

“I Know They Are Listening”: Understandings of In-Home Physical Digital Assistants

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ABSTRACT

In recent years, Digital Assistants have become a popular topic of discussion in the field of human-computer interaction(HCI) as well as becoming increasingly common in households across the globe. This paper presents findings of in-home physical DAs based on semi-structured interviews with people from 13 households. The findings are summarized in seven themes that provide understandings of people’s experience of in-home physical DAs. Participants reported similar use cases, motivation and challenges of their in-home digital assistant. I discovered varying ways the participants’ perceived their in-home physical DA. It was also found that there were minimal privacy concerns amongst participants in regard to physical placement of the in-home DAs. I conclude with a discussion of the findings and provide suggestions that can be considered when looking to improve the experience of in-home DAs in the future.

Author Keywords

In-home physical Digital Assistants; Clova Friends; Amazon Echo; Google Home;

INTRODUCTION

In recent years, Digital Assistants(DA) have increased noticeably in popularity since the release of Apple’s Siri in 2011[7]. Today, DAs are available in physical form, which people are able to set up in their home and use in everyday life. The most commonly known in-home physical DAs are Amazon Echo and Google Home, which have been accompanied by Apple HomePod, Microsoft Invoke, LINE Wave and Clova Friends.

Synonymous with Voice Assistant, Intelligent Personal Assistant, Virtual Assistant, in literature DAs have been defined as *“an application that uses input such as the user’s voice ... and contextual information to provide assistance by answering questions in natural language, making recommendations and performing actions.”*[1].

Research on DAs include studies examining mobile DAs, such as Siri, Cortana and Google Now, within the topic of user expectations and user satisfaction from the perspective of experienced and inexperienced users[5, 6, 38], as well as exploring usability within certain user groups[35]. Physical DAs, such as Amazon Echo, have been explored in recent research [16, 17, 18, 28]. Aside from mobile DAs, there has been focus on Amazon Echo when conducting studies on

physical DAs, leaving out the other physical DAs, such as Google Home. Further, just one study was found that dealt with physical DAs in the home setting[8].

This study is based a total of 13 semi structured interviews with participants from different households that are everyday users of physical DAs. To broaden the scope this study have included findings from households located in two different countries, Denmark and Japan. These data are analysed using the method of Thematic Network Analysis(TNA)[9] in which I have derived seven main themes in this process: 1. Usage; 2. Motivation; 3. Learning how to use in-home DAs; 4. Placement; 5. Challenges; 6. Perception of in-home DA; 7. Trust and Privacy.

I present household experiences of three different brands of in-home DA, the Amazon Echo, the Google Home and the Clova Friends in order to achieve a holistic view of the experience of in-home DAs used in everyday life. The study provides insights to households experience of physical DAs in the context of the home. Five households located in Japan and eight located in Denmark answered open-ended questions of their usage and experience of their DA. The findings from interviews present insights into people’s experience of in-home physical DAs. Varying brands of in-home physical DAs have been discussed, which contribute to a deeper understanding of their role in the home. From the perspectives of households located Japan and Denmark, I present findings aiding in understanding how people from different backgrounds and family sizes use and experience physical DAs in the home. These findings aid in highlighting consideration in improving the experience of future in-home physical DAs.

The following research questions were created in order to achieve the wanted outcome:

1. What is the experience of in-home physical DAs?
2. What reflections were made when placing these devices in the home?
3. How is privacy and trust experienced in the context of the home in relation to in-home physical DAs?

RELATED WORK

DAs have expanded into multiple platforms since Siri by Apple was first released on mobile in 2011[7]. The initial research in the area of commercial DAs focused on mobile DAs such as Siri and Google Now. Such studies had focus on understanding the topic of DAs in regard to user concerns, experience and the subject of trust. A paper by Luger and Sellen[5] studied the experience of frequent users of DAs in mobile devices, such as Siri and Google Now. The study found that unrealistic expectations affected the ongoing usage of the mobile DA. Cowan et. al. further examined the topic of mobile DAs. Using focus groups, the study revealed infrequent user concerns regarding handsfree interaction, speech recognition and public use, as well as adding that cultural norms and social embarrassment were of significance of the people using the mobile DA[6].

Today, DAs are available in in-home physical form, such as Amazon's Echo and Google's Home speaker, which have moved into multiple homes across the world[11, 29]. Recent research has delved into the world of physical DAs and how they are experienced, which is elaborated in the following section.

Experiencing In-home Physical Digital Assistants

In-home physical DAs have been studied in various ways. Research has focused on topics like everyday usage, perception and smart home integration to mention a few.

A study from 2017, drawing from user reviews of Amazon Echo, examined how users would refer to Alexa. The study provided insight to which degree people would personify Amazon Echo and discovered a higher degree amongst multiple member households[16].

Two different studies from 2018 studied the usage of in-home physical DAs in everyday life. One study focused on practical achievements of DA users by studying audio data from households with Amazon Echos[15]. Additionally, a research paper by Sciuto et. al.[8] was published studying the in-home DAs usage. Their work provided a comprehensive list of in-home physical DA use cases, which gave in-sight to what in-home DAs are used for in the daily life, done by studying history logs of Amazon Alexa users consisting of 278,654 commands. Further, they conducted seven semi-structured interviews to understand how people are integrating in-home DAs into their every day life, which concludes in design improvement suggestions[8].

