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A preliminary study of Hello Barbie in Brazil and Argentina

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ABSTRACT

A smart city is an urban development vision based on Information and Communication Technology (ICT) and the Internet of things (IoT) for the city's management and operations. The smart city concept is raised simultaneously in many modern societies. IoT is always playing an important role as smart devices to support complex scenarios in smart cities. A smart toy, such as "Hello Barbie," is a smart device consisting of a physical toy component that connects to a computing system with online services through networking to enhance the functionality of a traditional toy. In this research, we particularly studied Brazilian and Argentinian consumers' perceived innovativeness, risks and benefits of smart toys and their purchase intention toward such toys. Results indicate that Brazilian consumers have better perception and evaluation of the toy and thus higher purchase intention than Argentinian consumers do. Such difference may be explained by the cultural differences between the two countries, such as relatively low vs. high uncertainty avoidance. We also provide our recommendations for smart toys manufacturers to address these issues for the future products.

1. Introduction

Toys have been a part of human existence for thousands of years, across every culture, being uncovered from as far back as ancient Egyptian times. A toy is an item or product intended for learning or play, which can have numerous benefits to childhood development. As such a substantial part of human development, toys have continued to maintain a presence in the daily lives of billions of individuals of all ages (Tracy and Westeyn, 2012). Toy makers are increasingly playing an important and innovative role in the global toy market. Based on the reporting from the 114th Annual American International Toy Fair, toy makers are aggressively incorporating Artificial Intelligence (AI) functions into their products using mobile software and hardware as the Internet of Things (IoT).

After Amazon's Echo line of smart speakers powered by its Alexa virtual assistant system became one of the best-selling products on Amazon in the past holiday seasons (eMarketer, 2016), children could have their own version of Echo, Smarty, a voice-controlled digital assistant designed particularly for kids (Corbyn, 2017). Smarty is just one example of the many Internet-connected smart toys that appear on the market in recent years. Another example is Osmo, which uses computer vision to identify different toys with which the kids are playing or drawings enabled by iPads (Hong & Baker, 2014).

A smart city is an urban development vision based on Information and Communication Technology (ICT) and the Internet of things (IoT) for the city's management and operations (Sotres, Santana, Sánchez, Lanza, & Muñoz, 2017). The smart city concept is raised simultaneously in many modern societies. IoT is always playing an important role as smart devices to support complex scenarios in smart cities (Marsella and Marzoli, 2017; Monzon, 2015). In 2015, the research team of this paper proposed a new concept called "Toy Computing," which transcends the traditional toy into a new area of computer research using services computing and mobile technologies (Hung, 2015). Hung et al. define a smart toy as a smart device consisting of a physical toy component that connects to one or more toy computing services to facilitate gameplay in the Cloud through networking and sensory technologies to enhance the functionality of a traditional toy (Rafferty et al., 2017). Some examples include Mattel's Hello Barbie, CogniToys' Talking Dino, and Fisher-Price's Smart Toy Bear. UK-based Juniper Research has reported that smart toys are the new key market for toy companies and the sales of smart toys would grow from $2.8 billion in 2015 to $11.3 billion by 2020 (Juniper Research, 2017).

These Internet-connected smart toys usually have a component that connects to a computing system with online services to enable voice

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recording, recognition, and database search. Therefore, a traditional teddy bear can now listen and talk back to a child intellectually. Whilst these are new educational and entertaining values of smart toys, experts have warned consumers of the data security and privacy issues of these toys. A recent U.S. Senate report states that these toys may gather a child's personal information, which may potentially cause serious consequences such as identity theft (Nelson, 2016). Likewise, the Federal Network Agency (Bundesnetzagentur) in Germany is telling parents to abandon Internet-connected smart toys designed for their kids because of it's insecure and hackable structure that could reveal personal information (Dudau, 2017). Further, the United States Federal Trade Commission (FTC) released an updated guidance document for complying with the Children's Online Privacy Protection Act ("COPPA"), which explicitly identifies connected toys as being covered under COPPA, on June 21, 2017 (Depas, 2017). The FTC COPPA protects the online privacy of children under the age of 13 and indicates that a child's personal information cannot be collected without parental consent. In 2010, an amendment to COPPA further elaborated that personal information includes geolocation information, photographs, and videos (Hung, Fantinato, & Rafferty, 2016).

