Out of the Box – Exploring the Richness of Children’s Use of an Interactive Table

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ABSTRACT
In this article we explore how to enrich the experience of toys that usually spend a boring time in their boxes in the toy store by digitally bringing them out of the box. For this purpose we have developed an interactive table based on the 3D game engine Virtools, together with the reacTIVision software and have studied and evaluated the use of the table in a full-scale, real-world situation in the toy department of a major Danish retailer. Our detailed analysis highlights the wide range of interaction forms and interaction modes facilitated by the table, moving from initial exploration to playful and engaging experiences, both on individual and social levels. We sum up our findings and their relevance for future design and show how the interplay of physical design, interaction, and content has been instrumental in giving children and adults a richer and extended experience of the toy – even though it remains in the box.

Categories and Subject Descriptors
H.5.2 User Interfaces: Evaluation/methodology

General Terms
Design, Experimentation, Human Factors

Keywords
Interaction design, interactive tables, children, interaction forms, interaction modes, experience design

1. INTRODUCTION
Tangible user interfaces (TUIs) have been explored as a way to enhance children’s engagement with digital content by combining physical and virtual spaces in physical interactive environments [4]. The majority of such spaces are oriented towards educational settings, either as formal learning in school or informal learning in public spaces, e.g. museums and libraries. The present study explores a TUI in a commercial setting – an interactive table in a toy department store – but the interactional aspects remain the same: it is essential to create and examine engaging experiences for children.

The Danish LEGO toy company has initiated a strategy of implementing digital 3D models throughout the whole business process, from design up. Today, the LEGO toy figures are designed in digital 3D, and the same digital 3D model is used to produce the casting moulds for the individual plastic bricks, graphics for the packaging, assembly instructions, computer games, promotional material for the web, and print as well as television advertisements. In the search for additional uses of these 3D assets, we have, together with the LEGO company, pursued the potential of using the digital 3D models and animations for promotional purposes in the retail setting, starting from the challenge of finding a way to get the LEGO figures out of the box in the store.

Our research interests in bridging physical artifacts with digital properties are part of a broader investigation of the uses of digital technology for designing engaging marketing experiences. Today, only a fraction of marketing is digital, and most of that web-based, like online advertising, search engine advertising [21], and recommender systems [14, 20], while little research has been done with regard to augmented and mixed reality in a toy store setting.

Our approach has been that of research through design [22], based on the development, testing, and evaluation of an interactive table in a full-scale, real-world situation in the toy department of a major Danish retailer. The specific circumstance has been the launch of the Bionicle 2008 product line.

Figure 1 The interactive table
Our interactive table, shown in Figure 1 is a square station (78cm x 105cm x 105cm) with an interactive surface (86cm x 56cm) together with a 35-inch monitor. Two sets of boxes, each with a small and large Bionicle figure, are furnished with fiducial markers on the underside of the base, which enable the interaction with the corresponding virtual figures in a 3D world viewed on
the monitor. The whole set-up is implemented using the 3D game engine, Virtools, together with the reacTIVision software [13]. Whereas a mainstream reacTIVision application uses projection on the interactive surface, we use a separate monitor as display. The table was in the toy department for a period of four weeks where we continuously made observations of the use. The physical design and the digital content provided a simple and open-ended interaction setup, where children and adults engaged in diverse and highly complex interactions. In this paper we focus on a single day’s use to provide a detailed analysis exploring the diversity of use situations facilitated by the interactive table.

The paper is outlined as follows: First, we position our work within the landscape of use studies of public, interactive installations and interactive table research, and then follow this with a more detailed presentation of the design of the table, based on an interactive marketing model. The main part of the paper describes the analysis of the way the table has been used highlighting the richness of the interactions spurred by the table. From the analysis we draw a range of characteristics describing the interaction forms and interaction modes facilitated by the interactive table. The interaction forms and modes conceptualize the richness of the analytic findings and contribute to a general understanding of designing interactive installations for children in public settings.

