

Mertala, P. (accepted). How connectivity affects otherwise traditional toys? A functional analysis of Hello Barbie. *International Journal of Child-Computer Interaction*.

Abstract

The current smart toy research has not fully acknowledged the existing research on traditional toys. Instead, the focus has been on the digital layer of smart toys. This study contributes to bridging the gap between traditional and smart toy research by applying the analytical model known as the functional manipulation potential of toys (FMP) to identify if and how smart features such as connectivity affect otherwise traditional toys. Based on purposeful sampling of informant-rich cases, this study uses FMP to analytically compare the digitally enhanced Hello Barbie doll to a traditional Barbie. The data, analyzed using abductive methods, comprises the tangible dolls and the 8,000 lines of dialogue that Hello Barbie can speak. The results show that connectivity can notably change the FMP of an otherwise traditional toy. These changes took place in two forms: additions and amplifications. Additions mean that Hello Barbie contains functional elements a traditional Barbie does not. Amplifications refer to situations where already existing elements were augmented by the connectivity. Implications for future research are discussed.

1. Introduction

Smart toys have become the subject of growing academic interest, and a selection of edited books [1, 2] and journal articles [3, 4] has been devoted to these toys. However, a review of the literature [e.g., 1, 2, 3, 4, 5, 6, 7, 8] suggests that the current smart toy research has not fully acknowledged the existing empirical and theoretical research on traditional toys. Instead, the focus has been on the digital layer of smart toys. This study contributes to bridging the gap between traditional and smart toy research by applying the analytical model known as the functional manipulation potential of toys (FMP) [9] to identify if and how smart features such as connectivity affect otherwise traditional toys. Although the FMP has been applied in toy, play, and design research with promising outcomes [e.g., 10, 11, 12, 13], thus far it has not been used to analyze smart toys.

Based on purposeful sampling of informant-rich cases [14], this paper compares the traditional Barbie doll with Hello Barbie, a connected smart toy. As Figure 1 illustrates, Hello Barbie does not differ externally from a traditional Barbie doll; it is in the interior and functionalities where these two dolls differ.



Figure 1: Hello Barbieⁱ (left) and traditional Barbieⁱⁱ (right)

Hello Barbie features a microphone, a speaker, and speech recognition technology that is activated by a push-and-hold button on the doll's belt buckle [15]. When talking to the doll, the child must push and hold the button. When the button is released, the doll will respond to the child.ⁱⁱⁱ To activate the two-way conversation, Hello Barbie must be connected to a cloud service containing more than 8,000 lines of dialogue via a wireless connection [15]. In this study, the tangible dolls and the list of Hello Barbie's lines were analyzed via abductive method [16] to seek answers to the three following questions:

- What kind of elements does traditional Barbie's functional manipulation potential consist of?
- What kind of elements does Hello Barbie's functional manipulation potential consist of?
- How does Hello Barbie's functional manipulation potential differ from that of a traditional Barbie?

Before moving further, two points related to the framing of the study need to be raised. First, it is crucial to acknowledge that the term "smart toys" conveys a vast array of toys that often share more differences than similarities [8]. The ideas and findings presented in this article are about the type of toys that can be referred to as smart dolls: toys that externally resemble

traditional dolls but are, for instance, able to have a two-way (verbal) interaction with the child. Second, this paper approaches Hello Barbie more as a manufactured toy than a cultural product. Thus, the culturally oriented research literature on Barbie (i.e., feminist studies, semiotic research) [e.g., 17, 18, 19] is touched upon only lightly in this study.

2. Background

Research perspectives on smart toys include the domestication of smart toys [3, 20, 21], the security issues of connected smart toys [22], and the learning affordances of smart toys [23], just to name a few examples. Despite the seeming versatility, from the viewpoint of toy research these discussions have been somewhat one-sided, as in them smart toys are mainly treated as smart/connected devices rather than toys. For example, in Berriman and Mascheroni's [6, p. 798] recent paper on the affordances of smart care toys, they note the following in the introduction:

Though smart toys continue to share many similar traits with traditional toys, often building on existing play categories such as 'care toys' and 'construction toys', we argue that they also increasingly share characteristics with domestic media and computing devices.

While they acknowledge that smart toys share traits of both traditional toys and domestic media/computing devices, the former dimension is not practically discussed in their paper. Almost identical framing is found from Mascheroni and Holloway [24, p. 3], who first write that

IoToys in their capacity as material objects are not dissimilar to other physical toys children are used to playing with. Their materiality is an important aspect of how children make sense of, normalise and incorporate the new generation of toys into their everyday play practices.

However, after this statement they immediately move to frame and discuss smart toys as a form of contemporary (digital) media. One more illustrative example of this "techno-centric" approach can be found in Peter et al.'s [7, p. 29, italics original] description of what smart toys are. According to them,

both smart and connected toys are electronic devices that need *energy* (from batteries or mains power). Second, both smart and connected toys tend to rely on one or more types of *sensors* (e.g. visual, audio, haptic) for input from their human and non-human environment. For smart toys, this input comes from their own, immediate environment and is unique to the particular toy. For connected toys, this input may in addition come from another, remote environment (e.g. in the form of information stored in the cloud). This input is thus unspecific to the particular toy. Third, smart and connected toys alike are *software-controlled*, which largely determines their “intelligence”. Whereas, in smart toys, the software is embedded, it may be controlled remotely in connected toys. Fourth, both smart and connected toys *interact* with children; they thus not only process input from their human environment, but also respond to it.

While these approaches have offered insightful notions regarding the technological nature of smart toys, they have neglected the information provided by the research on traditional toys. That said, it must be emphasized that this critique is not to say that previous research has done an insufficient job. Since smart toys are a novel form of toys, it is understandable that the focus has been mainly on the digital layers. As explained by Mascheroni and Holloway [24, pp. 20–21], “as a new category of toys, it is the digital connectedness and associated communicative affordances (...) that are frequently promoted, critiqued and researched”. Nevertheless, approaches that acknowledge findings of traditional toy research are needed as research suggests that technological features do not necessarily determine the way children play with smart toys [20, 21, 25]. These findings indicate that smart toys—or at least some of them—contain playful affordances even when powered off or disconnected from the Internet. Put differently, besides digital technologies, smart toys are also tangible objects, which highlights the importance of paying attention to the research on traditional toys.

The phenomenon of techno-centeredness is also present in the existing attempts to classify and/or categorize smart toys. Mascheroni et al. [5] proposed that smart toys (or software-based toys, to use their actual concept) can be divided into three overlapping dimensions: Internet connectivity, simulation of human interaction, and programmability by the user. Hello Barbie—the empirical subject of the present paper—could be located at the intersection of Internet connectivity and the simulation of human interaction. In other words, the doll is connected to the Internet and enables human-like interaction, but it is not programmable by the

user. The big question is, does this definition capture the essence of Hello Barbie as a toy as a whole? Based on a glance at the research on traditional toys, the answer would be no.

As Hello Barbie is a female doll, many toy researchers would also classify her as a feminine toy [26, 27]. However, the use of overarching categories such as masculine, feminine, and neutral [28] contains its own issues. In Hughes’s [29] classification, puzzles and books were labeled as gender-neutral toys. A few years later, in a paper by Blakemore and Centers [27], balls were labeled as masculine toys. A more recent example is the study by Dinella et al. [28], which labeled playdough as a gender-neutral toy. The problem with these umbrella categories is that there are thousands and thousands of different puzzles, balls, books, and Play-Doh sets, and although some of them surely can be labeled as neutral, there are roughly an equal number that cannot (see Figure 2). The same also applies to categories such as “care toys” and “construction toys” [6]. Consider Legos, for example. Initially, it appears logical to label Legos as construction toys, as they are attachable plastic blocks of various sizes, shapes, and colors. However, when the construction—for instance, a police vehicle and an officer—is complete, the toy can be used in a socio-dramatic figure play.



