

This essay contains a selection of insights from developmental psychology. They are intended to help you understand children as a target group when designing interactive media products. The focus is on development up to 12 years of age.

Designing for children

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version 3.1

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Table of contents

1	Preface	1
2	Why learn about child development?	2
3	Who to believe?	2
4	What do we mean by development?	3
5	Models of development: 'stage' and 'transformational'	3
6	Development is not a steady, linear increase in ability...	3
6.1	Pattern 1: Continuous, increasing ability	3
6.2	Pattern 2: Continuous, decreasing ability	4
6.3	Pattern 3: Step or stage-like	4
6.4	Patterns 4 and 5: U-shaped curves	5
7	Sensitive periods	5
8	Big names and ideas	7
8.1	Piaget	7
8.2	Vygotsky	7
8.3	Erikson	7
8.4	Montessori	7
9	Age segmentation	8
9.1	0 - 2: THE AGE OF DISCOVERY	8
9.1.1	General implications for design	8
9.1.2	Key cognitive developments	8
9.1.3	0 - 2: Example design guidelines	8
9.2	3 - 7: THE MAGIC YEARS	10
9.2.1	Types of identification	10
9.2.2	Key cognitive developments	10
9.2.3	General implications for design	10
9.2.4	3 - 7: Example design guidelines	10
9.3	8 - 12: Rules, roles, logic	12
9.4	Key cognitive developments	12
9.5	General implications for design	12
9.6	Example design guidelines	12
10	DIRECTIONS IN INTERACTIVE MEDIA	14

1 Preface

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2 Why learn about child development?

Many - probably most - great creations for children, Bugs Bunny or Peter Rabbit or Barbie, were made by creative people with strong empathy and an affinity with their own childhood experiences - in other words, people using their intuition. They did not need first to become experts on human development.

But many were working autonomously. As design professionals, we must be prepared to work using programs of requirements that include age. Your 'common sense' and 'intuition' can be wrong and lead you to make products that don't work for the kids they were intended for. Wrong ideas about children can also make you blind to opportunities.

A basic framework of knowledge about child development can help you *avoid mistakes*, and *find new inspiration* and opportunities.

3 Who to believe?

As design professionals, we have to develop special abilities to filter information for our own purposes. We must avoid pseudoscience - there are hundreds of popular books full of oversimplifications and outright wrong information, which become hypes as they are uncritically accepted by large audiences.

Two rules of thumb to filter sources:

1 - Look for objective data backing up conclusions - testing of hypotheses.

Check how the conclusions were arrived at. If the authors can't provide scientifically viable evidence, they're probably guessing or worse.

An example of a myth is the popular idea that teenagers are master 'multi-taskers' with interactive and other media technologies: that they can handle a lot of different inputs and feedback at once. They can't - all tests reveal that kids between 12 and 16 years of age do miserably badly at multi-tasking, compared to older users. It has to do with brain development. In fact, they're sequentially tasking and losing 50% efficiency in every task.

2 - Don't trust only one discipline to draw broad, general conclusions about all child users.

Disciplines validate and correct each other!

For example, in the debates on the influence of gender, it's misleading to base conclusions only on observations of infant boys and girls by psychologists. The discipline is oriented to researching children as *individuals*. The social environment greatly influences whether inborn inclinations are developed, and to what extent. So sociology and anthropology, with their orientation to whole collectives, are essential to understanding the influence of gender.

4 What do we mean by development?

1. Cognitive - mental and intellectual growth
2. Physical - fine and gross motor skills and coordination
3. Social / emotional - developing ties with others / understand & regulate emotions, empathize

5 Models of development: 'stage' and 'transformational'

1. Stage model: phases which follow each other, clearly starting and ending (example: Piaget's four stages)
2. Continuous transition with shifts in abilities without a clear beginning or end (example: early behaviorists like Watson)

There is no one, right model - both of these views are correct for various different aspects of development.

