Being Playful – learning from children

Alan Dix
Computing Department, Lancaster University
Lancaster, LA1 4YR, UK.
alan@hcibook.com
http://www.hcibook.com/alan/papers/IDC2003/

ABSTRACT
This paper explores children's understanding as a resource and inspiration for interface design and beyond. From children we can understand innate intelligences and skills, including a sense of number and the nature of play. Play is possibly one of the origins of imagination, which in turn is essential for our own creative thought. Surprisingly few adults engage in creative play, but it is when adult-like rationality and child-like imagination meet that we can best produce effective and innovative solutions. Even writing a paper has aspects of playfulness, such as the puzzle of phrasing an abstract in exactly one hundred words... or so.

Keywords
Play, imagination. creativity, virtual crackers

ONCE UPON A TIME ...
Children like stories to start off in the proper way, but having got the abstract out of the way I thought we could depart from that. I'm going to take advantage that this is a paper for a keynote to present both a loose narrative and also a range of side boxes representing different issues and projects ... think Dorling Kindersley rather than ACM format. However, there is a theme, so this is not a post-modern story.

As we grow up it is easy to cast off childhood completely, but just as it is childish to foolishly not develop and change, it is equally adultish (the peculiar foolishness of being adult) to discard completely the insights and special things of childhood.

I'm going to start by looking first at the things we learn about our own thinking and about interaction design in general from looking at children. Unclouded by our adultishness they often give us clear insights into issues that affect us also as adults.

I'll then look at aspects of play: play as the means of long-term species learning through vicarious experience, play as the roots of imagination, play as an orderly world of its own and finally playfulness in research.

Finally we'll see that we are often at our best and most creative when we appreciate both the child-like and adult-like sides of our nature.

IDC2003 7/03 Preston, UK
(c) ACM 2003 ISBN 1-58113-732-X/03/07 ..$5.00

LEARNING FROM CHILDREN

just thinking
We have so many layers of understanding, of thinking about things, of thinking about thinking about things, it is hard to make sense of us. I guess this is good news for cognitive scientists, otherwise they would be out of a job.

One of the oldest and most successful uses of cognitive psychology in interaction design has been the keystroke-level model (KLM), which makes predictions about the time taken to perform trained computer tasks [1]. KLM includes various operations: pointing (P), moving between keyboard and mouse (homing, H), etc. These operators have timings associated with them based on things like typing speed for keystrokes and Fitts' Law for pointing. However KLM also has an operation called M – mental activity. Whenever the user has to decide what to do, or think about a response, one inserts an M operator. Although an M operator can be given a minimum time based on the fastest mental operations, it is the place where KLM loses predictive accuracy. Typing times are reasonably predictable on average – thinking is not.

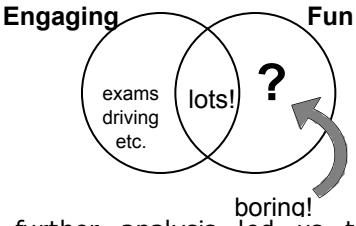
However, there are certain types of thinking that seem to just 'come naturally', we do not consciously reason, we just 'know' the answer. The evolutionary psychologists, such as Cosmedes and Tooby, are particularly interested in these more innate intelligences which are often specialised for particular domains [14]. They have developed techniques for studying this in adults, for example the Wason Card Test, which is known to be difficult when given abstractly or concretely in many forms, suddenly become 'obvious' to the majority of people when cast as a social 'cheating' situation [2].

number sense
Whilst some of these innate understandings develop and need the raw materials of experience, others are there from the beginning and are perhaps more clearly studied in children than in adults. For example, experiments on the smallest babies use the length of gaze as a measure of 'surprise'. When shown objects being placed behind a shield and then revealed, the babies are found to be able to 'count' up to three, virtually from birth. If two teddy bears are placed behind the shield and when it is removed there are three the babies, on average, stare longer than when there is the expected number [3].

Strangely this 'number sense' develops before the ability to distinguish different kinds of things. Put two identical teddy bears behind and then reveal two dolls and the length of stare is shorter than three teddy bears. Cognitively the 'it-ness' of things precedes their identification through attributes.

