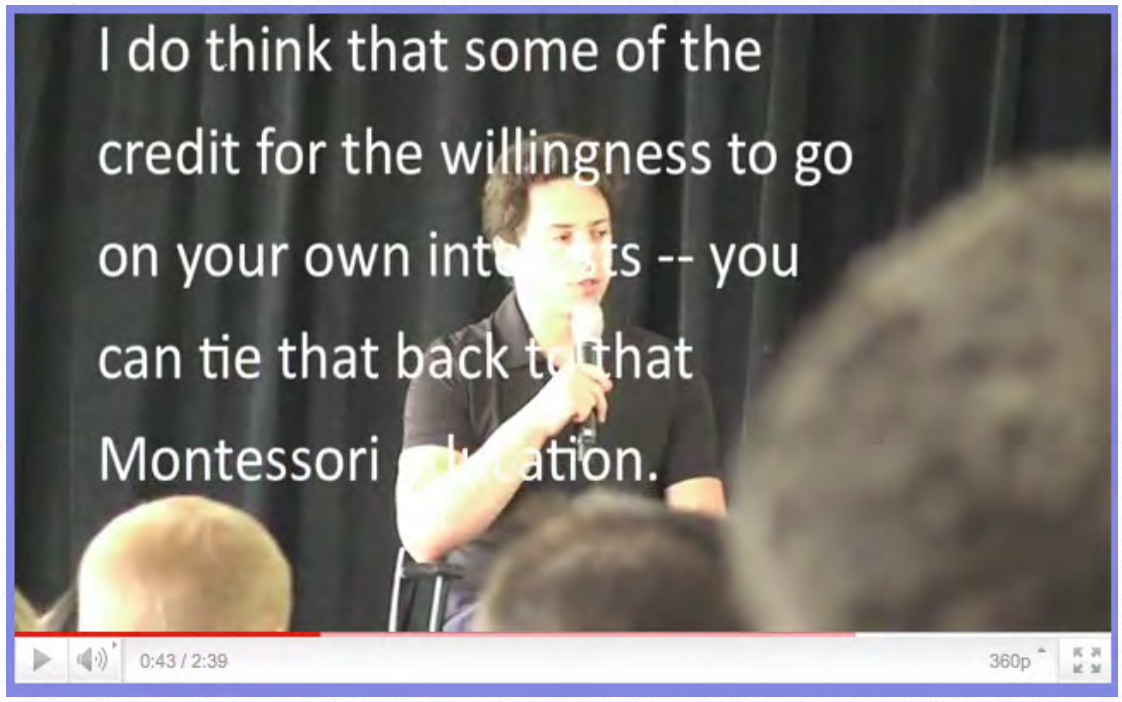
What a wonderful thing, to see a bill of currency and a commercial jet bearing the name of an educator.

Constructivism's Influence on Design

- **Apple's concept of the Home key**. This single control mechanism may be the biggest contribution to technology-based constructivism, because of the control it offers a child or an adult. It makes it possible for a child to get out of whatever he or she gets into.

- **Linking forms of language**. Piaget and Vygotsky both wrote a great deal about language as a vehicle for packaging knowledge and would undoubtedly have a lot to say about word/object association techniques used in apps like ABC Actions (Peapod Labs, 2013) that pair words with still, clear photos and videos of meaningful objects. It is possible to toggle from Spanish to English at any time.

Touch the picture to watch Google Co-Founder Sergey Brin Discuss his Montessori Roots, and his first computer (a Commodore 64)



- **Self-correcting problems that dynamically adjust**. Both Thorndike and Piaget would've liked Motion Math: Hungry Guppy (Motion Math Games, 2012), a bottomless pitcher of finger driven, self-correcting math manipulatives. The better you do, the harder the challenge, which is evidence of the eclectic design of apps.

- **Instant formative feedback**. Montessori wrote about automatic or auto didactic materials that provide instant feedback to a child. She might have liked the way LetterSchool (Sanoma Media Netherlands B.V., 2012) quietly directs a child toward the correct result, in a way that is driven by the child's initiative.

- **Programming.** Sometimes interactive media experiences can allow a child to control a screen—rather than the other way around; representing an embodiment of constructivism ideals. One of the first programming languages specifically adapted for children was Logo, which was created at the Massachusetts Institute of Technology (MIT) by a team led by one of Piaget's coworkers, Seymour Papert. More recently, Scratch 2.0 (Maloney, Resnick, Rusk, Silverman & Eastmond, 20I0) and Hopscotch (Hopscotch Technologies, 2013), a Scratch-like programming experience for the iPad, let children "code" using jigsaw-puzzle like commands, routines, and subroutines. Papert called this **constructionism** around the idea that children can also construct cognitive models outside the head.

Section 2.
Developmental Milestones

The following pages offer descriptions of children's "ages and stages" and what children can do on the computer at what age. Also presented are some general developmental milestones that children display during their early years. These age estimates and developmental attainments are based on several instruments used to track young children's growth. While this compilation will help you get a sense of what children can do at each age level, keep in mind that individual children acquire skills at different rates.

Knowledge of children's developmental abilities is particularly important when designing interactive media for younger children (below age 6). Many aspects of interactive media will be affected, such as menu design, content, reinforcement messages and so on.

Developmental Milestones

Birth to 18 Months

To babies, a computer or an iPad is little more than a busy box. They love to look at the colors on the screen, hear the sounds from the speakers, mouth the mouse cord and touch the keyboard. Don't expect young babies to make the connection between their movements of the mouse or keyboard and events on the screen.

18 Months to 2 1/2 Years

While the computer is still viewed as an electronic busy box, at about 18 months, children first begin noticing that they can have an effect on objects on the screen. They'll need some assistance, as they don't have the necessary skills to use the mouse, but they can use a touch screen. This is an age where they start understanding that they can drive the actions on the iPad's screen.

✓ Can recognize pictures of objects.
✓ Can identify body parts on self or on a doll.
✓ Can place individual shapes on "form board" type puzzles.
✓ Can use a pencil to imitate a vertical line.
✓ Can match objects by color.
✓ Can match objects by simple shapes.
✓ Can understand the concept of "here."
✓ Can remember a missing object if it is presented and then taken away.
✓ Begins to categorize objects according to function (e.g. places all of the spoons together).
✓ Enjoys and remembers nursery rhymes.
✓ Enjoys taking things apart and putting them together again.
✓ Has limited attention span.
✓ Can name 1 to 2 colors.
✓ Enjoys copying activities of parents and siblings.
✓ Generally plays alongside of peers rather than cooperatively with peers.

2 1/2 to 3 Years

Age 2 1/2 for many children is a real turning point when it comes to traditional computer use. Not only can they sit for a bit longer (we've seen kids who can sit for as long as 1 hour), but many have the fine motor control to use a mouse independently. Now they can easily negotiate the activities in programs like Reader Rabbit's Toddler, or Fisher-Price Ready for School: Toddler. They especially love singing along with the music, while watching events on the screen. Keep in mind that children develop their mouse skills at different rates. Kids may be ready earlier than age 2 1/2 or they may need more time. Also remember that computer use is a very social activity for young children .... they love sitting in a parent's lap to experience the activities together.

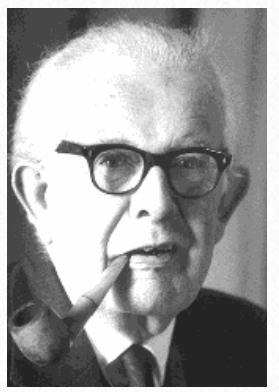
✓ Asks "why" and "how" questions.
✓ Can describe the functions of objects (e.g. "What do you sleep on?").
✓ Can anticipate consequences and understand the impact his or her own actions can have (e.g. understand the relationship between clicks of mouse and actions on the screen).
✓ Can recognize several colors.
✓ Knows the sounds that animals make.
✓ Can count to 2.
✓ Engages in simple fantasy play (driving vehicles, cooking meals, feeding baby, etc.).
✓ Is able to answer simple questions.
✓ Usually speaks in short but complete sentences.
✓ Understands the concept of "now."

3 to 5 Years

These are the first real years of independent computer use. Children can now manipulate the mouse expertly (providing they've had plenty of time to practice), and can use a variety of programs. Kids at this age typically want to share the fun with a friend. Narrative driven apps work especially well at this stage, as well designed, highly responsive apps from Toca Boca.

Age 3 to 4 Milestones

✓ Recognizes most colors.
✓ Can identify simple shapes (e.g., square, circle, triangle).
✓ Understands the concepts of "same" and "different."
✓ Can play independently for extended periods (approximately 20 minutes).
✓ Begins to play cooperatively with peers.
✓ Enjoys and remembers a favorite song.
✓ Can follow two simple directions in the correct sequence.



✓ Can complete a 4-piece puzzle.
✓ Can copy a cross (+).
✓ Can draw a circle.
✓ Build towers of 10 or more blocks, and can build simple bridges.
✓ Can recognize many letters.
✓ Counts to ten.
✓ Shows some understanding of one-to-one correspondence (when counting, each number represents an object being counted).
✓ By age 4, can use a pair of child-size scissors to cut on straight, thick lines.

Age 4 to 5 Milestones

✓ Understands the concept of "today."
✓ Makes fine size discriminations (e.g. can order objects according to size, can match objects according to length).
✓ Makes broad classifications according to type (e.g., animals, foods, clothing).
✓ Understands the sequencing of events (e.g., First we go to the store to buy a cake mix, then we will bake it, and after dinner we will eat it).
✓ Begins to comprehend simple logic puzzles (e.g., If I cut an apple in half, how many pieces would I have?).
✓ Independent play is longer (45 minutes or more).
✓ Plays cooperatively with peers for extended periods.
✓ Abstract thinking is becoming more advanced. For example, children this age can often comprehend the concept of "opposite." They can also complete simple analogies (e.g., Birds like to fly, fish like to _____).

Watch for these guidelines come to life on a playground.

✓ Uses some irregular past tense of verbs (e.g. ran instead of runned, left instead of leaved, fell instead of falled), but still over generalizes rules of grammar.
✓ Can play simple organized games, while remembering the rules (e.g. musical chairs).
✓ Enjoys pretend play with themes familiar to child (going to work, taking care of pets or babies, etc.).
✓ Can build relatively complex structures with blocks or LEGOs (houses, etc.).
✓ Fine motor skills are increasing, e.g., by age 5 many children can operate difficult wind-up toys or use a key.
✓ Can follow 3 simple directions in the appropriate sequence.
✓ Can answer questions about a short story.
✓ Can draw a person with 5 parts (e.g., head, hair, legs, arms, eyes).
✓ Can recognize letters and associate some letters with their sounds.
✓ Demonstrates understanding of one-to-one correspondence.
✓ Can complete puzzles with 8-12 pieces.
✓ Can copy a square.
✓ Can cut on curved lines.
✓ By age 5 can write own name.
✓ Can recognize numerals from 1 to 10.
✓ Can choose objects that have a similar characteristic, and express why they are similar.

5 to 6 Years

Kindergartners and 1st graders can use pull-down menus to launch programs themselves (some will even install them for you!). They can also use the computer for simulations, creativity and even for reference. With some help, they can go onto the Internet to research a topic of interest, such as dogs, cats or that special pet lizard. This is a time when solid computer activities can play a valuable role in supporting and building school skills. By this age, children know where the keys are on the keyboard, and can hunt and peck their own names. But don't expect them to be able to type yet... formal typing skills will come much later.

I agree. My best stuff came from watching my own two kids.

✓ Understands the concepts of tomorrow and yesterday.
✓ Understands the concepts of morning and night.
✓ Knows his or her birthday month.
✓ Can tell time on the hour around age 6.
✓ Associates most letters with their sounds.
✓ Begins to recognize simple words.
✓ Knows both upper and lower case letters.
✓ Can match simple words with each other.
✓ Can answer "why" questions appropriately.
✓ Waits for turn while playing or while waiting for adult attention.

✓ Can follow the rules and directions of a classroom.
✓ Continues to engage in pretend play with themes familiar to child.
✓ Can adeptly use tools such as scissors, hammers, screwdrivers, etc. Can use scissors to cut out magazine pictures.
✓ Can use visual details to determine if two pictures are the same or different.
✓ Can copy a triangle.
✓ Can color pictures within the lines.
✓ Can write numerals from 1 to 10.
✓ Completes 10 to 15 piece puzzles.
✓ Can solve simple addition and subtraction exercises (If I had 4 apples and added 1 apple, how many would I have?).

Ages 7-up

Just because we stop describing developmental attributes at age six doesn't mean that human development stops. Keep this in mind:

- The most dramatic and observable cognitive change happens before age 12.
- Cognitive growth happens within the context of social and physical development. There's no way you can separate one from the other.
- Just because you may be able to operate at a "Formal Operational" level doesn't mean you'll behave in a formal operational way, especially under stressful conditions, or when encountering a complex interface.
- Making an interface that is useable at the sensori-motor level user does not mean "dumbing it down." The elevator button is one example.

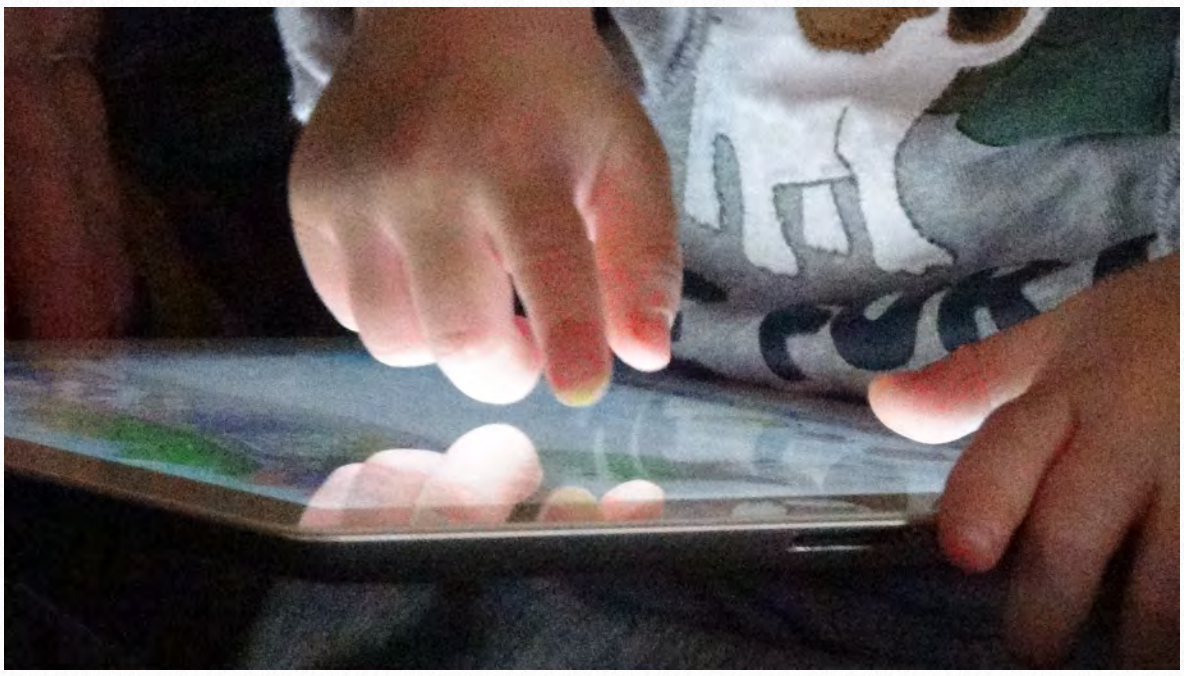
Penelope (7-months) likes the free Pianooohh! app on her mom's iPad.