2. RELATED WORK

As a tangible user interface (TUI), our interactive table is related to early works on interactive tables such as ActiveDesk [6] with its tangible manipulation of interface elements using “bricks”, i.e. small cubes providing positional and orientation information. The table essentially operates on the same principles, each Bionicle box providing position and orientation. Incidentally, LEGO bricks were central to the motivation and inspiration for the ActiveDesk prototype.

Several taxonomies have been proposed to help characterize TUIs in general [5][5], 10] and media tables specifically [17]. To briefly characterize the interactive table using some existing distinctions, one could say the following, cf. Mazalek et al. [17]: The object design is less constrained when it comes to control and mappings (because the interaction is quite generic) but more constrained in its customization (because the appearance of the boxes correspond exactly to the virtual entities). The interface and control has a less constrained shared interaction approach (simultaneous movement of several boxes) and a more constrained multi-viewpoint approach (the orientation is fixed toward the front). The table is not networked.

In order to highlight other characteristics, we can also compare the interactive table directly to similar tables/surfaces in specific settings:

The Tangible Programming exhibit at the Boston Museum of Science [8] shares many design considerations with our table, e.g. a TUI in public space (a museum in this case) should be: inviting, engaging, supportive of group action, and inexpensive and reliable. They confirmed their design to be all of these, but while their evaluation of engagement was primarily quantitative (based on frequency and duration), the evaluation of our interactive table was mostly qualitative (based on interpretation of interaction forms and modes). It is interesting that both studies find support for the notion that table-based TUIs possess said qualities even though they follow different evaluation paradigms.

BattleBoard 3D [1] is a mixed-reality chess-like board game based on AR Toolkit. Each game piece has an AR Toolkit tag on it, which is visible through each player’s head mounted display as a 3D LEGO mini-figure warrior. When two opposing pieces are physically put together, the combined tags are interpreted and enacted as a battle. The 3D world is also shown on a monitor so that bystanders can see what is going on. Although there is some objective resemblance between our table and BattleBoard in the use of visual tags, a 3D virtual world, and the ability for characters to engage in battle, there are several marked differences: BattleBoard is much more structured and follows the strict rules and interaction patterns of a game, making it unsuitable for casual play in different social contexts. The use of head mounted displays also makes it less accessible for casual use and shared experiences.

StorySurfer [3] is a not just a table but anyway it shares many characteristics with the interactive table: It is a combined surface (floor: top-projected, table: back-projected) installation, which allows children to browse and select books in a library. The interface encourages playful and social interaction, and the interaction patterns resemble those of our table setup.

In addition to the work done on designing and describing TUIs, there has also been an increasing research interest in conceptualizing and describing the use of interactive installations in public space as exemplified in [10, 2, 7, 8, 15]. [10, 2] focus their attention on the lived experience of audience members. Through techniques for verbal reporting [10] develop a two-tiered evaluation model that responds to the concerns of interactive artists to be used to improve the design of the Influencing Machine, an interactive artwork; [2] use video-cued recall to elicit verbal descriptions of audience experience to develop Cognitive State and Movement codes, which are then combined with artist Sidney Fels’ four categories of embodiment (response, control, contemplation, belonging), giving a detailed and categorized account of people’s experience of an interactive kaleidoscope named tamascpe. Although informed by [10, 2] in uncovering pertinent aspects of the interaction, both the design and the analysis of the interactive LEGO table supplements their work by introducing a study of an interactive installation in a commercial setting.

[7, 8] develop an understanding of users’ interactions with interactive installations in museums and galleries inspired by research into interaction and conversation analysis. The authors develop a CSCW-inspired naturalistic analysis of visitors’ use of museum technologies specifically focused on the social interaction and material conditions for the interaction with the technical and the social aspects of low-tech assemblies [8]. The analysis consists of findings covering pertinent issues related to future design and development work presented in the form of rich narratives leading to a set of design sensitivities relevant for museums and exhibitions [7]. Following this we also seek to identify characteristics of the interaction in order to make sense of and explore the use of the interactive installation in order to understand the conditions of use and to influence future designs.