Although I wrote 'count' the evidence is that for babies, this is more of an immediate apprehension of number and this appreciation of quantity seems to be shared by many animals – all with a similar 20–30% 'error' in estimation – which enables us to appreciate numbers up to 3 with total accuracy, but makes it hard, at a glance, to distinguish 8 items from 10. In fact, we do accomplish this more accurate distinction as we get older, but by actually counting – replacing innate apprehension with a linguistic and logical process. However, even as an adult, if numbers are small or arranged in groups that we can immediately apprehend, the time to make numerical decisions radically reduces.

Masitah Ghazali and I have been looking at the nature of experience and in particular the way fun is related with engagement. As we discussed this we found many examples of experiences that were fun and engaging (virtually any sort of play) and also experiences that were engaging but not fun (e.g. doing an exam!). However we found it very hard to find things that were fun and not engaging – see the Venn diagram below.



However, further analysis led us to try and transform experiences by small alterations to move them from one category to another. In particular we took experiences that were neither fun nor engaging (basically boring!) and make them fun, thus letting us populate our empty gap. One such boring experience was waiting for a kettle to boil. However, we imagined a small bird that pops up, driven by the pressure of the steam when the kettle boils. As it pushes open a little trap door in the kettle lid the bird begins to sing (the traditional whistling kettle). Although it is only engaging at perhaps the moment it pops up, it adds an element of fun to the whole 'boiling the kettle' experience.

We have learnt a lot from these exercises about the nature and qualities of fun and engagement including the importance of internal vs. external motivation and the need to add fun elements that relate to critical features of an existing activity.

Box 1. **making fun** (with Masitah Ghazali)

In general, if we understand our more innate abilities when designing interfaces, whether for adults or children, we are more likely to create pleasurable, accurate and efficient interactions.

peek-a-boo

When babies get slightly older, we find that peek-a-boo will engage a 20-month-old child far longer than most adults are prepared to play. There is an extreme joy in the discovery and reinforcement of the knowledge that things hidden will reappear: the underlying continuity of existence. It is interesting that different forms of 'conservation' underlie several of Piaget's stages of development .

As adults we may understand limits to conservation and continuity and also question it philosophically – I recall as a schoolchild talking to a lecturer at the local university who said "in the end we can never be sure that there will be a dawn tomorrow, it is purely a matter of faith" and in geology the assumption is explicitly named as the 'law of uniformitarianism'.

Despite these moments of existential angst, most of us do go about our lives basing it on this thesis without thinking about it and get frustrated when a lost item is not where it is expected to be or we realise that for the 100th time we have bought a new biro and it has disappeared before it was half used. Perhaps this explains our fascination with the dénouement of a book where things suddenly make sense, the vanishing acts of illusionists and the hiddenness we will discuss later in Christmas crackers.

learning about ourselves

A short while ago a television programme followed the lives of three AI researchers trying to make artificial life. One was in Star Labs using a massive connection machine with thousands of processors in order to emulate evolutionary development. A quick estimate of the massively greater computational power of real evolution over 2 billion years tends to make me doubt this approach, but in fact his greatest problem was simply getting the machine to work!

The second was Stephen Grand, developer of the commercial ALife game 'creatures' who was developing (the head of) an artificial child, Lucy. Stephen, along with many others and mirroring the approaches of situated action [13] and distributed cognition [9], believes that true intelligence needs to be embodied. Recently Stephen Grand has received a NESTA 'Dream Time' Award to develop a new body for Lucy called ... well, you guessed, Lucy 2 [10].

However, it is the third researcher that was most interesting. An MIT doctoral student, he was working on developing an electronic child and letting it learn just like a real baby learns. The child was built with vision, through a digital camera, arms and a mouth. Initial algorithms included built-in object recognition and allowed the child's eyes to track moving objects, just like a baby does when born. Although the initial idea was to let it learn it was possible, although not explicitly voiced, to see that more

and more was being 'built in' to the algorithms and software that drove the electronic child.

The real give away came when the child learnt to copy body movements. The researcher moved his hand up, the child did so too: – side to side, up and down. However, very cleverly, when the researcher moved his right hand, the child moved its right hand too – it took me 27 years, until I was learning to drive, before I learnt left from right and this electronic child did it almost at once! In fact the mimicry was programmed in – and had to be so because as I looked closely I realised the arms of the robot child were outside the narrow visual angle of the camera. It could never learn to mimic others' actions because it could not sense its own.