Prior research on data privacy shows that greater concern often leads to negative responses (Sheehan & Hoy, 1999) and consumers often weigh the consequences of personal information disclosure against the value offered by the marketer (Hann, Hui, Lee, & Pang, 2007). However, most such research has primarily focused on western cultures and not much research has studied data privacy issues among Brazil, Russia, India and China (BRIC) countries (Martin & Murphy, 2017). Further, although smart toys have been getting their popularity in developed countries, they have not been widely introduced in emerging markets. The objectives of this research are to investigate: (1) whether consumers in emerging market such as Brazil and Argentina perceive the innovativeness, risks and benefits of the conversational function of smart toys differently, and (2) how such perceptions influence their overall evaluation of and purchase intention toward smart toys. Therefore, this research contributes to the literature of consumer data privacy by demonstrating the outcomes of data privacy concerns in Brazil and Argentina. Further, our research also adds to the literature of consumer new product adoption by demonstrating how perceived innovativeness of a product may have either positive or negative impact on product evaluation and purchase intention in different cultures.

It is believed that information and communication technologies like smart toys will play an important role in context gathering and predicament to realize more intelligent and sustainable environments (Silva & Analide, 2017) (Sotres, Santana, Sánchez, Lanza, & Muñoz, 2016). The objective of this study is to investigate how privacy concerns affect adoption decisions in different cultures from the concepts of risk perception and adoption decisions. This paper is organized as follows: Section 2 provides background information, Section 3 describes the research framework applied, Section 4 presents the results of our empirical study in Brazil and Argentina, Section 5 provide a discussion for parental control and Section 6 concludes the paper with future work.

2. Background information

Brazil (Portuguese: Brasil) is the largest country in South America and Latin America. Brazil is ranked the fifth-largest country in the world with the population size of 210 million in 2017. In Brazil, the toy industry has been growing significantly during the last decade. According to ABRINQ, the Brazilian toy association, the toy industry has earned more than BRL 5934 billion in 2015. Brazilian consumers are eager to follow the newest international trends regarding toys (Euromonitor International, 2017). For example, a Brazilian toy named Elo was developed by Amaral Carvalho foundation, a Brazilian hospital in Jahu city, inside São Paulo state. Elo delivers audio messages to kids under cancer treatment by pressing Elo's hand (Hung, 2015). On the other side, toys industry in Brazil, unfortunately, is facing some problems with public safety. Since 2003, the Brazilian Federal Government has prohibited the production and sale of replica toy. However, this action was not sufficient to avoid and stop crimes made using toys (Hung, 2015). According to Instituto Sou da Paz, between 2011 and 2012, 37.6% of guns used in crimes inside the state of São Paulo were toys, simulacrum or pressure guns. In 2014, the state of São Paulo approved a project of law to prohibit production and sale of toy guns to prevent crimes.

Argentina is a federal republic member of the G-20 world's largest economies with a population size of 44 million in 2017 and is third in population in South America. It is a federation of twenty-three provinces and one autonomous city, Buenos Aires (Roa, Villarreal, Fantinato, Hung, & Rafferty, 2017). Traditional toys and games, which accounts for over 56% of total toys and games in value terms globally, recorded its best performance for more than a decade in 2014 with 5% value growth while sales exceeded US$85 billion marks (Euromonitor International, 2015). Latin America benefited around 6% increase in value sales in 2014, and Argentina was part of the world's top 5 best-performing markets with double-digit growth rates (Euromonitor International, 2015).

Both Argentina and Brazil incorporate the Technical Regulation about Toy Safety (International Council of Toy Industries, 2015) in conformance to the Resolution N° 23 of the MERCOSUR (Common Market of the South), which establishes essential toy safety requirements that must be fulfilled to commercialize toys in countries of the MERCOSUR, including Argentina, Brazil, Paraguay, Uruguay, and Venezuela. Safety measures include physical and mechanical properties of toys, inflammability, electrical properties, sanitation, radioactivity, chemical properties, and noise.

The Congress of the Argentine Nation ratified the Convention on the Rights of the Child on September 27, 1990 (Office of The High Commissioner, 1990) through Law 23,849 and the Constituent Assembly incorporated it into Article 75 of the Constitution of the Argentine Nation in August 1994. From this commitment, The Government must make every effort to ensure that all children and adolescents have access to all the rights contained in the Convention, including article 16, "No child shall be subjected to arbitrary or unlawful interference with his or her privacy, family, home or correspondence, nor to unlawful attacks on his or her honor and reputation," and "The child has the right to the protection of the law against such interference or attacks."