A Taxonomy of Touch

"Nothing lowers the age bar or makes interface invisible like touch capability. Hopefully the iPad will represent the best from both our old Touch Window and the Koala Pad, and go forward from there. Remember what was new and amazing about both of those?"
- Donna Stanger, Former CEO, Edmark, Corp.; March 2010, two months before the release of the iPad.

A perfectly flat, glassy surface is magical all by itself. It doesn't exist in nature, and when it's covered with fog or a slippery oleophobic coating, it gets even more interesting to your fingers. If you have an iPad nearby, lay your palm over it and pretend to be a baby. Now, layer 786,432 responsive pixels (in a first generation iPad) just a few millimeters below the surface, and you have a puddle of control unequaled in any previous computing experience.

As a result, all of the thousands of ways you could fail with a mouse and qwerty keyboard have dissolved into just a few dozen with the iPad, and a new pipeline of interactivity has arrived.



The Minimum User Competency (MUC) has dropped from around 2 1/2 years (for the mouse) to around 12 months (for the iPad). Don't take my word for it. Simply go to YouTube and search "baby" and "iPad." You'll find the work of hundreds of proud parents who understand that their baby is doing something rather remarkable. Back in the good old days, you videotaped your child's first steps. Today it seems it's your child's first app.

I've sorted through hundreds of videos and tried to put them all in a single playlist. They were captured in October, 2010.

This presents new opportunities for children's interactive media developers. It's nothing short of a new era in computing, as the user interface becomes increasingly invisible.

The implications for design are profound, however it requires some understanding of how it works. One way to do this is to watch the app-happy kids play, through Piaget's developmental filter. Using this method, I created a draft taxonomy (Table 1) of touch-related behaviors. Besides watching the videos (Table 2), I also tested approximately 200 children's iPad apps, noting the required interactive behaviors.

Table 1: A Taxonomy of Multi-Touch Interaction Styles, by Stage

Age and Stage	Intentional Touch-Related Behaviors	Motion/Voice Behaviors	Examples
Birth-24 Months Sensorimotor	• Mouth • Bump/Swat • Kick • Jab/poke • Smear • Grasp • Swipe, dig or scoop • Swipe directionally (up, down, left or right), e.g., to turn pages or change photos. • Single tap/ single touch with coin-sized icons	• Jolt • Shake • Feel the vibration from the iPad's speaker • Rock • Blabber • Lean (whole body) • Sit • Throw • Single-word commands	Look for apps that deliver high cause/effect ratios. These are also called "busy box" apps, "interactive play doh" or rattles. These experiences can empower a child, letting them bang on a keyboard**, pop bubbles, or make waves in a pond. Show children where the "change app" button is, so they can get out of what they get into.
2 to 5 Preoperational	• Scribble* or finger paint. • Touch and use BB-sized icons • Slide objects (with thumb or finger) • Flick and throw (skeet ball, a shooting gallery) • Trace • Cut or slice • Alternate hands (e.g., on a piano keyboard) • Press and hold (e.g., as a timer fills) • Double tap	• Tilt to steer (like a steering wheel) • Align camera viewfinder	This is the age when a child's motor abilities start to catch up with his or her cognitive abilities. They can find and touch smaller icons, do dot-to-dot puzzles and control things by shaking or tilting the screen. They start to employ their emerging temporal and spatial thinking abilities in their iPad interactions.
5 to 12 Concrete Operational	• Spread out (with thumb and index finger, going in different directions) • Pinch in (with thumb and index finger) • Press soft, press hard • Rotate • Hit the target • Push a magnet (like herding cats) • Two or more combination movements, like tilt and shoot.	• Balance (tilt) like a plate • Jump to hop, while throwing a ball (with a tap).	By the time they are reading, children are ready to fully explore the iPad's multitouch screen, working in concert with the microphone and accelerometers. Prior experience will increase confidence. If your goal is to develop a proficient iPad user, provide plenty of exposure to a variety of apps.
12 - up Formal Operational	• Isometric rotation (both fingers move the same distance, in the same or opposite direction). • Simultaneous rotation, such as with a compass (hold thumb in one space, and rotate other finger). • Augmented reality camera-based applications such as a virtual planetarium***	• Children can start to use the compass, and conceptualize the accelerometer.	

*How a two-year-old uses an iPad

**Baby plays minisynth pro on iPad

***Virtual planetarium app

MONOTOUCH VS. MULTI-TOUCH. Touch screens have been around for many years and have been implemented well in the Leapster and Nintendo DS. Multi-touch is a very different psychology, however. While both require fine-motor dexterity of the variety that has been well-documented by penmanship researchers, there is a different set of rules at play with the iPad screen. The iPad's uncanny ability to tell the difference between a child's palm, mouth or each finger, working in concert with the microphone and the motion detection accelerometer make it well suited for a detecting a range of otherwise undetectable behaviors.

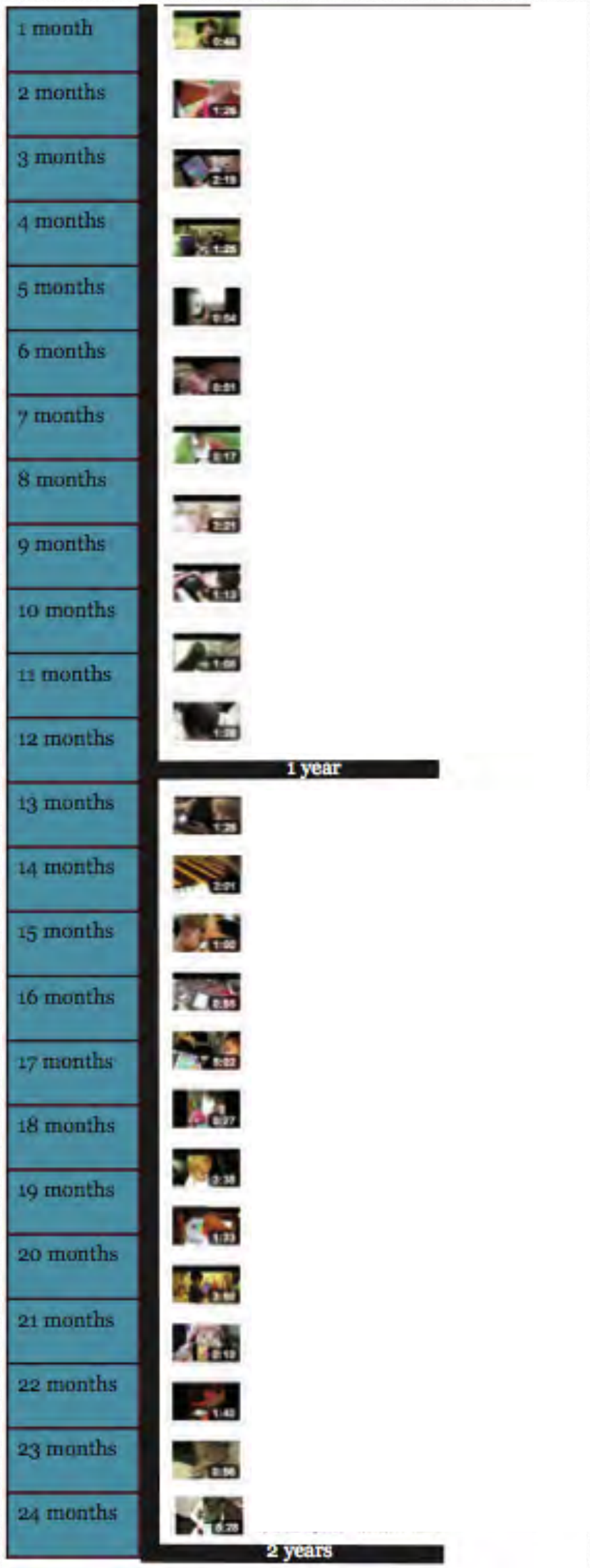
UNDERSTANDING THE IPAD'S LIMITATIONS
While the iPad is amazing, it isn't the perfect children's computer. Here are some problems we've noted:

- Young children move— a lot— and can become confused by features like automatic screen rotation. It helps to turn the lock button on.
- If you have more than a dozen apps, finding a specific one can be frustrating for a child because the icons look similar. The anticipated folder feature (in the next iOS) can help. It would also be nice if the default size of the thumbnail could be changed in size.
- It is possible for children to get into complex apps or features such as the keyboard (when searching). There's also your email, the app store, YouTube or your browser. You can hide and lock these features in the Settings. Go to Settings/General/Restrictions and make a pin.
- The iPad can be heavy and slippery. It helps to use a silicon or foam shell that fits snuggly around the iPad, increasing the grip and serving as a cushion, just in case.
- Plugging in the cable for charging could be much easier. It has to be facing up, and finding the port ("which end?") is confusing.
- The volume is hard for children (and adults) to find and understand.

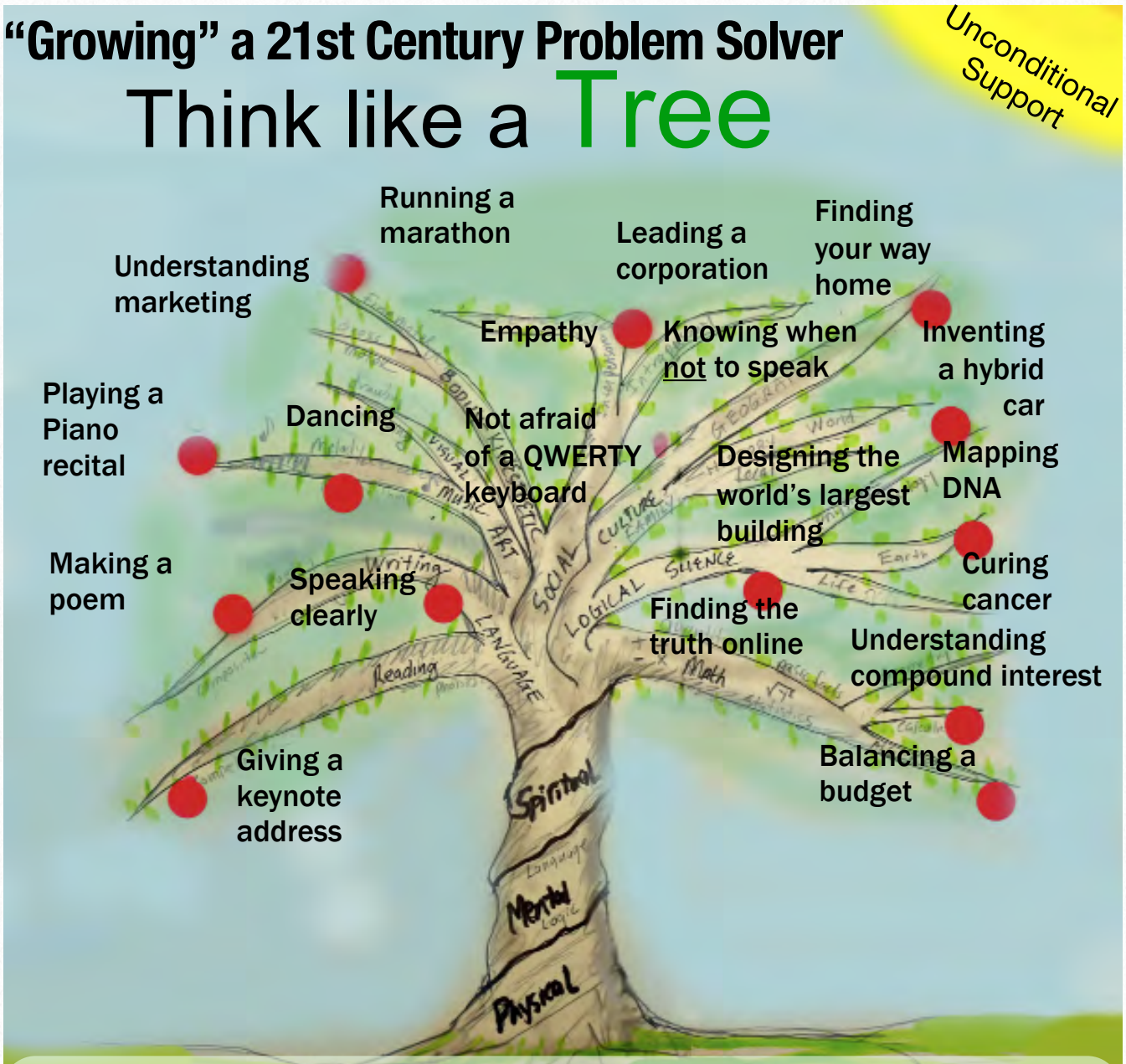
WHAT'S IT ALL MEAN? The key to unlocking the power of the iPad for children is to watch how they use it. Stay tuned for some pretty amazing children's apps in the upcoming year as more children's developers figure out how to better tame the full potential of multi-touch screens. These will undoubtedly expand beyond the iPad to the iPod Touch, Microsoft Surface and Android-based devices. Besides being good for children's interactivity, the iPad effect is important for adults and busy teachers who don't have time to fuss around with a mouse and keyboard. All they have to do is reach out and touch.

Table 2: YouTube Multi-Touch Examples, by Age

A (Rough) Developmental Listing of Multi-Touch Interaction Styles During the First Two Years of Life



YouTube Playlist



I started using a tree metaphor for human development when I was a consultant at the High/Scope Educational Research Foundation; like Stone Soup many people have contributed ideas to the tree parts. This model has limitations. For example, because it considers a single individual, it doesn't help us think about the influence of culture (see Vygostky) — that a "tree" is part of a forest. But for a single child, I've found it to be useful. I've since added Maslow (in the trunk) and Gardner (in the branches). By Warren Buckleitner.