The young researcher had evidently not watched a real baby watching its own fingers moving, experiencing that sense of power as it reaches out and spins a wooden block, grabs a finger or touches a nose. The understanding of what constitutes 'me' is a learnt thing.

This is something I have rediscovered for myself in two contexts. First in looking at the nature of driving and similar activities it is obvious that we are still able to redefine and re-map our sense of physical identity. This goes beyond knowing that when I turn the steering wheel the car will move, it is a deeper innate ability to extend our notion of sense to include tools that presumably dates back to the earliest tool using hominids or beyond [4].

However, the ability to see oneself from the outside is also important in day-to-day work. I have what I call the **golden rule of design**:

understand your materials

In HCI the materials include people and computers, but in our own work (writing, research, verbal presentation) the materials include the physical or electronic tools that help us (word processors, OHPs, laser pointers) but also, most important of all, ourselves.

assumptions

When my eldest daughter was about 2 1/2 years old a linguistics student came to tape her conversation for a dissertation project. At one point they were talking about her baby sister. My daughter said that they had been to the doctor. "Where did you go" asked the student. "Up the steps" said my daughter. The student took this for a non-sequitur, but in fact any mother in the area (and a few, but not every, father) would immediately have understood. The local General Practitioner's surgery had a small set of concrete steps that were a nightmare to negotiate with pram or pushchair. My daughter did not fail to understand the question, but did fail to understand the social situation and the knowledge to be expected of the visiting student.

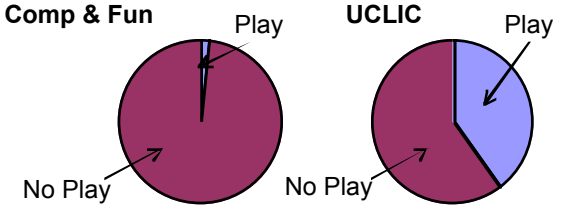
Again, some of Piaget's tests are based on issues of egocentricism. If you listen carefully to children it is frequently this social understanding not cognitive limitations that are evident in 'wrong' answers. Read education books and again and again examples are given of cognitive 'problems' with young children where it is obvious that other aspects of communication are the issue.

For example, when the same daughter was little I tried to do the classic number conservation test. I was aware that the wording "same number as" would be problematic, so instead laid out two lines of Smarties (small sweets). In classic Piaget style I disrupted one of the lines and asked "which line of Smarties would you like to have". She chose the longer line (but with the same number of Smarties in). Slightly disappointed I asked "why". "Because it has the red one" she answered.

Piaget's tests themselves, as this example shows, are laced with social overtones. Imagine yourself a small child looking up a white coated experimenter. The experimenter shows you two lines of counters "are there the same number" – they are identical "yes you say". The experimenter pushes the counters in one line closer to each other. "Are there the same number", he asks again. Why did he ask this, he must have changed something, he can't want me to say "yes" again otherwise he wouldn't have asked.

Margaret Donaldson and co-workers tried variants of Piaget's tests designed to reduce this social pressure . The variant of number conservation involved "Naughty Ted". Imagine yourself again the child as before with two

Highly unscientific surveys were conducted over two years at the Computers and Fun workshops in 2000 and 2001. Only 2% of participants admitted to any form of creative play. Based on the sample size and assuming that participants at C&F are at least as likely to engage in creative play as members of the academic community in general, we can estimate that no more than 5% of academics engage in creative play ($n=100$, $p<1\%$). One further fact that could affect the statistical significance of the findings is that the 2% represented the author himself on both occasions. However, the other participants found this highly significant.

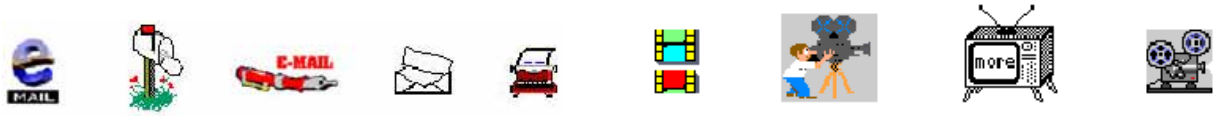


The survey was repeated at UCLIC (University College London Interaction Centre) and there approximately a third of attendees at a talk (again self-selecting) said they engaged in some form of creative play.

Why so little play generally, and why do particular groups encourage or attract playful people? Is it that society and schooling destroy the ability for creative play? Is it that some people simply never grow up?