Why are smart toys under scrutiny for data privacy and security? We illustrate this issue using the example of Hello Barbie. Hello Barbie is a smart toy manufactured by Mattel Inc. (Mattel, 2015). Mattel leads traditional toy market in Brazil, accounting for 15% of total value sales in 2016 (Euromonitor International, 2017). Mattel introduced Barbie in early 1959, the doll has then gone through many phases, allowing it to sell over 800 million units around the world. Thus, Barbie has become a fashion doll icon. Hello Barbie is introduced as "the first fashion doll that can have a two-way conversation with girls" with speech recognition and cloud computing technologies (Hung, Iqbal, Huang, Melaisi, & Pang, 2016). While the doll is made by Mattel, the online conversation software is powered by ToyTalk. ToyTalk has previously released a smartphone application known as SpeakALegend, which allowed children to interact and engage in conversation with imaginary characters such as the unicorn, mermaid, and Bigfoot (Mattel, 2015). With their expertise in this field, Mattel cooperated with them to develop the software behind an interactive Hello Barbie. Referring to the vocabulary of Hello Barbie as of November 17, 2015, she can speak 56,367 total English words and 3935 unique English word forms in 8000 English phrases (Hung and Iqbal et al., 2016).

Referring to Fig. 1, the children interact with Hello Barbie equipped with WiFi, microphone, and speaker in a physical and social environment. When Hello Barbie turns on, the system inside the doll checks if the doll has been linked to a ToyTalk.com account via WiFi. For the parental control, the parents/guardians must download a mobile

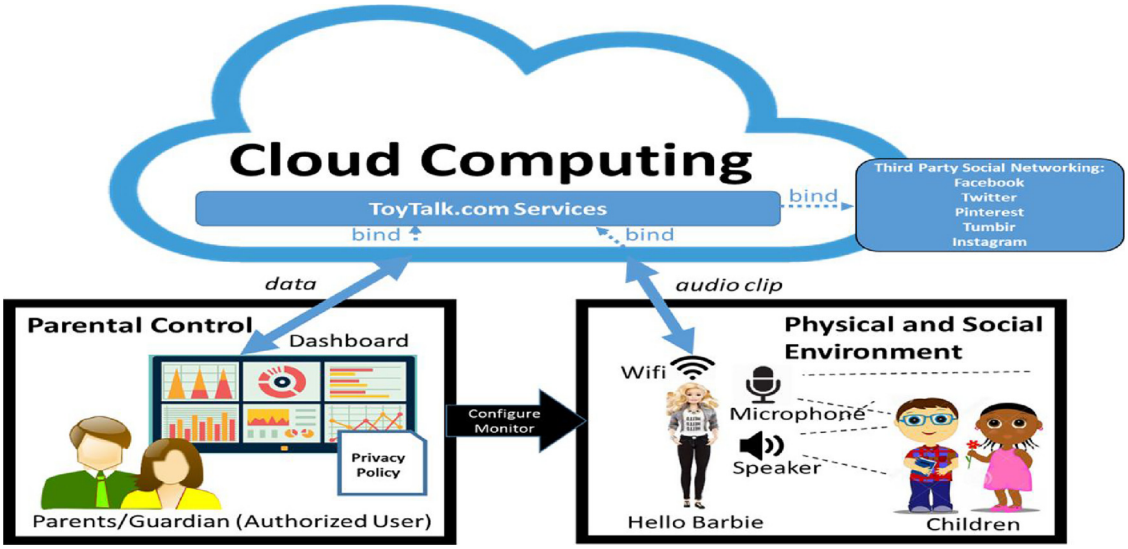

Fig. 1. Conceptual Model of Hello Barbie and ToyTalk.com.

application called "Hello Barbie Companion App" on a smartphone to configure the WiFi settings. The ToyTalk.com account provides the parents/guardians functions to manage the conversation options. Following that, the app asks the parents/guardians for their consent to allow the company to use their child's information, such as voices, their birthday and holidays they care about. If the parents refuse to give permission, ToyTalk.com will not store any information in the Cloud and the account will be deleted in a reasonable time. If the parents give permission, ToyTalk.com will have the right under their privacy policy to gather information from Hello Barbie or even other smart toys of the same account. The conversation options allow parents to provide the doll with information about the child that is using the doll. The information consists of important holidays, such as Halloween, Thanksgiving, Christmas, Diwali, and Hanukkah. Parents can also provide the child's day and month of birth to Hello Barbie. These options do not require the doll to be in connection mode, which means that the data is stored in the doll internally.

The physical interface between a child and a smart toy is usually via a touch, e.g., digital button (Goldstein, Buckingham, & Brougère, 2004). After this point, the child should be able to engage in conversation with Hello Barbie via a button, while the parents can access the conversation audio clips via the ToyTalk.com account. Hello Barbie sends the collected voice in audio clips to ToyTalk.com services, and ToyTalk.com can bind with other third parties social networking services such as Facebook, Twitter, Pinterest, Tumblr, and Instagram, in the Cloud. Both Mattel and ToyTalk.com have its own privacy policy that outlines information including how they collect, manage, share and retain the user's personal data.