Figure 2. Collection of balls, Play-Doh sets, and puzzles

Some researchers have tried to tackle the problem of broad categories by increasing the number of classes to sort toys into. In a study on Swedish children's toy collections, Nelson [30] came up with a classification scheme of 28 items. However, the addition of categories does not necessarily lead to conceptual refinement. According to Nelson's [30] model, Hello Barbie would be categorized as a toy that represents an adult figure—a factual but not very informative description. One implicit attempt to use deductive categorizing for smart toy research exists. In their paper, Berriman and Mascheroni [6] offer three characteristics to describe smart toys: liveliness, affective stickiness, and portability. However, they underline that these features are not meant to convey all smart toys but a subset they refer to as "smart care toys." While not explicitly stated, the choice of words implies that smart toys could also be divided in several different categories, one being smart care toys.

To avoid the above-mentioned issues, some toy researchers have come up with models that move beyond deductive categorizations and rely to design-based approaches which acknowledge that "toys communicate through their design (colour, faces, costumes, accessories etc)" [31, p. 212]. One example is Kudrowitz and Wallace's [32] Piaget-influenced idea of a play-pyramid and sliding scales of play where each toy can be located uniquely within the different play types (construction, sensory, challenge, fantasy) and affordances (involvement, social involvement, level of restraint, mental/physical, gender) the toy offers. Hello Barbie would be categorized to afford fantasy play with low social involvement. Engagement with Hello Barbie would be more mental than physical, and the toy would be interpreted as more female than male. While Kudrowitz and Wallace's [32] model is a welcomed addition, it—like any other model—is not without limitations. The model, for example, makes no distinction between fantasy play where the child acts in a role in relation to the toy (e.g., acting as a baby doll's caregiver) or through the toy (e.g., speaking for the doll). Acknowledging these issues, Mertala et al. [9] have presented the idea of the FMP. The FMP is a multidisciplinary framework which, instead of using upper-level classifications, provides an "exploded view" of each toy by unpacking it into various, intentional, built-in purposes called elements. The model and its relation to smart toy research is discussed in detail in the following section.

3. The functional manipulation potential of toys

Inspired by the seminal works of Piaget [33] and Vygotsky [34], Mertala et al. [9] argued that play (as the object manipulation of toys) can be conceptualized through the themes of

functional thinking/symbolic thinking and functional manipulation/symbolic manipulation. By ‘functional thinking which leads to functional manipulation,’ they mean forms of play in which no symbolic thinking is needed. Examples of such types of play are throwing or kicking a ball, or flying a kite. By ‘symbolic thinking that leads to functional manipulation,’ they mean forms of play in which symbolic thinking is needed to actualize the functional manipulation potential of a certain toy, and that describes the ways in which the user is intended to play with it. For example, acting out a caregiver–child role-play with a doll requires that the players transform the doll into a baby, by using their symbolic thinking ability. By ‘symbolic thinking that leads to symbolic manipulation,’ they mean cases in which the result of the manipulation cannot be returned to the functional manipulation potential of a toy. In the case of a baby doll, the type can be tracked back its functional play affordances, as it resembles a real baby, and thus, creates the opportunity for socio-dramatic role-play. In contrast, if children use a small ball as an apple while playing, the form of manipulation cannot be seen to result from the functional manipulation potential of the toy. In other words, despite a (small) ball and an apple having a physical resemblance, such a manipulation is not an intended design feature.

In the original model, each toy’s FMP was argued to derive from 10 intentionally designed elements (representational, gendered, sensory, productive, performative, normative, technological, social, and educational^{iv}) [9]. With the exception of the gendered element, these aspects are designed to provide pragmatic play affordances [9]. The gendered element, in turn, is an attractive element that “invite[s] children to pick out a certain toy from the broader toy-pool” [9, p. 13]. Concrete examples of this element are the princess figures printed on the plastic balls in Figure 1. Since the model was originally designed for analyzing traditional toys, it pays only minimal attention to the digital layer of smart toys. Thus, to be relevant in relation to the changing landscape of playthings, the model needs to be extended and refined with respect to the insights provided by smart toy research. In practice, this extension and refining means the introduction of an additional element (affective) and new value for social element (simulated social interaction).

Drawing on Berriman and Mascheroni’s [6] idea of the affective stickiness of smart toys, in this paper, an affective element is added to the original elements. An affective element refers to the pursuit of an emotional bond between the child and the toy. A toy whose well-being depends on the child’s actions contains an affective element with “dependency” value, whereas a toy that imitates a peer contains an affective element with “reciprocal” value. An example of

a toy with dependency value is the handheld virtual pet Tamagotchi^v, which requires constant caretaking from the child and eventually dies if its demands are not met [6]. An example of a toy with reciprocal value would be My Friend Cayla^{vi}, a speaking child-doll that can have two-way peer-like interaction with the child, but which requires no caretaking and, thus, is not dependent on the child. Smart toys' ability to respond to two-way interaction is one of the core features of connected toys [6, 7]. To paraphrase Chaudron et al. [36, p. 14], with (some) smart toys the child can interact reciprocally and the "interaction can be personalized to the wishes and needs of the particular child, for example through 'memory' for previous interactions." This feature is here conceptualized as simulated social interaction. It is not a new element, but a sub-value of the social element. Simulated social interaction can take the form of human-like interaction [5] that uses speech as the communicative medium between the toy and the child. My Friend Cayla is a representative example of a toy with such value. Other toys, in turn, can provide simulated social interactivity that resembles the one between a pet and its master and uses spatial gestures as the medium. One example of such toys is the robotic dog CHiP, which responds to hand gestures, follows commands, and adapts to the user's preferences.^{vii} Table 1 summarizes the 10 original and one additional element, including literature-informed examples of how smart features can affect toys' FMP in general as well as in relation to smart dolls like Hello Barbie.