Box 2. **creative play**

Some years ago Lorna Uden and one of her students conducted a participatory design exercise with 5- and 6-year-old children, looking at the design of icon-based Internet access. This involved the selection of icons from a large set garnered from existing interfaces, image libraries, etc. Lorna and I subsequently analysed this stage in more detail [[UD00]]. Here is a small selection of the email icons studied for writing email and 'show a movie'.



(i) (ii) (iii) (iv) (v) (vi) (vii) (viii) (ix)

Many of these icons are based partly (iii) or solely (i) on words. Also (not shown) were several dependent on recognising "@" to mean 'email'. Notice the US mailbox icon (ii), the images of the fountain pen (iii) and old-style typewriter (v). None of these would form part of the iconic culture of a British 5- or 6-year-old. In fact, the children's preferred icon was (iv) – the letter, something they had seen and understood. It was also animated!!

Icons (vi) to (ix) are some icons for 'show a movie'. Again all represent items outside the normal experience of a 5 or 6 year old. The first is both very abstract and refers to reel film. Similarly both (vii) and (ix) depict celluloid not TV or digital photography. Even the TV is a 1950s model with legs and aerial!

Surprisingly it was (vii) that the children readily accepted. Clearly they had never seen anyone using this type of camera, but we surmised this was from cartoons. Even when culturally sensitive it is easy to forget that culture is shaped as much by media as real life.

Finally it is worth remarking on the use of 'old fashioned' icons. We realised this was because an up-to-date typewriter (where used), video recorder, television, etc. are all virtually identical – a plastic box, possibly with a screen and buttons. Old artefacts were often driven by their mechanisms: function created form. In newer artefacts the functionality is in a small chip buried deep inside – form does not reflect function and objects are indistinguishable. Both icon designers and cartoons often use older-looking artefacts as these are visually distinguishable.

Box 3. **picture this – icons for kids** (with Lorna Uden)

identical lines of counters before you. The experimenter says "are there the same number" – "yes" you reply. Now she puts on a small glove puppet "oh look it's Naughty Ted" she says. Naughty Ted then moves the counters in one column closer to each other. "Oh Naughty Ted, what have you done" she says. then asks you "Are there the same number".

Notice that this time the social situation is different, it is a reasonable social question – the experimenter may be uncertain whether Naughty Ted had perhaps taken or added counters. In fact, you as the child have been able to see that no counters had been added or removed and so can quite reasonably answer "yes, still the same".

In fact this is precisely what they found: at a younger age (on average) than normal for the standard Piaget test, children faced with this revised task were able to correctly show conservation of number.

Going back to the issue of egocentricism. It is interesting to look again at the student's question about the doctor "where did you go". The student was clearly (to an adult listening) wanting to know whether the doctor was in a hospital or was a GP. To expect a 2 1/2 year old to say "at the hospital" is perhaps reasonable, but for a GP what was expected? Just as my daughter failed to make allowances for the fact that this student was not local to the area and did not frequently push a pram to the doctor's, the student failed to realise that her question was not reasonably answerable within a child's vocabulary.

Children are very good at forcing us to see the assumptions which underlie our day-to-day lives. Lorna Uden and I saw this in studies of icons for children, we not only came away understanding children better but also the nature of iconography itself and the loss of functional transparency in electronic artefacts (see box). And, of course, we live within multiple cultural assumptions all the time and these are as much a problem for adult–adult communication as adult–child.

PLAYING

long-term learning

Although any educationalist will tell you about the importance of play, especially creative play, during early learning, there is also a longer term sense in which play is an integral part of species learning. By species learning I mean the way in which a species learns to adapt its behaviour to a changing environment.

The most obvious way in which species adapt is through natural selection by genetic mutation and/or sexual reproduction. This is very flexible allowing not just behavioural but physical differences (uni-cellular/multi-cellular, four limbs, six or eight, etc.). However, it can only adapt very slowly over hundreds or thousands of lifetimes, with many many 'wasted' mutations on the way and only able to adapt easily to very slowly varying circumstances.