We are, however, working with a somewhat different setting, namely a toy department store, which bears different characteristics than that of a museum or artistic exhibition space.
Recently [18] has given insights into how users approach, participate and interact with a large multi-touch display in public space, the CityWall. Through detailed observations and analysis the authors identify findings relating to dynamics of approach, social interactions at the display and transitions between activities and participants which can be useful for designing systems for urban environments. Our work is closely aligned with these concerns of designing interactive installations for public spaces which we seek to extend by exploring the dynamics of initiation, relation and interaction focusing on the richness of children’s use of the interactive table.

In the next section we present the motivations and considerations for designing the interactive table followed by a detailed account of the richness of the interaction forms and modes facilitated by the table.

3. THE INTERACTIVE TABLE

The design and intentions of the interactive table can be explained by using the model suggested by Mailund and Halskov [16]. The model was originally developed to address design issues in the context of designing experiences with a marketing effect in mind, but can equally well be applied with other kinds of effects in mind, e.g. designing for achieving a learning effect at museums or schools.

According to Mailund and Halskov, the model is composed of three horizontal and three vertical categories (see Figure 2). The three horizontal categories constitute the three mechanisms of IT-based experiences: A) physical design, B) interaction, and C) content. The three vertical categories – 1) behavioural, 2) cognitive, and 3) affective – constitute three types of marketing effects, which together ensure the achievement of the desired overarching marketing effects, and which may be defined as a form of action or reaction on the part of the recipient of a communication (see [19]). At the junctions of this three-by-three matrix, the model’s nine design strategies are to be found, each of which can be considered a means for attaining a desired marketing effect. An example of this would be a physical design that attracts attention, thus drawing people to the installation (i.e. eliciting a behavioural effect).

3.1 Physical design

An essential consideration concerning the physical design was the location of the table during the field test in the department store, where the table was right at the boundary of the toy section, facing the top of the ascending escalator, clearly visible to people on their way up, and intended to create an initial awareness which would attract people to the table (see Figure 3).

The height of the table, the position of the monitor, and the size of the interaction surface were consciously designed with the target group in mind (children 6-16 years old), so that they could easily see the display, and operate on the entire surface. The size of the boxes with Bionicle figures was defined by the actual size of the individual Bionicle boxes, which were of a size that children could conveniently grasp. The bases of Bionicle boxes with identical colour have matching base profiles as part of their physical design (see Figure 4). The physical appearance and positioning of the Bionicle boxes at an unconventional place (i.e. at the table) was expected to attract the awareness of the children, and perhaps their parents. In sum, the physical design was primarily intended to have the behavioural effect of attracting attention, creating an initial awareness, and making the children pick up the boxes.

3.2 Interaction

The design offers three basic kinds of interactions, based on picking up one or more of the boxes (see Figure 5). First, it is possible to put a box on the interaction surface and have the corresponding digital 3D model appear; you can turn it around and move it on the surface, and the digital 3D model behaves in a similar way on the display. Second, if you move a red Bionicle close to a green Bionicle (or vice versa) they start fighting. Third, if the base of a small Bionicle box joins the base of the Bionicle of the same colour, the digital 3D model of the small figure jumps on the back of the big figure. First, the interaction strives to achieve a behavioural effect by inviting play with the figures, whereas a cognitive effect arises from interaction with the content.
3.3 Content
The physical content, i.e. the actual physical packaging, with the Bionicle labels, and colours corresponding to the specific Bionicle figures, relates in the setup to virtual figures. The four Bionicle figures are all part of the Phantoka clan: The two heroes, the large Lewa Nuva, and the smaller Tanna in green, and the two villains, the large Radiak and the smaller Antroz, in red.

The basic digital content provided by LEGO is the high-quality animation associated with each of the four figures, each of which can stand, walk, hover, fly, and fight. Moreover, Tanna can connect to the back of Lewa Nuva, and Antroz can connect to the back of Radiak. The drama of the four virtual figures unfolds in a virtual 3D world created from the same digital 3D models as the graphics on the boxes (see Figure 6). The content is intended to contribute to a cognitive effect by increasing knowledge about the product, but also to support a behavioural effect, by tempting passers-by to pick up the boxes. The fascinating universe of fighting, high-resolution Bionicle figures was expected to create an affective effect.