Table 1. Elements of the FMP and their relation to smart toy research

Element	Definition
Representational	Representational elements can be labeled as realistic or fantasy-oriented. The realistic label is given to toys that replicate real-life archetypes. This feature is dominant when the whole toy is a replica of the target and moderate when a representational element, usually a picture, is added to an otherwise nonrepresentational toy [9]. Smart features can enhance toys' liveliness [6, 20] and representational value due to their ability to provide adaptive two-way interaction [7, 24] and their capability to learn about the child [36].
Gendered	Gendered elements use familiar cultural constructions as a means of defining what is masculine, feminine, and neutral. For example, a police car (along with all of its baggage of cultural connotations related to action and aggression) is labeled as strongly masculine, whereas a baby doll that relates to caregiving is labeled as strongly feminine [9]. Smart toys', especially smart dolls', ability to speak can either create, maintain, or challenge the gendered depending on the content of the oral communication of the toy [37].
Sensory	Sensory elements are those features of toys that produce a sensory stimulus. Features created in this way may be auditory, visual, tactile, or olfactory [9]. Smart toys can provide various sensory stimuli including sounds and haptic [e.g., vibration] or visual [e.g., lights] feedback [8, 23]. ^{viii}
Productive	Productive elements can be divided between constructions and aesthetic productions. Constructions can be further subdivided into given and open-ended productions. A jigsaw puzzle has a given constructive value and generic building blocks are open-ended, while themed Lego sets are both, as although they direct children to build certain types of constructions, they are not restricted to this task. Jigsaw puzzles also lack the adaptive affordance that construction blocks have [9]. With programmable smart toys like Code-a-pillar, a child can produce open-ended sequences of moves and sounds. ^{ix} The variety of smart toys also includes puzzle and building games like Osmo and Lego Fusion [8]. No smart doll-related examples of the productive element were found in the reviewed literature.
Performative	Performative elements have two different values: performative and transitive. The expression "performative value" refers to an action during which children act or embody a role. For example, a baby doll has performative value, as by playing with it children embody themselves as the caregivers. "Transitive value" refers to forms of play during which children act out a role by a toy [9]. Both values are identified from smart toys as well. For example, children in Heljakka and Ihamäki's [38] study told that they would play with talking dolls by talking with them or acting as their caregiver (performative value).
Normative	Normative elements imply that functional manipulation is possible only by following rules. Rules are understood not only as protocols followed when playing games but also as "rules in form" which, for example, have a dominant feature in jigsaw puzzles, and a moderate feature in types of Legos which offer a model and instructions for building a construction at the same time they also encourage personal outcomes [9]. Smart toys that require building and programming [8] contain "rules in form." Also, toys that react and respond to children's initiatives in an adaptive but preprogrammed manner can be argued to contain a normative element, as they can be located under the label of persuasive technologies/toys [39].
Technological	Technological elements are dominant in toys that can no longer be functionally manipulated if the technological features are damaged, and moderate in toys that can still fulfill their functional purpose even when the technological features do not work [9]. All smart toys, by default, contain a technological element [e.g., 6, 7, 24].
Social	Social elements are understood as connoting a need for at least two players to use a toy functionally, while "social interaction" can be either cooperative or competitive [9]. Smart toys can provide simulated social interaction that resembles that between two agentic subjects, such as two people or a pet and its master [5, 7, 39].

Motoric	Motoric elements are divided into two categories: fine and gross. Their features are dominant or moderate. To be dominant, the motoric feature must be the main function of the toy (as in the case of a hula hoop or jump rope). Moderate motoric value is determined by comparing motoric tasks to other functional potentials provided by the toy [9]. Some smart toys, for instance the tangram games of Osmo, require a notable amount of fine-motor manipulation. ^x No smart doll-related examples of motoric examples were found from the reviewed research.
Educational	Educational elements are the possible learning experiences children can glean from intentionally inserted features [9]. Some smart toys, like Code-a-pillar and Bee-Bot, are designed to teach children elementary programming [8]. Talking dolls' lines can include educational content such as fun facts [23].
Affective	Affective elements relate to the pursuit of an emotional bond between the child and the toy. A toy whose well-being depends on the child's actions (and reminds the child about it) contains an affective element with "dependency" value, whereas a toy that imitates a peer contains an affective element with "reciprocal" value. Tamagotchi, which requires its owner's constant concern, can be argued to have an affective element with dependency value [6]. An example of a toy with reciprocal value would be My Friend Cayla, a speaking child-doll that can have a two-way peer-like interaction with the child [8].

4. Method

4.1. Sampling rationale

The present study applied Patton's [14] ideas on the sampling procedure of qualitative inquiry. As Patton [14 (*italics original*)] argues, "qualitative inquiry typically focuses in depth on relatively small samples, even single cases ($n=1$), selected *purposefully*" and "the logic and power of *purposeful sampling* lies in selecting *information-rich cases* (...) from which one can learn a great deal about issues of central importance to the purpose of the inquiry." Hello Barbie can be described as an informant-rich case, as it enables a functional comparison with a traditional Barbie doll, a non-connected equivalent. Put differently, such comparison produces novel information on what connectivity affords to and/or abrogates from smart toys when they are compared with their "traditional" counterparts. Nevertheless, the relatively small number of toys analyzed in the present study can be considered a limitation, and any changes identified in Hello Barbie are not generalizable to other smart toys by default.

4.2. Data

The data used in this study consist of the traditional Barbie doll and the tangible Hello Barbie toy and the list of lines it is able to speak. The comprehensive list of the lines Hello Barbie says [40] was downloaded from Hello Barbie's official webpage on 11 February 2019. The length of the document is 216 pages when converted into a text document (Calibri 11, spacing 2), and it consists of 4,197 lines equaling 55,892 words. The number of lines is notably smaller than the "more than 8,000" stated by Mattel [15, p. 1]. This mismatch is due to different calculating strategies which are explained with the help of the following extract:

Line 307: Good idea! Let's make sure it's a magazine that we can use for arts & crafts.
Oh and if you need help--cutting out, don't be afraid to ask someone, ok?

In the "What does Hello Barbie say" document [40], the extract is represented as an entity, and thus is counted as one line in the present study. However, it seems that Mattel calculates it as three different lines (Good idea! --- Let's make sure ---- Oh and if ---), although they are always said together.

4.3. Analysis

An abductive approach was used to analyze the data. This approach discards the idea that the researcher's observations and interpretations can be purely inductive and acknowledges that

there is always a guiding theoretical thread included in the analysis process [16]. However, unlike in deductive analysis, the following of a theoretical thread does not mean that the theory is taken as given or that the role of the analysis is simply to test the theory. Instead, in abductive analysis the researcher moves between inductive reasoning and existing theoretical models to open up new ways of theorizing about the phenomenon under investigation [41]. In this paper, the main theoretical thread is the FMP framework. As the present study is the first attempt to utilize the FMP to analyze smart toys, the framework was understood as subject to refinement during the analysis. Analysis was conducted by the author.

4.3.1. Identifying the FMP of a traditional Barbie

First, I analyzed the traditional Barbie's FMP using Mertala et al.'s [9] analysis of a Bratz doll as a deductive thread. Bratz dolls are representations of humans, and their representational element was labeled as realistic with a moderate fantasy-oriented feature due to their huge eyes and lips (see Figure 3). Since Barbie's facial features are more realistic than those of Bratz dolls, I coded Barbie's representational element as dominantly realistic, with no fantasy value. Both dolls were understood to afford forms of manipulation where children are expected to present their role via the figure and, thus, to contain the dominantly transitive value in the performative element. Last, as both dolls represent female characters, I categorized them as containing a dominantly feminine gendered element. FMP analysis of the Bratz doll and traditional Barbie is summarized in Table 2 which also presents the coding system; capitalized words signal dominant values and those in lowercase signal moderate values.



Figure 3: Traditional Barbie^{xi} (left) and Bratz doll^{xii} (right)

Table 2. Summary of the functional differences of Hello Barbie and traditional Barbie

Element	Bratz doll	Barbie doll
Representational	Realistic; fantasy	Realistic
Gendered	Female	Female
Performative	Transitional	Transitional

4.3.2. Identifying the FMP of Hello Barbie

In the second phase, I explored Hello Barbie's FMP and compared it to that of a traditional Barbie. This phase contained two sub-stages, the first of which focused on tangible dolls and the second on the textual data. First, I compared the powered-off Hello Barbie and the traditional Barbie as tangible dolls, to identify whether there were differences between them (e.g., whether their joints were equally adjustable). After that, the textual data was put under investigation. Initially, I categorized Hello Barbie's lines using color codes to mark the element that each line was about. Table 3 provides examples of the questions asked of the data during this phase.

