Designing Tangible Artefacts for Playful Interactions and Dialogues

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Abstract. This paper reports on the design process and iterative development of two tangible artefacts that aim to encourage and explore playful interactions and dialogues between grandchildren and grandparents living at separate locations. These designed prototypes respond to the Magic Box which is a cultural probe specifically created to explore playful activity at-a-distance in a non-electronic way. This paper reports on the process of project definition, technical design requirements, scenario creation and iterative prototype development. We interpret the ethnographic data from the Magic Box research; we develop activity scenarios to describe potential activities; and we design and develop working interaction prototypes to be tested in the field in future studies.

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1 Introduction

Encouraging playful interaction for non-task oriented means has gained some currency in recent years within the interaction design research community. Gaver et al [6] argue that Ludic activity is based on promoting such goals as curiosity, openness and ambiguity. Their Drift table is an example of how these goals can be achieved in an electronic piece of furniture that allows you to navigate through a changing view of the British landscape. The engagement with this image is through a small circular viewport that is placed in the centre of the table surface. The image “drifts” as you apply weight to one of the tables four corners. Another concept of interest is Phatic Technologies [11]. Phatic Technologies seek to enable a social awareness and sustain social interaction through the use of information and communication technologies (ICT’s). This shift in the purpose of ICT’s, from information provision to communicating presence or engaging playfully with digital technologies, encourages new approaches to interaction design that are not preoccupied with conventional ideas of affordance and usability.

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In our project we drew inspiration from these notions of ‘Ludic activity’ and ‘Phatic technologies’ to explore and design for playful activities to enable social awareness and social interaction. The context for our project was found in the empirical data from the original Magic Box research [12]. This research showed us that the dialogues amongst grandchildren and grandparents living at separate locations are not task oriented but rather spontaneous and playful, as they provide insights into the activity of one’s day, snippets of history, something made at school and so forth. Our design question in context therefore became:

To enable and extend the play and dialogues that are present with the non-electronic Magic Box using information technology with a focus on the interaction design?

1.1 The Magic Box

The Magic Box [12] is a form of cultural probe [5] specifically created to explore playful activity at-a-distance. It was part of a study into Intergenerational Play at the University of Melbourne. The Magic Box carries gifts, toys, photos, souvenirs, messages and other special items. Late each evening a ‘magic fairy’ (in fact a researcher) exchanges the Magic Box between the homes of the participants. Vetere et al. [12] reports on the use of the Magic Box with four extended families, consisting of children, parents and grandparents – where grandparents were not living with the children or parents.

There were two types of activity around the Magic Box; the playful collection of artefacts and the contextual account of those artefacts, often by the grandparent. In some cases the grandparents opened up a dialogue about aspects of family history and thus served to create a family knowledge and a closer bond between the generations. Some of the findings arising from the study include:

• The families valued the time for play and interaction that contributed to relationship building
• The Grandparents valued their role as mentor
• The exchanges were often non-task oriented or phatic [11]
• The exchanges were idiosyncratic and unique.
• The grandmothers contributed more to the Magic Box than the grandfathers.

The Magic Box acted as a receptacle for memories, happenings and stories. Apart from the physical limitation of the boxes’ size, the Magic Box did not prescribe the form of the content. It was therefore an open system that encouraged unique content to be shared enabling spontaneous and playful dialogues across the generations.

1.2 The Value of Play

There is growing research interest in the creative use of interactive technology for playful activity [1], [10], [14] and in particular play between grandparents and grandchildren [7]. Play is “an experimental dialogue with the environment” [3] and is well
acknowledged as critical part of early childhood development [13]. Childhood play can result in innovative contributions [2] and playful exploration among children may be especially important for developing new solutions to a problem [8]. We contrast play, a predominantly open-ended activity with fluid rules of engagement, with game-playing, which tends to be more goal oriented with winners and losers. Play is different from other childhood activities such as classroom learning. Play tends to privilege spontaneity and discovery rather than the acquisition of knowledge and skills, though of course this is also possible.