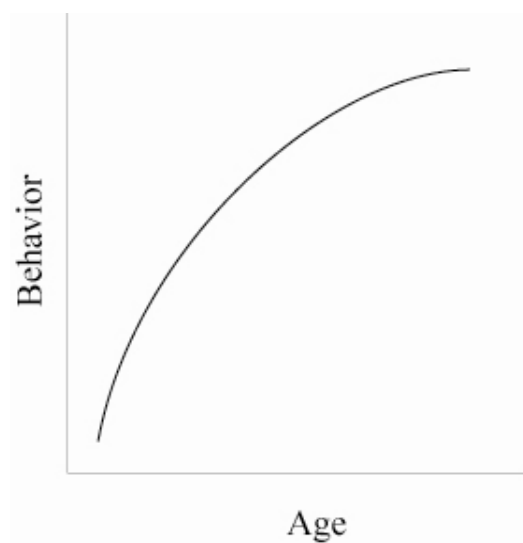
6 Development is not a steady, linear increase in ability...

...from a 'child' to an 'adult' level. As a child grows, abilities increase, but also decrease, in various different patterns. There are five main patterns, called 'developmental functions'.¹

6.1 PATTERN 1: CONTINUOUS, INCREASING ABILITY

We get better and better, gradually.

Example: precision with which infants reach for and grasp an object during the first year of life increases steadily



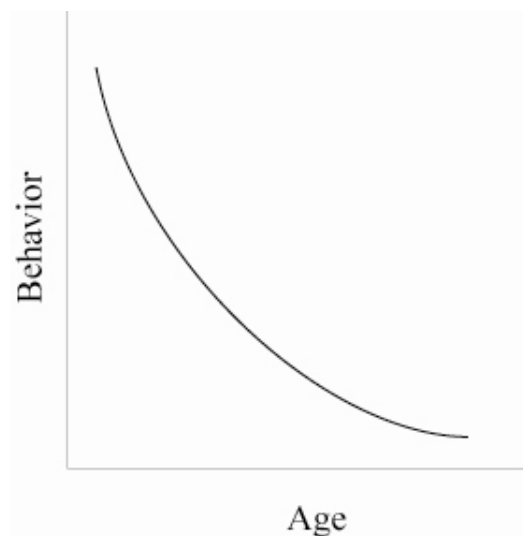
¹ Allen Slater and Gavin Bremner, *An Introduction to Developmental Psychology* (Massachusetts, 2004), 26.

6.2 PATTERN 2: CONTINUOUS, DECREASING ABILITY

We get worse and worse, gradually.

Example: precision with which infants can discriminate between sounds decreases steadily from about 6 months to 1 year of age

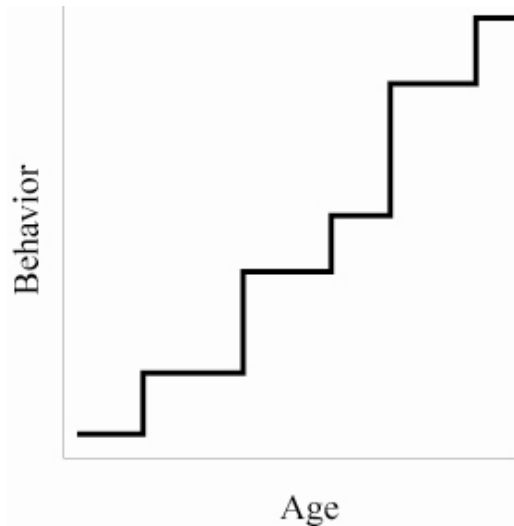
Researcher Janet Werker calls this 'becoming a native listener' - they distinguish only the sounds of their own language, so for example, Chinese 1-year-olds no longer distinguish between 'belly' and 'berry'. Children of English native speakers no longer distinguish between various 'k' sounds which Chinese children distinguish.



6.3 PATTERN 3: STEP OR STAGE-LIKE

Development leaps forward at 'milestones', at which ability level and/or behavior changes radically. Examples: transition from 'magical thinking' of 4 or 5-year-old (believes in Santa Claus) to the more analytical logical thinking of the 7 - 8-year-old (actively rejects such fantasies as 'childish'). This has to do with a shift in the brain's development (from right 'mapping in' to left brain development, which is associated with logic and reasoning capacities).

For the work of design, this means being aware of how firmly the child can suddenly start rejecting things it found appealing only a short time before, and the transition from mere accumulation to a more discriminating activity like collecting.