Table 3. Examples of analytical queries asked of the data to identify Hello Barbie's FMP

Element	Data	Analytical query
Technological	Tangible	To what extent are traditional Barbie and Hello Barbie comparable when the latter is not powered on (i.e., are their joints equally adjustable)?
Productive	Tangible	Must the child assemble the tangible doll before it can be played with, or is construction a central form of play?
Representational	Textual and tangible	Do the lines in the phrase bank include examples where Hello Barbie represents herself as a human-like subject?
Sensory	Textual and tangible	Does playing with Hello Barbie produce a sensory stimulus (i.e., does the doll make sounds or does it provide tactile stimulus)?
Performative	Textual	Do the lines in the phrase bank guide the child to act or embody a role in relation to Hello Barbie, or are children expected to act out a role by a toy?
Educational	Textual	Are there lines in the phrase bank where Hello Barbie teaches children about things (i.e., math, history)?
Gendered	Textual	Are there lines in the phrase bank that either challenge or reinforce the assumption that the child playing with Hello Barbie is a girl ¹ , or is the child performing traditionally feminine roles through play?
Affective	Textual	Are there lines in the phrase bank that engage emotional involvement?
Social	Textual	Are there lines in the phrase bank that simulate two-way interaction between two subjects?

Normative	Textual	Are there any explicit or implicit rules included in interaction with Hello Barbie (i.e., does the child’s communication with Hello Barbie have to follow certain patterns or protocols)?
Motoric	Textual	Do the lines in the phrase bank include content that engages the playing child to gross or fine motoric activities (i.e., drawing or some kind of physical exercise)?

¹Mattel informs that Hello Barbie is designed for girls [15, p. 1–2].

Next, I created a new document for each element to enable a more close-up inspection. At this point, I noticed that the original coding system was not always sufficient to capture Hello Barbie’s FMP. For example, some elements (representational, gendered) which were already dominant in traditional Barbie were recognized to be even more dominant in Hello Barbie. I therefore included an additional symbol—the plus (+)—to signal an amplification provided by connectivity. To ensure the transparency of the analysis process, several data extracts are provided when presenting the findings.

5. Findings

The findings of the present study are presented in seven subsections. A summary of the functional analysis and comparison of traditional Barbie and Hello Barbie is presented in Table 4.

Table 4. Summary of functional differences of Hello Barbie and traditional Barbie

Element	Traditional Barbie	Hello Barbie	Nature of difference
Representational	Realistic	Realistic+	Amplification
Gendered	Female	Female+	Amplification
Performative	Transitive	Performative; transitive	Addition
Technological	-	technological	Addition
Educational	-	educational	Addition
Affective	-	Reciprocal	Addition
Normative	-	normative	Addition
Sensory	-	auditive	Addition
Social	-	Simulated social interaction	Addition
Motoric	-	-	-
Constructive	-	-	-
Productive	-	-	-

The + symbol is an addition to the original coding. This symbol is used to pinpoint where the smart toy features add something to the already dominant value.

As the Table 4 illustrates, the FMP of Hello Barbie differs from that of a traditional Barbie. The differences took two different forms. The first is *amplifications*, which refers to the ways that connectivity can augment some elements in toys. An illustrative example would be the representational element, as a doll that is able to speak is more life/human-like than one that cannot. The second form of differences are *additions*, which refers to elements that exist only in Hello Barbie. These differences are discussed in detail in the following sub-sections.

5.1. Technological element

The first, and largest, difference between traditional Barbie and Hello Barbie is the technological element. This, of course, is evident, as connectivity is one of the core components that distinguishes smart toys from traditional toys [E.g., 6, 7, 24]. As suggested in the FMP framework, technological elements are dominant in toys that can no longer be functionally manipulated if the technological features are damaged, and moderate in toys that can still fulfill their functional purpose even when technological features do not work [9].

According to Hello Barbie FAQ page, ‘when not activated she’s a basic fashion doll’ [15, p. 2]. Based on the analysis of the tangible doll, this appears to be the case. Hello Barbie’s arms have three adjustable joints (shoulder, elbow, and wrist) and her legs one adjustable joint (knee). Like the vast majority of Barbie dolls, she cannot stand up without assistance. Practically, the only difference between a traditional Barbie doll and a powered-off Hello Barbie is that the former has a flexible torso whereas the latter does not, because much of the technology is located in Hello Barbie’s upper body. The other difference is that Hello Barbie wears flat shoes instead of high heels, as the docking technology is located under the doll’s feet. These differences are by no means dramatic, and although connectivity changes Hello Barbie’s FMP when compared to traditional Barbie, losing connectivity does not mean that the doll would not be playable as a basic fashion doll. Thus, Hello Barbie’s technological element is evaluated as moderate whereas traditional Barbie contains no technological element.

5.2. Representational and sensory elements

Both dolls are designed to represent a realistic human being, and thus are coded to have dominant realistic representational value. However, Hello Barbie’s ability to speak increases the doll’s realistic representation compared to the traditional Barbie figure, as a doll that speaks is more human-like than a doll that does not, and the sensory element (the toy’s ability to make sound) intertwines with the increasing representational element. In addition, Hello Barbie

represents herself as a subject with emotions, experiences, and thoughts. The extract below is a piquant example of the last two categories:

Line 209. Hey! I've got a quick question for you. I just saw a movie and there was a unicorn... but it also had wings!

Line: 210. So is a unicorn with wings still a unicorn or is it something else now?

Turkle [42] refers to this phenomenon as an evocation of life that invites children to imagine and treat the toy as a living object. Berriman and Macheroni [6], in turn, approach the same phenomenon with the concept of liveliness. To acknowledge the added representationalism of an already dominantly realistic toy, an additional symbol (+) is used to pinpoint the increased realism.

One could, of course, argue that Barbie's physical appearance is more fictitious than realistic, as her body shape is almost impossible to achieve [17]. Thus, instead of representing a young woman, Barbie can be argued to represent a (thin) ideal of a female body [19]. That said, it must be acknowledged that accurate body proportions are not common in other toys, either: Action figures are more muscular [43] and animal plush toys' heads and eyes are often notably larger than their real-life counterparts (see Figures 4 and 5). This notion is not meant to trivialize the critical viewpoints related to Barbie's representation of the female body [17, 18, 19], but to demonstrate how playing with the measures of body parts is a common maneuver in toy design, to increase the attractiveness of the toys. For instance, the combination of a large head, a round face, and big eyes typical of plush toys is often referred to as a "baby schema" that "induces cuteness perception" and "motivates caretaking behavior" in people [44, p., 257].



Figure 4. Turtle^{xiii}



Figure 5. Turtle plush toy^{xiv}

5.3. *Performative and social elements*

The traditional Barbie figure contains a transitive form of the performative element. What is meant by this is that with a traditional Barbie, the child occupies a role through the doll. This play mode is well illustrated in the following play example from Kuther and McDonald [45, p., 43] in which an adolescent girl recalls her childhood Barbie play:

We used to make... [Barbie dolls] talk. One day we had a wedding for Barbie and Ken. So, I went and got all the [stuffed] animals from my room [as an audience] [additions original].

As Hello Barbie is able to speak, the child no longer performs the role through the doll, but in relation to the doll. This changes the nature of the performative element from dominantly transitive to dominantly performative, in which the child occupies and embodies a role in relation to the toy. Since a non-activated Hello Barbie is almost identical to a traditional Barbie, its performative element also has a moderate transitive value.

Given that the vast majority of Hello Barbie's lines are those in which the child is asked about everyday issues regarding her family, hobbies, and friends, one could argue that talking with Hello Barbie is not playing but merely responding to a fixed set of questions. Based on a careful reading of the lines, such interpretation appears to be oversimplified, as the analysis suggests that the doll is designed so that the playing children should have the sense that they are talking with another agentic subject. Hello Barbie, for example, refers to the child as her friend (i.e., "you are my best friend" [Line 1370]) [see also 22] and tells things about her life as well:

Line 226: Oh hi! Have I ever told you about the time I went to Hawaii?