1.3 The Nature of Intergenerational Communication

Communication between grandchildren and grandparents has its own particular motivations and content. Grandparents have an interest in observing the growth and development of their grandchildren [4]. This satisfies their need to care and nurture and leads to a different type of communication activity that is playful and incidental [12]. Communication-at-a-distance between grandparents and young grandchildren (up to 7 years of age) is difficult, especially via telephone, because children are unable to contextualise their shared experience [4]. The same is applicable for email. There appears to be a need to provide greater real-world context to often disembodied communication between grandparents and grandchildren.

An example of providing real-world references to communication is the Peek-A-Drawer [9]. Peek-A-Drawer enables images of objects such as toys to be sent over a network and thus create a new form of visual “lightweight” communication, which enables playful exchanges that can support or create the context for a phone call. Sio et al. demonstrate that grandparents often want to share in the activities and lives of their grandchildren, even when they are living at a distance from one another, through representation of physical objects [9]. So apart from mediating a new form of play and encouraging a dialogue, artefacts enable a context for a phone discussion to be enriched. They also offer a new way to have digital presence across generations that helps satisfy the Grandparents need to care and nurture.

2 Designing the Artefacts

2.1 Design Challenge

Playful interaction is our aim as an alternate motivation for engaging with information technology. In the context of this project we saw the need to extend this play to foster dialogues for intergenerational communication. Play is of value for thinking and learning, and as demonstrated via the use of the Magic Box probe is a unique characteristic of intergenerational communication. What helped mediate this play and dialogue with the Magic Box was the exchange of artefacts and what they represented. There is clear social value in communicating across generations particularly for the grandparents. Again the Magic Box contributed to a dialogue that was created around the exchange of artefacts.
The design challenge was therefore to explore appropriate design languages and interaction experiences for intergenerational communication given its unique playful nature.

2.2 Design Requirements

Given the design challenge we set requirements to explicitly describe the conceptual and technical limits of the project. We wanted to develop prototypes and had a limited budget. Technologically we needed to work with readily available electronics and programming software. The requirements were specified thus:

- The device should support playful activity between grandparents and grandchildren at a distance (collocated interactions may also be possible).
- Exchanges should be asynchronous (though synchronous interactions may also be possible).
- The device should afford curiosity, openness, ambiguity, and unintended use, but remain mono-functional.
- The prototype should be built with available technology and with limited external expertise.
- The device should be fun and engaging, and afford exploration of content to stimulate dialogues.

In order to further inspire and ground the design activity to the Magic Box findings, a storyboard scenario was created.

2.3 Scenario’s of Use

The scenario contained 55 vignettes, of which a small section is shown in Figure 1 below. The scenario captured a significant activity from the original Magic Box data into one family’s narrative. Within this family the mother often had to travel interstate for work and the grandmother would look after the two children aged 4 and 2.5 in the mother’s absence. The scenario did not contain the use of intervening technology or a new design concept. The purpose of the scenario was to translate the data from the Magic Box research into a form that would facilitate design activity.
2.4 Early Conceptual Designs

The scenario was used as a lever through which design concepts were explored. The conceptual designs were imagined within the narrative of the scenario and then informally assessed to gauge meaning and usefulness against the activity suggested in the scenario. Three of these design concepts are presented here:

- **Impressionistic Scanner. Roller scanner** - A Cylinder that gathered impressions by rolling over children’s drawings, photo’s or books. This information is sent over a network and rendered collage-style on a large digital display located on a wall within the grandparents living room. The collage display of sent artefacts acts as a chronicle of mixed media offerings between grandparents and grandchildren. It encourages discussion of random issues and happenings in a playful and spontaneous manner.

- **Magic Sound Box for Secret Stories** – This is a literal interpretation of the Magic Box that enables the transfer of sounds from Grandchildren to Grandparent. The intent is to encourage special types of playful communication across generations in the same way that the Magic Box encouraged special gifts and activities.

- **Box Puzzle** - This idea consists of a series of different coloured boxes that encourage an action reaction sequence in real time across a network or as a shared experience in the same room. As the grandparent talked into the green box, the green box
at the grandchild’s location started shaking. When opening the green box the child
could hear the clue left by the grandparent. This clue could indicate which coloured
box to open next. This open, yet complex system allowed for different playful ac-
tivities, e.g. storytelling, solving puzzles or hide-and-seek.