As smart homes are getting more common, it has been of relevancy to investigate the different privacy and security concerns were discovered in earlier studies to uncover how these concerns affect people's usage and user perception of DAs such as Amazon's Echo and Google Home[17] and in the context of smart homes[18].

Additionally, studies have been conducted on different user groups. These studies researched the interaction between children or elders and Google Homes[28, 34].

Who is Clova?

As Clova has not been a subject of discussion in previous research, it was found of importance to clarify what Clova Friends DA is and how it is different from other known DAs.

Clova has been the newest in-home DA on the market and is developed by the Japanese company LINE. LINE is also known as a Japanese messaging app with over 700 million registered users[13, 24] Since then, Clova has been developed to control in-home smart devices such as Philip Hue lights, and is slowly catching up to the functionality of Alexa and Google Assistant.[23, 25]

Clova is limited to the Japanese market and was first built into the speaker named Wave by LINE, which was released in 2017[13]. In December the same year, LINE expanded its smart speaker line with Clova Friends, which was a line of speakers with character-like designs *"themed after popular LINE characters Brown and Sally, in order to make a speaker that users would feel comfortable to talk to."*[12]. Clova Friends differs from other known DAs as LINE developed it to create more of a companionship type experience, *"the character-themed smart speakers have been offering a new experience to users who feel as though they are talking to the smart speaker's themed character"*[22] A few studies have been conducted of the in-home assistants Amazon Echo and Google Home, whereas there has not been conducted studies including Clova Wave or Clova Friends in DA research. Only one survey on Clova Friends reported, *"(...) a great deal of users responded (...) that they felt as if they were speaking directly with the characters, leading them to treat the speakers like their friends, or even a member of their own family."*[14].

METHODOLOGY

In this study, I seek to understand people's experience of in-home physical DAs in everyday life. The study is based on semi-structured interviews with participants from varying households and contributes to research and understandings of people's experience of in-home physical DAs.

Participants

The interviews were conducted with one participant from each household. The data collection was conducted through semi structured interviews[10] with everyday DA users from 13 different households, five from Japan and eight from Denmark, as a way to achieve a more in depth understanding of the experience of in-home DAs. The participants were recruited for interview participation through social media. Five participants were female and seven were male who all came from varying backgrounds. All participants reported daily use of their in-home DA and were all what one would consider frequent users. Google Assistant available on Google Home was the most frequent DA amongst the interview participants followed by Alexa available on Amazon Echo. Only the Japanese participants were also owners of the Japanese DA, Clova Friends, introduced by the Japanese company Line in autumn of 2017[2].

#	Gender	Nationality	Living in house hold	No. of devices	In-home Physical DA device
P1	F	Danish	2	1	Amazon Echo
P2	M	Danish	1	1	Google Home Mini
P3	M	Danish	2	2	Google Home, Google Home mini
P4	M	Danish	3	2	Google Assistant (2 Marshall speakers)
P5	M	Danish	3	1	Amazon Echo Dot
P6	F	Japanese	2	5	Echo Plus, Clova Friends, Echo Spot, Google Home Mini
P7	M	Danish	4	1	Google Home Mini
P8	M	Danish	4	3	Google Home, Google Home Mini (2)
P9	F	Danish	3	2	Google Home, Google Home Mini
P10	F	Japanese	1	3	Google Home Mini, Amazon Echo Dot(2)
P11	M	Japanese	3	4	Amazon Echo, Clova Friends, Google Home Mini, Amazon Echo Dot
P12	F	Japanese	1	2	Google Home, Clova Friends
P13	M	Japanese	7	4	Amazon Echo(2), Clova Friends, Google Home,

Table 1: Summary of participant households.

Data Collection

The interviews ranged from 20 minutes to 1 hour and 20 minutes. The interview process lasted from the 18th of February 2019 to the 11th of May 2019. All Danish interviews were conducted in person, whereas Japanese participant interviews were conducted over Skype due to geographical distance. Interviews were run until data saturation was reached.

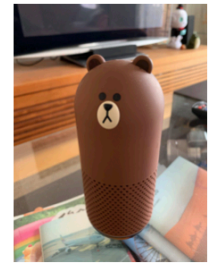
An interview guide was developed by reviewing established topics of previous DA studies, which included the topics as privacy, motivation of use and user barriers. Further, the first two interviews served as a pilot in order to test the interview guide and ensure that unforeseen discussion points were incorporated to the following interviews. The participants were additionally asked to take pictures of their in-home DA, which gave insight to the placement of the DA and how it fitted into the home, as well as opening up a discussion on both privacy and the physical design of the DA, examples can be seen in image 2.



P1(Kitchen)



P2(Kitchen)



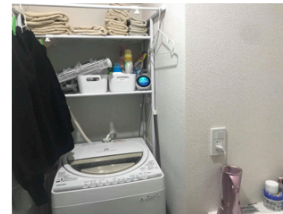
P12(Living Room)



P7(Kitchen)



P3(Living Room and Kitchen)



P6(Bathroom and Bedroom/Living room)

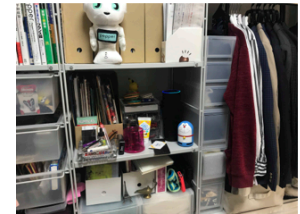


Image 2: Examples of pictures that were taken by interview participants.

Data Analysis

Transcriptions were created of all interviews in preparation for the analysis process. The interview transcriptions were then analysed using Thematic Network Analysis(TNA), which is “(...) a way of organizing a thematic analysis of qualitative data. Thematic analyses seek to unearth the themes salient in a text at different levels, and thematic networks aim to facilitate the structuring and depiction of these themes.” [9].