Line 233: Anyway, when we went there, my sisters and I got to swim with dolphins. It was so magical! What's the--coolest thing you've ever done on vacation?

To conclude, by using Vygotsky's [34] famous example of two sisters playing sisters as an analogue, the performative element of Hello Barbie is built on a theoretical premise that when playing with the doll, the child tries to be what she or he thinks a friend should be, as the child relates to the doll as her friend. This notion also highlights the existence of a social element in the form of simulated social interaction between two people [7, 36, 39]. Traditional Barbie contains no social element.

The performative element is also present in the more explicit forms of role-plays Hello Barbie engages in with the child. Here, “role-play” refers to play situations in which both Hello Barbie and the child act in a role. In the following extract, Hello Barbie invites the child to embody the role of a supportive and motivational sports team captain:

Line: 2562: Okay, let's play a game! Let's pretend we're playing on a team and you're the Captain! It's late in the--game, the other team is winning, but there's still time left for us to make a killer comeback and win this--thing! So, you gather the team together for one final pep talk. What do you say!?

If the child agrees, Hello Barbie begins to play the role of a team member who changes from dejected to excited due to her team captain’s pep talk:

Line 2564: (PLAYING A DEJECTED TEAM MEMBER) But Captain, what if we lose? There's no way we can possibly win now. We're doomed! What are we gonna do? [capitals original]

Line 2565: (PLAYING A SLIGHTLY LESS DEJECTED TEAM MEMBER) You think we can do it, Captain? You really think we can win? Huh? Huh? [capitals original]

Line 2566: (PLAYING EXCITED TEAM MEMBER) All right, team! You heard our Captain! Get out there and show 'em what we're made of! We got this! (LAUGHS) Wow, you definitely know how to give a pep talk! [capitals original]

5.4. Normative element

The presence of normative elements implies that functional manipulation is possible only by following rules, which here refer to a set of demanded technical and linguistic practicalities that the child needs to obey to be able to play with Hello Barbie. First, to be able to interact with the doll, the child must follow a certain technical protocol to activate the speech recognition technology and the Wi-Fi connection:

Line 99: Now, first, before we get started, I want to make sure that I can hear you properly. So, to talk to me, you need to hold down the silver button on my belt the WHOLE time you're talking, then let go when you want me to respond to you [capitals original].

Second, Hello Barbie is programmed to expect and respond to certain kinds of conversations and answers. The number of lines, 4,197, is not enough to imitate real-life arbitrariness, and the child must adapt her way of speaking and the topics of conversation within certain linguistic and thematic rules and protocols. There is no improvisation, and the following quotation from Jones's [22, pp. 244–245, emphasis original] paper piquantly illustrates Hello Barbie's inability to improvise, as in it the doll ignores—figuratively speaking—the child's initiative for which it has no pre-sequenced response:

Barbie: Oh yeah? And what sorts of performances do you like watching? Do you like live music? Or dance?!

Me: If I tell you, you're not going to tell anyone else, right?

Barbie: I think if I entered a talent show, I'd do some stand-up comedy. I've been working on some jokes. Wanna hear?!

Heljakka and Ihamäki [39] refer to toys like Hello Barbie as persuasive toy friends: toys that engage the child into a two-way interaction, the rules of which are determined by the toy. Because these rules are less strict than, say, with board games and jigsaw puzzles, Hello Barbie's normative element is labeled as moderate. Traditional Barbie does not contain a normative element.

5.5. Educational element

The analysis of Hello Barbie's lines also suggests the presence of an educational element, which refers to the possible learning experiences children can glean from intentionally inserted features. The doll, for example, teaches the child about how fast butterflies can fly and what kind of conditions they need to live:

Line 234: Did you know that butterflies can fly up to 12 miles an hour?

Line 240: --- Oh, and did you know that butterflies live everywhere in the world except Antarctica?

Line 241: Antarctica is the continent at the South Pole! So... why do you think there aren't any butterflies there?

Line 247: It's way too cold down there for all the plants and flowers they need.

In addition to butterflies, Hello Barbie teaches the child about elephants, Hinduism, and elementary multiplication, to give a few examples. The educational element is evaluated as moderate, because the lines intended for teaching things comprise a minority of Hello Barbie's phrase bank. Traditional Barbie does not contain an educational element.

5.6. Gendered element

Both Barbie models can be labeled as predominantly female-gendered, as they represent a female [26, 27]. As was the case with the representational element, Hello Barbie's ability to talk (more precisely, the content of the lines the doll speaks) increases the doll's gendered value, as the lines include explicit and immediate, as well as implicit, gender assumptions. Similar to the representational element, the increased value is marked with a plus symbol. The doll, for example, refers to the child as the "belle of the ball" (Line 3544) and tells the child that "it's so cool that you want to be a mom someday" (Line 2915). A similar statement about fatherhood is not included in the phrase bank. Additionally, the historical or contemporary personages Hello Barbie refers to are more often female than male. If the child expresses an interest in computers, Hello Barbie responds: "You're just like Ada Lovelace! She was an amazing woman—the first computer programmer ever! What do you love about computers?" (Line 2603). In addition to Ada Lovelace, the figures Hello Barbie introduces to the child include Marie Curie and Sacagawea, among others.

5.7. Affective element

The affective element of Hello Barbie is mostly built on reciprocity and praise, as the doll creates and establishes an affective bond between herself and the child by expressing how important the child is to her and by making herself likeable by giving compliments to the child: "(IN A BURST) I'm so happy you're here because you're smart and funny, and you're super nice, and you're just the best!" (Line 221, capitals original). In addition, the doll shows compassion in cases where the child has lost the family member Hello Barbie is asking the child about:

Line 2205: (GENTLE) Oh.. did you say your grandma passed away? I'm so sorry...
[capitals original]

Line 2208: (MUCH EMPATHY) I really am very sorry to hear that. You're very brave, and I appreciate your telling me about her [capitals original].

There is one affective line included in the phrase bank suggesting that the doll misses the child when in absence: “You’re back! Yay! I’ve really missed you! What do you want to do first today?” (Line 122). This line alone, however, is not enough to connect the existence of the affective element with the “dependency” value, and Hello Barbie’s affective element is labeled as dominantly reciprocal. Traditional Barbie does not contain an affective element.

6. Discussion

The underlying motive for this study was to compare modern smart toys with their traditional equivalents to identify whether and how smart features such as connectivity affect toys. To achieve this aim, a framework of toy FMP [9] was applied to analyze one of the most well-known contemporary smart toys Hello Barbie, and a functional comparison between this toy and the traditional Barbie doll illustrated how connectivity changes FMP. These changes took two forms: “additions” where Hello Barbie contained functional elements that a traditional Barbie does not (i.e. educational, normative, and affective elements) and “amplifications” where existing elements were augmented by connectivity (i.e. representational and gendered elements).

Applying a framework from traditional toy research in studying smart toys implicitly suggests that smart toys should be approached primarily as physical objects. As discussed in the Background section, however, smart toy research has thus far focused mainly on digital rather than physical aspects and has therefore often neglected more traditional perspectives. It was also argued that such framing is most likely due to the novelty of Internet-enabled and/or computer-powered toys. Emphasizing novelty reflects the conventions of academic communication in which authors must create a niche for their research [46], for example by highlighting how the current topic of study differs from previous related work. An emphasis on the digital aspects of smart toys is therefore both logical and understandable, and, similarly, the technocentric nature of existing smart toy studies was used in the present paper to create a research space [47] for an approach that draws on traditional toy research instead.