We all tell our kids "someday, you'll grow up to be the President." Could technology help with the job? If so, how? During a presentation I prepared for the Darien, CT Public Library (called "Raising a 21st Century Problem Solver: A Recipe for Modern Parents.") I had to come up with a recipe. That's what inspired this article. But first, here's a strong disclaimer: that parenting is loaded with "known unknowns" to quote Donald Rumsfeld. I'm willing to share my own "best-guess" at a recipe, based on what worked and didn't work for our particular family. However, we must all first agree that (1) parenting is a humbling process despite college degrees and hundreds of advice books, and (2) every family recipe is unique. Ours, for example, involved moving a piano across the country and adopting a rejected New Jersey race horse. Who would've guessed? To help with the job, I shared a tree metaphor for child development, updated to put technology into context.

"Before I got married I had six theories about bringing up children. Now I have six children, and no theories." John Wilmot

Technology can be like Fertilizer....

Access to quality, developmentally appropriate technology at each stage can increase a child's chances of bearing fruit. But too much fertilizer can burn the plant, so use in moderation.

BABIES & TODDLERS

- Rattles, toys & apps like doorbells, piano keys and light switches high in cause/effect that are "food for the senses."
- Symbolic representations of the world are less effective at this stage, especially if non-interactive.

PRESCHOOL

- Tools for creative expression with both music and/or touch.
- Offer a choice of easy-to-use, well designed apps and video games, on various platforms.
- An iPad, Nintendo DS, Leapster, MobiGo or iPod Touch.
- Old fashioned bedtime stories.

EARLY ELEMENTARY

- Search engines with moderate filtering.
- Social games like Pokémon.
- A Wii, PS3 or Kinect for four players.
- A steady supply of new apps.
- Technology supports for emerging passions.

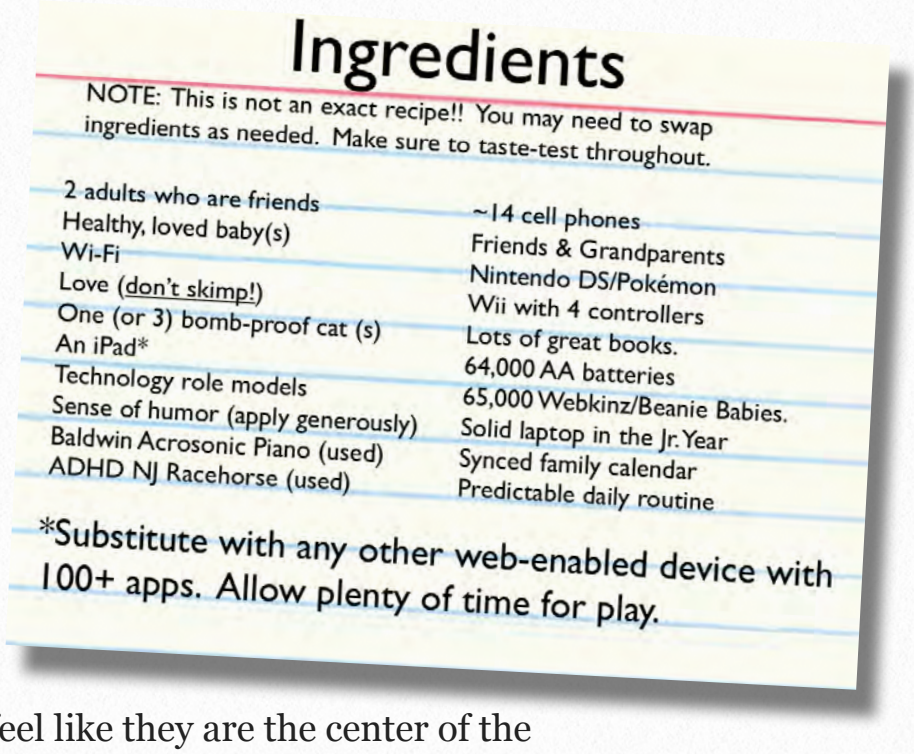
UPPER ELEMENTARY

- Programming experiences, like Scratch.
- Free, supervised access to a reliable laptop with a working browser, exposure to both Mac and Windows.
- High doses of love and supervision.

TEEN

- A smart phone w/video camera and if possible, a data plan.
- Their own laptop in the Junior year of high school.
- Facebook/Twitter/email.
- Software for video and photo editing and word processing.
- Open all channels of communication, from smoke signals to SMS to Skype.
- Free access to emerging products.

Here's a closer look at each part:



SOIL AND PLANTING symbolizes a good beginning. You start by carefully setting the stage for the best chances of success, for each stage of life (or your tree). A young seedling requires nutrients from the soil and must be located where it can get gases from the air, sunlight and water. An experienced gardner (a parent/grandparent/pediatrician) knows this process. The beginning involves guesswork, faith and fear that comes with the uncertainty that accompanies this process. You never know where roots will grow, or what the magic is that drives this life force, but you do your best to clear a weed-free path towards success. It helps to have a good pre-natal coach.

SUN symbolizes unconditional love. Every child needs to feel like they are the center of the universe at some point— that their ideas are valued and that there is a place for them in this world. Without sun, everything dies.

WATER symbolizes interesting stuff, for each age and stage. For a young sapling, water is required for the roots to grow. Boredom, or not enough water, leads to withering roots. Increasingly, developmentally appropriate technology options can get and hold a child's interest; and resources like YouTube and Google provide an answer to any question.

TRUNK symbolizes a solid foundation for the challenging times that lie ahead. In this model, there are three parts to the trunk: spiritual, mental and physical, and each needs plenty of water, sun and time.

BRANCHES symbolize the knowledge domains, of the variety that you can find in Howard Gardner's multiple intelligences or on any school curriculum chart. Branch growth is stimulated by exposure to interesting things over time. The older a child gets, the more developed the branch structure. The wonderful thing about raising a young child is that you have no idea how they will turn out. Some children may have a strong musical ability while another might have physical or mathematical aptitude. Many parents want a child that is well rounded, with a variety of skills and competencies, while others seem most interested raising a master athlete or a virtuoso musician.

BUDS symbolize accomplishments, large and small. Each accomplishment, from "I can walk" to "I can play guitar" grows into a LEAF, which gives back to the tree, making a thicker trunk and a more diverse branch system. Leaves need a continual supply of sun (love), and water (new challenges) in order to return each season.

FRUIT symbolizes life accomplishments, large and small. For psychologist Abraham Maslow (Maslow's hierarchy) the "fruit" means reaching a state of self actualization; when an individual accomplishes their life dreams. Fruit is commonly celebrated, on shows like American Idol (musical fruit), or the NCAA Finals (athletic fruit). Less obvious fruit might include making a friend, paying taxes or helping a neighbor in need. Small things can hold a society together.

As parents of 21st century children, we all want our children to reach their full potential. Despite having iPads, Wi-Fi and baby monitors, the process is just as scary as it was in 1963, when a single mother named Anna Dunham was faced with the task of juggling a career and raising her 2-year-old son. But with the help of some Grandparent sunshine, he really did grow up to be the President.

The President of the United States sits on his Grandfather's shoulders in the early 1960s. His maternal grandparents had an important influence on his developing roots (photo from osu.edu image archives).

Section 3. Application

Capturing the Magic of Interactive Media

If you want to design great interactive products for kids, it pays to have one. A kid, that is. Many case histories of excellent design begin when interactive media programmers become parents, as was the case with Shelley Day. Mom Shelley wanted to find new ways for her son to play with his favorite homemade bedtime stories about a little car named “Putt Putt.” Putt-Putt became the “vehicle” that helped Humongous Entertainment become a $60 million dollar company.

It’s all about knowing and understanding kids. For both Mark Schlichting of the Living Books and Craig Hickman, who single handedly programmed the first version of Kid Pix, design success was born out of wanting to improve current products for their own children. Several years ago, Schlichting shared this story of how he became captivated by interactive technology.

“I’m a parent of three boys and I’d bring home what I thought was good learning interactive media. Then my sons would play with it once, maybe twice and that was it. Around the same time, one of my older boys and his friends rented a Nintendo game. In the course of three hours they were up to the 52nd level of play. I thought to myself ‘Look how motivated these kids are to figure this out. There’s an incredible amount of critical thinking going on, but in an environment with absolutely no content. Wouldn’t it be great to use this natural draw to technology to deliver real learning through play and exploration?’” (A Conversation with Mark Schlichting, CSR March 1999).

Watching kids makes you wise. Schlichting’s Living Books went on to become a standard-bearer of quality, loved by children, parents and teachers alike for their emphasis on good stories and entertaining exploration.

Kid Pix, the classic children’s drawing program, was born out of frustration when programmer/ photographer Craig Hickman saw his three-year-old son Ben struggling to use MacPaint.

“I was surprised at how quickly he got the knack of using the mouse and how easily he was able to select tools. The problem was that he didn't have total control of the mouse and would occasionally (like every five minutes or so) pull down a menu and bring up a dialog box that he couldn't dismiss without being able to read. Everything was fine as long as I was in the room, but if I stepped out for a few minutes I would come back and find Ben kicking on the floor in frustration. This was not what I had in mind for his introduction to the computer.” (http://pixelpoppin.com/kidpix/index.html

Thanks to Ben, Hickman went on to design Kid Pix, a rich, open-ended draw and paint program rating high in child control.

Since Brøderbund’s first publishing of the of the interactive media in 1991, Kid Pix has been translated into dozens of languages and used by over ten million children around the globe. By CSR count, over 6,000 children’s interactive media products have been developed in the last 15 years, and you can bet your bottom dollar that the best of these were made by folks who know and love kids. By playing with and observing children— programmers, product managers, CEOs and even reviewers can learn some powerful lessons. To borrow from Bob Hughes’ book on interactive media, Dust or Magic, (Addison Wesley) some of the stuff is pure magic, while some is nothing but dust. Here are some of the ingredients of “magic” interactive products.

LEARN FROM THE LEGENDS

Watch Craig Hickman tell the story of KidPix.

Listen to Mark Schlichting share his secrets of animation.

Listen to Don Rawitsch tell the story of how three student teachers made the Oregon Trail.

Attributes of Magical Design

Is easy to set up. Complex installation and registration routines have damaged the industry. It must be no harder than push the button, and it works.

Lets kids "accidentally" succeed in the first 5 to 30 seconds. Children, like grown-ups, want control! Early success in a program is like that great golf shot— it keeps you coming back for more. The program must provide the most direct path to what Hickman calls "the prime directive." Take the typical racing game. You want to race cars, right? But some racing programs put roadblocks in between you and the racetrack, in the form of layers of customization menus. Let me race the car. Give me the preferences if I want them.

Overdelivers and undersells. Few products build customer loyalty faster than interactive media. Parents and teachers can see the difference a well designed program makes for a child, and this builds an emotional bond to the product.

Has a crisp, responsive interface that wants to please. Each program takes a child into its own little world, with its own set of rules, and a distinct emotional climate. We tell designers to imagine their program as a "dinner date." Some "dates" talk way too much, can't be interrupted, or don't remember things you'd already discussed. Author Bob Hughes offers another way to look at an interface, using a good dog as an analogy. Most computer interfaces are like "stuffed dogs"-- static, they don't do anything. Other programs or toys are like hyperactive puppies—with so many writhing, flashing icons, they look like the Las Vegas strip. The "new & improved" Kid Pix 3 suffers from this fate, because an artist decided to overstylize the icons at the expense of child control. A "good dog" interface is alert, alive and "ready to help," but it doesn't detract from your attention. Developers forget that children are very tuned into subtle messages that they get from the program. Tiny delays in the action, non-intuitive icons, or sluggish reactions to a click can convert feelings of control into irritation.

Is consistent. Any teacher can tell you... when children know the rules, they settle down and are much less likely to misbehave. A good interface establishes the "rules" early on, and keeps them the same. Want to see a child throw a mouse? Make an icon that works only after the narration has stopped. Worse, make the same icon do different things, or put two "exit" icons on the same page. Hughes calls programs that change themselves around "Gestapo Interfaces" and compares the experience of trying to use a poorly designed web site (of which there are no shortage) with talking to a paranoid schizophrenic, where the rules can change at any time. "Do I click, or don't I click? How do I get back to that screen I was playing a few minutes ago? Where's the undo? ARGGGH!"

Helps kids know where they are. Most interactive media uses some kind of "space" and that space needs to make sense to a child. One of the simplest approaches is to keep everything on one screen, like Space Invaders. Other tried and true techniques include an octopus-like storyboard, with different activities radiating out from a constant menu screen. Maps are another useful navigational tool. Programs like School Zone's On Track series keep a constant navigation strip on the bottom of the screen. In this case, the strip is made of footprints, each one representing a page. The longer a child plays, they more footprints are filled in. Once they get to the edge of the screen, they've completed the book. Define the space, define the goal, and have a visible reminder of progress.

Doesn't underestimate or talk down to kids. A wise Mississippi preschool teacher once said "young children can't spell hypocrite, but they know what one is." The same goes for interactive media interfaces. Even very young children are smart when it comes to sniffing out the real play value of a product, especially programs that are dressed up in flash animations. Media pioneers such as the late Walt Disney understood that children can be the harshest critics. Kids respond to (and deserve) good art and music and original full-strength storylines. They don't like being talked down to, patronized or underestimated. Interactive media developers should be well versed in child development, so they understand what kids can do and when.

Follows tried and true play patterns. We call it "riding the horse in the direction it's going." Think about it. Why are RPG (role playing games) so successful? Simple— children love to pretend. RPG games are natural extensions of what kids are already doing. (Of course in our day it was cowboys and Indians, not warrior princesses and aliens!) Programmers and designers should spend some time at the playground. Things you notice there can end up as important elements in your products. Hickman writes "When Ben built something out of blocks, he enjoyed knocking his structure down almost as much as he did building it. Getting rid of the picture should be fun." Hence Kid Pix' exploding firecracker eraser, one of the greatest (and most controversial) menu tools ever created. Other good designs let children interact with products in ways that aren't always intended, another hallmark of children's play. Stretching a graphic or font way too big, piling up layers of stickers, creating chaos; are all part of sending the message to the child that they have control of this world.

Offers social experiences. Kids like games they can play together (ask Nintendo why they have four controllers). They also like games where they can print something out and share it with others, another important social opportunity. The Internet has connected computers, making the hard drive a virtual one. The Instant Messaging phenomenon, both on computers and handheld toys, is evidence of this "magic." The ability to play basketball with another person across the country, or to drive a submarine in Castle Infinity (you steer, I'll navigate), or capture the flag in Disney's Atlantis, all create interesting contexts for socialization and group interactions.

We have a long way to go before all the bugs are worked out and these interactive social experiences are fully studied; but this trend is certainly the wave of the future and has "magic" written all over it.

Enemies of Magic— (What Makes a Product "Dust")

It's not really accurate to classify all children's interactive products into either "dust" or "magic." Few are actually dust, most are fair, many are good. Only a dozen or so per year really stand out as "pure magic."