The analysis procedure followed the steps that TNA provided,

“Thematic networks systematize the extraction of: (i) lowest-order premises evident in the text (Basic Themes); (ii) categories of basic themes grouped together to summarize more abstract principles (Organizing Themes); and (iii) super-ordinate themes encapsulating the principal metaphors in the text as a whole (Global Themes). These are then represented as web-like maps depicting the salient themes at each of the three levels, and illustrating the relationships between them.”[9].

Firstly, the interview transcriptions were analysed at the lowest level, which created a number of basic themes that were later categorised into organising theme. Lastly, the themes found in the analysis formed a global theme that uncovered the over all theme which aided in a holistic

understanding of the data set.

The study is structured by main seven themes and corresponding sub-themes. The findings section have provided a holistic understanding of the participants concerns and barriers in relation to their experience of using an in-home physical DAs. Through thorough thematic analysis of the interview transcriptions, the analysis have uncovered certain tendencies amongst the interview participants that provide an insight of the user experience of in-home DAs.

FINDINGS

This study has provided insight to people's experience of in-home physical DAs aided by the developed research questions. The study explores topics like: What people use their DA for, what considerations they have made about having a in-home DA as well as delving into the topic of trust and privacy. I explore different DAs from the perspective of people with different background and households. The findings have been summarized in seven main themes, as well as sub-themes, that aim at structuring findings to present the participants' experience of physical DAs in an in-home context. The main themes are as following: 1. Usage, 2. Motivation, 3. Learning how to use DAs, 4. Challenges, 5. Placement, 6. Perception of in-home DAs, 7. Trust and Privacy. The findings within these themes will give insights to people's experience of Amazon Echo, Google Home and Clova Friends. Some participants owns multiple brands of DAs and will thus further highlight the perceived differences there may be between the DAs. The themes that were uncovered in the data, will be elaborated in the following sections.

Learning how to use DAs

It was apparent that most of the users had experience with using their DA in their phone, such as Siri, before investing in a physical DA which would be integrated into their home. Their experience with the mobile DA made for a smoother transition, although all users still revealed that they had a trial period when they first got their in-home physical DA. Initial interactions with the physical DA consisted simple tasks such as asking for the weather forecast.

P7, which had owned an in-home physical DA for approximately two months, reported testing its capabilities, as a way to reveal functionality limitations. *"And there's also someone that knows something that Google can't do. And then we tried to challenge her[Google Assistant] a little bit. So for me, but it's because of this a person I am. I think that's funny."*(P7) This finding directly correlates with previous research that uncovered the initial exploration phase for in-home physical DAs where households reported testing the intelligence of the DA when they first got it[8].

Further, many participants described having joined a Facebook group dedicated to in-home DAs to learn more about the functionality their devices. *"I saw a lot of Youtube videos and I am also in a group on Facebook. And then I tried to say this and tried to say that. And then get some fun out of it but mostly trying to get it to work."* (P3)

It was evident that the participants had an initial learning period in the beginning of owning their in-home physical DA. One participant suggested how he wished the DA would update him of its capabilities,

"I think actually that's one if the things that I would appreciate if somehow you could get information about what this device has to learn. I know that for Alexa,(...), you get an email update with stuff that Alexa now supports, some use skills, and so on. Which I think is great. But it's easy to overlook those emails. So it would be kind of cool to have the device itself somehow indicate that if it has learned new skills, or you could ask it ... for instance being able to ask Alexa, "What did you learn today, Alexa?"(P4)

No participants reported getting updates through DA in order to learn about its capabilities, but instead gathered information through e-mails or through social media, for instance being a part of a Facebook group that related to the specific brand of in-home DA.

Usage

The participants reported that they typically used their in-home physical DA to set timers, playing music or asking for the weather forecast. These align with the use cases that was listed in previous research[8]. An interesting finding was that Clova was capable of most of the things that Amazon Echo and Google home were in terms of functionality. However, when discussing usage with the participants that owned a Clova Friends, they reported that they mostly used Clova for sending messages on the Japanese chat application LINE.

Further, participants reported using their Amazon Echo or Google Home for controlling smart devices in the household. These smart devices included lights, TV, speakers and for some households(P7, P8, P9) their vacuum cleaner. Some of these activities were added into daily routine, which allows the in-home DA to complete multiple activities in one command,

"When we are leaving for work in the morning we turn off the lights and turn on the vacuum. Actually, we just say "good bye" to it and when it hears the command "good buy" then it turns off music and lights and turns on the vacuum."(P8)

The above mentioned use cases corresponds to what has been found in previous research[8], although the interviews from this study presented some other notable use cases that is highlighted in the following section.

In some of the family households with young children, the DAs were also a means of entertainment. For instance, P9 used their in-home DA to play a game or sing a song for her child, as way to entertain the child. *"When we talk about animals then we can ask Google: How does a panda say?"(P9)*. As the quotation illustrates, the mother applies the assistant to ease her in everyday tasks, for instance through using the in-home physical DA to entertain her children whilst she is occupied with other tasks.

A few participants reported that they use their DA as a way to learn the English language. Some purposefully set their DA to the English language setting, whilst others used the

in-home DA for children's word games. *"I wanna practice my English so sometime I try English skills[commands] for kids and it is a very good level for me. Or an animal game where Alexa says what the animal looks like and I guess"* (P10) This type of use was both reported by Danish and Japanese participants.