More complex organisms, and even to a limited extent some very simple uni-cellular organisms, are also able to

learn during their lifetimes using a range of techniques including immunological adaptation, condition responses and complex memories. These enable us to learn things like: last time the bushes moved like that I was almost caught by a lion, better run straight away this time. Of course with only individual memory each individual starts with a clean slate. My mother only just got away from a lion, but, except for any genetic predisposition to run inherited from her, I have to experience this for myself. *Lifetime learning* allows adaptation to things varying much faster than genetics, but does not allow any learning between generations.

Herd animals and also animals that succour their young and have close parent–child relationships attain a new level of learning. I am out with my mother or with my pack and the bushes rustle: everyone runs so I run too. Next time I see bushes moving I recall that we ran last time and I don't wait for the rest of the herd, I start to run straight away. Note that the combination of *imitation* and *lifetime learning* allows me to learn from my family and herd. I do not actually have to have had a close encounter with a lion, it is enough that an ancestor has. So this allows learning across generations, but much faster than natural selection. However, notice that the bushes had to actually move – I am only able to learn through shared experience.

Note that both lifetime learning and the ability to imitate are themselves 'learnt' through natural selection over a longer period – genetics gives the raw material for faster and more flexible adaptation. Also some simple bacteria exhibit forms of Lamarkian adaptation and in mammals cross-placental mechanisms allow some forms of inter-generation adaptations to simple chemical and immunological environments.

Still a parent that has encountered a lion cannot pass on that experience unless something happens to duplicate some aspect of it. In human development social culture and language have enabled us to achieve cross-generational learning without shared experience and writing means that this can even 'skip' generations. However, there is another mechanism that precedes writing.

When young animals play they recreate potential life experiences, hunting, competing for a mate, but without actually encountering them. Play allows learning through *vicarious experience*. Play relies on imitation and lifetime learning, but also one other vital ability – *imagination*. The current experience in some way stands for something other than it is. So play allows learning across generations without the need for shared experience.

Imagination is critical for language (including gesture) – when we talk about something we have to call it to mind and so does our partner. Is play just a side effect of the acquisition of imagination for other purposes, or is play more than that? Perhaps play is the source of imagination and hence the thing that has made language, culture and civilisation possible.

play and creativity

In play it may seem like imagination is unbridled, but if you can recall your own early childhood, or have talked to small children, you will know that the world of the imagination is far less unruly than it at first appears:

adult: "Why don't you invite your invisible friend in"

child: "Silly, she can't come in the door's closed"

The world of the imagination must make sense. Children will create elaborate explanations and attribute complex self-consistent attributes to invisible friends.

This sense in which the imagination seems to have a life of its own is also evident in many creative areas and novelists talk about characters as if they were people they knew not a fiction they had created. Recently I was playing with metre, trying to write day-to-day language and wrote a few lines about a mother talking to her young son Johnny. Suddenly I found I wanted to "know more" about Johnny's mother and so had to complete the poem in order to "find out" about her.

Johnny get your friggin' shoes on quick,
your daddy's coming soon to pick us up;
and don't forget your schoolbag and your lunch,
I did you egg, I know you like it best.
...

Box 4. **new school**
(www.hcibook.com/alan/words)

In my own thinking about the role of the imagination in cognition it has become clear that the amazing property of the imagination to feed back as if it were real perception enables different aspects of world knowledge and innate intelligences to be brought to play on the same problem. Because of this linking role, the imagination is a central point of many kinds of deep and complex cognitive activity [6]. The fact that it links different kinds of knowledge and intelligence is perhaps part of its surprise value too – each aspect of our understanding is 'looking' at our imagined images and scenes and 'commenting' on their felicity. Because this self consistency is so strong it 'kicks back' at any attempt to do the impossible both physically and socially. In 'getting to know' Johnny's mother I was consciously discovering what my unconscious social knowledge knew about someone 'like that'.

(re)discovering play

Various researchers are discovering or rediscovering the importance of more playful activity, both as an end in itself and as part of the process of research.

Bill Gaver has championed what he calls the 'ludic' aspects of design especially for the home and leisure [8]. One example is the drift table, which has a small screen in the middle showing a portion of an aerial photograph. The table has photographs of all of Britain in it and can navigate to any place. However it does not have an explicit interface to do this. Instead it makes use of load sensing technology and the table sees to drift in the direction that there is most weight on the table. You can control this by deliberately leaning on it, or if you just leave a book or a cup on it will simply drift over the map [11].