Though Mattel claims that Hello Barbie is compliant with COPPA, this paper assumes that although the information disclosure practices are outlined in the privacy policy on smart toys, and the parents/guardians have provided their consent for their children, the parents/guardians are not actually aware because they did not read or understand the policy. For example, ToyTalk.com, which is the Cloud service provider of Mattel, outlines the Hello Barbie privacy statement (Taylor and Michael, 2016):

> "[…] use, store, process, convert, transcribe, analyze or review Recordings to provide, maintain, analyze and improve the functioning of the Services, to develop, test or improve speech recognition technology and artificial intelligence algorithms, or for other research and development and data analysis purposes."

Referring to Fig. 2, ToyTalk.com services on the Cloud has a list of English phrases that Hello Barbie is the one who is asking a question and waiting for a response. After that, Hello Barbie requests a phrase from ToyTalk's services and plays an audio response for the user. The conversations vary from talking about specific topics such as fashion, school, friends, and family, to playing games and listening to interactive stories. In addition, Hello Barbie tries to ask the user questions regarding these topics to engage them in the conversation. For example, the phrase "Well, we've been talking so much about school… what about all the things we can do when we're not in class? Let's talk about that!" intends to change the topic from talking about school to talk about hobbies or other interests. In this scenario, one can see that Hello Barbie may actively drive the flow of the conversation.

Referring to Fig. 3, the speech recognition services on ToyTalk.com receives the child's recording and analyzes it to find the best response. Many conditions control the flow of the conversation. In the beginning, ToyTalk.com checks if the user has said phrases or words from a priority list. This list contains command phrases, such as volume up and down, which makes Hello Barbie repeat the last statement in a lower or higher voice. Other phrases include Hello Barbie questions such as "Can I ask you a question?" Another type of conversation is a narrative interactive story. In this scenario, Hello Barbie gives the child two options to choose. If the child's answer is vague, Hello Barbie will ask the child again. If the child does not answer clearly for the second time, Hello Barbie will assume one option and carry on with her own story. In a regular topic conversation, Hello Barbie says something and then asks the child-related questions, such as what food they like, how they dressed for an event, what they like about school etc. In this type of conversation, Hello Barbie asks general questions and does not change her behavior based on the answer. Hello Barbie will remember a few things, such as whether the child has a pet. Another thing Hello Barbie can remember is the last conversation or a previous game played by the user, in which case Hello Barbie says something like "Do you remember when we did this?" This kind of memory might help to strengthen the connection between Hello Barbie and the user.

After discussing the underlying causes of data privacy and security issues in smart toys, we present a research framework to understand how consumers' perceived risks and benefits of the smart toys may influence their product purchase decision in the next section.

3. Research framework

Understanding consumers' new product purchase decision is very important for companies to successful design and manages their new

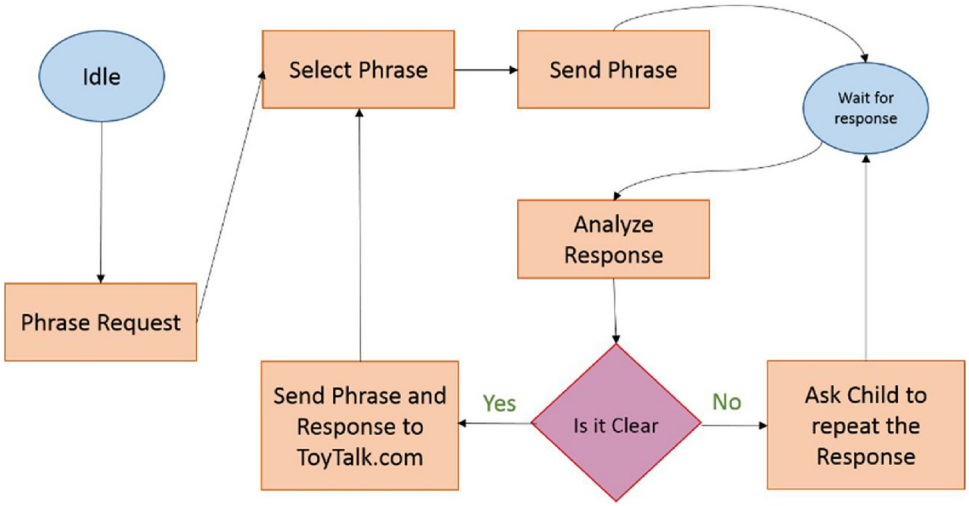

Fig. 2. Hello Barbie Phrase Conversation.