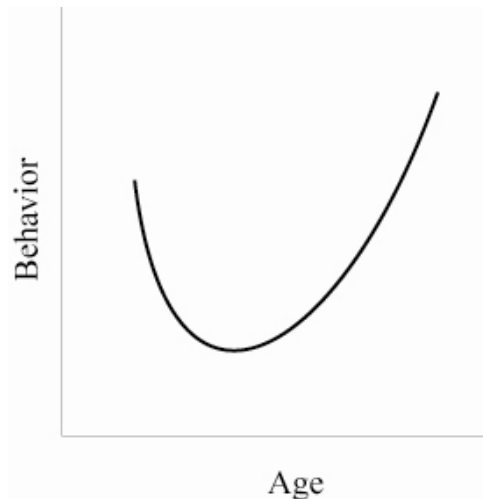
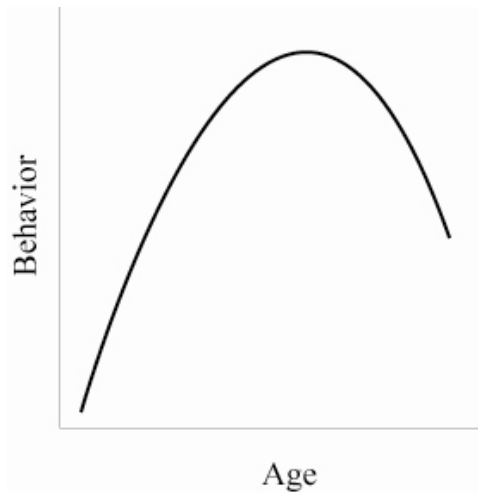


6.4 PATTERNS 4 AND 5: U-SHAPED CURVES

Ability increases and then decreases steadily; or the opposite.

Examples:

- Inverted u - visual acuity over one's whole life span - after reaching a peak, it begins to steadily decline
- Upright u - ability of newborn infants to turn their heads and localize sounds disappears around 6 weeks, but comes back strongly around 4 months



7 Sensitive periods

When the effect of experience on the brain is particularly strong during a limited period in development, this period is referred to as a sensitive period. The brain is extra flexible and plastic - the brain is uniquely equipped to create connections which will result in abilities. If development of ability doesn't happen in this period, it will be difficult to achieve later.

There are long and short sensitive periods.

Example: language learning. Up to around age 11 or 12, you can learn to speak a second language without grammatical mistakes and without an accent. After that, it will be extremely difficult. This has to do with the amount of gray matter being produced, and (according to one theory) the 'cleansing' of weak connections that takes place around age 11. This 'cleansing' makes the brain less flexible, but more efficient - strong connections are fixed into place, weaker ones are discarded.

This concept is also central in the educational approach of Maria Montessori (she also noticed a kind of 'sensitive periods').

Sensitive periods mean opportunities for design - products which fit perfectly to a child's state of mind and needs during these periods, will be used intensively and successfully.



To realize the power of a toy or design that completely fits the sensitive period of a child, just watch a two-year old play with a traditional Russian nested doll. (This child was 19 months old at the time the photo was taken.) But why the seemingly endless repetition? Why stack and unstack the dolls over and over again? She's essentially a learning machine who inside of her brain, is turning surrounding reality from rough sketch, to sketches with detailing, to catalogues of themes and variations. Themes like 'inside / outside' , 'open / closed' . It is very important that she be allowed this endless, spontaneous repetition.

8 Big names and ideas

8.1 PIAGET

Jean Piaget's 'stage development' theory of cognitive development. In brief, he identifies four main phases in the growth of mental abilities, the ability to mentally represent and manipulate information:

1. 0 - 2 years of age - The *sensorimotor period* is dominated by congenial reflexes and impulses
2. 2 - 7 years of age - The *pre-operational stage* - children begin representing objects with words and images, but still use intuition rather than logic (famous example of candy experiment)
3. 7 - 11 years of age - The *concrete operational* stage - children can use logic appropriately and sort objects according to size, shape, or any other characteristic
4. 11 - ... years of age - The *formal operational* stage - acquisition of the ability to think abstractly, reason logically and draw conclusions from the information available. (Concrete thinking is 'this dog on a rug'; abstract thinking is the concept 'on'.)