The exploration of the different types of use cases in the in-home DAs leads to the question of why the participating households own and use these types of devices. This will be discussed in the following section.

Motivation

Motivation has also been a theme a study researching the experience of mobile DAs[5], which found multi-tasking and time-saving to be the reasons why people found it useful. In this study, convenience was the single most common word used to describe how they felt about using DAs. As convenience is rather subjective, the following will examine what exactly make in-home DAs so convenient and what motivates households to use such devices.

Saving Time

Time-saving was an aspect that was mentioned both by Danish and Japanese users. A Japanese participant reported that he used the in-home DA to get information, instead of spending time looking for the information on the phone. *"So every morning I don't have to check my smart phone for the schedule or the weather."*(P13) This is an example of creating a DA routine that would execute multiple actions within one command. This feature was also used by one household when controlling other in-home smart devices. *"We're telling Alexa to turn off the house, all lights and all electricity so we go at work and when we come home we turn lights on again and turn on the TV"*(P5).

Further a Danish participant felt that he was saving time by using the in-home DA as the phone was described to be able to prompt him to go on social media and thereby wasting time on something that was not initially intended.

"When you bring out your device[phone or PC] you for something simple or quick, maybe you need to look up a recipe, or you need to look up information or just check a text or whatever. Quite frequently you find yourself stuck with that device for much, much longer than you intended because while you're in there you might as well check your email, or you might as well check on Facebook, maybe you want to reply to a comment that was sent. That interaction being a quick three-second interaction just to set an alarm, you get stuck with our device for 5 or 10 minutes sometimes." (P4)

Overall, it seemed like the in-home DA served in time saving.

Hands-free Interaction

In-home physical DAs can only be interacted with through voice, which was another convenience point that reported to make daily tasks easier, *"It's easier just to, to speak up. Also with the laundry in both hands and you have to walk in, then "please turn on lights" and it's done."*(P9) This was mentioned by all participants across all households, *"Especially in the kitchen if you don't have your phone you can just say play this or play that and when you get in the*

door you can get it to play before you even have taken your jacket off"(P3). The ability to use the in-home physical DA handsfree was a one of the most common points of motivation and the reason the participants found the in-home physical DA useful. However, this could be seen as a negative aspect of voice control as the surrounding environment must retain a certain level of quiet for it to effectively applied.

Health

Two female Japanese participants were the only ones to mention that less screen time was a motivating factor in regard to health. *"Actually I'm hoping to, um, functionalise every single stuff around me by voice cause I don't want to see like smart phone screen. No, it's not good for your eyes."*(P6) They reported that their in-home DA allowed them to cut back on screen time by using voice to excuse certain activities which saved their eyes from a phone screen.

Challenges

The challenges the participants reported were both related to human DA interaction as well as the challenge of incorporating the in-home DA into the household. The three main ones, Voice Recognition, Remembering Commands and 3rd Party Devices will be discussed in the following.

Speech Recognition

When discussing the challenges households faced voice recognition was found to be a common challenge amongst participants. *"I struggle a bit to get it to do the exact thing I ask. And I might think it is because of my accent."*(P1) This was also found to be a challenge in previous research where people using Siri reported similar issues with voice recognition of local or non-native [6]. Voice recognition was a common challenge for most participants, although it was to varying degree dependent on which DA was used. For instance, it was especially true for the Japanese in-home DA Clova. Participants from Japan expressed their frustration, which for some led to little to no use of Clova. *"Clova has terrible voice recognition so she reacts and interrupts the conversation."*(P11)

Remembering Commands

Additionally, participants from both Japan and Denmark expressed the difficulty of remembering the various voice commands for their DA. If they do not use a certain command frequently, they were more inclined to forget how to say it, *"I forgot the echo device skill name, what skill I enabled and what skill... I don't remember every skill name so I stop to use additional skill."* (P13) Unlike on a phone, where you recall its functionality through the interface, there are nothing to recall the capabilities of the DA on the spot. An example of this came from a participant that wanted to turn down the music during the interview, but forgot how to say the command correctly.

"(...) normally we can say turn down the music down, but I need to give it a number and then sometimes that's the most annoying part of Google is that you'll forget some of the commands like, now, I just forgot I have to say turn down with 30% and then they can turn down 30 percentage[the speaker]" (P7).

3rd Party Devices

The challenge that presented itself to the participants who had integrated their DA into their smart home, as it requires it to connect to third party devices which users expressed to be very time consuming,

“(...) it takes a lot of third-party devices to make it all interact to Alexa so you have to spend not a lot of money but a bit of money to so make it successful. It's not just buying the Alexa and then you can switch on lamps and the garage and so on, it's not possible to do that.” (P5)

None of the in-home DA brands, Google, Amazon or LINE offer their own brand of smart home devices that can be controlled by a corresponding in-home DA, instead participants describe having to also learn about 3rd party smart devices, which was described as being very tedious and frustrating,

“I am excited for when it will be a little better at connecting to other systems, we have these Sonos speakers and it would be nice if they [Google Home and Sonos speakers] somehow work together; so it does not start playing music on its own[Google Home] terrible speakers”(P8).