Furthermore, approaching smart toys as physical objects goes beyond this broadening of research perspectives. The conceptual sphere of smart toy research is an emerging arena with no agreed principles on what counts as “smart”. For example, Peter et al. [7, n.p.] point out that

“the difference between social robots and smart/connected toys is rather subtle” and, by bundling smart and connected toys together, imply that the same could be said about their respective qualities too. Some have suggested that all of the networked devices that children play with should be labeled as being on the Internet of Toys (IoToys), and, in a recent empirical study, playing a cloud-based digital game on a tablet computer was itself conceptualized as playing with an “IoToy” [49]. One motive behind using such inclusive categorizations appears to be to break the boundaries between playing and gaming [50]. Nevertheless, this kind of inclusivity can lead to conceptual stretching—adding multiple ideas and things under a single concept [51]—which lessens the precision and utility of the concept [52]. Sartori illustrates this idea with reference to the “Hegelian night in which all the cows look black (and eventually the milkman is taken for a cow)” [51, p. 1040]. To put this statement in context, if a tablet computer used to play a cloud-based digital game is labeled as an IoToy, does the same definition apply to laptop and desktop computers as well? Could old microcomputers with no Internet connectivity, like the Commodore 64, also be categorized as smart toys?

Here too, a glance towards research in traditional toys helps bring clarity to the present. Conceptual issues around what constitutes a toy are, for example, quite familiar for traditional toy and play research. Throughout (modern) history, children have used various objects for play: industrially produced toys, other manufactured artifacts (e.g. pots and pans), as well as natural materials (e.g. sticks and stones). To bring conceptual structure to this apparent messiness, the term “toy” is typically reserved in traditional research for physical objects that have been produced for no other purpose than to play [32, 53]. The other items that are played with are referred to in broader terms, such as “the things children play with” [53].

Related views have been expressed in the field of smart toy research. Recently, Mascheroni and Holloway suggested that a distinction should be made between apps and smart toys, arguing that “essentially, IoToys continue to be physical toys” [54, p. 272]. This notion is easy to agree with since the physical object is the primary interface with which a child interacts, and so the physical dimension of smart toys needs to be fully acknowledged in their research and design frameworks. Following ideas from Light et al. [55] about the walkthrough method to analyze apps, Mascheroni and Holloway suggest that a similar approach would be valuable for analyzing physical smart toys as well. Walkthrough analysis of connected toys could contain

a walkthrough of the physical interface (toy) could analyse the tactile qualities of the toy (whether soft, hard, fluffy), its kinetic qualities (static or dynamic, and in what way), its auditory [and textual] qualities (language, sounds and their content and tone) and the overall visual imagery of the toy (whether anthropomorphic, zoomorphic or machine-like) in order to read the different levels of meaning embedded in it. The walkthrough could also investigate the level and type of toy/child interactivity and agency that are afforded by the toy [54, p. 272]

The applied version of FMP introduced in this paper provides a roadmap for such walkthroughs by providing eleven analytical elements to scrutinize how toys are designed to be played with. FMP also acknowledges that different elements can interact with each other: For example, Hello Barbie's auditory and textual qualities (its ability to mimic human interaction by talking like a human) interact with its visual anthropomorphism (its realistic human appearance), and this increases the toy's representational value by making the doll more "human" than its traditional counterpart (see section 5.2. for more detailed discussion). This also illustrates the added value provided by this empirical comparison between Hello Barbie and a traditional Barbie, through which the present study has articulated and illustrated one way in which smart features—here connectivity—changes a toy's FMP. Because FMP is a design-oriented model, changes in a toy's FMP equate to changes in the way it was designed to be played with. Thus, on a theoretical level, the FMP differences between Hello Barbie and the traditional doll indicate that playing with one is different to playing with the other. Indeed, whether and how digitalization is changing children's play is one of the issues with which contemporary play and childhood research is interested [56, 57], and a major question is whether the differences provided by smart features are good or bad in terms of the quality of play [24].

Such questions are too complex and multifaceted to be answered through functional toy analysis alone. Research has shown that children play in accordance with toys' built-in affordances as well as use them in unexpected ways [58], suggesting that although intentionally designed functionalities are persuasive [10], they do not by themselves determine the way that a toy is used. As Sutton-Smith notes, "children have a way of doing things with toys over and beyond the apparent character of the toy" [59, p. 38]. This argument resembles Norman's ideas on affordances which refer "to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used" [60, p. 9].

Affordance theory has been widely applied in human-computer interaction (HCI) research [61, 62] including smart toy studies [6]. However, McGrenere and Ho's review suggests that the concept of affordance has been used in varying, and even contradictory, ways in these fields [61].

Given that connections between affordance theory and FMP have been identified [e.g. 9, 10], an FMP framework could provide the conceptual structure for affordance-focused smart toy studies—an emerging branch of HCI research. The intersection between affordance theory and FMP is possible because FMP acknowledges the actual properties of a toy, or its “apparent character” in Sutton-Smith's terminology [59], in the functional elements that are intentionally designed into it. Perceived properties, on the other hand, are subjective and situational as a child's past experiences, as well as the needs of the present situation, often shape the affordances that can be read from toys. Research suggests that both functional/actual and subjective/perceived properties play a role in the toys that children select [9] and how they play with them [10]. To conclude, the better we can map, analyze, and articulate the actual properties of a toy, the better we can observe and understand what the toy and what the child respectively bring into play.

References

- [1] G. Mascheroni, D. Holloway, *The Internet of Toys: Practices, Affordances and the Political Economy of Children's Smart Play*. Springer, Cham, 2019. <https://doi.org/10.1007/978-3-030-10898-4>
- [2] J. K. Tang, P. Hung P C, *Computing in Smart Toys*. Springer, Cham, 2017. <https://doi.org/10.1007/978-3-319-62072-5>
- [3] R. Brito, P. Dias G. Oliveira, Young children, digital media and smart toys: How perceptions shape adoption and domestication, *British J. of Educational Technol.* 49 (2018) 807–820. <https://doi.org/10.1111/bjet.12655>
- [4] D. Holloway, L. Green, The internet of toys, *Communication Res. and Pract.* 2 (2016) 506–519. <https://doi.org/10.1080/22041451.2016.1266124>
- [5] G. Mascheroni, D. Holloway, R. Kupianen, Introduction, in: G. Mascheroni, D. Holloway (Eds.), *The Internet of Toys: A report on media and social discourses around young children and IoToys*, DigiLitEY, 2017, pp. 1–11. <http://digilitey.eu/wp-content/uploads/2017/01/IoToys-June-2017-reduced.pdf> (accessed 17 June 2019).