Those products that are "dust":

- are hard to install or crash
- talk too much
- offer too many symbols and abstractions that are not part of children's past experiences
- sacrifice ease of use for trendy design
- talk down to kids
- too hard or too easy
- lack "crisp" interactivity
- are inconsistent and confusing

An iPad's point of view on a group of children. As a designer, it's alway critical to keep this perspective.

What All Interactive Media for Children Must Have

✔ Clear picture menus that do not require reading

✔ Simple “one layer” menus that provide direct access to activities

✔ Limited wait times to match short attention spans

✔ Quick, clear response to keystrokes

✔ Interruptible routines (e.g., opening sequences, animation, etc.)

✔ The ability to handle “machine-gun” tapping without buffer problems or crashes.

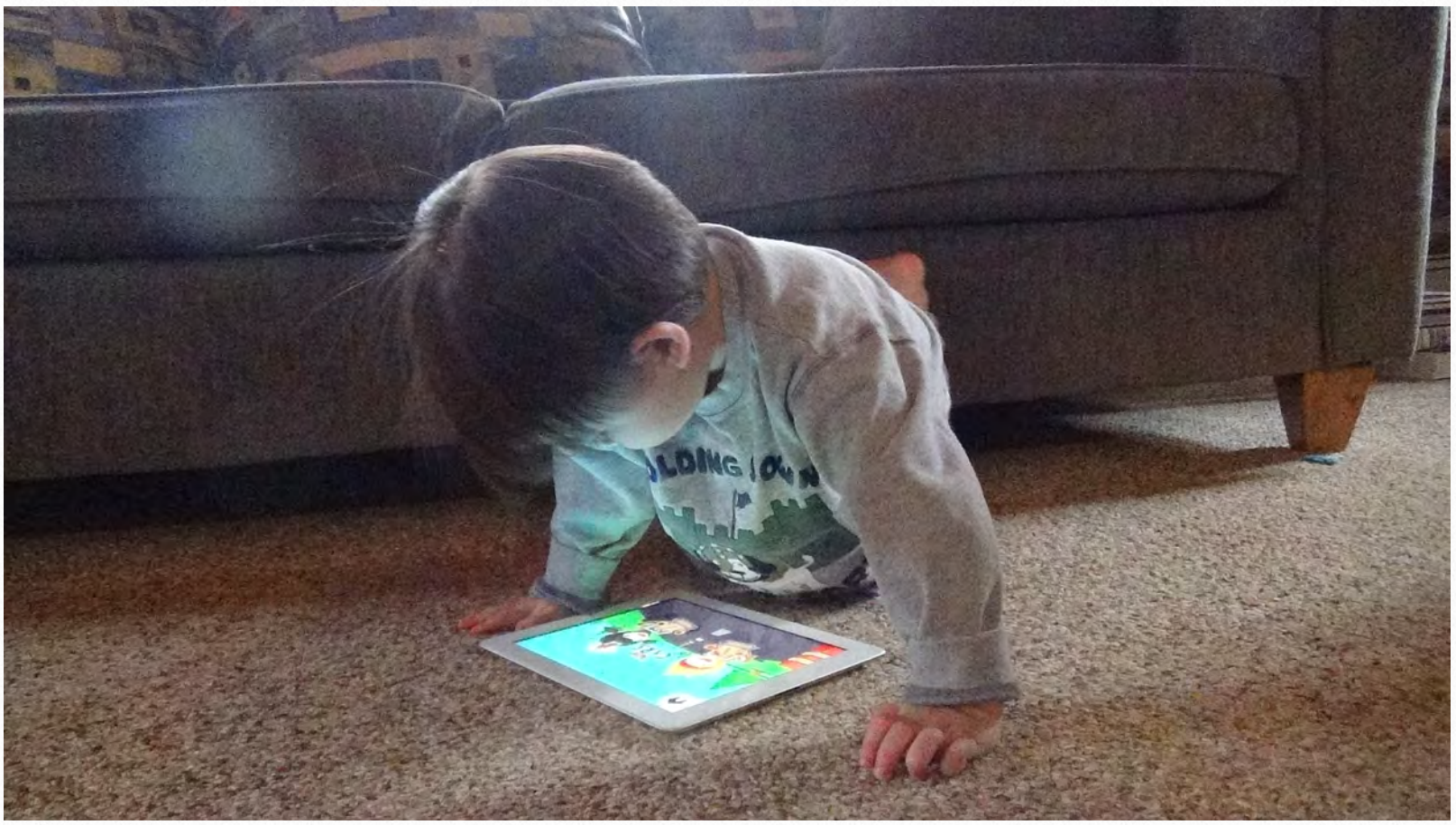
✔ Help that’s delivered via clear speech in the context of the problem (the program should not jump to a separate help sequence).

✔ Icons that are large, understandable to children (meaningful) and easy to select. Avoid using “phantom icons,” in other words, objects that ask to be clicked on but don’t do anything.

✔ Picture-driven printing and saving routines (not text-driven). Parents or teachers should have options for disabling the printing routines.

✔ Feedback/help that goes beyond simple reinforcement messages such as “nice job” or “try again.” The program may narrow the options (to increase the chance of success on a second try) or provide a hint to coach the child along.

An well designed children’s interface invites engagement, like this door knocker (from the streets of Bologna, Italy).



The Roots of Magic in a Structured Activity

A dissertation on the Effects of Praise and Reinforcements on Engagement

One Activity and Two Interfaces (download full study as a PDF)

There is an established body of research that has examined the interaction style between humans and children.

Some studies measured behavioral outcomes, such as various aspects of the educational effectiveness of the interaction. In the famous "wait-time" study, Mary Budd Rowe (1974) observed that the average time teachers waited between asking a question and taking further action to elicit a response is about one second. When a student responds to the question, teachers wait, on the average, less than one second before reacting to the response. Rowe called these two time periods-- the period between asking the question and acting further, and the period between the student's response and the teacher's reaction-- wait time. By asking teachers to increase their wait time to between three and five seconds, she observed a 300% increase in the length of students' explanations (Rowe, 1974).

Teacher/child interactions have been documented in intrinsic motivation literature (see Ames, 1990; Brophy, 1981; Lepper, 1985; Smilanski, 1968; Stipek, 1988 to name a few). Directly related to the study described in this dissertation is the literature that considers the quality and quantity of a child's engagement with a given task, as influenced by an adult/child interaction style. This relationship has been documented by Gerald Mahoney and James MacDonald (2003) with a population of young children with and/or at-risk for developmental problems. When children and parents or caregivers participated in two types of interactions (didactic and responsive), a positive relationship was identified between a responsive interaction style and children's social and linguistic development (Mahoney & MacDonald, 2003; Wolock, 1990; McWilliam et al., 2003).

Are there observable differences in child behaviors in two versions of the same software sorting activity, one with a high level of instruction and reinforcement (high computer control), the other with relatively few instructions and reinforcements (high child control)?

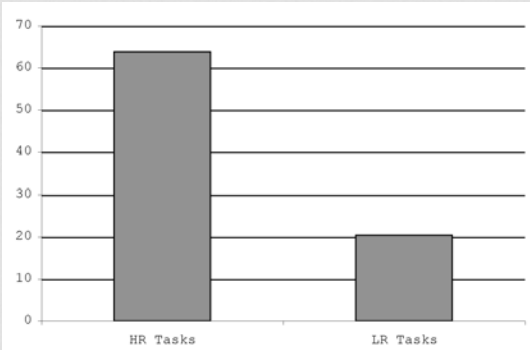
Designers and evaluators of interactive media products for children should pay careful attention to the degree to which the implementation of control mechanisms such as reinforcements can have substantial effects on children's interaction with the software.

I was interested in looking at these relationships in an interactive media context. A computer classification activity was created that was modified to simulate two contrasting teaching styles, similar to the Mahoney & MacDonald technique. The first style, called "high computer control" attempted to simulate a teaching style where the teacher carefully introduced each problem, and provided frequent praise and encouragement throughout the experience. As a result, the child had less control over the flow of events, making the experience less responsive. The second style, called "high child control" presented the identical sorting experience with the instructions, praise and encouragement turned off. As a result, a child experienced more control over the events, resulting in a more responsive overall experience.

Control was varied by changing the quantity of instructions and reinforcements. The engagement of the child was measured by counting observable child behaviors. These included 1) the number of tasks completed, 2) the number of clicks, or attempts to influence the instruction flow, and 3) the length of time the child chose to spend with each condition. The study population was 38 preschool-aged children.

The Results in Brief

The measures revealed some interesting, statistically significant ($p < .05$) relationships.



MORE ACTIVITY:
Children in the high child control treatment were more active, completing more tasks (mean = 64 vs. 20; p < .05), clicking the mouse more times (mean = 129 vs. 73; p < .05), and getting more tasks correct (mean = 41 vs. 16; p < .05). Children rated both experiences highly, and spent about the same amount of time with each condition.

Children in the high child control setting performed more mouse clicks (129 vs. 73) and had lower accuracy rate for problems (68% vs. 85%), in about the same amount of time. In the high computer control setting, there were more clicks per task (mean = 4.07 vs. 2.09; p < .05), and children had a higher accuracy level (mean = 85% vs. 68% respectively).

MORE CORRECT ANSWERS:
Children attempted over three times more problems (64 vs. 20) and more than twice as many correct answers (41 vs. 16) in the high child control condition. While no significant differences were found by gender or session administration, the age of the children did matter in terms of the amount of time spent with the task.

MORE CLICKS:
Children clicked more in the HICHILD setting, but had fewer wasted clicks than in the HICOMP setting. For the purposes of this study, a click is defined as the two part motion (and up and down stroke) when children choose to interact with the interactive media interface. The click was easily counted due to the distinctive sound associated with stroke, as well as the visual clues provided by screen events.

In the high child control setting, children clicked more (mean = 129.08 vs. 73.68 respectively; p < .05) over the same amount of time as the high computer control setting. This outcome has more meaning when interpreted in the context of the number of problems completed in each setting. In the HICHILD setting, children attempted more than three times (320%) the number of tasks (63.8 vs. 20.4; p < .05), resulting in a click per task ratio nearly two times (194%) that of the HICOMP setting (4.07 vs. 2.095; p < .05). To conclude, when responsivity was increased, children were much more active, clicking more frequently; and more of those clicks were related in some way to an intended outcome (from the perspective of the interactive media designer). In the HICOMP treatment, the added narration and reinforcement statements seemed to create a barrier to child's activity and problem solving effort.

YOUNGER CHILDREN STAYED LONGER THAN THE OLDER CHILDREN The ANOVA revealed some notable findings when the entire group of children was divided by younger and older age groups. The 14 younger children, aged < 50 months on average chose to stay with the experience longer than the 22 older children (p < .05) regardless of the experimental condition. An explanation for this may be the challenge level, which started with three objects to sort, based on one attribute, and increased to five objects and three attributes. Because most of the problems were geared toward the middle of the age group (46 to 52 months), the older, more competent children more quickly exhausted the novelty and challenge available in the experience than the younger group, resulting in a loss of interest, and less time on task. For designers, this helps illustrate the importance of having a fluid challenge level that either automatically adapts to the child's ability level, or that lets the child have some control over the challenge setting.

CHILDREN TRIED MORE PROBLEMS IN ONE CONDITION. In the HICHILD condition, the children were 317% busier, attempting 63 problems in approximately the same amount of time spent in the HICOMP condition with only 20 problems solved (p < .05).

When children experienced a more structured and controlled interface with a high level of narration and direction, they showed a decrease in activity, as measured by number of problems attempted. Anecdotal observations supported this observation, with more fidgeting, yawning, and placing head on the table during the HICHILD situation.

Another observation relevant to this topic was that the HICOMP treatment work was more accurate, with a higher percentage of correct answers (84.95% vs. 67.97% respectively; $p < .05$). When there was increased activity, there was a decrease in accuracy. When the sum of correct answers, however, was compared between the two conditions, during the HICHILD condition children ended up with 393% more correct answers -- 41.0 vs. 16.1 ($p < .05$).

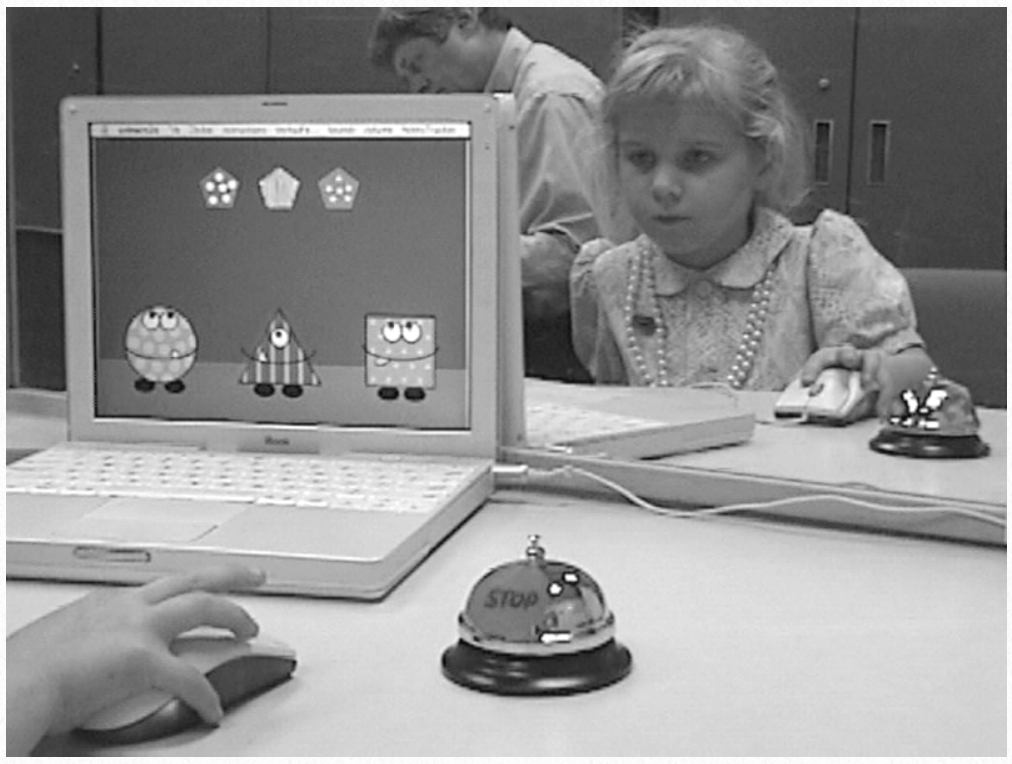
Interpreting the significance of this finding is dependent upon the theoretical framework and associated instructional objectives of the interactive media designer. If the end goal is for the learner to solve a higher number of correct answers and increase the amount of experimentation, the HICHILD setting is the preferable design. If higher accuracy regardless of the number of problems is the only goal, the HICOMP setting is the preferable option.