Placement

In majority of the households, the physical assistant had been placed in the kitchen area as it was often determined as the best accessibility point and where most time was spent “, the kitchen is where we spend the most time overall throughout the day.” (P4) Image 3 showcases Google Home Assistant in the kitchen of a Danish household. Danish participants who owned a single in-home DA had in all instances placed it in the kitchen, “that’s the best place to set it up because there is a lot going on in that area in that part of the house in the daytime.” (P5)



Image 3: P9 - Google Home (Kitchen)

Participants who owned multiple in-home DAs, had the living room as the second most popular placement. Only a two participants of different Japanese households had an in-home DA placed in the bedroom, as well as bathroom, image 1 is an example of an echo spot in the bathroom.



Image 4: P6 - Echo Spot(Bathroom)

By the pictures, seen in Image 6-8, taken of the physical DAs in the participating households, it is clear that the surroundings of the DA were different according to the country the household was from. In the cases of Japanese households, they were less concerned about hiding their devices and even to an extent purposely placed their various physical DAs right next to each other in a small area, see Image 5 and 6.



**Image 5:
P11 - Amazon Echo,
Google Home Mini and
Clova Friends (Living
room)**

**Image 6:
P6 - Google Home Mini
and Clova Friends
Combined living room/
bedroom)**

As image 5 shows, Clova has a very different in-home DA design compared to Google Home and Amazon Echo, although matched the environment of a Japanese household which especially can be seen in image 6, where the Clova is surrounded by other Japanese character-like things.



Image 7:
P8 - Google Home
Mini(Living room)

Image 8:
P8 - Google Home Mini
and Clova Friends
(Hidden behind PC)

In contrast, the Danish households were more inclined to make sure that their physical DA device(s) fit into their current living space, which in some cases made the physical DAs almost unnoticeable at first glance, which is exemplified by image 7. Majority of the Danish participants agreed that the simple design of their DA and, by the picture, it is especially noticeable how the white Google Home devices blend into the Danish interior “(...) so of course I think a bit about it but I also wanted it to be a bit neutral to our already existing house.”(P5) Only one household(P8) expressed concern with the design and wished to keep their DAs hidden,

“I have seen other people making a type of box for it, which I strongly consider getting, because I don’t think that they are that great looking. We are very minimalist and I think it is very bulky with regard to cables.”(P8)

Image 8 illustrates the laptop that the Google Home mini is hidden behind in the household of P8.

Perception of in-home DAs

The perception of the DAs varied greatly depending on the physical design, functionality and the task that was performed of the DA. These perceptions proved to be affected by the context the DA existed within and what the DA was being used for. For instance, Clova has very similar functionality features to Google Assistant and Amazon Alexa, for instance, checking the weather forecast, connecting to lights, etc., but is perceived very differently from the other in-home DAs. The findings highlighted four main words the participants would describe their in-home DA: Gimmick, tool, human-like and pet-like. Examples of these description were dependent on the subject of the discussion, which included the subject of DA Personification, Personality, Physical Design and Functionality.

Personification

From the interviews it was found that there were tendencies of the participants personifying their in-home DA and happened across all brands. Majority of the interview

participants were inclined to describe their in-home DA in a human-like way. The participants from both countries used she/her pronouns at some point during the interview to reference their in-home DA, “*She can remember where you put your passport or something(...)*”(P3) Some of the participants veered away from using she/her pronouns in reference to their in-home DA, but still discussed the subject of personality of the DA, “*Alexa does tend to ... a bit more of a fun personality. And I think Amazon has a little bit more leeway when it comes to giving Alexa more of an actual personality with a bit of an attitude.*”(P4) Another, participant stated that he was annoyed that his Google Home devices were not more personified, “*I think it is ridiculous that you wake it by the company name. Personalizing it in one way or another would be fun. Also because it’s kind of part of the family in the way we use it. It’s kind of a pet you can just call.*” This was only in terms of the DA voice and personality, as he preferred to be as unaware of the physical design as possible, which was further discussed in the placement section.

For two Japanese participants it was normal for them to chat casually with their assistant. One further suggested that people living alone get an assistant as a way to feel less alone,

“And I know it and it’s saying that it’s really convenient for life. Also. Um, if the, if their mom is living alone, um, I sometimes strongly recommend to have any assistant. Cause it’s like a feeling like living some with someone the other some others.. Cause you know when you are alone in a home, you don’t really talk cause you alone. But it’s probably good to have something to talk with them when you’re home.”(P6)

DA Personalities

The perception of personalities varied from brand to brand of in-home DAs. A participant from Japan who both owned a Google Home and Amazon Echo stated that,

“I tell Alexa good night and Alexa responds kind of like a greeting[responds by saying ‘Good night’] (...) Google says you can set evening routine by setting[Recommends activities].. It’s very practical but not like a greeting. Alexa has a lot of character, but Google just behaves like an assistant. (...)Google assistant responds more like a robot”(P10)

She further stated that she would never use the ‘sing a song’ command for Google Assistant, which she regularly did with Alexa. Additionally, she elaborated on her perception of the DA across platforms, “*On smart phone assistant is just assistant, won’t say sing a song or how are you on the phone, but when I come home I try to greet to assistant[Amazon Echo].*”(P10)

Contrasting, Google Home was perceived by a female Danish participant, *I think that she’s fun.*”(P9) Which shows how Google Home is personified in her household unlike in the other participant’s household.

Further, a participant who owned an Amazon Echo, revealed that he sometimes acted toward Alexa as if the in-home DA was human, “*So I try to not show my angry[anger] even though they won’t understand.*”(P11) which another example of the DA being personified.