- [6] L. Berriman G. Mascheroni, Exploring the affordances of smart toys and connected play in practice, *New Media & Soc.* 21 (2019) 797–814. <https://doi.org/10.1177/1461444818807119>
- [7] J. Peter, R. Kühne, A. Barco, C. de Jong, C. L. van Straten Asking today the crucial questions of tomorrow: Social robots and the internet of toys, in: G. Mascheroni, D. Holloway (Eds.), *The Internet of Toys: Practices, Affordances and the Political Economy of Children's Smart Play*. Springer, Cham, 2019, pp. 25–46. https://doi.org/10.1007/978-3-030-10898-4_2
- [8] A. Velicu, C. Lampert, The composite world of IoToys, in: G. Mascheroni, D. Holloway (Eds.), *The Internet of Toys: A Report on Media and Social Discourses around Young Children and IoToys*. DigiLitEy, 2017, pp. 15–24. <http://digilitey.eu/wp-content/uploads/2017/01/IoToys-June-2017-reduced.pdf> (accessed 17 June 2019).
- [9] P. Mertala, H. Karikoski, L. Tähtinen, V. M. Sarenius, The value of toys: 6–8-year-old children's toy preferences and the functional analysis of popular toys, *International J. of Play*. 5 (2016) 11–27. <https://doi.org/10.1080/21594937.2016.1147291>
- [10] E. Balzan, P. Farrugia O. Casha, A. Wodehouse, Evaluating the impact of design affordances in preschool children's toy preferences, In: *DS92: Proceedings of the DESIGN 2018 15th International Design Conference*, 2018 pp. 2165–2176. <https://doi.org/10.21278/idc.2018.0155>
- [11] P. Fikar, F. Guldenpfennig, R. Ganhör, The use(fulness) of therapeutic Toys: Practice-derived design lenses for toy design, in: *Proceedings of the 2018 Designing Interactive Systems Conference: ACM*, 2018, pp. 289–300. <https://doi.org/10.1145/3196709.3196721>
- [12] T. J. Jirata, The cultural spaces of young children: Care, play and learning patterns in early childhood among the Guji people of Ethiopia, *Glob. Studies of Child*. 9 (2019). 42–55. <https://doi.org/10.1177/2043610618817317>
- [13] T. Page, G. Thorsteinsson, Designing to Support Children Development: A Literature Review, *i-Manager's J. on Educational Psychol.* 12 (2018) 32–42. <https://doi.org/10.26634/jpsy.12.1.14605>
- [14] M. Q. Patton, Sampling, Qualitative (Purposeful), in: *The Blackwell Encyclopedia of Sociology 2015*, <https://doi.org/10.1002/9781405165518.wbeoss012.pub2>
- [15] Hello Barbie messaging Q & A. Available at: <http://hellobarbiefaq.mattel.com/wp-content/uploads/2015/12/hellobarbie-faq-v3.pdf>, 2015 (accessed 9 April 2019).
- [16] M. Grönfors, *Laadullisen Tutkimuksen Kenttätömenetelmät [Field Methods for Qualitative Research]*. SoFia-Sosiologi-Filosofiapu Vilkka, Hämeenlinna, 2011.

- [17] K. I. Norton, T. S. Olds, S. Olive, S. Dank, Ken and Barbie at life size, *Sex Roles* 34 (1996) 287–294. <https://doi.org/10.1007/bf01544300>
- [18] R. D., Jellinek, T. A. Myers, K. L. Keller, The impact of doll style of dress and familiarity on body dissatisfaction in 6-to 8-year-old girls, *Body Image* 18 (2016) 78–85.
- [19] K. Rice, I. Prichard M., Tiggemann, A. Slater, Exposure to Barbie: Effects on thin-ideal internalisation, body esteem, and body dissatisfaction among young girls, *Body Image* 19 (2016) 142–149. <https://doi.org/10.1016/j.bodyim.2016.05.003>
- [20] J. Marsh 2017 The internet of toys: A posthuman and multimodal analysis of connected play, *Teachers Coll. Rec.* 119 (2017)
- [21] J. Marsh, The Uncanny Valley Revisited: Play with the Internet of Toys in: *The Internet of Toys: Practices, Affordances and the Political Economy of Children’s Smart Play*. Springer, Cham, 2019, pp. 47–65. https://doi.org/10.1007/978-3-030-10898-4_3
- [22] M. L. Jones, Your New Best Frenemy: Hello Barbie and Privacy Without Screens. *Engaging Sci., Tech., and Soc.*, 2 (2016), 242–246. <https://doi.org.10.17351/ests2016.84>
- [23] K. Heljakka P. Ihamäki, P. Preschoolers learning with the Internet of Toys: From toy-based edutainment to transmedia literacy. *Seminar. net* 14 (2018) 85–102.
- [24]. G. Mascheroni, D. Holloway, Introducing the Internet of Toys, in: *The Internet of Toys: Practices, Affordances and the Political Economy of Children’s Smart Play*. Springer, Cham, 2019, pp. 1–22. https://doi.org/10.1007/978-3-030-10898-4_1
- [25] M. T. Payne G. Streier, Redesigning game industries studies, *Creative Industries J.7* (2014), 67–71. <https://doi.org/10.1080/17510694.2014.892292>
- [26] C. J. Auster, C. S. Mansbach, The gender marketing of toys: An analysis of color and type of toy on the Disney store website, *Sex Roles* 67 (2012) 375–388. <https://doi.org/10.1007/s11199-012-0177-8>
- [27] J. E. O. Blakemore, R. E. Centers, Characteristics of boys' and girls' toys, *Sex Roles* 53 (2005) 619–633. <https://doi.org/10.1007/s11199-005-7729-0>
- [28] L. M. Dinella, E. S. Weisgram, M. Fulcher, Children’s gender-typed toy interests: Does propulsion matter? *Archives of Sex. Behav.* 45 (2017) 1295–1305. <https://doi.org/10.1007/s10508-016-0901-5>
- [29] F. P. Hughes, *Children, Play and Development*, Allyn and Bacon, Boston, 1999.
- [30] A. Nelson, Children's toy collections in Sweden – A less gender-typed country? *Sex Roles* 52 (2005) 93–102. <https://doi.org/10.1007/s11199-005-1196-5>
- [31] S. Kline, Toys as Media: The Role of Toy Design, Promotional TV and Mother’s Reinforcement in the Young Males (3–6) Acquisition of Pro-social Play Scripts for Rescue

- Hero Action Toys, in: ITRA conference, Halmstad, Sweden, 1999. <http://www.sfu.ca/media-lab/research/toys/toymedia.pdf> (accessed 11 December 2019).
- [32] B. M. Kurdrowitz D. R. Wallace, The play pyramid: A play classification and ideation tool for toy design. *Int. J. of Arts and Tech.* 3, 2010, 35–56. <https://doi.org/10.1504/IJART.2010.030492>
- [33] J. Piaget, *Play, Dreams and Imitation in Childhood*. Routledge, Abingdon, 1962
- [34] L. S. Vygotsky, Play and its role in the mental development of the child, *International Res. in Early Child. Education* 7 (2016) 3–25, <https://doi.org/10.2753/rpo1061-040505036>
- [35] J. Lorber, *Paradoxes of Gender*, Yale University Press, New Haven, 1994
- [36] S. Chaudron R. Di Gioia M., Gemo D. Holloway J. Marsh G. Mascheroni J. Peter D. Yamada-Rice D, Kaleidoscope on the Internet of Toys - Safety, security, privacy and societal insights, EUR 28397 EN, <https://doi.org/10.2788/05383>
- [37] K. Sathyamurthy, Toying with Gender: Doll Studies Amidst the Internet of Toys, *Grad. J. of Graphic Des.* (2018), <https://design.ncsu.edu/andso/2018/06/01/toying-with-gender-doll-studies-amidst-the-internet-of-toys/> (accessed 11 December 2019)
- [38] K. Heljakka, P. Ihamäki, Verkottunut esineleikki osana esiopetusta. Lähikuva–audiovisuaalisen kulttuurin tieteellinen julkaisu, 31 (2018) 29–49. <https://doi.org/10.23994/lk.75048>
- [39] K. Heljakka P. Ihamäki, Persuasive Toy Friends and Preschoolers: Playtesting IoToys, in: G. Mascheroni, D. Holloway (eds.), *The Internet of Toys: Practices, Affordances and the Political Economy of Children’s Smart Play*. Springer, Cham, 2019 (pp. 159–178), https://doi.org/10.1007/978-3-030-10898-4_8
- [40] What does Hello Barbie say?, <http://hellobarbiefaq.mattel.com/wp-content/uploads/2015/11/hellobarbie-lines-v2.pdf>, 2015 (accessed 9 April 2019).
- [41] I. Dey, *Qualitative Data Analysis: A User-Friendly Guide for Social Scientists*, Routledge, London, 2003
- [42] S. Turkle, Tamagotchi Diary, *London Rev. of Books* 28 (2006) 36–37.
- [43] H. Boyd, S. K. Murnen, Thin and sexy vs. muscular and dominant: Prevalence of gendered body ideals in popular dolls and action figures, *Body Image.* 21 (2017) 90–96. <https://doi.org/10.1016/j.bodyim.2017.03.003>
- [44] M. L. Glocker, D. D. Langleben, K. Ruparel, J. W., Loughhead, R. C. Gur, N, Sachser, Baby schema in infant faces induces cuteness perception and motivation for caretaking in adults, *Ethol.* 115 (2009), 57–263. <https://doi.org/10.1111/j.1439-0310.2008.01603.x>