4. The older group of children chose to spend less time in the HICHILD setting than the younger group of children. When the population was grouped into two parts by age (over 50 months and under 50 months), there was a significant and interesting difference in the amount of time the two groups choose to stay with the activity. Regardless of the experimental condition, the younger group stayed longer than the older children ($p < .05$) although the HICHILD setting held them longer. (610 vs. 442 seconds, whereas the HICOMP setting was 573 vs. 567 seconds).

5. Children rated both experiences highly, but anecdotal observations seemed to indicate that children generally preferred the HICHILD treatment over the HICOMP treatment. A formal measure of the child's feelings about each treatment was attempted using a Likert-type scale. There were no significant differences between the two groups (4.65 for HICHILD, 4.58 for HICOMP; $p > .05$). When children were asked "how did you like it?" immediately after a treatment, they would say either nothing or that they liked it, by touching one of the smiles faces. It was hypothesized that children would rate the HICOMP experience lower than the HICHILD setting. This was not supported by the survey ratings.

Additional information was gathered less systematically, by observing children's reactions when their turn came up to play the second trial. In general, they would respond enthusiastically to the idea of coming back to the room to play the game some more, regardless of the first condition they experienced.

Nine of the children, generally older, were able to verbally compare the HICHILD and HICOMP treatments after the second session. From these videotaped conversations, it was possible to determine that these children had more positive things to say about the HICHILD experience. In order to more accurately understand children's reactions to each treatment, additional exposures to both the HICHILD and HICOMP treatments would be necessary, over a longer period of time. It is likely that children would have a more discriminating attitude toward between the two treatments after the novelty of the experience is reduced.



This study helps connect the established principles of human/child interaction to computer/child interaction, including the role of external reinforcements and the level of responsivity of the interaction. The results of this study suggest that designers and evaluators of interactive media products for children should pay careful attention to the degree to which the implementation of control mechanisms such as reinforcements can have substantial effects on children's interaction with the interactive media.

Eight Lessons for Structured (Didactic) Activities

The following elements of the Cookie Critters experience appeared to make a difference in the quality of the child's time with the Cookie Critter's activity. These non-systematic observations were taken as notes during each administration session and while coding the tapes.

1. Include a brief, ten second "launching experience." The importance of providing a launching event, or an "anticipatory set" (**Madeline Hunter**, 1982) that could get a child's attention (**Robert Gagné**, 1977) and then provide a clear path for the child to take the next transaction in the interaction played a key role in a child's initial reaction to the Cookie Critters activity. In both the HICHILD or HICOMP treatment, a short, one sentence phrase such as "click a cookie" that is spoken as the clickable cookie is highlighted on the screen, advertised what was needed to do in order to get started. When the launching instructions were toggled off, or when they were set on the maximum setting, the younger children seemed more likely to become lost or distracted.

2. Insure quick success for every child, regardless of developmental level. Approximately five of the 41 children were resistant to participation. This may have been due to some past unsuccessful experience with a computer activity, but it is important to note that approximately 12% of this particular sample seemed to feel strongly that computer activities were not something for them. When the first few screens and the introductory sequence were short, clear and easily bypassed, children seemed more likely to experience some degree of "accidental success." There was one flaw that was identified in the Cookie Critter's activity that affected ease of use for several children. The first screen starts with an inch-wide round target with the printed word "start" on it (Figure 10). In order to unlock the activity screen, children are required to hit this target, which implies that they will know that the button means start. While this is logical to an adult who can read, a preschool child can't, so there is no indication what to do. One way around this bottleneck would be to make the screen so that any click, regardless of where the cursor is, advances the program to the next screen.

3. Incorporate dynamic, or "living" features that are driven by, or respond directly to the child's actions. In the starting screen in Figure 10, for example, children would be more likely to become engaged early on if the eyes in the word "Cookie" followed the cursor around the screen. Dynamic animation properties such as these, that follow the initiation of the child, seem to be effective for increasing initial engagement.

4. Use humor carefully and intermittently. Children seemed to respond well to events such as when the critter burped after eating a correct match, and "bonk" sounds when the cookie did not match. These small events worked very well to support children's engagement.

5. Opt for context sensitive "roadside assistance" in place of lengthy segments of spoken instructions. Ideally, interactive media products designed for young children could be able to sense outlier behaviors, such as series of errors, and respond appropriately. This assistance cannot disrupt the current activity; for example, by launching a new path with a help sequence. It needs to happen out of the way, while respecting the child's current problem solving space.

6. Put children in the role of being in control. In this case, it was being able to be in charge of feeding the cookies, determining which cookie was able to eat, and which wasn't.

7. Capitalize on a child's initial motivation. Each child started both HICHILD and HICOMP experiences with some level of motivation. It is up to the designer to determine how this motivation will be spent. This study illustrated that this motivation can be either used for more accurate responses and less activity, or more activity with more correct answers and more mistakes, depending on quantity of the reinforcements and instructions. In the case of an activity like Cookie Critters, it is a question of the instructional design priorities.

8. Provide a meaningful context, from the perspective of the child, not an adult. The first administration session used a version of Cookie Critters with a visual progress tracking feature turned on. This made it possible for children to see how many problems they had solved, and how many more they had to do before the next challenge level. This technique has been used in commercial software products, including Stickybear Math (Optimum Resources) and School Zone's "On Track" series of software.

Select Articles on Design

Instructions on Giving Instructions

When it comes to designing children's interactive media, former US President Harry Truman might have been on to something when he said, "I have found the best way to give advice to your children is to find out what they want and then advise them to do it." Unfortunately, too many of the products I review were designed by people who've forgotten this free advice.

In countless kids apps, the first few screens are filled with introductions, non-descript login icons, or other control-sapping hoops. Instructions aren't inherently bad things. On the contrary, when it comes to assembling a bicycle or baking a cake, they can be lifesavers. But when it comes to interactive products for young children, excessive instructions can just gunk up the works.

In fact, interactive product designers should take their cues from decidedly non-digital but skilled instruction givers - the people who design children's rides for amusement parks. The Big Rigs ride, found at the Waldameer Amusement Park in Erie, Pennsylvania, is a good example. While standing in line at a nearby roller coaster, I noticed a chorus of goose-like honks pealing through the park at five-minute intervals. Curious about the noise, I wandered over and watched a batch of eager kids climbing into a train of double-decker truck cabs.

Each truck was equipped with two steering wheels and two horns with rubber squeeze bulbs.

There were no instructions or helpful early childhood educators waiting with a mini-orientation. However, instantly, the children started busily exploring the controls with wide eyes and busy hands. Most tested the steering wheel first. Kids over age four seemed to know it wasn't functional, but quickly learned the air horn was no fake. A squeeze made the sharp goose-like honk. Better yet, if you squeezed harder, you got a louder sound. And if you squeezed it several times, several honks followed. And nobody said stop! Soon, another chorus of honks filled the air, as each child signified their understanding of the task: "I'm an active learner, I'm alive, this is my space, and I'm in control."

Contrast this with the WordGirl maze game. The activity would be better if it just showed a maze and didn't assume children need to be told to use the arrow keys - something they probably picked up from Webkinz long ago. Besides, if they can read that much text, they probably don't need practice matching words, right? To make matters worse, the same instructions are parroted at each level.

The dos and don'ts
There are many types of interactive media, so there's no one way to give instructions. That said, here are some general dos and don'ts for incorporating directions into a children's interactive media product:

- **Don't incorporate directions**.
- If you do, keep them Twitter-sized, and remember that children have limited buffers. "Click to start" is better than a mini- lecture on the QWERTY keyboard.
- **Do embed the instructions in the activity, but get children busy doing something like popping balloons or spinning a steering wheel first.** If nothing is happening, then provide an "over the shoulder" instruction, such as "Try the arrow keys to move." If you front-load kids, they just tune out.

- **Don't parrot.** In a sorting game, it's okay to state "Sort the shapes" the first few times. But after the third prompt, disable the feature.
- **Don't assume default ignorance.** The world's most successful interface, Google, has no instructions, yet it is used successfully by millions of children every day, including preschoolers who aren't supposed to know how to type or read. Google replaces prompts with white space.
- **Make every first level a tutoria**l, but don't call it a tutorial.
- **Support all learning styles.** Give the traditional "I read the instructions" type of person by including a complete set of text-based instructions (e.g., the user's manual) in the help icon on the first screen - it's fine to lecture here.
- **Kid test.** The younger the children, the more they differ from one another. If your interface works consistently for 20 kids, you're likely to get similar outcomes with 200,000.

Finally, remember that all of us, no matter how old we are, want to honk the horn.

The “Butter” of Interactive Design -- Active Learning

The great cook Julia Child understood the magic of butter - a substance that can pull together diverse ingredients to create a delightful culinary sensation. And if there's a butter-like equivalent in the creation of children's interactive media, it's active learning. While active learning may be harder to taste than butter, it can have an equally transformative effect on multi-media ingredients.

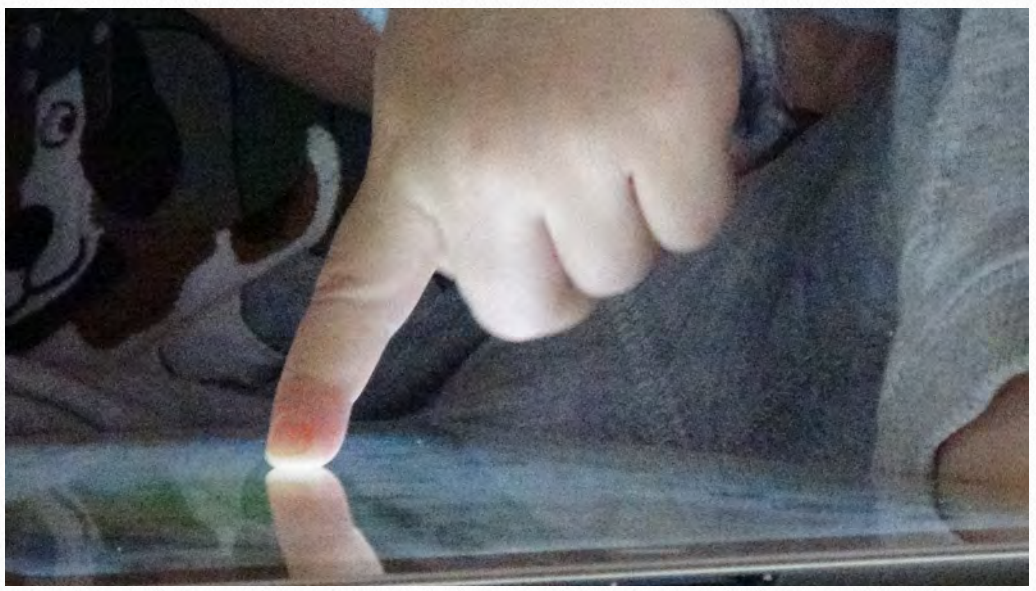
Years ago, early childhood curriculum designers at the High Scope Educational Research Foundation, where I trained teachers, distilled active learning into five components - materials, manipulation, choice, language and support. While we had teachers in mind, these key points work nicely with kid's interactive experiences. To illustrate, let's examine two similar, but differently designed activities. One is made with active learning in mind, the other without. Can can tell which is which? (Warning: this will require some active learning on your part.)

Approach #1: Wheels on the Bus from Sesame Workshop (available at Sesamestreet.org/game). The activity opens with Elmo saying, "Let's play silly songs. Elmo the bus driver is ready to play. This song is, `The Wheels on the Bus.' When you hear the music, press the key." But which key? And if Elmo is ready to play, you're probably asking why can't I just push the keys? Did you notice how you can't control the pace of the song, and how the actions on the bus are pre-scripted? It makes this a flavorless experience.

This activity suffers from "**TV writer's disease**," according to veteran digital designer Erik Strommen. "The dialogue was written as if for TV, not for interactive media, so it's longwinded and not very focused or directive," he says.

Approach #2: Wheels on the Bus from Duck Duck Moose Design (available in the US at the iTunes app store). The only instructions for this iPod Touch/iPhone app involve a silent finger, suggesting where you might touch the screen to open the doors or move the wipers. This activity exemplifies the ingredients of active learning much better than the first.

Now let's examine both games through the active-learning lens. It'll help to run each experience through the following checklist to find out just how tasty it is.



- **Materials** How much content is there to explore? In the first experience, there is just one version of the song and few surprises from page to page. The bus always does the exact same thing. Contrast that with the second approach, where, along with a variety of versions of the song, there are multiple things to click on each page - there's just much more to actively manipulate.
- **Manipulation** You have the content, but what can you do with it? Manipulation encompasses both little things, like rolling over an icon to see what's highlighted, and big things, like the ability to change the background graphic, record your own song, or start a giant bus rolling. The slightest tap makes a big honking noise, and the wipers seem glued to your fingertip when you slide over them. The first approach assumes toddlers are too young to understand these relationships, but nothing could be further from the truth.
- **Choice** In approach #1, children are given no choice in the pace or version of the song or the ability to stop and start over. In the second game, children get to choose the song version or language, and complete silence is also an option. And if you have an iPhone, it's possible to record personal vocals in the dialect of your choosing.
- **Words** As recognized by cognitive scientists like Robert Gangé and Jerome Bruner, for a young developing child, language facilitates cognition. In other words, if you want to get a child thinking, get them talking. The Sesame app talks at children, while the Duck Duck Moose one gives children the option to talk as they listen to different forms of language.
- **Support** Both activities make it impossible to fail. However, the second one does a better job of supporting a child's natural instinct to poke, slide and touch - minus the lecture. As such, a child is better-supported from a developmental perspective.

The lesson here? In the quest to craft the perfect interactive beef bourguignon, good ingredients like popular licensed characters, funny writers and famous narrators certainly can't hurt. But when they're bathed in active learning, a child is much more likely to come back for seconds.

Digital Play-Doh and the Principle of Accidental Success

Can you recall peeling the lid off a fresh container of Play-Doh?

Remember that distinct smell and feel of the fresh stuff squeezing through your fingers? Once you started, it was hard to stop - it's even rumored that some kids may have had a taste or two.

If ever there was a material that delivers on the promise of an immediate no-fail experience, Play-Doh is it. You can roll it, squish it and poke it full of holes. Mistakes are easily reversed by rolling it back into a ball, and your ideas can be can be saved forever when you put your project on a shelf to dry overnight. It is the ultimate interactive play substance, and failure is not an option.

Now consider the first screen kids encounter on their favorite website, toy or app. Besides Play-Doh's strange salty flavor, do they have similar attributes? Do they have what's become known around our office as the "accidental success" factor that mirrors that of the famous molding compound? It's what we look for in every interactive children's product we review. Here's our checklist.