For a participant that owns a Clova Friends expressed that it was expected of Clova to wake unexpectedly and even interrupt conversations because of its low ability for voice recognition. Majority of participants with home in Japan reported being annoyed by this, only P6 who described Clova as a “*little charming assistant*” was less inclined to get annoyed at its interruptions,

“Any like a similar words and she tries to hear it and mishear and wake up “What can I help you?” That’s, you know, um, as a functionality it’s not a good quality, but I kinda like it cause she’s trying very hard. Yeah, to me it’s one of her personality and I am, I kinda like it. I don’t know for other people, but I kind of like it.”(P6)

Other participants also described Clova as being cute, although for one participant Clova did not meet her expectations, “*Actually, I expected more friendly experience with Clova because it looks like a cute bear; but actually Clova friends have.. it doesn’t have a characterized voice, it is similar to Siri or Echo.*” (P12)

To summarize, Google Assistant, Alexa and Clova were in terms of personality described in varying ways depending on the interview participant, however Clova did stand out in terms of design, which will be presented in the following section.

Physical Design

When comparing the physical design of these in-home DAs, participants from Japan reported that they liked the simple physical design of Google Home and Amazon Echo and did not want it to have character-like design like Clova. “*So if Alexa has faces or something like that maybe it’s going to be a little weird when she’s like starting microwave or clocks.*”(P6) The Google Home and Amazon Echo were describes in similar ways, whereas Clova was perceived as a cute character. “*Amazon echo and assistant fits my home, but Clova is a little bit too cute for me, but my daughter loves the design.*”(P11)

Clova Friends was the only smart speaker with character-like design features. Four out of the five Japanese households who participated in the interview owned at least one Clova. Clova was not something they would consider a “real” assistant like Google Assistant or Amazon Alexa. “*And I guess having character and faces, um, it’s maybe good for Japanese markets cause, we don’t think assistant is a assistant, but like we’ll like assistant is um, not human... Something living with us.*” (P6)

Additionally, P6 reported that in Japan, Clova communities exist where people go to interact with other Clova Friends owners and buy outfits for their Clova Friends DA, which additionally emphasizes the pet-like perception of the DA.

“Especially for girls... And I actually, I’ve been to the community events, um, where they like create outfit for Clova and like, so some like some girls get together in a weekend and we create an outfit for like a few hours and then we put it on Clova and it, you know, it’s all our own Clova. And like “See my Clova is the cutest” things like that.”(P6)

An example of a Clova Friends outfit can be seen in image 9.

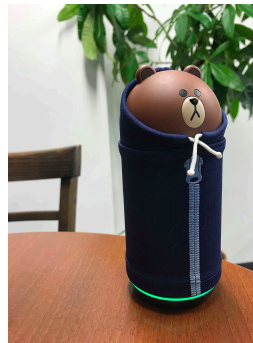


Image 9: Clova Friends outfit (P6)

Functionality

Other than referring to their DA in a humanlike manner, all households described that they used either their Google Home or Amazon Echo as a tool to improve daily routines. Participants that regularly used their DA as a mean to control in-home smart devices were more inclined to describe their in-home DA as a tool and less of a gimmick. Although, when asked when asked why they bought a physical DA, users reported that it was out of curiosity and just for fun. Although, most users still perceives it as a fun gadget as they did initially, time and experience with the device seems to alter their view making it something they could not see themselves without. “*In the beginning I thought: Well that is a cool gadget I don’t think we will use so much. And now I say I would not be without.*” (P9) In households, where the in-home DA was not bought by the participant them selves they describe more as a gimmick that they could easily live without,

“I thought it was a lot more intelligent than it really is. And I don’t know if that is just because the Danish language is not fully developed yet or if it’s just like what it is. But I thought It could do a lot more stuff.”(P2)

Neither of these participants had experience with using DA routines, so the limited use may explain their gimmicky perception of in-home DAs.

Whenever the in-home DA was used in a practical manner participants were more inclined to refer to the in-home DA as a tool, “*The kids ask for the weather forecast, to check if they need to wear rubber boots or sandals, and we use it to check traffic when we’re heading to work.*”(P8) Additionally, it was discovered though the interviews that there were a difference in how the participants perceived certain functionality “*Google is good at using Google tech like maps, but Alexa is not good with geography*” (P10). The functionality that the participants will not use for their in-home DA will be discussed in the following section of Trust and Privacy.

Trust and Privacy

Trust and Privacy have been found to be a common subjects of discussion on previous research and has also been found of interest in this study. The following section have covered the themes of the physical placement of the in-home DA, the issue of having guests and what people would not use their in-home physical DA for.

Placement

In the context of privacy and the placement of a physical DA, most households expressed little to no concern in this regard. The decision of placement came down to convenience as well as accessibility and not the matter of privacy in most cases. It appeared that in most households users were aware of the possibility of being “listened” to by the physical DAs, but did not face them as they argue that everyone is already being listened to through their phone or computer. Without any exceptions, their reason to the lack of concern for their privacy came down to the fact that they did not regard themselves as being anything special, *“There live a billion people in the world, so if they want to listen to me go a head - I think I am boring. I don't think I'm such a special person that they want to.”*(P7) For one participant it was even regarded as a way of getting direct marketing,

“I know if they got some data from me I know that they are giving me specific and direct marketing directed to me so I think I'm also helping them a bit to get some data from me so I can get more direct marketing I think that's why I don't care.”(P5)

This was also true for a Japanese participant, *“If I wanna try something new, I need to rely on the technology”* (P10)

Only one Japanese household expressed concern about their privacy, *“In the living room we can talk anything and maybe it's not private (...) It is not good to have smart speaker in bedroom”*(P11) This participant had decided to keep private conversations exclusive to the bedroom as he found that the physical DA would not be able to listen to them in there.