- [45] T. L. Kuther, E. McDonald, Early adolescents' experiences with, and views of Barbie, *Adolescence*. 39 (2004) 39–52.
- [46] K. Hyland, Activity and Evaluation: Reporting Practices in Academic Writing, in: J. Flowerdew (ed.), *Academic Discourse*, Longman, London, 2002 (pp. 115–130).
- [47] J. Swales, *Genre Analysis: English in Academic and Research Settings*, Cambridge University Press, Cambridge, 1990.
- [48] S. Chaudron, D. Geneiatakis, I. Kounelis, R. Di Giola, Testing Internet of Toys Designs to Improve Privacy and Security, in: G. Mascheroni, D. Holloway (eds.), *The Internet of Toys: Practices, Affordances and the Political Economy of Children's Smart Play*. Springer, Cham, 2019 (pp. 223–239), https://doi.org/10.1007/978-3-030-10898-4_11
- [49] T. Lundtofte, S. Johanssen, Video Methods: Researching Sociomaterial Points-of-View in Children's Play Practices with IoToys, in: G. Mascheroni, D. Holloway (eds.), *The Internet of Toys: Practices, Affordances and the Political Economy of Children's Smart Play*. Springer, Cham, 2019 (pp. 241–263), https://doi.org/10.1007/978-3-030-10898-4_12
- [50] M. Koivula, M. Mustola, Leikisti pelissä: pohdintaa lasten digitaalisesta leikistä. Pelitutkimuksen vuosikirja (2015), <http://www.pelitutkimus.fi/vuosikirja2015/artikkeli-leikisti-pelissa-pohdintaa-lasten-digitaalisesta-leikista> (accessed 9 March 2020)
- [51] G. Sartori, Concept misformation in comparative politics *The American Political Sci. Rev.* 64 (1970) 1033–1053,
- [52] L. Palsa, H. Ruokamo, Behind the concepts of multiliteracies and media literacy in the renewed Finnish core curriculum: A systematic literature review of peer-reviewed research, *Seminar.net* 11 (2015) <https://journals.hioa.no/index.php/seminar/article/view/2354> /accessed 9 March 2020).
- [53] M. Kalliala, *Enkeleiprinsessa ja itsari liulumäessä. Leikkikuttuuri ja yhteiskunnan muutos*, Gaudeamus, Helsinki.
- [54] G. Mascheroni, D. Holloway, Hybrid Methods for Hybrid Play: A Research Toolkit, in: G. Mascheroni, D. Holloway (eds.), *The Internet of Toys: Practices, Affordances and the Political Economy of Children's Smart Play*. Springer, Cham, 2019 (pp. 265–282), https://doi.org/10.1007/978-3-030-10898-4_13
- [55] B. Light, J. Burgess, S. Duguay, Light, B., Burgess, J., & Duguay, S. (2018). The walkthrough method: An approach to the study of apps, *New Media & Society* 20 (2018), 881–900, <https://doi.org/10.1177/1461444816675438>

- [56] M. Mustola, M. Koivula, L. Turja, M. L. Laakso, Reconsidering passivity and activity in children's digital play, *New Media & Soc.* 20 (2018) 237-254. <https://doi.org/10.1177/1461444816661550>
- [57] R. Slutsky, L. M. DeShetler, How technology is transforming the ways in which children play, *Early Child Dev. and Care.* 187 (2017) 1138–1146. <https://doi.org/10.1080/03004430.2016.1157790>
- [58] N. Howem, S. Abuhatum, S. Chang-Kredl S, “Everything's Upside Down. We'll Call It Upside Down Valley!”: Siblings' Creative Play Themes, Object Use, and Language During Pretend Play, *Early Education and Develop.* 25 (2014) 381–398. <https://doi.org/10.1080/10409289.2013.773254>
- [59] B. Sutton-Smith, *Toys as Culture*, Gardner Press, New York, 1986.
- [60] D. Norman, *The Psychology of Everyday Things*, Basic Books, New York, 1988
- [61] J. McGrenere, W. Ho, Affordances: Clarifying and evolving a concept, in: *Graphic Interface* (pp. 179–186), 2000, <http://teaching.polishedsolid.com/spring2006/iti/read/affordances.pdf> (accessed 9 March 2020).
- [62] K. Roskos, J. Brueck, L. Lenhart, An analysis of e-book learning platforms: Affordances, architecture, functionality and analytics, *Int. J. of Child-Comp. Interact.* 12 (2017) 37–45, <https://doi.org/10.1016/j.ijcci.2017.01.003>

ⁱ Retrieved from <https://www.flickr.com/photos/101677470@N02/16540825615>

ⁱⁱ Retrieved from <https://pixabay.com/fi/photos/kauneus-barbie-aika-nukke-1261464/>

ⁱⁱⁱ Various unboxing and showcase videos illustrating the functionalities of Hello Barbie can be found on YouTube. See, for example, <https://www.youtube.com/watch?v=1WS78OTEMVo&t=626s>; <https://www.youtube.com/watch?v=OpPbN-GueZQ>

^{iv} Mertala et al. [9] used the term “gender” to describe the elements that contain notable masculine or feminine connotations. In this paper, however, the term “gendered” is used. This form is preferred here for two reasons. First, it better conveys the idea that these connotations—or “gender signs and signals” [33, p. 112]—are social constructions rather than natural, law-like facts. Second, the idea that the inclusion of these signs and signals is the result of decisions by toy designers is more explicitly present in the term “gendered” than in “gender.”

^v For further information, see <https://en.wikipedia.org/wiki/Tamagotchi>

^{vi} For further information, see <https://myfriendcayla.fr/>

^{vii} <https://wowwee.com/chip>.

^{viii} <https://www.youtube.com/watch?v=XO7OQZAwSR4>

^{ix} <https://www.youtube.com/watch?v=XO7OQZAwSR4>

^x <https://www.youtube.com/watch?v=88NIZXw9OSc>

^{xi} Retrieved from <https://pixabay.com/fi/photos/kauneus-barbie-aika-nukke-1261464/>

^{xii} Retrieved from <https://pixabay.com/fi/photos/bratz-nukke-nukke-lelu-leikki%C3%A4-1406953/>

^{xiii} Retrieved from https://en.wikipedia.org/wiki/File:Florida_Box_Turtle_Digon3.jpg

^{xiv} Retrieved from <https://pixabay.com/images/search/soft%20toys/>