8.2 VYGOTSKY

Among other ideas, Lev Vygotsky is known for the 'zone of proximal development'. His view is that higher mental abilities are first encountered in social settings outside one's self - the didactic relationship with other individuals is of prime importance.

At any stage of development, the child has a certain level of understanding. A little beyond this level is the zone of proximal development, in which things that are too difficult for the child can be explored and understood with help from adult.

In my view, his ideas have relevance for interaction design, especially for educational products - think of computer-adaptive testing, and the increasing capacity to engage the child in dialogue with game characters that exhibit sophisticated behaviors. Think also about the extension of the social setting into virtual spaces like online communities. I know one 8-year old who spends three hours a day playing an online multi-player game in which he collaborates with others to 'colonize' regions in a virtual world. Vygotsky's ideas are certainly relevant for this kind of social space.

8.3 ERIKSON

Erik Erikson created a stage development model with eight stages of 'psychosocial development' which cover both childhood and adulthood. In each stage, the person has a central challenge or 'crisis' to meet - dealing with these successfully paves the way for the next stage.

8.4 MONTESSORI

Italy's first woman doctor invented an educational method which enables children to learn while 'decentralizing' teaching. It is based on her observation of 'sensitive periods', of the type of behavior described above in section 5. She noticed that when supplied with the right tools, very young children tend to engage in precisely the right activities to develop themselves, without any need of heavy-handed external structuring of the activity.

9 Age segmentation

This is the most common kind of requirement you'll find in programs of requirements for children's products.

There is no one correct way of dividing children into age groups according to their development. Marketers, researchers, designers, artists and educators all have a different focus. It depends on the goals and the context of use of the product. Some examples:

- Fisher Price toys are segmented in 'birth to five months', 'six to eleven months'
- Brain researchers segment 'adolescence' into early (10 - 15), middle (15 - 18) and late (18 - 22)
- Marketers identify the 8 - 12 segment as the 'rules and roles' stage crucial for the development of brand loyalty

Below, I've drawn on several kinds of age segmentations, with examples of consequences for development and of the impact on design. Please note: this is a selection, not a comprehensive set of guidelines.

9.1 0 - 2: THE AGE OF DISCOVERY

0 to 2-year-olds are busy roaming and experimenting:

- Establishing emotional security
- 'Mapping in' basic experiences about the physical world and language

'Mapping in' means basic structuring and development of neurons (brain cells), for example, for the infant to be able to hold something by herself.

9.1.1 General implications for design

Keyboard and screen as input devices - even in friendly forms like hand-held pen - don't really match kids this age. Excessive structure in tasks, and immobility, is counterproductive.

The question for design professionals is:

- Does interactive media have a place in the world of these children?
- What form should it take? (Input devices, feedback? Distribution of computing through objects which remember or respond in various ways?)

Think about sound and language learning. Are there products which might support the natural real-life learning process and make it more effective? Help parents to transmit language more effectively? Increase sensitivity during the process of 'becoming a native listener'?

9.1.2 Key cognitive developments

- Object permanence
- Cause and effect (by objects outside of self)
- Beginning of logical analysis and thinking

Towards the end of the first year, the child's conceptual representation of objects begins to become fixed. He perceives their size and shape as constant, and sees them as causal agents outside of himself. This is the very beginning of logic - the child begins to be able to create strategies to achieve goals by manipulating objects outside of itself.

9.1.3 0 - 2: Example design guidelines

Motor and physical

- Unrefined (fine and gross)
- Senses - highly interconnected
- Continual movement with short focus of attention

Do's and don'ts:

1. Don't require them to mimic exact shapes and actions; enable a child to add her own contributions
2. Don't create play experiences that overly depend on a logical beginning, middle and end
3. Design for a tiny explorer who is pushing, pulling, filling, tumbling, smelling, tasting, feeling...

Social

- Solitary play (later parallel play)
- Enjoy pretend play and imitate parents

Do's and don'ts:

1. Do create games or activities they can successfully complete by themselves.
2. Create designs that allow them to play together without interfering in each others' solitary play.
3. Don't require co-operation.
4. Do create products that mimic real-life objects they are likely to be familiar with.