We decided to create a device with toy like qualities that would support content that
could be created and exchanged, rather than goal-oriented tasks such as a game or
puzzle. Therefore the Box Puzzle was dropped. This decision was taken for two rea-
sons. Firstly, the original Magic Box research, whilst intending to discover and under-
stand play, was based on content exchanges and not games. We wanted the prototype
to have similar properties. Secondly the age of children participating in the Magic Box
research ranged from 2 to 10, with most of them above 4. Children at this age are
capable of developing meaningful shared content. Therefore the Magic Sound Box
was selected for prototype development.

The first concept, the impressionistic sca
ner was an excellent means to potentially
engage both the grandparents and grandchildren in playfu
l and even non-literal visual
exchanges. However it was beyond our sc
ope both technologically and economically.
However we all agreed to that video exchanges needed to be considered but within the
suite of technologies that were available for this project.

2.5 Concept 1 - The Seed and Pod.

Because of the meaning embodied in the box as a holder of gifts the project discus-
sions included the need to capture this ability to magically “contain” in the design. On
the other hand a box is an impersonal and abstract shape. The shape affords nesting
and stacking, which could be used for playful activities but deemed meaningless in the
context of containing and sharing content and stories. Therefore we agreed that it was
not boxes as such, but *containers* or *vessels* that became the guiding metaphor. This
metaphor opened the possibilities to explore the aesthetic and formal characteristics of
the design towards a more friendly and natural shape. An organic sensibility started to
emerge (see Fig. 2), which developed as a need to present an object in an evocative
way.

Soft forms were explored in an attempt to create an enduring physical experience
with the design. These early form ideas revealed the metaphor for the seed and pod.
The seed being the device you held, talked and listened into and the pod being the
base that the seed nests into to send the data content. The coupling of the seed and pod
in interaction and symbolic terms was considered by the group to be the way forward.
The content that the seed and pod would contain was recorded verbal stories or
sounds. These would be asynchronous so the engagement would be listening, reflect-
ing and responding in an ongoing or developed dialogue rather than a phone conversa-
tion that tends to require immediate responses.

It was envisaged through our scenario’s that the exchanges would happen at differ-
tent times in the day, for example the Grandparents telling a story during the day with
the children listening to this story when they returned home from school or other daily
activities. This slowing down of the sending and receiving was a purposeful
attempt to encourage more thought and reflection, which was demonstrated through the activity with the Magic Box.

Fig. 2 Early organic form sketches

2.6 Technological Development of The Seed and Pod.

We explored this interaction through electronic mock-ups using the Phidgets interaction toolkit (http://www.phidgets.com/) and Macromedia Flash. These technologies offer simple easily available plug and play components. Playing with the toolkits helped demystify the technological possibilities and also inspired creative discussion of how the actual interaction might be mediated to support playful content sharing.

Fig. 3 Technological Mock-ups

The scenario was revisited and walked-through with the Seed-and-Pod as a technological intervention. The Seed and Pod enabled a sharing of the activities and experiences the children had with their Grandmother in the Mother's absence. The Mother could reciprocate with stories of her day through her Seed and Pod. This walkthrough helped to confirm contextual relevance and the place of the technology within social interactions. (Fig.3)
2.7 Description of Use

The Seed-and-Pod exchanges content via ends of the seed. The seed has an opening with a microphone for speaking or recording sounds (Fig. 4 right) and a speaker for the transmission of the content (Fig. 4 left). This data content is sent across a broadband network via a CPU. When the content or message arrives at another seed—which is cradled in the Pod – the seed starts to glow to indicate something inside. When the seed is touched or picked up the user is directed toward the speaker end of the seed again via light illumination and the message starts to play after a one second delay. When the message is completed the user shakes the pod to erase the message and the speaker end of the seed illuminates to encourage a response. To respond the user talks or records sounds into the microphone end of the seed. The seed is glowing throughout, once completed the seed is placed into the Pod at which time the data is transferred and this is indicated by the light moving through the Seed to the Pod to indicate a flow of data. When the data is sent the Pods lights turn off.