products. Previous research shows that consumers' purchase intention towards a new product can be influenced by several factors such as consumers' perceived innovativeness, perceived risk, and benefits of the product (Hoeffler, 2003; Jhang, Grant, & Campbell, 2012). The degree of the innovativeness of a new product may vary from new to incrementally new (Garcia & Calantone, 2002; Hofstede, Hofstede, & Minco, 2010). Really new products use ground-breaking technologies (e.g., digital camera) or establish new markets with existing technologies (e.g., Sony Walkman) (Garcia & Calantone, 2002). New products incrementally provide improvements over existing products (i.e., iPhone 7 vs. iPhone 6). Therefore, new products provide entirely new benefits not available on existing products, whereas incrementally new products enhance the benefits currently offered by existing products. The literature shows that new products often provides more added benefits to consumers, but at the same time also come with more risks. Ziamou proposes that consumers perceive more benefits from new products than incrementally new products and thus are more likely to adopt such products (Ziamou, 1999). Whereas, other research has demonstrated that consumers may find it difficult to understand the benefits of new products and are thus more likely to focus on the risks of these products, which then negatively affects consumers' purchase intention toward such products (Jhang et al., 2012).

Referring to the discussion above, smart toys feature the conversational function and use network technologies. They can be considered new products as smart toys have been categorized as a new market for toys to differentiate from traditional toys. The conversational function of smart toys does resemble the features of many voice recognition functions of adult mobile apps. Therefore, how innovative consumers perceive smart toys may affect how they evaluate the risks and benefits of smart toys and consequently influencing their purchase intention toward smart toys. As depicted in Fig. 4, we designed a research model to examine how consumers' perceived innovativeness of the toy, perceived risks of the conversational function and perception of the conversational function to influence their overall evaluation of the toy, attitudes toward the toy, and purchase intention toward the toy (Ling & Yuan, 2012; Reza Ashari Nasution & Astuti, 2012).

Further, the existing literature also recognizes the effect of cultural differences and social contagion on consumer new product adoption process in different countries (e.g., (Van den Bulte & Stremersch, 2004)). For example, the uncertainty avoidance dimension of Hofstede's culture typology measures "the extent to which the members of a culture feel threatened by uncertain or unknown situations" (Hofstede, 2001; Hofstede et al., 2010). Therefore, consumers in countries with high uncertainty avoidance scores are less likely to adopt innovations given their risk avoidance nature. As Brazilians scores, relatively lower than Argentinians on this dimension (76 vs. 86), we argue that Brazilian consumers are more likely to adopt smart toys than Argentinian consumers are, as they are less risk-averse. In addition, the power distance dimension addresses "the extent to which the less powerful members of a culture expect and accept that power is

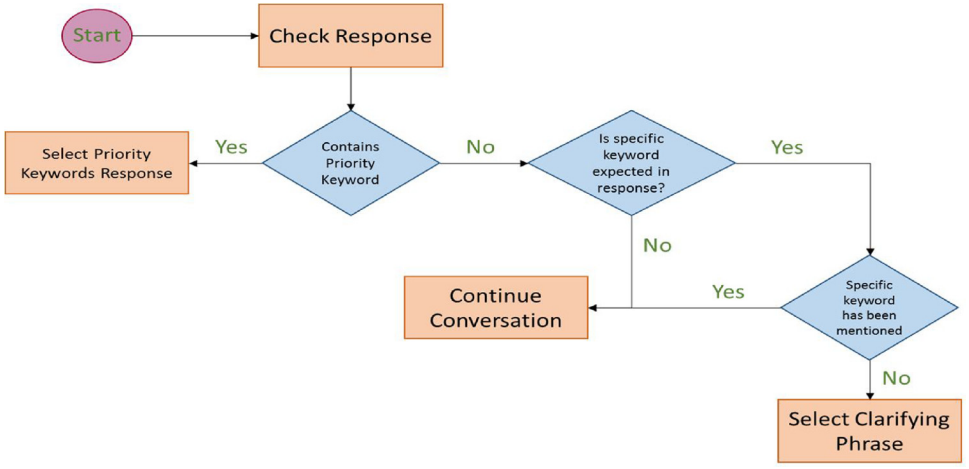

Fig. 3. Hello Barbie Keyword Interaction.

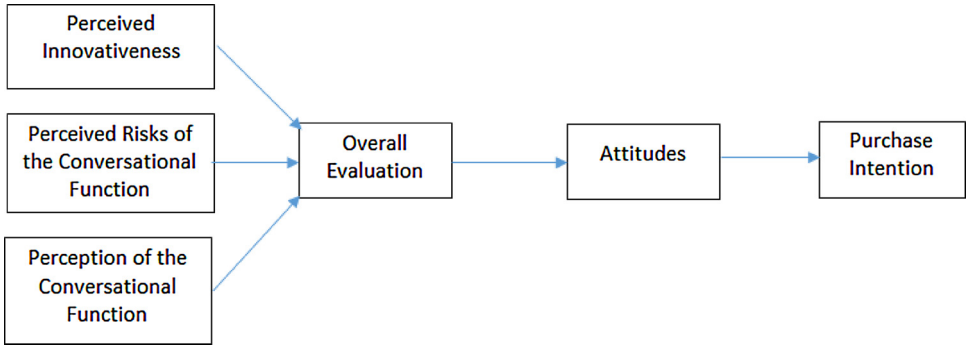

Fig. 4. Proposed Research Model.