“So do you change what you talk about in the living room compared to the bedroom?”(Interviewer)

“Especially after reading article[Article title: 'Amazon staff listen to customers' Alexa recordings, report says'(The Guardian)] about that so I am aware of it and I have a little concern of what we talk in the living room a bit but most of the case it is okay.”(P11)

The general consensus of having the DA placed in the bedroom varied from household to household. Regardless of culture, half the participants stated that if they did not already have a DA in the bedroom they would be investing in one, the other half viewed the bedroom as a private space where DAs did not belong.

Having Guests

As mentioned previously, the majority of participants were not concerned in regard to the possibly DA audio recording their in-home conversations. In some of the interviews, this opened the discussion of whether relatives or friends felt similarly or if they had expressed concern about their privacy when visiting them. In a Japanese household, the participant reported that it depended on who is visiting her,

“There are two types of people. There is like my friends like keeps ten assistants in their home and then they all know how to talk with them. (...) But the others is like Assistant is sneaking our home. Yeah, I [friends] don't want to keep it. It is kind of scary.”(P6)

In this instance, the topic of privacy was discussed amongst the in-home DA owner and the visitors. However, P11 was yet to encounter such privacy conversation with visitors as they had not questioned him in this regard, *“In Japan smart speakers still not popular”*(P11). His presumption was people did not question their privacy as in-home DAs were not very common in Japan as of yet.

The same applied to the Danish households. None of the participating house holds experienced being confronted by the issue of privacy by visitors. One participant(P7) stated that in the future he was aware that more people would have an opinion regarding his in-home DA, and speculate that some people may stop visiting as a way to protect their privacy. Both P1 and P3 did not have experiences with visitors feeling uneasy within the presence of their in-home DAs,

“Interviewer: Have you had any experience of people questioning your...”

P1: Whether they[visitors] feel comfortable?

Interviewer: Yeah.

P1: No, never.”

In this study, privacy has not been expressed as a concern in the context of having people over visiting in any house holds.

Would not use for

The interviews provided insight of what the participants did not feel comfortable using their device for. It was mentioned by a few participants that they would never consider using it for online shopping, *“I can't see how you can trust it enough to buy things. Maybe it can just put it into the basket on Amazon or something.”*(P2) Participants expressed that they needed visuals in form of an interface in order to feel comfortable shopping online, *“Buying because I can't see price, so I might buy something higher priced”*(P11) One participant would not trust it to write perceived to be important or formal messages *“I would use it I think .. to my girlfriend or something. If it is an important message I think I would like to write it myself.”*(P3)

Additionally, personal information proved to be a concern of the participants. P10 reported that she would not connect her phone contacts to the device, as it may call someone by accident. *“I try not to add contact list cause it is very risky”*(P10) Another participant, added that he had purposefully disconnected his personal calendar from his Google Assistant,

“The devices we have at home right now, they do not have access to any of my personal data. So we're not doing any interaction with calendars or email or anything like that with those at the moment.” (P4)

These are examples of what these participants considered to be high risk tasks that they would not trust the in-home physical DA handling.

Only, a couple of participants stated that they did not have any limitations that they knew of and they completely trusted their in-home DA even for what would be

considered high-risk tasks such as controlling the locks on the door.

DISCUSSION

The findings contribute to different topics of discussion in relation to people's experience of in-home physical DAs. Perception, Cultural Variability and Privacy and Trust are discussed in the following sections. These sections will provide understandings of the in-home physical DA experience by incorporating prior studies that may aid in explaining certain experiences participants had in relation to their in-home physical DA.

Pet, human or a tool?

It was discovered in the findings that convenience proved to be a big factor, when describing the use of their in-home DA. Whenever convenience was associated with the DAs, the participant were more likely to describe their in-home DA as a tool or a mean to an end. However, this was not true for all DAs. Some of the digital assistants like the Clova line was not described as a tool. Clova took the role of a pet and not a tool like Alexa and Google Assistant. The Device Paradigm by Albert Borgmann[19, 26] can aid in explaining why certain DAs may be perceived differently from each other. Borgmann distinguishes between technology as 'focal practices' and 'commodities'. Following the logic of Albert Borgmann, Alexa and Google Assistant are perceived as tools or commodities, replacing what he describes as focal practices or 'things'. These practices or 'things' can be tedious in the modern world and being able to replace them with commodities such as DAs is viewed as a convenience to the person. Being able to use a voice command and a smart device start vacuuming the entire home is perceived as convenient to the person as they avoid the practice of cleaning themselves. As Clova is inadequate in performing these practices for the person, one may suggest that is why Clova is perceived as to be more pet-like than a commodity or tool.

Additionally, in-home DAs such as Amazon Echo and Google Home have, in previous research, been referred to as a "helper" by participants in a study on households desires for their smart home, which uncovered three smart home personas: The helper, optimiser and hedonist[20]. This validates the findings in this study in relation to the personification of in-home physical DAs.

Cultural Variability

Cultural differences have proven to affect people's experiences in other areas such as web-design[4, 35] and therefore should also be considered within the context of experiences of in-home physical DAs.