Cognitive / Intellectual

- Like to hum and sing - simple memorization activities
- Like to repeat words and names
- Can identify body parts when asked
- Attraction to animal figures
- Pace and focus is slow

Do's and don'ts:

1. Kids like: designs that make music or sounds.
2. Kids like: Activities that require the right answer.
3. Kids like: designs that emphasize that they are a unique and separate person
4. Kids like: books and activities that use single words and two-to-three-word sentences.
5. Kids like: finding out how to use common items (buttons, zippers, etc.)

NOTE TO STUDENTS: examples of well-designed products for 0 to 3-year-olds will be added to online resources. Please feel free to suggest products.

9.2 3 - 7: THE MAGIC YEARS

3 - 7 years olds are busy imagining:

1. Playing pretend
2. Identifying and emulating hero and other figures
3. Accumulating (not yet collecting)

This is a pre-logical development phase: anything is possible in the child's mind. Elaborate symbolic representation is possible. A stick can be a snake, a tree can be a monster. There is 'anthropomorphism' - attributing human characteristics and personalities to any and all objects.

9.2.1 Types of identification

- Nurturing - the child takes care of doll, animal, character
- Like me - sees the doll, animal, character as similar to her/himself
- Emulatory - wants to be like the doll, animal, character
- Disidentification - does not want to be like the doll, animal, character (but is attracted to and fascinated by it)

9.2.2 Key cognitive developments

- Centration - focus on single visual stimuli
- Magical / fantasy thinking (representational)
- Need for power and control
- Egocentrism (decreases with age)
- Language acquisition

9.2.3 General implications for design

1. 'Overcuing' - creating a big, bright feature the child will fixate and focus on (example of doll with right red bow)²
2. Stories can rely more on fantasy than logic - the child often cannot trace its thinking processes back to their beginnings, is still pretty impulsive
3. Emulation of destructive power figures (Bing Gordon of Electronic Arts observes that the three and four year olds tend to wreak total destruction in a game. In the real world, everyone tells them what to do. In their game world, they're the boss.)
4. Language is very quickly acquired between 2 and 4, and increasingly socially used approaching 6, 7. Independent reading can be relied on increasingly.

9.2.4 3 - 7: Example design guidelines

Motor and physical

- Large motor skills and balance
- Small motor skills
- Likes to be challenged

Do's and don'ts:

1. Designs can become competitive and require more elaborate physical interactions.
2. Craft and art activities are possible (scissors, crayons, markers, construction toys).
3. Measurement of performance can enter the picture (timing, having to do two things at once).

² A good example is the 'Cabbage Patch Doll' The design has roundish, exaggerated features with the eyes as a strong focal point (overcuing). Most adults found them ugly - but through the 'filter' of a 3 - 7 - year - old, they're very attractive.

Social

- Can increasingly work cooperatively (wait for turn)
- Can discuss topics as a group
- Can plan ahead
- Develop empathy for others

Do's and don'ts:

1. Sharing is possible and adult intervention is not always needed for game play.
2. Group activities are liked (planting a garden)
3. Delayed gratification is possible - designs can take time to achieve a specific result.
4. Activities can involve elementary concepts of ethics - fairness in rules.

Cognitive / intellectual

- Develops commitments with people other than caregivers
- Acquiring reading skills
- Like routines
- Like to talk
- Memory is developing

Do's and don'ts:

1. Designs can involve relationships with others, and role play.
2. Plots, characters and themes can become more complex.
3. Designs linked to repeating rituals of use (bedtime stories) are successful.
4. Designs can enable oral expression.
5. Designs can work with patterns, simple but well-defined rules.

9.3 8 - 12: RULES, ROLES, LOGIC

8 - 12 years olds are becoming critical intellectuals:

1. Actively rejecting the 'childish' things they previously liked
2. Forming attachments to real-world role models
3. Developing rational, logical, abstract thinking

9.4 KEY COGNITIVE DEVELOPMENTS

- Have most of the perceptual and thinking tools of an adult
- Beginnings of self-reflection
- Attention to details
- Self-expression (see their things as expressions of themselves)

9.5 GENERAL IMPLICATIONS FOR DESIGN

While logical thinking is strong, it is still very concrete and black-and-white. The capacities for abstract thinking (math, for example) are developing.