distributed unequally (Hofstede, 2001).” Research shows that people in high power distance countries are likely to buy products for its social status and imitate the behavior of other people (Van den Bulte & Stremersch, 2004). As Brazilians score higher than Argentinians on this dimension (69 vs. 49), we expect Brazilian consumers are more likely to adopt smart toys as a status symbol than Argentinian consumers are.

4. Methods and results

We conducted a survey about how consumers perceive Hello Barbie in Brazil and Argentina. We used Hello Barbie as an example of smart toys as smart toys including Hello Barbie have not been widely marketed in Brazil and Argentina. Thus, we can assess consumers’ reaction toward a new product with networking technologies. We measured all the variables in our research model (cf. Fig. 4) using a 5-point scale with items adapted from a related work (Ma, Gill, & Jiang, 2015), which are described as follows (Reza Ashari Nasution & Astuti, 2012; Ling & Yuan, 2012):

- *Perception of the conversational function* of the smart toy was measured by two items, “to what extent does the conversation function of Hello Barbie make sense to you” and “to what extent do you like the conversation function of Hello Barbie” (reliability = 0.61). A variable, e.g., purchase intention, sometimes is measured by several items (questions). To make sure that these measurement items are consistent with each other, we use reliability as an indicator. Usually, a reliability alpha higher than 0.7 means reliability, and higher the number the higher the reliability. This number is not used in the analysis, but to show that the measurement items are good. For those variables only measured by one item/question, there is no reliability.
- *Perceived risks of the conversational function* of the smart toy was measured by three items, “I am afraid/worried that the conversation function including the recording function of Hello Barbie may ‘violate the user’s personal privacy’/‘gather too much of the user’s information’/‘lead to some potential data security issues in the future’” (reliability = 0.89).
- *Perceived innovativeness* of the smart toy was measured by one item, “how innovative do you think Hello Barbie is”, ranging from “1 = not at all innovative” to “5 = very innovative.”
- *Attitude* toward the smart toy was measured by three items asking participants’ overall evaluation of the toy being “very bad/very good,” “very unfavorable/very favorable,” and “not at all appealing/very appealing” (reliability = 0.82).
- *Overall evaluation* of the smart toy considering its benefits and risks was measured by one item, “please provide an overall evaluation of Hello Barbie after considering its benefits and potential risks,” ranging from “1 = risks outweigh benefits” to “5 = benefits outweigh risks.”
- *Purchase intention* toward the smart toy was measured by two items, “how interested will you be in buying a Hello Barbie for yourself or a child” and “what is the probability that you will buy a Hello Barbie for yourself or a child” (reliability = 0.79).

We conducted this preliminary study at the University of Sao Paulo in Brazil and National Technological University – Santa Fe in Argentina. Before the survey, we gave a presentation of Hello Barbie’s functions and related background information to the participants. They are either university faculty members or students. This study also measured participants’ trait innovativeness, history of using smartphone and speech recognition software, whether they had heard of the toy before, and demographic variables as control variables. There were 118 participants (73.9% male and 24.6% female) completed the questionnaire. Among them, 46 (39%) were from Brazil and 72 (61%) were from Argentina. The average age was 28 years. We first analyzed whether Brazilian participants perceived Hello Barbie differently from Argentinian participants. Analysis of Covariance (ANCOVA) with perception of the conversational function, perceived risks of the conversational function, perceived innovativeness, overall evaluation, attitudes and purchase intention as separate dependent variables and age, gender, number of children, whether they had seen the toy before, individual trait innovativeness and speech recognition application usage as covariates showed that none of the covariates were significant. Therefore, these covariates were dropped in the analysis and we report the results of ANOVA. As we have predicted, Brazilian participants perceived the conversational function of the toy better (3.54 vs. 2.95, $F(1, 116) = 8.41$, $p < .01$), had better overall evaluation (2.93 vs. 2.15, $F(1, 116) = 16.25$, $p < .001$), had more positive attitudes toward the toy (3.25 vs. 2.57, $F(1, 116) = 14.24$, $p < .001$) and hence expressed higher purchase intention toward the toy (2.26 vs. 1.63, $F(1,116) = 14.17$, $p < .001$) than Argentinian participants did. However, different from our expectation, there was no significant difference between the Brazilian and Argentinian participants in their perceived risks of the conversational function (4.17 vs. 3.91, $F(1, 116) = 1.80$, $p > .1$) and perceived innovativeness of the toy (3.87 vs. 4.07, $F(1, 116) = 1.25$, $p > .2$). In other words, participants in both countries assessed the smart toy as equally innovative and risky. Then, why did this equal innovativeness and risk perception lead to different levels of overall evaluation and purchase likelihood? We answer this question in the following analyses.