A central point is that the three types of effects described earlier often interact in order to achieve a broader marketing objective. Frequently, therefore, one may speak of a network of objectives and effects that follow one another in a strategic effort to attain a broader objective, like increasing knowledge about a product (a cognitive effect) or increasing the positive attitude towards a product or a brand (an affective effect), which may ultimately lead to the customer picking up a Bionicle box (a behavioural effect).

4. ANALYSIS OF THE TABLE IN USE
We now move on to a situated analysis conducted in the specific setting (physical and conceptual) the interactive table was located in. In the analysis we seek to contribute to a general understanding of children’s interactions with interactive installations in public space by identifying a set of interaction forms and interaction modes we find instrumental for informing future design practices in similar settings.

4.1 Data Collection
The empirical data gathering consisted of field observation and five hours of video recorded on-site in the department store on Saturday, 29th of March 2008, from 9.30 to 15.30. The camera was installed six meters from the set-up, with a clear view of the table, the display, and the surrounding environment but with no auditory input. The data was logged and classified with respect to interaction times, number of people interacting, gender, and age.

In the six hours of observation data we identified 94 interactions ranging from six seconds to 25 minutes in length. The distribution of the interactions over time is presented in Figure 7. The Figure also shows how the interactions overlap, and the presence of bystanders, i.e. people watching others interact, which is also relevant in relation to the table’s function in a commercial setting. A total of 124 people were observed interacting with the table. The distribution of gender and age is shown in Figure 8 indicating that a wide variety of people engaged in the interaction, though most were boys less than 16 years of age. In conclusion, the observations clearly show that the table was successful in attracting people to use it and explore the figures coming out of the box.

Moving on from a quantitative summary of how the table was used, we proceed to a qualitative analysis of the interactions. The analysis has been carried out on a purely behavioral basis. In order to identify the interaction forms and modes facilitated by the table, the design team engaged in an Interaction Analysis Lab session [12]. This resulted in an initial set of understandings, which were refined iteratively through more close observations of the collected data. In the following, we describe two sets of interaction forms related to the initiations and relations of use facilitated by the interactive table. We then highlight three general interaction modes pertinent for our specific setting and useful for talking about interactive installations in public space in general.
We then utilize the proposed interaction forms and modes as a vocabulary making sense of a complex interaction scenario. Finally, we sum up and identify general tendencies concerned with the design of an interactive table to be used in a commercial setting and how these findings might be beneficial in other contexts of use.

## 4.2 Interaction forms: initiation and relation

During our in-depth analysis of the collected data, we identified a number of interaction forms concerning the initiation and social interaction relevant to an understanding of the interactive table in a marketing perspective. Figure 9 (left) presents the initiation forms. **Walk-up-and-use** applies when a person approaches the table and starts interacting within five seconds of arrival. A total of 45 interactions begin like this, indicating the ease of use of the physical and digital setups. Another prominent form is **Watch-and-join**, referring to interactions initiated by people who watch and then join those who are already interacting with the table. **Watch-and-take-over** describes situations in which people who have been watching the table wait until the other users have gone away before engaging in the interaction. **Interact-and-run** is for the interactions characterized by people only briefly initiating the interaction before leaving the table. **Return** describes people who have already interacted, and then return to the table.

![Figure 8 Duration, gender and age](image)

### 4.3 Interaction modes

Through our observations, we further identified three general interaction modes dominating the collected data. The **explorative interaction** mode describes an interaction whose primary goal is to determine how the table works and how you can interact with it. The observations contain several examples of first-time users of the table, and how they seek to uncover its basic functionality. The **playful interaction** mode describes an interaction whose primary goal is to play with the figures and the table. This playful interaction mode is characterized by the focus being not on uncovering the immediate functionality of the table, but on playing with the physical (figures) and virtual 3D worlds. The **playful exploration** interaction mode describes a cross-over situation, where the basic functionality of the table is uncovered through playful engagement. Although the three interaction modes overlap, they function as a conceptual framework for understanding typical use situations. An interaction can consist of several interaction modes composed dynamically over time. To empirically support and describe the richness of the interaction with the table and how this relates to bringing the toy out of the box, we will now describe typical examples of how the different interaction modes are present in the empirical evidence.