9.6 EXAMPLE DESIGN GUIDELINES

Motor and physical

- Fine hand muscles / hand-eye coordination
- Very active, but need rest times
- Develop strong preferences
- Can become sedentary without intervention

Do's and don'ts:

1. Crafts can become quite elaborate, can use very small and difficult-to-handle pieces.
2. Designs can be suitable for quiet use alone.
3. Designs can leave room for addition of 'favorite' elements, like stickers from favorite activity (skateboarding).
4. Designs and activities can include ways of keeping track of progress.

Social

- Increasing concern for peers' opinions
- More time in pairs and groups; less time alone
- Team players
- Enjoy competition and a degree of risk
- Respect others' space and expect respect of theirs
- Recognize emotions and react appropriately

Do's and don'ts:

1. Looks for identifiable groups; seeks to conform, to know he fits in. 'Billboard' effect - highly sensitive to public image, but will still retain behaviors (and designs) from an earlier period in private.
2. Designs can include visual representations of the groups to which the child belongs.
3. Designs can integrate more elaborate forms of competition.
4. Risk also extends to visual design and styling - they're willing to take some chances.
5. Designs that are customizable are popular.
6. Can 'complete the picture' (in illustrations, for example), based on understanding they have of general principles of ethics, overarching story, other more complex frames of reference.

Cognitive / intellectual

- Strong increase in reading skills
- Finer distinction in color and styling
- Math concepts
- Understand natural world
- Multifaceted humor
- Abstract thinking

Do's and don'ts

1. Instructions and longer blocks of text work well. At the top of the scale, newspapers and magazines.
2. Greater detail in illustrations, depth - (example: exploded view of model in instructions for assembly). Also typefaces: those that reflect a strong mood are popular.
3. Designs can require mental manipulation of quantities, space; working with time and money.
4. Realistic graphic expressions of natural phenomena are popular.
5. Understand jokes, riddles, satire, cultural references.
6. Collection and connoisseurship replaces mere accumulation.
7. Computer games (as we now know them) come into their own! Offer virtually everything this group is looking for.

10 DIRECTIONS IN INTERACTIVE MEDIA

Now, a virtual interactive realm has been added to real-life experiences. Children inhabit virtual worlds and playgrounds. If a child buys a real-life toy, a digital realm comes with it. Example: Club Penguin



Motion sensors and computing are being added into physical objects. Example: The Zig-Zag-Zog robot runs around, avoiding obstacles, while the baby chases it.



Physical toys such as bicycles are becoming input devices. Example: Fisher-Price Smartbike.



Input devices are moving beyond the 'keyboard and pointer and screen' approach. Example: The Swinx carry-around game companion uses only sound and touch feedback.



Literature

Fishel, Catharine, *Designing for Children*. Gloucester, Massachusetts: Rockport Publishers, 2001.
Richly illustrated with very well-chosen examples and interviews with the creators and marketers of the products. Contains overviews of 'age cues' and 'design clues' for each age segment.

Acuff, Dan S., *What Kids Buy and Why*. New York: Simon and Schuster, 1999.
Marketing-oriented, extremely well-researched guide to children's perceptions, needs, wants, key behaviors. Includes sections devoted to gender differences and kids' relationship with characters.

Crone, Eveline, *Het puberende brein*. Amsterdam, the Netherlands, 2008.
Highly readable explanation for non-scientists by brain researcher Crone, who has done pioneering work on adolescent brain development. Focuses on the 'learning, social, emotional and creative brains' of adolescents. (Dutch language)

Bremner, Gavin, Allen Slater. *An Introduction to Developmental Psychology*. Malden, Massachusetts: Blackwell Publishing, Ltd, 2004.
Vast, but transparently structured an easily scannable guide to this complex subject. Each chapter starts with a overview of key concepts, and ends with a concise summary and discussion points.

Fraiberg, Selma, *The Magic Years*. New York: Charles Scribner's Sons, 1959.
Takes readers into the mind of a child up to six years of age. A very accessible account of the difficult journey children make, stage by stage, as they tackle and resolve the problem of their relationship to themselves, others and their surroundings.