Accidental success defined
A good product has to meet many requirements, but few are as essential as accidental success - especially when it comes to interactive devices and software designed for kids.

- Is it responsive? If you jab it, do you get something?
- Can you operate it with your elbow? Try this. Close your eyes and start touching things. Can you do something right, or more accurately, non-wrong?
- Is it smart? Can it tell if you are simply guessing and provide help as needed?
- Does it require reading? Could a non-reader succeed within the first few screens?
- Is it reversible? Can you get out of anything you get into?
- Does the first level ensure success for even the youngest child?
- Could your cat make it work?

With checklist in hand, it's now time to look at two examples. Both apps are designed to give children a musical experience. One exceeds the criteria for accidental success, while the other is cluttered with instructions.

Go, Diego, Go Musical Missions

The music and the main menu are certainly nice, but the activities are frustratingly didactic in this iPhone/iPad app designed for Nickelodeon by Chewy Software. There are six songs, including "Jingle Bells" and "Mary Had a Little Lamb" each set in a different environment (i.e. the Savannah or the Arctic). The instructions are excessive and Diego talks too much. Also, the notes on the flute don't line up with the notes on the musical staff, which is confusing. One child in our review group even noticed that you can get through a level faster by randomly pressing notes instead of acting on Diego's clues. (Available at www.nick.com, US$1.99.)

Magic Piano

Ideal for children, adults or cats (according to YouTube), Magic Piano turns the iPad's multi-touch screen into a twistable, turnable, resizable piano keyboard. In default mode, it starts with the press of a key and emits a clear note. At any time, you can switch to a different keyboard layout, or squeeze or stretch the keyboard to add or subtract keys. You can also play chords, just like on a real piano. An interesting and somewhat spooky feature of the program is the duet mode. If your iPad is online, you can play a tune with someone else who is also connected to the net. In the "world" mode, you can see where the songs are be-

ing played on a map of the globe. A control panel lets you control such things as auto-sustain and pitch mapping. If you're looking for an excuse to purchase an iPad, Magic Piano just might bend your arm. (Available at www.smule.com, US$0.99.)

To be fair, it is not entirely accurate to compare such differently designed experiences, especially when one has the advantage of featuring a popular licensed character. However, it is fun to think about how to redesign Go, Diego, Go Musical Missions, mixing in a dash of accidental success.
And if you need reminding what I'm talking about, go out and pick up a fresh eight pack - of Play-Doh, peel back the lid and enjoy a sniff.

The Waterline Principle

When I was doing teacher training for ECE classrooms, I came up with the "waterline principle" to help teachers visualize material access. This means that you set up an environment for children where everything they can reach is "on limits" rather than “off limits.” You create an imaginary line that represents the **tallest child's reach**. All toys and materials that are above that line should be out of sight, and out of mind, as to not tease a child with choices they can't have. Everything below the line should be fair game for use.

What does this mean for children's interactive designers?
First, designers need to take a global look at their experience, starting with the packaging and installation and ending with the exit routines. Most trouble happens when starting or ending an interactive experience.

Typing in a registration code or reading an acceptable use policy is above the complexity waterline. Preferences such as network settings or your computer's clock are the equivalent of your classroom's supply closet. You don't want children to be playing in there. So they need to be out of sight, and beyond a child's line of sight. If you have preferences, say for changing players or for adjusting the sound, you need to make sure they are usable by the intended audience. Otherwise, you open the possibility for frustration.

Instead of the tallest child, think about the most bored and curious child. They're the ones that are likely to test the limits of your interface.

Building Feelings of Ownership in an Interactive Space

Everyone wants to attract kids to a website, or keep them interested in a new video game. The secret? You just need to employ the FOO factor. Instilling FOO (a.k.a. Feelings of Ownership) in children within their first few minutes of using a game, website or interactive application may be one of the most important keys to digital success. It works like magic. Just ask game designers Shigeru Miyamoto of Nintendo or Will Wright from Emeryville, California-based Maxis. Neither are strangers to the concept of FOO - or money.

Not sure where to start? Keep the following in mind.

- Can you turn up, or turn down the music or sounds, or is there an obvious "mute" button?
- Can you pause the game at any point?

- Does the program ask for your name upfront, and then use it at various points in the game (e.g., on a bill board in a racing game, or hidden in an I SPY puzzle?)
- Let kids choose the gender and ethnicity of their individual digital characters.
- Give the child a variety of "skins" or customizable elements to choose from. For example, if the game or environment provides users with a room, give the kids the ability to click on the walls and toggle between different wallpaper designs. Also, make sure one is white, in case they don't feel like having any designs pushed at them.
- On-the-fly control. If there's music playing in the background provide a radio icon so kids can choose the channel, just like Grand Theft Auto does in the adult digital space.
- A space of one's own. One of the most compelling things about Club Penguin is that it lets kids have their own igloo, where they can store their stuff. Kids come to depend on having a place to sock away meaningful items, so it's worth building that into an application, even if it isn't the focus. Note that if you let them collect stuff, make sure you don't use it as blackmail to get their parent's to subscribe. See the Code of Ethics.

Kids aren't always good at articulating what they need to adults, so let me try to translate for them. TVs, books and movies are your (the producers) space. Interactive media, on the other hand, is as much MY space as YOUR space. Please give me some.

Miyamoto's Mii avatars populate the millions of Wiis installed in houses across the globe and represent the underlying philosophy of the revolutionary console-every player is instilled right off the bat with FOO on every game. Instead of filling the grandstands with animated characters in Mario Kart, for example, kids get to see their best friend's Mii avatar cheering them on. They feel part of the game.

Wright has famously applied FOO to SimCity and The Sims, which includes a powerful set of face and body editors.

The best part of FOO is it's royalty-free. No business entity owns the concept. And it's not new. Remember Mr. Potato Head, Play-Doh, Lego and sandboxes? All are high in FOO.

Pondering Pokémagic

OK class, it's time to learn about effective interactive design. Today's case study? Pokémon.

I was reminded of the power of the Pokémon brand recently when I spotted three style-conscious high school boys, each with a red-and-white Pokéwalker pedometer hanging off their belts. These guys are supposed to be too old for Pokémon, but apparently they didn't get the memo.
The gadgets, which are included with the some titles, like Pokémon Soul Silver and Pokémon HeartGold are part of the property's interesting recipe for creating interactive design that works.

And adhering to the recipe is what's helped the Pokémon franchise hold up so well against the continual ebb and flow of video game technology. It also helps us understand why there's a Pokémon store in Rockefeller Center in New York City.

Of course, the best way to understand why Pokémon works so well is to cough up 40 bucks and play it yourself. But if you don't have the time or money, start by watching the first 12 minutes of one of the new Pokémon demo spots filmed in real time.

Now consider these eight ingredients.

1. Success, right up front: All DS Pokémon games start the same familiar way. The MUC (Minimum User Competency), in this case reading, is well-matched with the task at hand. All introductory videos can be skipped, and it is possible to experience success in the first few seconds of the game.
2. Hooks to a child's life (a.k.a. meaningfulness): Pokémon games let players explore towns, talk to mentors, have friends and take care of pets, which start weak and become stronger with the player's help. And the fight against bad guys could be pulled right out of Carl Jung's archetypal playbook.
3. Free exploration: Pokémon takes place in maze-like sets of connected villages, and players can go where they please, using a map for help. So Pokémon provides structure, within which players can exercise creativity - they can always get out of whatever they get into and there's no single way to play the game.
4. Feelings of ownership: The Pokémon players I interviewed while reviewing this title described their Pokémon experience as "mine." This sensibility is engendered right at the outset. Children enter their names at the start and they're then embedded into the game's dialogue. This tried-and-true technique is applied with mastery here. Kids can also customize their persona, play as a male or female and give their Pokémon creatures silly (or serious) nicknames.
5. Surprises: You never know what is going to spring out of the grass, or when it will happen. This element of surprise is enhanced by the knowledge that there's a special Pokémon creature waiting for the player at the end of the game.
6. Collectibility: A big part of the Pokémon experience is accumulating items that represent the game experiences. Critics might call it consumerism (see a child's collection of Pokémon swag) or digital trick-or-treating, but the idea of collecting pulls kids in - like magic.

Lessons in App-Craft: Notes from Kate & John

"One night, a prosperous publisher was dreaming up an exciting new app ... "

So began the talk by John Cromie of Touch Press that you can watch at http://youtu.be/R82og144EG8.

John's story, called "the publisher, the app, and his budget" describes how a grand app idea can end with a sadly if it is approached with traditional thinking. His talk was one of two, behind-the-scenes presentations on what Cromie calls "app-craft" given at the first ever Dust or Magic Bologna Masterclass, held the day before the Bologna Children's Book Fair. A second presentation approached the topic from a fiction angle, given by Kate Wilson of Nosy Crow. Wilson also provided a generous look into the Nosy Crow creative process. Note that the notes in this article are loosely transcribed from the talks, and should not be taken as direct quotes from either speaker without their permission.

Two talks were given in the context of the Bologna Children's Book Fair in March of 2014.

Here are some of the key points.

Non-Fiction Case Study: Touch Press

JOHN CROMIE is the co-founder and chief technology officer at Touch Press. He's been making CD-ROMs for many years which has prepared him well to lead the team of engineers at Touch Press. Some main points:

• If you have a craft, you must also have a medium (a potter has clay, for example). App-crafters have a new and mostly unexplored medium that has really come into being in the last 12 months, thanks to instantly responsive multi-touch screens with no lag; high speed solid state drives and always on connectivity, not to mention all sorts of sensors and a compact form. What we do with these devices isn't television, books or the web. It's something that is new and unique.

• Go native. While there are a lot of app development environments, like Unity, that you can choose, the Touch Press solution is to use the native SDK so that nothing stands between your creative team and what is possible on that platform. Anything that gets between the ideas and the possibilities presents a new set of constraints.

• The biggest enemy to an app-crafter is an attitude of "it's good enough, lets get it out the door."

• As the technology improves, we, as a larger culture, are also evolving in our expectations of what apps can do, which explains why the notion of skeuomorphism (making screen objects resemble real objects) is starting to fade for the first time. We need to start thinking about an "app" as a much broader thing.

• Understand your medium. A carpenter understands wood and a set of tools, and the limits of what wood can do. The same is true for app makers.

• Interactions between people and apps can be intimate experiences, and this type of special interaction must be understood in the design process.

• Every app is an original work even though it may be based on existing content.

• App-craft requires a creative team with multiple levels of expertise, and each team member must work in sync with the others. This includes knowing each person's limits, and understanding when to back away from a task that someone else might be better qualified to handle. The best attribute for a team member is a passion for both the content and the audience. In other words, a bird lover is likely to make a better app about birds.

• Passionate engineers are those that try their best to come up with a viable answer to the question "what if;" for example, "what if we added another language" or "what if we could put every Disney film on a single screen." It's also someone who never admits "it's good enough."
• Creative teams work incredibly hard, under inspirational leadership and they hate the word "impossible."
• Sweat the detail. (Cromie showed a globe with hand painted tiles, where you could see the brush strokes, as an example).
• Make apps for "all ages." A two year old child can enjoy spinning a responsive globe, or watching text sparkle.
• Save some room for polish, and tidy up the loose ends. Polish is what you do when you've done everything you plan to do, and you have some time left. This is time that needs to be built into the budget.

Fiction Case Study: Nosy Crow

KATE WILSON, Managing Director of Nosy Crow, is a passionate champion for reading, and the role that reading can play to empower a child. Her enthusiasm was baked into every aspect of her talk; and she started by reminding the group "there are no experts, only explorers." Nosy Crow is a 15 person company that has published 100 print books and 12 apps that have inspired the field of children's app-makers with their uncompromising quality. Some main points:

• Fairy tales are extraordinarily robust, which is why we like to turn them into apps. You can bend them and you can twist them, whether it's in a book, film or app -- and they don't break. There's a good reason they've been going for 100's of years.
• Today's children come to an iPad with an expectation about screens, and reading must not be the most boring option for them. We're trying to create new kinds of reading experiences that present different types of reading opportunities in a non-linear way.
• Making our apps is not like a relay race, where one person hands off a job to another. The process is fluid and dynamic, and requires a lot of give-take and revision.
• When I design, I try to empower the child. How scary should we make it? That type of decision affects the level of complexity and the interaction, and it must be just right for the intended audience.
• Nosy Crow apps start with original source material. Little Red Riding Hood began with a close look at ways the story has been told and retold over the years. The idea of giving the girl a choice in the path she takes to get to Grandma's house came from came from one of the classic early versions of the story. Finding these things takes research.
• Nosy Crow infuses fiction with real elements. The clouds in Jack and the Beanstalk come from photographs of real clouds; and a well where Jack finds a key is made from stones that were photographed at a castle in North Wales.
• An iPad screen is roughly the size of one page of a board book. That's not very big, and can feel very limiting to a publisher who is used to a large format printed page. That's why Nosy Crow has implemented several page expanding features, such as the ability to scroll or zoom. We also use motion driven 3D effects to help to make a child feel welcome.
• We have two levels of writing. One has the main story, with a beginning, middle and an end. On top of that, we float non-linear writing which consists of conversations between the characters that, if we're doing it right, increase your understanding of the characters, but won't interfere with the story.
• Imaginative engagement already exists in a book. Our app design invites them further into the experience.
• Like Touch Press, we prefer to use native tools to increase our control over the medium. It's harder, but we've been able to create a box of code with each app that gets better and better.
• It is so important to test with children. We keep lists of the bugs to fix on a collaborative list. We've learned that left and right handed children touch the screen differently, and we've had to adjust such things as which direction characters enter a scene.
• Making an app is a collaborative and collective process, rather than based on a single individual's talents (Wilson frequently seconded Cromie's message about the need for creative teams working together). The work is anonymous in a lot of ways, and that's quite an interesting concept.

A Code of Ethics for the Publishers of Children's Interactive Media

Make interactive products that you'd want your own children or grandchildren to use.

If you care about young children, a look at the ten random hours of young children (ages 3-8) using online content would make you livid. Some sites behave like a manipulative salesman working an angle. Of course not all apps are like this. But the reality is that in the unregulated wild west environment of online content, hits = money, and we don't care about age. When this thinking drifts into preoperational and concrete operational thinking, trouble can begin.

When we started collecting video footage for the Consumer Reports WebWatch study "Like Taking Candy From a Baby: How Young Children Interact with Online Environments" (Buckleitner, 2008) we didn't have a title, and we didn't know what we'd find. Once we watched the footage, collected by parents in ten homes, the hard-edged title was necessary and accurate. The study confirmed that the digital world offers a wealth of opportunity for young children to play and learn. But even in this small sample of 10 families there were repeated examples of attempts to manipulate children for the sake of commerce. Some sites such as Millsberry.com, EverythingGirl.com, M&Ms.com and Hasbro MonkeyBar TV, for instance, appear to exist solely to extend a brand name, or to influence the purchasing decisions of busy parents.