### 4.3.1 Explorative interaction

The explorative interaction mode is characterized by people closely examining the installation or picking up the figures to explore them as physical objects, before engaging in the interaction. People interact very systematically, trying out different positions on the table, relating them to placement and changes on the display, constantly switching focus between the physical and virtual worlds.

![Figure 10 Explorative interaction, Example 1](image)

**Example 1**: a boy (aged twelve) approaches the table, stands on the right side, and observes for a minute what is going on in the virtual world. He then lifts the small green figure, and looks underneath it, where he discovers the visible tag. He then carefully starts moving the small red figure, turning it around on the table while moving around the table himself. Afterwards, he tries to couple the small red and the big green figure. He then interacts with the big red figure, moving it around the table, removing it from the table, and placing it on the table again, to see what happens. He also tries two figures that are not interactive, but are standing on the table. He then moves the big...
red figure across the table. He gradually starts interacting with more figures simultaneously, coupling the two green figures and moving them around on the table. While doing so, his attention continuously shifts between the physical figures and the virtual world, trying to make a connection between his actions and the actions of the figures. Other people join the interaction, and he leaves, forgetting his bag on the table. His observation lasts 53 seconds, the subsequent interaction approximately two minutes.

The explorative interaction is evidenced by the way the boy closely observes the virtual world, and starts making a link between the figures by exploring their physical shape, and how they might relate to what is going on in the virtual world. The boy builds up knowledge, interacting with one figure at a time, exploring the correlation between their physical position on the table and the corresponding actions in the virtual world. After exploring the basic functions of the individual figures, the boy then starts exploring the ways the figures might be coupled, thus adding a new layer to his basic understanding.

4.3.2 Playful interaction

The playful interaction mode is ascribed to interactions that transcend the initial exploration and fascination of the basic functionality of the table, leading to a more profound and intentional interaction. One of the cardinal points of this interaction form is the way the figures and the digital 3D world come together to create a universe where the users can play with the table and each other.

Example 2; a girl (aged seven) approaches the table from the left side, because other people are interacting with the figures. After a couple of minutes, she starts arranging the physical packages on the table in different patterns, making them fight on the display. She watches the animations on the display, and tries out different combinations, always starting by positioning the figures on the table, after which she looks at the results in the virtual world. After each arrangement, she contemplates the effects on the display. She does so for nearly eight minutes.

This is an example of playful interaction, where the girl transcends the initial exploration by using the table to choreograph her play. In this way, the interaction is not concerned with the functionality of the figures/the table, but more on how you stage a choreographic use of the interactive capabilities. It is especially interesting to notice the way the attention is deliberately focused on both the physical and virtual sides of the table.

4.3.3 Playful explorative interaction

The exploration of the basic functionality of the interactive table is also the starting point for the playful explorative interaction. This interaction mode is characterized by less structured exploration of the figures and the overall interaction possibilities, mainly visible in the way the figures are moved randomly instead of systematically.

Example 3; a girl (aged six) approaches the table from the front, and starts shaking the green figures and moving them around. Another girl (aged six) approaches from the right side, watches for six seconds, and moves the small red figure around. A boy (aged ten) approaches the front of the table and starts moving the big red figure. The first girl starts moving the figures in the direction of the boy’s figure. The second girl disappears, and the two remaining children start moving the figures as fast as possible around on the table, back and forth, around and around, while watching the actions on the display. The boy looks at the packaging. One of the figures tumbles down on the table, and the children start slamming the figures together and lifting them off the table. The second figure, the little green one, falls down. In the end, the children start placing the figures on top of one another and slamming them against the table. A parent stops the interaction.