Fig. 4 The Seed Prototype has a speaker for the transmission of the content (left) and an opening with a microphone for speaking or recording sounds (right)

2.8 Reflection on the Seed and Pod

It was decided to build the Seed and Pod using rapid hand modelling and software programming techniques. Committing to this outcome at an early stage enabled a greater understanding of the technological, aesthetic and ergonomic implications of what we had proposed on paper. We could also gain some understanding of the temporal nature of the interaction. For example how the light would provide feedback for the state of the system and actions like touching and shaking would both invoke and erase messages. This was useful in assessing to some extent the playfulness of the actions.

The prototype needed technological refinement to enable it to work independently and therefore assess the design idea working through an actual use scenario. After discussion amongst the project group, and some time away from the project, the Seed and Pod, whilst being an interesting metaphor, did not translate as a container of gifts in its realised physical form. This was an important part of the Magic Box as it presented a gift to the participants. The Seed and Pod still felt and looked like a variation
of the telephone with its speaker and microphone. We presented the work to an international conference for review and some of the feedback supported this criticism.

“The Seed and Pod prototype seems like an asynchronous phone or networked recording device with an unusual shape”

and,

“why is this better than a microphone with a simple switch”.

This feedback had confirmed some of our earlier concerns about the lack of the containment metaphor. The Seed had lost the ability to be opened which took away the important playful elements of curiosity, surprise and spontaneity experienced when a gift is presented in a package. The Seed was confusing in that it did not represent a “container” semantically. During the technical development we had lost the focus of our design intentions.

3 Containers for Playful Dialogues

3.1 New Artefacts and Actions

Armed with these reflections and knowledge we decided to revisit both the type of artefact and the visual semantic that would suggest containment and allow for curiosity, surprise, spontaneity and play. Similarly, what physical actions would afford such an experience? For example an opening needed to be a physical opening not an abstraction of this theme. These actions need to support and encourage the playfulness within this system. We literally went back to the drawing board. Over a 2-week period we had intense design brainstorming sessions starting with thumbnail sketches exploring many new containers for these intergenerational messages.

We were happy with the temporal interaction sequence that existed with the Seed and Pod and decided the basis of this was to be maintained as we had the Flash programming developed. After much discussion, design and debate we arrived at two new concepts, i.e., The Bag of Gifts and The Magic Bottle.

3.2 The Bag of Gifts

The Bag of Gifts is quite a departure from the Seed and Pod both in terms of its formal visual language and the ways with which it can be engaged. The bag hangs permanently in the children’s playroom or bedroom wall and is connected to an Internet network. (Fig.5)
3.3 Description of Use

A video message is recorded by a Grandparent using conventional video chatting hardware and software. This is sent to the Bag of Gifts and registers as the light on the front of the bag glowing. The curious grandchild opens the bag on seeing the light and reaches inside to grab a trinket that is vibrating. On removing the trinket from the bag, a message plays on the video screen on the inside of the bag flap. Once the message finishes, the child can replace the trinket inside the bag to activate a video recording sequence. They then record their response, which is sent when they close the bag flap. (Fig. 6)

The design rationale for using an artefact such as a bag was that the Magic Box study group had children ranging in age from 2 to 10, with the majority above 4. These children are either at school or pre-school. They all use and identify with the school bag. The Bag of Gifts is not a school bag but a physical way of mediating and sending video messages. It references the functional ability of the bag as a means of creating a novel interaction experience with digital imagery.
The light on the outside is the first to trigger the child’s or grandparent’s curiosity. In terms of affordance the concept uses the opening of the bag as a way of initiating the interaction sequence and the closing as a way of completing the sequence. The trinkets inside represent the message or messages sent and partially embody these as physical objects. This references the gift in the box notion that was a powerful part of the Magic Box cultural probe. Ideally the trinket would be the message, for example have a small video screen, but this was out of the range of technologies we had available for the project. Instead we have a small video screen that is activated by taking the trinket out of the bag.