Publishers of children's Internet content need to be reminded they are dealing with an audience that thinks differently than adults.

Considering how easily millions of adults are regularly fooled by offers of "free credit reports," deceptive advertising, and "order before midnight" commercials, it is unreasonable and irresponsible to subject children to the same hardsell tactics. Publishers of children's Web sites need to understand there's more at stake than simply making money.

Publishers of interactive media need to better consider the developmental level of their audience. In addition, they should disclose the publisher, author and studio information. It's hard to imagine buying a children's book without being able to find out who's the publisher, author or illustrator. Yet many children's Web sites bury this information or don't list it. Prices for services should be displayed at the start of a transaction, not the end. The time remaining in a game should be displayed on all main screens in a way that makes sense to a young child. In addition:

- Keep free trials free. Publishers shouldn't require a credit card for a free trial. If there are "hidden" fees, don't hide them. Disclose them clearly.

A Code of Ethics for the Publishers of Interactive Media for Children

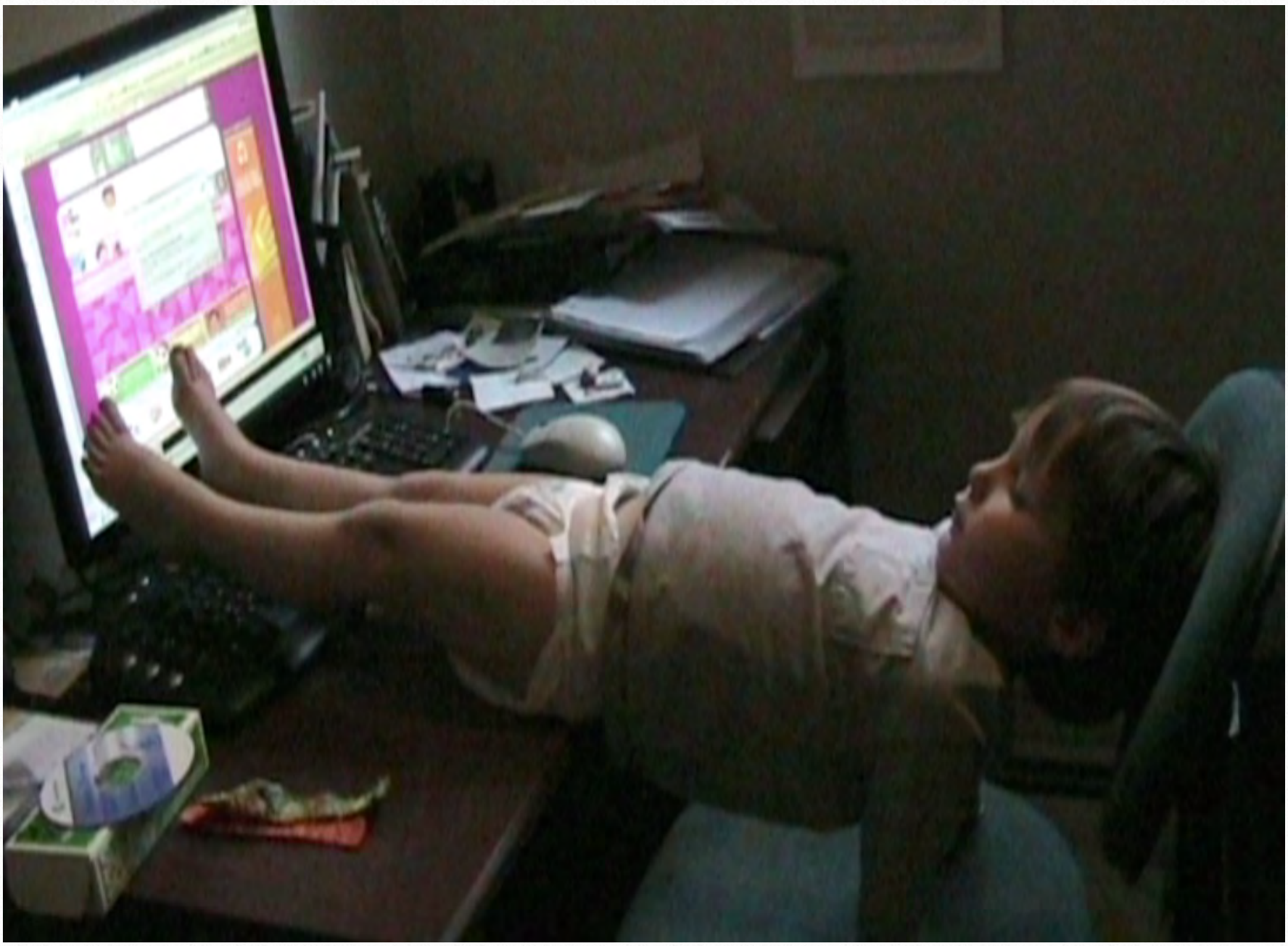
- I will not sell development, e.g., "smarter, brainy kids," without specific references to valid studies.
- I won't hold a child's past work or experience hostage, as an incentive to renew a subscription or purchase an additional product.
- I'll understand the difference between informing and selling, especially when embedding brand names and/or including in-app sales techniques.
- I won't exploit a tired, flustered parent for my own profit.
- I will identify (with name and affiliation) the authors, writers and developers who created my product.
- I will disclose costs in clear language at the start of the consumer/publisher relationship.
- I'll read and abide by the Consumer Reports WebWatch guidelines.
- If I sponsor a contest that will involve the public school system (e.g., students, teachers, classroom time that is funded by public money) I will not use products with indirect costs that (a) require an additional subscription or (b) tease or tempt children with add-on content that costs money after the school year ends. I will also make sure that every child has equal access to the same set of tools and content.
- I will not confuse marketing with educating.
- My product or service will treat every child the way I'd treat my own child or grandchild.

Technology changes quickly. If you want to add a suggestion, send me an email or edit the page directly, and please identify your contributions.

Citation: Buckleitner, W. (2011), A Code of Ethics for the Publishers of Interactive Media for Children, online at http://bit.ly/eo9cui

- Don’t use free trials to entice children into buying subscriptions. Club Penguin regularly displays subscription only items to children playing on free accounts. Our observations demonstrated an instance in which a child clicked on a common object in the game environment which led to the following message: “Oops, you’re not a member, but we’d love to have you become one.” Sites should only display “free” options in free trials.

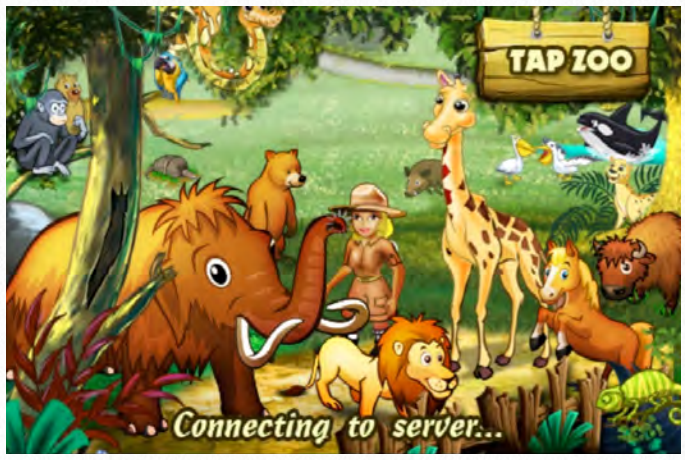
- Don’t try to cover up or play sleight of hand with junk food ads. Our observations noted pictures or graphics proclaiming healthy themes like “get exercise,” or “eat healthy foods,” juxtaposed with junk food ads. This tactic, probably designed to neutralize concerns of parents, is confusing and misleading. Child obesity is a serious health concern in the United States and other countries. Be open about these kinds of ads, avoid manipulation and disclose nutritional value of advertised foods. Don’t dress them up with pictures of broccoli stalks.



See the Consumer Reports WebWatch Study

Why Tap Zoo is a Morality Fail

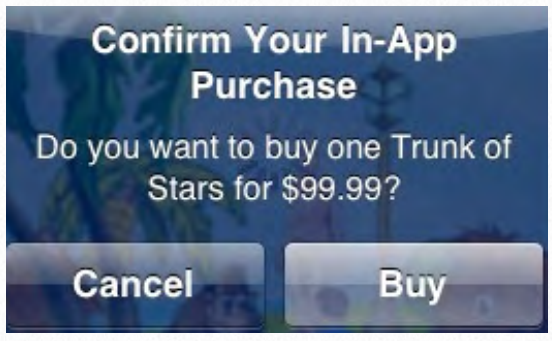
A pretend letter from Daniel Terry and Harlan Crystal, who published Tap Zoo, a top Grossing App.*



Psssst. Hey you. Wanna make some ca$h? A LOT of cash (like $millions?). Here's what you do, and we promise, no laws or bones will be broken. First, find yourself an innocent slighlty bored 5 to 7 year old kid with an iPad or iPod touch. Now come up with an item that kids can't resist. We've had good luck with cute looking animals— stuff that makes a kid say "awwww!"

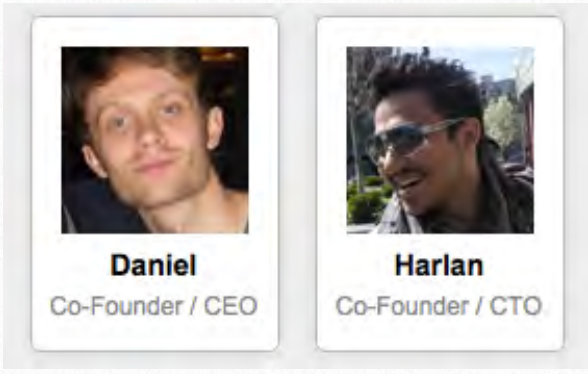
Now make a free app with an icon that has kid appeal. That's your lure; design it carefully. It needs to shout "come play with me!" You can copy a game (we used Zoo Tycoon and FarmVille) and offer up a pair of free gorillas. Make it a snap to download and get started. You need to get the little kids invested and feeling like they own the zoo at the beginning. This is very important. If you want ideas for roping in a child, visit a casino and watch some compulsive gamblers. You can learn how to trick a little kid into wanting to keep playing. For example, every four minutes or so, we deliver a little bit of pretend money, making them think they can buy more animals if they stay with their zoo. It's like a digital M&M, and those little suckers fall for it!

After they are lovey dovey with their gorillas, it's time for the big tease. Show them other peoples zoos, teaming with tigers, penguins, sea turtles, monkeys -- or perhaps even "the Big Castle!" It's mean but it works. You can't have supply unless you have demand, right? Associate the cool stuff with an order form, so those penguin-loving kids start getting on their parents. You see, a six or seven year old kid is too young to understand abstract things like passwords and credit cards. To them, its just part of the "get mom to give me stuff" game that every child is born with. And stop thinking of this kid as a person. She's your mule to get to mommy's bank account. The best part of this whole robbery is that you're going to have Apple driving your getaway car! They keep a cut, but they also cut the checks. Apple is like is your Swiss bank account.



Make sure you use a currency system that sounds fake and harmless. Don't call it "dollars" because that could tip off mom or dad. We use "stars" and one of our competitors, CapCom's The Smurfs' Village, uses "Smurfberries." Another thing you don't want to do is to tell the parents that a simple, functional zoo might cost well over $400, about the cost of a dish washer. Keep these dirty little secrets as hidden and cryptic as possible. Also, sell a lot of starter items for just $.99, to numb them up, so a parent will think, "well, that isn't much, OK, squirt, here's my iTunes password, now keep quiet." Believe me, kids are great at getting that password. We've seen four year olds do it.

The buying part needs to be really thought out carefully. Make it so that when the kid touches the "Buy Stars" you tease 'em with a model zoo, teaming with animals and then deliver them to iTunes as quickly and as frequently as possible. Sure, they'll see the "Do you want to buy one Vial of Stars for $0.99?"warning, and they might hit "cancel" but non-readers have fair chance of hitting "OK." Here's another great trick. Sell stars by the barrel for $99.99! To a kid, a barrel sounds like more fun. Finally, make sure all sales are final. No refunds. How much money can you make? We're over a $million bucks A MONTH! Dude, it's so easy, it's like stealing candy from a baby!



Sincerely,
Daniel Terry and Harlan Crystal, Co-Founders of Pocket Gems (www.pocketgems.com)

**Note: This is a pretend letter (by Warren Buckleitner) based on existing practices. The photos of Daniel and Harlan are from http://pocketgems.com/about/team. We appreciate the fact that they didn't attempt to hide their identity, and welcome their response to this letter.*

Evaluation Form

CTR's Generic Rubric: An Attempt to Quantify Quality."

We believe that a review is the start of a conversation, and it is important to start this process by acknowledging that any two people will have different definitions of quality based on many factors.

Children's Technology Review is just one of many views. Here is the generic version of the instrument we use to generate a program's rating, letter grade, and percentage. While what we use is automated, the version below is non-interactive, and requires some simple math in order to calculate the final rating. Three points for Always, 2 points for Some Extent, 1 Point for Never or NA (the item is not considered in the final calculation).This instrument was constructed to be used as a general framework to capture many of the design factors that are defined in this book. In general, innovative products that are responsive, high in child control and have quality illustration and audio are likely to score higher.

I. Ease of Use (Can a child use it with minimal help?). Score ___

1. Skills needed to operate the program are in range of the child.
2. Children can use the program independently after the first use.
3. Accessing key menus is straightforward
4. Reading ability is not prerequisite to using the program.
5. Graphics make sense to the intended user
6. Printing routines are simple.
7. It is easy to get in or out of any activity at any point.
8. Getting to the first menu is easy.
9. Controls are responsive to the touch.
10. Written materials are helpful.
11. Instructions can be reviewed on the screen, if necessary.
12. Children know if they make a mistake.
13. Icons are large and easy to select with a moving cursor.
14. Installation procedure is straightforward and easy to do.