It was found that the majority of Danish and Japanese participants personified in-home DAs by how they referred to the DAs as a she/her. Previous research has dealt with the personification of DAs[6, 7, 16, 21]. One study found that in-home physical DAs were more likely to be personified by multiple member households contrary to DA owners living alone[16]. Another study suggested that, the extent of personification had to do with user's technological knowledge, as self-proclaimed tech-knowledgeable users

were less likely to personify their DA[5].

These findings were also found to be true in some instances of this study, however in this study the Japanese participants who had a lot of tech-knowledge were just as likely to personify their in-home DAs as ones with lower technical knowledge, which may suggest that technical knowledge does not affect the personification of the DA. However, it was found that the degree of which the in-home DAs were personified varied from between the Danish participants and the Japanese participants. Through the analysis there was discovered that two of the Japanese participants appeared to have formed a somewhat of a personal affiliation with one or more of their DAs, as they referred their in-home DAs as a pet, family member or friend. These descriptions of the Japanese participant's DAs denotes a higher level of personification than found in Danish households. It was discovered in the way two Japanese talked about their in-home DA. One recommended that people who lived alone should invest in an in-home DA, as it would bring a little life to the home. Another, described wanting to bring her in-home DA on holiday, as she reported that she had missed it when she was away from home. These findings can be considered when designing DAs for the Japanese market, by designing a DA that can substitute the lack social presence in certain situations through personification of the physical in-home DA.

Further, it can be discussed how the physical design of the in-home DAs fitted into the households, respectively located in Japan and Denmark. As discovered, the Danish participants were more inclined to have their in-home DAs discretely placed, which made the DA almost unnoticeable amongst the Danish interior. However, in Japanese households it was found that the DAs were on display, as the majority owned more than one brand of DA which were placed together making them more visible in the home. This may suggest that the physical design should be considered according to different cultures, as Danish households prefer the discreteness of the minimalistic and the Japanese households were more inclined to put their DA on display. Households participating in another study[8] reported that the placement of the in-home physical DA mentioned that they felt like the lights from the DA intruded on their private space, which suggest that the location of the DA is not only affected by design aesthetics but also the issue of privacy.

Previous research have examined varying user norms within cross-cultural communications, and highlighted the importance of considering these differences when designing tools for cross-cultural communication[37]. Cultural variability in regard to DAs has also been a point of discussion in previous research[5,6], which supports that that norms around DAs may also vary across cultures affecting the experience of the DA.

The varying norms around in-home DAs across two different countries found in this study, suggests that there exists cultural variability, which can be taken into

consideration and addressed when improving the experience of in-home DAs.

However, these findings are only indications of varying cultural norms between Japanese and Danish households based on five example cases from Japanese households in which majority of the users work in with the field of robotics and eight danish interviews with varying backgrounds.

The Issue of Privacy and Trust

Across all households placement, in regard to in-home privacy, was not considered a concern. Interview participants reported that they did not consider themselves that important and did not have anything to hide. This was also discovered in previous research that studied privacy behavior amongst people using in-home DAs[17, 33]. Most households had located a DA in the kitchen which correlates with surveys that report that over half of in-home DAs are placed in the kitchen[31]. Households with multiple DA devices addressed having placed them in multiple rooms such as the office or living room. Previous studies, reported the majority of their interview participants actually placed their in-home physical DA in the bedroom[30]. However, this study found some users preferred to keep their bedroom private from the in-home physical DA, as it was of concern that it may be audio recording. For future design, it could be considered incorporating recording indicators into the physical design, which would allow people to be aware of their privacy and be able to make informed decisions. This has also been discussed in previous research that examined privacy concerns regarding audio recording children's toys, which is of relevancy in this study as many of the participants lived in multimember households [27].

One participant reported not having concern with the DA being located in her bedroom, however she did not trust it for having access to her phone contacts, which relates to the issue of participants trust in regard to the functionality of the DA. In this instance, the mistrust was related to the concern that the device might call someone by accident, which she heard had happened to other people. In research, this a result a break in reputed credibility, which can affect user trust[3, 36]. This may also explain why one user would not purchase a Clova Friends, as it had accumulated a bad reputation.

Further, a few participants reported that they would not trust it for making purchases or writing important messages, as it was described as being a high risk task. BJ. Fogg, who has done studies on the relationship between technology and user trust, found that technology does not lose credibility by making errors on low risk tasks, however when technology made errors with high-risk tasks it was detrimental to the credibility of the device[3]. However, this may aid in explaining why the participant, that controlled the locks on his door through the in-home physical DA, fully trusted his DA to do so. The participant had only experienced errors that were what he considered to be low

risk, such as the lights not functioning as wished. As he never experienced errors within a high-risk task resulted in him never questioning his trust in the in-home DA.

Conclusion

In this study, I presented a study that examined how households experience in-home physical DAs. For this study I interviewed people from 13 households, where five of them were located in Japan and the remaining were located in Denmark. As a result of the data analysis, the findings were categorised into seven themes; How the in-home physical DAs were used, what motivated them to use it, how did they learn to operate the device, what challenges have they met, what perception did they have of their device, where did they locate it, and concerns regarding trust and privacy. This study further validated existing studies whilst offering new knowledge in areas such as cultural variability, privacy and user perceptions of in-home DAs. The findings give insight into different households experience of physical in-home DAs and conclude in a discussion of the findings along with suggestions of considerations for future design of physical in-home DA.

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