3.4 The Magic Bottle: Description of Use

The Magic Bottle was a refinement and improvement on the Seed and Pod. It is similar in that it uses light to indicate a message, touching the bottle to activate the message and shaking the bottle to erase the message. However the bottle had the addition of a stopper that needs to be removed to allow the message or sound to be heard and has a lip on the opening that affords a holding to the ear in the same way you would hold sea shell to hear the sounds of the ocean. (Fig. 7)

Fig. 7 Development of the Magic Bottle

The Magic Bottle is small enough to hold and its sense of magic comes from the way the message is contained and one interacts with its sequences of light that represent its state. We have kept the Seed and Pod interaction sequence as we felt it was worthy of development into a prototype. (Fig. 8-9)
3.5 Discussion

The Bag of Gifts and the Magic Bottle are artefacts that attempt to embody messages and encourage playful and spontaneous dialogues between the grandparents and grandchildren. They extend the idea of the Magic Box to include the advantages of being able to send information electronically over a network. They don’t allow for the exchange of actual artefacts as the Magic Box does, but rather representations via video or sound.

The Bag of Gifts is quite a departure formally from the Seed and Pod. This departure was a conscious attempt to not only create a stronger containment metaphor but to have a device that references and attempts to repeat the element of curiosity and surprise the children experienced with the Magic Box in both a physical and playful way. This physicality extends to the gift trinkets that are inside the bag on opening. Again we referenced the physical action of removing the gift from the Magic Box in this way. We feel satisfied now that the container of playful surprises and dialogues has been achieved with the Bag of Gifts.

The Magic Bottle is clearly a bottle in its visual semantics. Aesthetically it is a beautiful form without considering the interaction qualities it might possess. It is small enough to hold and its sense of magic comes from the way the message is contained and the children interact with its sequences of light.
4 Conclusion

If we reflect back on our original question, *to enable and extend the play and dialogues that are present with the non-electronic Magic Box using information technology with a focus on the interaction design*, we cannot describe the nature of the play and dialogues with both of the Magic Bottle and the Bag of Gifts as they are yet to be observed as prototypes in the field. There is still some work in the programming and assembly to be completed before this can be done. However we set challenges for the design of these prototypes and through phases of reflection and development we have moved significantly from the original Seed and Pod concept. Ultimately these changes came about due to our own dissatisfaction with the Seed and Pods ability to represent containment. It did not afford opening and closing movements. These were important aspects of the Magic Box as they helped to provide the element of surprise at the gifts that had been given and the ritual of opening and discovering that followed. So we are satisfied that the challenge to find the appropriate design languages and interaction sequences for playful interaction and dialogues has been fulfilled with the design and development of the Magic Bottle and Bag of Gifts. This satisfaction came in part from the iterative nature of the design development. This was encouraged by the critical feedback we received and the design groups own ability to reflect on the strengths and weaknesses of the earlier designs for the chosen context. As a method we maintain that it is better to prototype sooner rather than later to understand the issues from an interaction design standpoint.

Both the Magic Bottle and Bag of Gifts have strong semantic and cultural references to artefacts we know as containers, namely the bag and the bottle. This we consider to be part of their appeal and an improvement on the Seed and Pod. When you combine this with the ability to send and receive digital messages the artefacts become playful technologies. They are playful due to the unique way that they embody the messages. Through using illumination to indicate a message received and actions such as removing stoppers or trinkets to open the message a sense of play is encouraged. The illumination magically represents the presence of a message or gift and the opening actions heighten the sense of anticipation of “who has left me a message”. These representations and actions are quite a contrast to a ring and call on a telephone or instant message on a computer screen.

As interactive devices both the bag and the bottle are explorative and ambiguous. They do not have a set of prescribed instructions or on and off buttons, but rather physical affordances and semantic references that encourage playful actions. These actions ultimately reveal the message but they also describe the use of the device. This concurs with Gaver et als [6] aims for ludic activity in offering a range of possibilities for the users to explore and the encouragement of non goal oriented playful activities. Not only are the bag and bottle explorative and playful due to the ways you interact with them but they also allow play and imagination with the content that can be placed in them. We saw from the Magic Box that in offering a container as everyday as a box that spontaneous exchanges developed that were playful. Of course this box was not an ordinary box. It was magic in the minds of the children as it offered new gifts on return from their grandparents. But it encouraged content that was not
prescribed, rather left to the imagination of the children. In a similar way the Bag of Gifts and the Magic Bottle are common artefacts, but they mediate and encourage a playful sequence of digital exchanges that we consider will be magic for children and their grandparents.

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