This example shows how the exploration of the basic functionality of the table can be very spontaneous, involving the trying-out of many interactions, as rapidly as possible. The children in this example are exploring whatever consequences their actions might have, in an unordered and playful way. The figures are moved unsystematically across the table in many different directions, and the children do not stop to reflect on their actions. The interaction lasts for two minutes and 34 seconds, and in that time, the children explore various types of physical interaction and their virtual correlations.

4.4 Interaction forms and modes: microanalysis

The interaction forms and modes are often intertwined in more complex interaction scenarios. In addition, several parameters can be highlighted to further nuance the richness of the interactions. The following microanalysis seeks to exemplify how the proposed vocabulary can be used to make sense of the interactions as well as how the interactions themselves open up interesting ways to talk about the mixture of the digital/virtual and the physical aspects of the installation. We offer a rich description of an interaction scenario schematized dynamically in relation to
interaction modes in Figure 13. This is followed by a discussion of a range of pertinent analytic findings relevant for an understanding of the interactive table and how this might be instrumental for future design of interactive installations for children in commercial and public settings.

4.4.1 Rich Description
Two girls approach the table. The first girl starts exploring the two red figures (walk up and use, individual interaction); first, she lifts the big red one in the air while watching the virtual world, then she interacts with both figures in an explorative, unstructured way. The second girl watches the interaction and quickly starts exploring the two green figures (watch and join, individual interaction). The girls move the figures around the table in an unstructured manner, and quickly start banging them together in a playful way, watching the display, to see what happens (group interaction).

The virtual characters are flying in the foreground of the picture, and do not fight, although the packages are banged together. The first girl leaves, and the other girl stays at the table, exploring the functionality of the table, and various ways of banging the figures together, in a more structured manner (individual interaction). A boy walks up to the table and starts watching the girl, as does another girl (watch and join, individual interaction); their mother comes to pick them up. The second girl aligns the figures horizontally on the table and tries to bang the two big figures against each other. They are in the middle of the table, with the small figures on each side, according to color. She jerks the figures around, moving them very quickly, and they do not start fighting in the virtual world. The second girl arranges the figures systematically on the table and leaves. The interaction lasts for about a minute and 15 seconds.

Approximately two minutes later, the second girl returns to the table (return, individual interaction). She starts lifting the figures, playfully exploring the packages of the big red and green figures. She then lifts all four figures off the table while looking for, and calling to her friend, the first girl. The second girl carefully places each figure on the table horizontally, red figures on the right, green figures on the left. She adjusts the figures while placing them. The first girl returns to the table (return, watch and join). She leans on the table and starts exploring the packages and moving the two red figures about. Soon, the two girls start fighting with the figures, moving them quickly against one another (group interaction).

The second girl moves, and quickly lifts the figures before placing them on the table. The first girl couples and decouples the red figures, and inspects the package and bottom of the big figure. The two girls start fighting with the figures, while turning them around and lifting them. The first girl moves to the left of the table and moves the figures from there, before moving back to the front of the table. The second girl bangs the two small figures together, while the first girl watches passively for 10 seconds. The big green and big red figures are left untouched. The two girls couple the figures; the first girl moves the red figures, the second the green figures. The second girl decouples the green figures, and tries to couple the small red and small green figure. Next, the girls couple their figures as they had before. They start to choreograph the figures in different ways, before they suddenly decouple them and start banging the small figures together. The figures in the virtual world are floating in the foreground, and do not fight. Their attention continuously shifts between the physical figures and the display. They then start to fight on the table again, moving all the figures around. The second girl lifts the small green figure and opens its lid. She suddenly removes both the green figures from the table. The first girl follows suit, and removes the red figures, while touching the table with her hand. The second girl also touches the table with her hand. They replace the figures, couple them and start moving them around on the table and in the virtual universe, first together, then apart. This last part of the interaction lasts for about two and a half minutes.