Second, we tested our proposed research model using structural equation modeling. The results are shown in Figs. 5 and 6. We tested the structural model with the Brazilian and Argentinian samples respectively. The Brazilian model received marginally good fit (Chi-square = 61.31, df = 46, $p > .05$; CFI = 0.95, GFI = 0.84, RMSEA = 0.08) and the Argentinian model received very good fit (Chi-square = 44.11, df = 46, $p > .1$; CFI = 1.0, GFI = 0.90, RMSEA = 0.00). All the relationships between variables were tested, but only the significant relationships are presented by lines in the figures. An interesting difference between the two models is that

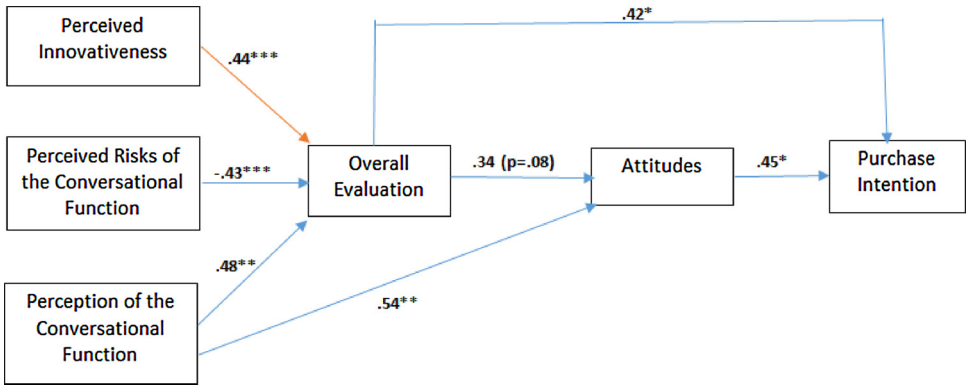

Fig. 5. Results in Brazil for structural equation modeling.

perceived innovativeness negatively affected people's overall evaluation of the toy in Argentina, but positively affected people's overall evaluation of the toy in Brazil (this relationship is highlighted in orange color in both figures for ease of comparison). This may suggest that although consumers in both countries have similar levels of perceived innovativeness of the toy, Argentinian consumers evaluate the toy worse when they perceive the toy as newer, whereas Brazilian consumers evaluate the toy better when they perceive the toy as newer. In other words, Brazilians like "newer" innovations and such preference contributes to their higher purchase intention. This difference may be explained by the different levels of uncertainty avoidance and power distance between the two countries. As Brazilian scores, slightly lower on uncertainty avoidance than Argentinians do (Hofstede, 2001), they may focus more on the benefits side than the risks side when evaluating new products such as the smart toys. Our results also showed that Brazilians perceived the conversational function better than the Argentinians did. Whereas, Argentinians might have focused more on the risks side when evaluating new products due to their relatively higher risk avoidance tendency. Further, as discussed earlier Brazilians score relatively higher on the power distance dimension than Argentinians do (Hofstede, 2001). Brazilians may be more interested in new products because the innovativeness nature of new products can help to serve as a status symbol. Therefore, the more innovative they perceive the smart toys, the better the evaluation and higher purchase intention. Taken together, the culture difference between Brazil and Argentina may help to explain the different consumer reaction towards smart toys in the two countries.

5. Discussion

A smart toy can easily capture a child user's physical activity state (e.g., walking, standing, running etc.), store personalized information (e.g., location, activity pattern etc.) through the camera, microphone, Global Positioning System (GPS), and various other sensors. These sensors enable smart toys to monitor and interact with children in ways which were not possible even five years ago. Advances in AI functions such as facial and speech recognition enable Cloud-based services to integrate this data and have the smart toy interact 'intelligently' with the users while allowing back-end systems to mine the data for a myriad of other purposes. For example, the Google Toy has been criticized in the media where people have expressed concerns about Google breaching the expected privacy of such devices (Heurix, Zimmermann, Neubauer, & Fenz, 2015).