II. Childproof (Is it designed with child-reality in mind?). Score ___

1. Offers quick, clear, obvious response to a child's action.
2. The child has control over the rate of display.
4. The child has control over exiting at any time.
5. The child has control over the order of events.
6. The title screen sequence is brief or can be bypassed.
7. When a child holds a key down, only one input is sent to the computer.
8. Files not intended for children are safe. The age gate is well designed for the developmental level.
9. Children know when they've made a mistake
10. This program would operate smoothly in a home or classroom setting

III. Educational (What can my child learn from this program?) Score ___

1. Offers a good presentation of one or more content areas
2. Graphics do not detract from the program's educational intentions
3. Feedback employs meaningful graphic and sound capabilities
4. Speech is used
5. The presentation is novel with each use
6. Good challenge range (this program will grow with the child)
7. Feedback reinforces content (embedded reinforcements are used)
8. Program elements match direct experiences
9. Content is free from gender bias
10. Content is free from ethnic bias
11. A child's ideas can be incorporated into the program

12 The program comes with strategies to extend the learning

13 There is a sufficient amount of content

IV. Entertaining (Is this program fun to use?) Score ___

1. The program is enjoyable to use
2. Graphics are meaningful and enjoyed by children
3. This program is appealing to a wide audience
4. Children return to this program time after time
5. Random generation techniques are employed in the design
6. Speech and sounds are meaningful to children
7. Challenge is fluid, or a child can select own level
8. The program is responsive to a child's actions
9. The theme of the program is meaningful to children

V. Design Features (How smart is this program?) Score ___

1. The program has speech capacity
2. Has printing capacity
3. Keeps records of child's work
4. "Branches" automatically: challenge level is fluid
5. A child's ideas can be incorporated into the program
6. Sound can be toggled or adjusted
7. Feedback is customized in some way to the individual child
8. Program keeps a history of the child's use over a period of time
9. Teacher/parent options are easy to find and use

VI. Value (How much does it cost vs. what it does? Is it worth it?) Score ___

Considering the factors rated above, and the average retail price of software, rate this program's relative value.

Poor.....Good

1 2 3 4 5 6 7 8 9 10

Five Attributes of Quality

Easy to use means providing feelings of success in the first few seconds; reversibility and "hooks" of meaning. The interface is crisp and responsive with no lags or "help" moments. The MUC is below the desired prerequisite behaviors.

Educational. You walk away from the experience with something you didn't have when you first came to the experience. And that "something" is deemed of value by the larger culture. Uses scaffolds and over the shoulder more capable other (see **ZPD**)

Entertaining. Well leveled, novel/surprises, a good story,

Features. Can you track progress? Toggle sound/language/levels? Multi-touch?

Overall Value. How much does it cost, vs. how much does it do? Is the price/feature/content ratio worth it? How does it compare with similar products?

Examples

- ☑ Consider the 15 apps that made it to the final list of the 2015 BolognaRagazzi Digital Award. Watch the jurors talk about the 15 apps (out of 193) that made it to the end of the contest, and why.
- ☑ Read "About the Ratings" on the Children's Technology Review site. Watch Chris Crowell and Warren Buckleitner discuss "How We Review Apps"
- ☑ Read "The Hunt for Five Stars." We ask the big question "what does a 5 star app look like?" At CTR, this question guides our search for the holy grail. Like the moving world record line that is super-imposed over an Olympic swimming event, it represents the continually fluid yardstick for quality that we hold every app, game, toy or site against.

Section 4. Keep Learning

Screen from Spot by David Wiesner

One thing you can count on when it comes to children's interactive media is that it will be different tomorrow. Definitions of "dust" and "magic" are fluid, and we all need to continually refresh our knowledge to maintain our validity.

Dynamic Resources

We have continually updated YouTube and Facebook group pages dedicated to current topics; and of course, there's the CTREX database, where you can read or write reviews of the latest products.

Dust or Magic alumni are also welcome to join (or observe) my TCNJ class blogs. I've found young students of interactive design to be a continual source of new tips and techniques. The TCNJ Sr. Thesis has a Google Community at IMM 498 Google Community.

Here's a set of select videos from past talks that will help you connect the dots.

HOMEWORK: Watch two per week; write up notes and be prepared to share.

Big Topics

What is a screen? Designed to challenge the monolithic view of screen based media, this video is a good place to start the conversation about interactive vs. linear media http://youtu.be/a7sw3fQCLOg

What/why is Flappy Bird? What would Piaget say about interaction style? What about BF Skinner? http://youtu.be/v4PlXQGfgz4

What's so cool about Minecraft? This is a pre-Microsoft edition of the PS4 version of Minecraft. http://youtu.be/y70joB8Tm0o

What is "embodied cognition?" Watch the video "Dive" from the Medialab in Amsterdam and explain how it works http://youtu.be/vDqiquvsiZU

Legends and Pioneers

Anyone who has designed an interactive media product over the past decade is a “pioneer.” Here’s a selection of a few individuals who have created magical apps, telling their stories.

Jeff Braun, How pizza and beer led to Will Wright, Sim City and Maxis http://youtu.be/3g1OZlj0dSQ

Raul Gutierrez, Founder and CEO of Tiny-bop and maker of The Human Body shares the story of his startup http://youtu.be/SuQiUwM65f8

Don Rawitsch The true story of the Oregon Trail http://youtu.be/Qhaojwllgqs

Björn Jeffery of Toca Boca gave a useful talk called "how to play, make apps, do good work, and even make a living." http://youtu.be/JPw8WHENTJE

What is **Shigeru Miyamoto’s** favorite game? http://youtu.be/_Fee-6ETQ5s

Pierre Abel: My Experience in the Edu App Market, by Pierre Abel of L'Escapadou https://youtu.be/PXXht2_7cSM

Meet the makers of **LittleBigPlanet**, at Media Molecule. This video was from the game was first released at E3 2007. The magic was easy to spot http://youtu.be/NxX-Fgj04YE

Meet the Makers of Angry Birds at E3 https://youtu.be/f0Lx4-3LPgw

Theo Gray: The Way it Was Meant to be Told -- Dancing With the Mouse. The story of Disney Animated. http://youtu.be/NiUgqs-c7mY

Some have compared the work of the **Spiridellis Brothers** (creators of **Jib Jab**) to the world of the Disney Bros. See if you agree http://youtu.be/PqgmSBep-7g

Becoming a Game Designer, Gender Equity and Child Development

Becoming a Game Designer

IndieCade at E3 2014

http://youtu.be/oXUZHkFB1ag

Daren Carstens on “How I Made an App”

https://youtu.be/slUYeRz4Hc0

Game Designer Advice from Jeremiah Slaczka, Creator of Scribblenauts

http://youtu.be/NQ-BLQ0IJQU

Game Designer Advice from Elliott Olson, the technical Game Designer for Rainbow Studios.

http://youtu.be/7Mhm0_Qg8BE

Drew Davidson - "The Dust Diaries" (why do some projects go horribly wrong?)

http://youtu.be/wHE9u7mxD8o

Gender Equity

Keli Winters: Thinking Beyond the Pink and Blue in Children's App Design

http://youtu.be/nW-TZhiWtzk

Proffessor Klas Halmgren's Gender Mender 3000 at Dust or Magic AppCamp 14 http://youtu.be/KgAw16TzQV0

Child Development

Erik Erikson's iPad, by Chip Donohue. Who was Erik Erikson? Why did Fred Rogers seek him out for child development advice? Here’s a very special presentation

https://youtu.be/nBmiYPRzz2M

New Interfaces

What is the "embodied cognition" as shown in http://youtu.be/vDqiquvsiZU

Exploring the potential of Sony's Project Morpheus, and 3D Goggles in General http://youtu.be/n9qRMLHL8Zg

Painting With Time with Bob Hone, Creative Director, Red Hill Studios www.redhillstudios.com; a demo on May 21, 2012. http://youtu.be/gi2JDw3s62A

Explore and explain the "negative touch" interface in 10 Fingers + http://youtu.be/yeTMEzDXIvg

Fuhu's Giant Android Tablet: How can you start making huddle experiences, for 2 to 10 players at once? http://youtu.be/cgo5beeP5KE

Clifford and I SPY Challenger on a Large Touch Screen: New UI from Scholastic and Intel http://youtu.be/xrGdEWVJ2VM

Furby's Sonic Chirp Technology. How does it work? Explore and explain the sonic chirp technology used in Furby

http://youtu.be/SIXNUWox-YY

http://youtu.be/d0cx-VM9jJc

Explore and explain RFID and NFC technologies used in Skylanders Trap Team http://youtu.be/TACSdAtbJKg

Living Books Legend **Mark Schlichting** explains the Art of the Animated Hot Spot. How do you do it right and wrong? http://youtu.be/cf4n3MJIelA

Wii U underlying psychology https://www.youtube.com/watch?v=sngjkghaoaA

Sony PS4 The Playroom (camera technology). Augumented reality for the gaming masses? Or billion dollar gimmick. http://youtu.be/qSTJc9UqNk8

Nabi Dreamworks Tablet with NFC Features http://youtu.be/5n-Lq1VVt-k

Fantasia: Music Evolved -- a Conversation With Matt Boch. From guitar hero to 4D. What's the future of this technology? http://youtu.be/UX2NG2IyuT0

Zoo Tycoon on Xbox One. What's Microsoft's strategy? Does this game stimulate any ideas, in the way they use voice and facial recognition? http://youtu.be/BdWlg6CA2RY

Publishing, Testing and Magic Making

Publishing

What are the elements of an effective development team? Drew Davidson of Carnegie Melon offers some thoughts https://youtu.be/Gdplt10BvMU

Working With the Press: Do's and Don'ts for App Publishers http://youtu.be/rwwnDrbMSMQ

Barbara Chamberlin: What are we even doing? Rethinking the impacts of our work at https://youtu.be/yEudbuR27Ec

Jason Krogh: Creating Apps Kids Love includes some nuts and bolts of kid testing https://youtu.be/KAVQlqByT3A

Ten Multi-Touch Affordances Every Educators Must Know shows how a multi-touch screen can expand learning and play https://youtu.be/-9MIHbImgU8

What is Magic?

Making magical interactive products is hard work, and often goes unrewarded. Several veteran designers have offered advice

Jesse Schell has given several excellent Dust or Magic talks on the topic of magic, including https://youtu.be/ZoyaBb4y88o

Daren Carstens asks “How do we get better at creating magic for children?” at https://youtu.be/DeDkz4NpttE and also in one of his standing ovation presentations at https://youtu.be/CLA_qFZnPME

A Literacy Theory Crash Course

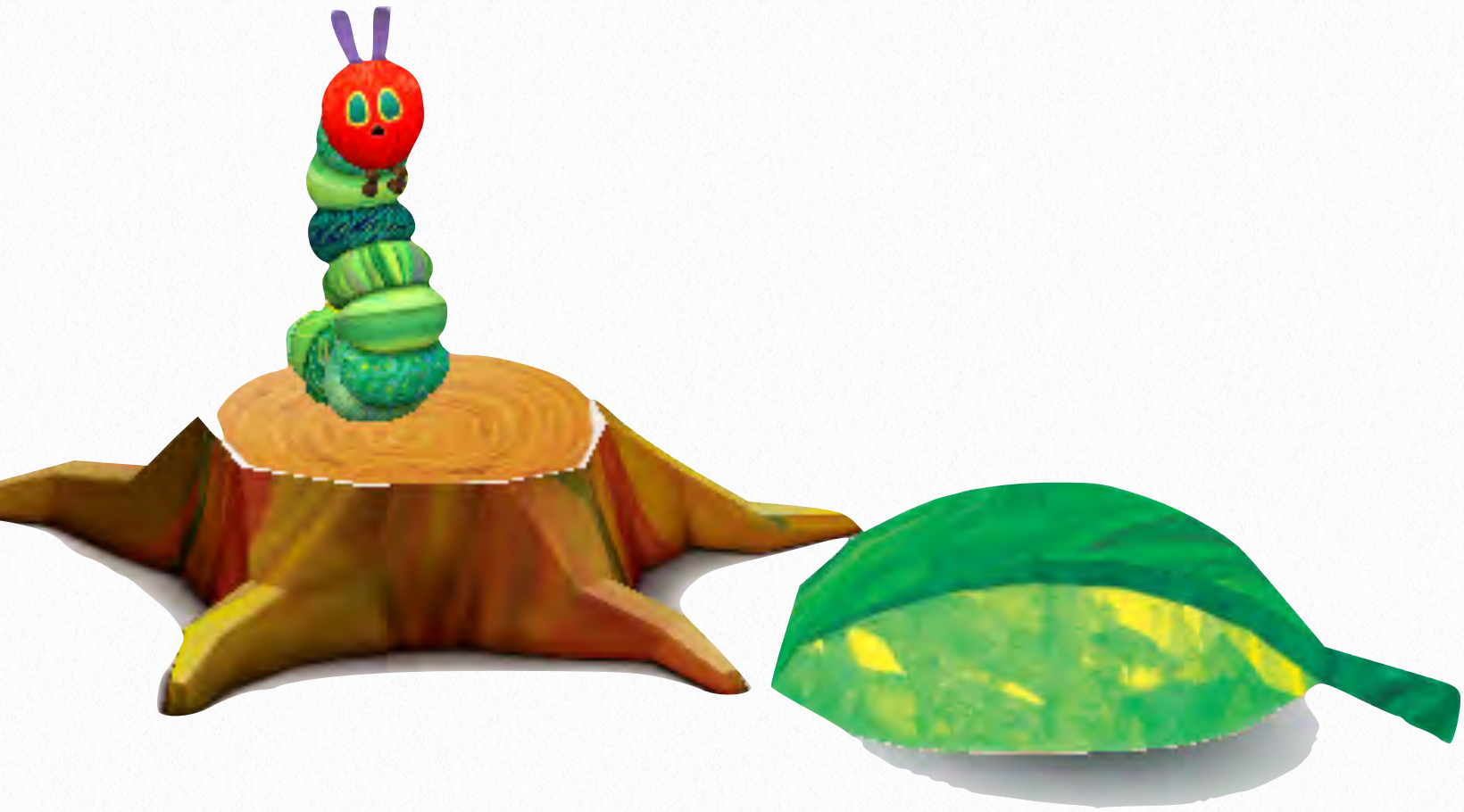
The Dust or Magic eBook Retreat at the Highlights Foundation considers interactive products related to literacy, specifically reading, writing, creating langauge, and techniques for supporting emerging readers. Here are three related talks.

A Literacy Theory Crash Course for the Tablet Age by **William Teale**, the Director of the Center for Literacy at the University of Illinois at Chicago.
https://youtu.be/sg9ED-Fdsks

Jeremey Bruek On the road to reading with ebooks https://youtu.be/nqPXzKzi9qo

The BolognaRagazzi Digital Prize 2015 Report from the Jurors, at
https://youtu.be/tPHa4aGl3z0

Gail Lovely: Technology & Literacy - Promises, Promises... and PROMISE! from the Highlights Foundation at https://youtu.be/k-BZ4Rg-CC0



My Very Hungry Caterpillar by StoryToys

The Final Word? Watch Children

Finally, keep your eyes open. Toys, nature, and real world items that children find interesting can inspire amazing interactive design. There's no substitute for playing along with a child and tuning into their point of view on the world. They are the best critics, and they'll tell you exactly what you need to know, as long as you learn to tune in. Making magic can be hard, but extremely satisfying. Good luck! We're looking forward to reviewing your magical product.