4.4.2 Analytic findings
As shown in figure 13, the girls move from an initial exploration of the basic functionality of the table to a playful and social engagement with the table and each other. When the first girl leaves, the second girl returns to her playful exploration, choreographing the figures on the table. Trying out various physical arrangements of the figures on the table both systematically and unsystematically, her attention shifts from the physical to the virtual world. Her interaction with the table also attracts bystanders. When the second girl returns, the two girls
continuously shift from play to exploration. The second girl even explores the packaging, trying to open the lid of one of the figures.

As this interaction scenario shows, the girls seamlessly shift between different interaction forms and modes facilitated by the design of the interactive table. The interactive installation allows for a range of relational arrangements on a social scale, both giving the two girls the opportunity to interact individually and to share the experience of interacting with the figures. The girls initiate their interactions in a number of ways, and the bystanders indicate how the two girls interacting attract attention to the table inviting other people to also explore the setup.

Through the description, it also becomes clear that the interaction forms and modes in no way are exhaustive for describing the richness of the interaction. An interesting point not covered in the proposed vocabulary could be made about the various ways the two girls interact with the physical figures. Their banging the figures together indicates that they are trying to make the figures fight. However, they never see the figures fighting in the virtual world, because they move them too rapidly for the computer to register the movements. This, however, does not seem to lower their interest or engagement. Their removal of all the figures from the table to see the empty virtual world is also an example of unintended use, as is the way in which they remove the figures while interacting. Other findings indicate that this is done to make the figures ‘invisible’ while observing and playing with the virtual world.

The microanalysis shows how the interaction forms and modes can be used to make sense of the dynamics of an interaction scenario facilitated by the interactive table. The manner in which the table supports various ways of initiation and relation and the dynamics of the interaction modes are instrumental in achieving attention in the setting. Further, the interplay between the physical and digital worlds also seems to play an important role in fostering and maintaining the attention.

5. CONCLUSION

In this paper, we have presented an interactive table design aimed at bringing the Bionicle toy figures out of their boxes in a toy department. Through an analysis of observations and video data, we have identified a richness in interaction forms and modes aimed at characterizing the interactive table in use. The forms and modes illustrate the variety of interaction possibilities the interactive table offers. The analytic findings reveal that the position and design of the physical table and boxes facilitates multiple ways of inviting children to engage in a range of interactions leading to an increased interest in exploring the Bionicle figures.

An interesting aspect of the findings is, that they indicate that the placement of an interactive table in a toy department demands that it should be accessible to both adults and children. The frequency of Family Interactions illustrate, that the table functions as a meeting place for both parents and children. In addition, the table has also been instrumental in bringing both children and adults that did not know each other in advance together in the interactions while retaining the possibility of individual interaction.

The analysis stresses the importance of the way the table seems to immediately invite people to interact with the boxes and figures, while at the same time retaining the possibility for very complex and long-lasting interactions. Despite a fairly simple interaction setup, the table provides for a rich combination of possible interactions, as described through the dynamics of the interaction forms and modes, ranging from short-term exploration to long-term explorative and playful engagement. This is also evidenced by the fact that people return to the table for further play and exploration, following their initial interaction.

The microanalysis makes particularly evident the many different intended and unintended use situations supported by the interactive table. The analysis is purely behavioral; however there are strong indications that the cognitive and affective dimensions mentioned in the marketing model are also at stake here. To be able to maintain the awareness of those interacting with the table, it needs to be possible to explore not only the physical and virtual worlds presented by the table, but also the narrative and playful dimensions evolving around the Bionicle Universe. Future work would seek to further inform the analysis, in order to reveal these dimensions, and also use interviews and recordings of the dialogue between those interacting with the table. It would also consist of further refinements of the analytic results, in order to use them as guidelines in a future design process.

With regard to the initial motivation for designing the interactive table, we conclude that, based on the analysis conducted here, the table has succeeded in bringing the Bionicle figures out of the box. We further believe the proposed interaction forms and modes can be instrumental for uncovering important design aspects when designing rich interactive installations aimed at creating engaging experiences for children in public settings.

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7. REFERENCES