Jennifer Sheridan and the .:thePooch:. group at Lancaster (www.thepooch.com/) have been using interactive performance art to investigate novel forms of interaction. For example, the "schizophrenic cyborg" involves someone wearing a small screen strapped to their waist (Teletubby style!) which they cannot see themselves. Another person at a distance types messages into a computer which are relayed via wireless network to the cyborg's screen. This gives a rather asymmetric three party interaction. Although this sounds strange it comes from ethnographic study of 'normal' cyborgs and types of three-way interaction she had observed [12]. The "schizophrenic cyborg" allowed a probing of this kind of interaction in a way that would have been impossible in a more 'serious' application.

This is important for all research and the first question I ask new research students is "what excites you in computing" and "what excites you outside computing".. This is then the start point for focusing on a project that is likely to hold their enthusiasm for a gruelling three years!

BEING CREATIVE

Although I've been emphasising the importance of play the most powerful creative work comes when the more childlike playfulness interacts with more adult-like rationality. Pure rational analytic thinking leads to ant-like innovations, convergent solutions, tiny incremental developments: each correct yet making slow progress. Pure imagination and play leads to flea-like innovations, divergent thinking, large leaps into the unknown, but unguided and as likely to end up nowhere.

Many of the best ways to teach children involve putting them in an environment with the right prompts and materials and letting them investigate and play within that carefully selected place. Similarly I find that analytic processes can help to create an intellectual place furnished with the right examples and concepts. Putting people in this 'place' for creativity allows their own creativity to flourish and invariably find interesting and novel solutions and ideas.

The design of virtual crackers very much followed this method. Virtual crackers are an electronic version of Christmas crackers, rather like electronic greetings cards … but more fun! The sender can choose a cracker design and gives their own and the recipient's email address on a web site and then, just like a electronic greetings card, the recipient gets an email with a URL of the cracker. When they go there they have to 'pull' the cracker and eventually get to a page with a joke, web toy and a cut-out mask.

An important thing about virtual crackers is that they do not exactly reproduce physical crackers in an electronic environment – this would be impossible: part of the nature of crackers is their physicality. However, they do recreate crucial aspects of the 'crackers experience'. This recreation was possible through an analytic process of deconstruction of the original experience into elements which were then reconstructed in the web environment. Some of these were fairly direct (joke or plastic toy becomes web toy), but others less straightforward (hiddenness, suspense and the paper hat). The actual reconstruction was not determined by the analytic process, but by giving us the categories and elements of experience needed we were 'put in the place' to creatively consider new solutions.

	real cracker	virtual cracker
surface elements		
design	cheap and cheerful	simple page/graphics
play	plastic toy and joke	web toy and joke
dressing up	paper hat	mask to cut out
experienced effects		
shared	offered to another	sent by email, message
co-experience	pulled together	sender can't see content until opened by recipient
excitement	cultural connotations	recruited expectation
hiddenness	contents inside	first page - no contents
suspense	pulling cracker	slow ... page change
surprise	bang (when it works)	WAV file (when it works)