To our understanding, toy safety guidelines, such as Health Canada's Safety Requirements for Children's Toys and Related Products, are out of date with the current innovations in smart toy technology. These guidelines concentrate on physical safety-related to traditional toys and do not consider recent developments in toy technologies, which now have a wide range of sensory and networking capabilities creating new privacy risks. Toy Industry Association (TIA) released a white paper regarding the changing privacy and data security landscape that the toy industry is facing with the emerging popularity of child-directed mobile apps. However, efforts like these ones made by governments and international organizations are not enough for parents to protect their children's data online. For this reason, parents need effective mechanisms both to understand and control their privacy. This implies mechanisms for being aware of the latest privacy concerns that may harm their children and family safety and implementing privacy controls to protect their children's sensitive data from such threats.

With parental control, the monitoring system can apply text mining techniques to identify suspicious dialogue and immediately alert the parents; the system can send alerts to parents in real-time (Tracy & Westeyn, 2012). The enhanced parental control system can continuously monitor the conversations, either in the form of text or audio voice, between the child and the smart toy. Referring to Fig. 1, the parent can periodically generate an activity graph to report the topics communicated between the smart toy and the child by time. The information could be useful for analyzing the development of a child. Parents may use this information to be aware of privacy issues and to teach and advise their kids. Further, in case the software system has identified some sensitive topics in the conversation, such as fire, suicide, sex, etc., the system can immediately alert the parents. One

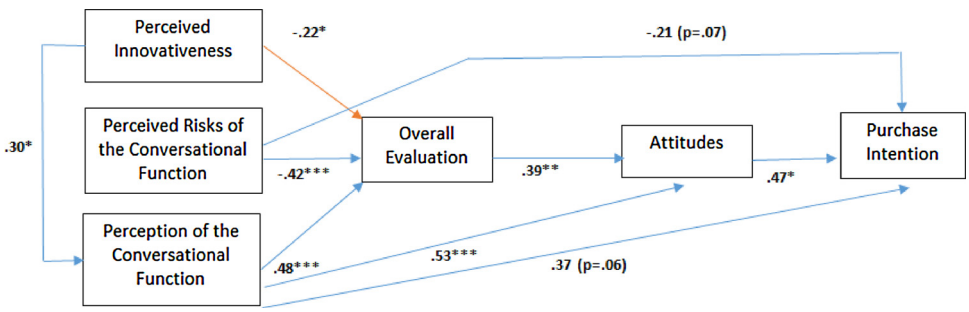

Fig. 6. Results in Argentina for structural equation modeling.

promising approach for topic detection is Latent Dirichlet Allocation (LDA), which has been previously applied to crime data mining (Basher & Fung, 2014; Blei, Ng, & Jordan, 2003).

6. Conclusion and future work

In summary, there are three properties of a smart toy: (1) Pervasive – a smart toy may follow child through everyday activities; (2) Social – social aspects and multiplayer are becoming a mandatory aspect of interactive smart toys in a one-to-one, one-to-many and many-to-many relations (Tath, 2006); and (3) Connected – Smart toys may connect and communicate with other toys and services through networks. Children provide a unique user base which requires special attention in several key areas related to their privacy. Children's data is widely considered to be particularly sensitive and should be treated with extreme care by law and legislation (Toy Industry Association, 2012). Privacy can result in physical safety of child user (McClary, 2004). A framework is required which can achieve these privacy goals by minimizing the collection and retention of potentially sensitive user data, as well as involving the user (or parent) in the control of their child's data. End-user requirements need to consider that the main user base is children, who have unique requirements as they are especially vulnerable and to protect their sensitive location data, parents/guardians require a method to implement privacy controls on their child's data.

Our empirical study shows that participants in both countries assessed the smart toy as equally innovative and risky. This demonstrates the data privacy concerns in Brazil and Argentina. Further, our research also demonstrates how perceived innovativeness of a product may have either positive or negative impact on product evaluation and purchase intention in diverse cultures.

The results of our empirical study suggest that smart toy manufacturers can emphasize the toy's innovativeness to enhance consumer acceptance level in relatively low uncertainty avoidance cultures and relatively high-power distance countries such as Brazil. Whereas, in cultures with relatively higher uncertainty avoidance and relatively low power distance such as Argentina, smart toy manufacturers can reduce consumers' perceived innovativeness by associating the conversational technology with existing technology such as voice recognition mobile apps to enhance consumers' evaluation of the toy.

By our best knowledge, this is one of the first research attempts to study the perceived innovativeness and privacy risk of smart toys in Brazil and Argentina. There is a limitation in our empirical study. The size of the collected sample data is not large enough to show a full spectrum of results. We will continue to collect sample data from Brazil and Argentina in compliance with the guidelines given by statistical sampling theory as a major future work (Garvin & McClean, 1997; Thompson, 2002).

For future research, we will collect more data in North America to compare the results between North and South America. Further, we will test different mechanisms (e.g., increasing consumers' perceived control over the data) to determine which one is more effective in mitigating perceived privacy risk in North and South America.

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