Table 1. the crackers experience

... HAPPILY EVER AFTER

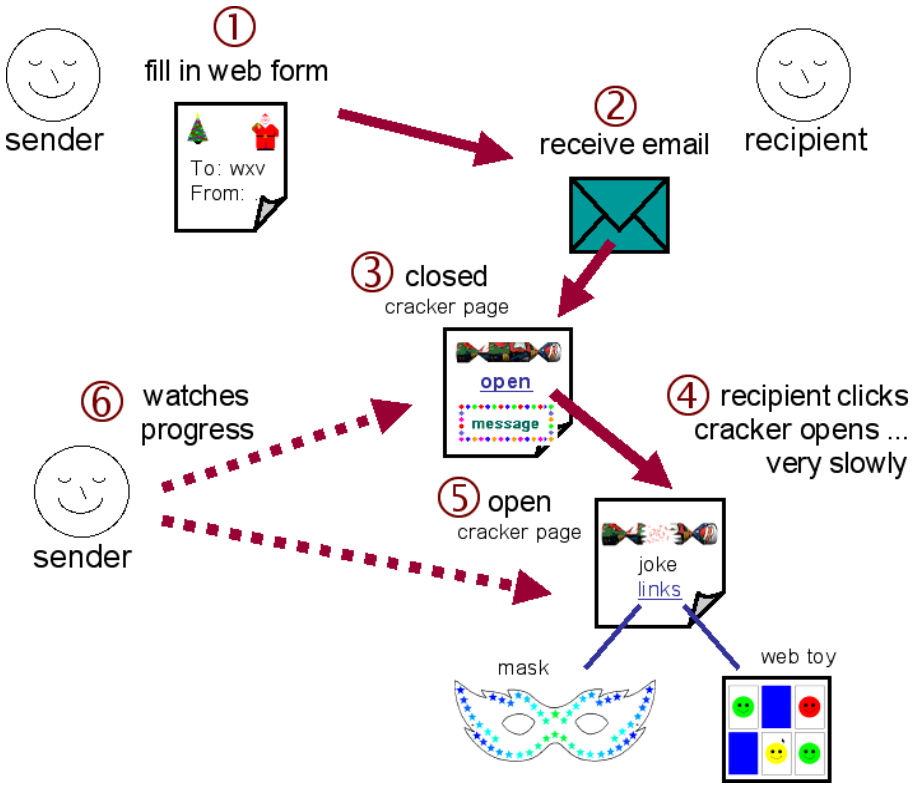
Studying children is not just important in order to design for them, but also because they give us a unique insight into the nature of humanity. In particular we've seen how play is significant in many ways and may even be the origin of aspects of imagination and hence an essential precursor to language and reasoning. The development of virtual crackers demonstrated how combining analytic reasoning with more playful exploration can lead to innovation and solutions that are both novel and useful.

READING CORNER

1. S. K. Card, T. P. Moran, and A. Newell. The keystroke-level model for user performance with interactive systems. Communications of the ACM, 23:396-410, 1980.
2. Cosmides, L. The Logic of Social Exchange: Has natural selection shaped how humans reason? Studies

with the Wason selection task. *Cognition*, **31**:187–276, 1989.

3. S. Dehaene (1997). The Number Sense. Penguin, London.
4. A. Dix (2002). driving as a cyborg experience. Workshop on Homopolybots: Building Modular Humans. Lancaster, 9th May 2002 www.hcibook.com/alan/papers/cyborg-driver-2002/
5. A. Dix. Deconstructing Experience - pulling crackers apart. In Funology: From Usability to Enjoyment. M. Blythe, K. Overbeeke, A. Monk and P. Wright (eds.) Dordrecht, the Netherlands: Kluwer, 2003.
6. A. Dix. Imagination and Rationality. Working Essay. Lancaster University, UK 2003. http://www.hcibook.com/alan/papers/imagination2003/
7. M. Donaldson (1979). Childrens Minds. W.W. Norton.
8. W.Gaver (2001). Designing for Ludic Aspects of Everyday Life. ERCIM News No.47, October 2001. www.ercim.org/publication/Ercim_News/enw47/gaver.html
1. Hutchins, E. (1990), The Technology of team navigation. In *Intellectual teamwork: social and technical bases of collaborative work.* Gallagher, J., Kraut, R. and Egido, C., (eds.), Lawrence Erlbaum.
9. NESTA Press Realease (2002). Stephen Grand OBE - Will Lucy dream of electric sheep? 11th Nov 2002. www.nesta.org.uk/mediaroom/newsreleases/3127/index.html
10. Furniture And Furnishings. Interaction Design Research, Royal College Of Art, London. www.interaction.rca.ac.uk/equator/weight_furniture.html
11. Sheridan, J.G., Lafond-Favieres, V., Newstetter, W. C. Spectators at a Geek Show: An Ethnographic Inquiry into Wearable Computing. Proceedings of the 4th International Symposium on Wearable Computers (ISWC) (October 18-21 2000) Atlanta USA
12. Suchman, L. (1987). Plans and Situated Actions: The problem of human–machine communication. Cambridge University Press.
13. Tooby, J. and L. Cosmides. Evolutionary Psychology: a primer. 1997. on-line at: www.psych.ucsb.edu/research/cep/primer.html
14. L. Uden and A. Dix (2000). Iconic Interfaces For Kids On The Internet. IFIP World Computer Congress, Beijing, August 21-25, 2000, pp. 279-286.



Thank you for putting a smile on my face and bringing back some funny memories! My mother is from England and I grew up pulling the "real" crackers during the holidays. cracker feedback

Box 5. **sending crackers** (www.vfridge.com/crackers)