# Storyboard study

This study evaluated the usability of adaptive user interfaces when used in mitigating interpersonal privacy violating scenarios. This study used storyboards as a stimulant to elicit user responses where each storyboard demonstrated how different variations of adaptive user interfaces can be used to mitigate different variations of interpersonal privacy violating scenarios. Here interpersonal privacy violations refer to privacy violations that happens between smart home users due to sharing smart home devices among themselves. There are two main variations of interpersonal privacy violations explored in this study:

* Interpersonal information privacy: Privacy related to information disclosures caused by shared smart home devices,
* Interpersonal physical privacy: Privacy related to disturbances caused by shared smart home devices.

The study used two hypothetical scenarios covering the two variations of interpersonal privacy:

1. Health information scenario (information privacy): Yasmin (care giver) tries to access the vital information of Sally (care receiver) over a smart speaker. During this, Zack (sally’s son) walks into the room who is not authorised to access Sally’s health information.
2. Meditation scenario (physical privacy): Zack (son) tries listen to music over the smart speaker while his Sally (mother) was meditating in a near-by room where his mother doesn’t want to get disturbed while she is meditating.

For each scenario, three variations of adaptive user interfaces (AAUI, CAUI, NAUI) were used to resulting in three separate outcomes. All together this created six unique scenarios. Table 1 explains the AUI variations along with other acronyms used in this document.

|  |  |  |
| --- | --- | --- |
| **Acronym** | **Meaning** | **Description** |
| AUI | Adaptive User Interfaces | User interfaces that change their behaviour depending on the context. |
| AAUI | Automatic Adaptive User Interfaces | AUI variation, which automatically adapts without user feedback. |
| CAUI | Choice-based Adaptive User Interfaces | AUI variation, which provides users with choices to select the adaptation and continues the adaptations based on user feedback. |
| NAUI | Non-Adaptive User Interfaces | Standard smart home user interfaces which are unable to adapt according to the context. |
| [N|H] | Non-adaptive | Health Scenario | Scenario which used NAUI in the health information scenario. |
| [C|H] | Choice-based adaptive | Health scenario | Scenario which used CAUI in the health information scenario. |
| [A|H| | Automatic-adaptive | Health scenario | Scenario which used AAUI in the health information scenario. |
| [N|M] | Non-adaptive | Meditation Scenario | Scenario which used NAUI in the meditation scenario. |
| [C|M| | Choice-based | Meditation Scenario | Scenario which used CAUI in the meditation scenario. |
| [A|M] | Automatic-adaptive | Meditation Scenario | Scenario which used AAUI in the meditation scenario. |

Table 1: Acronyms and explanations

Participants of the study were asked questions based on these storyboards regarding the usability of the AUI and this document provides the transcription of those interviews.

This study was approved by the Open University’s Human Research Ethics Committee (**HREC/3417/Wijesundara**).

# Storyboard study interview transcripts

## Post-scenario questionnaire interview answers

**Scenario [N|H]**

|  |  |  |
| --- | --- | --- |
| **Participant ID** | **How effectively did the smart home user interfaces preserve the privacy of the smart home users? Please explain your answer.** | **If you have any comments or suggestions, please write them here** |
| PU1 | Not at all, Sally does not want that Zack knows but the system did not prevent this to happen. | The system is not integrated at all, IT is a simple smart speaker scenario. Integration with the doorbell at a minimum is required. |
| PU2 | No privacy. | - |
| PU3 | Not at all. | Even if it provides better usability, if it causes privacy breaches then I would not use this system. |
| PU4 | Not very well. smart speaker is broadcasting to whoever is listening and is present in the room. | - |
| PU5 | It didn't preserve the privacy of the user, but it could be improved by sending the response directly to the caregiver's phone. | - |
| PU6 | Not very effectively. Sally's preferences are not satisfied, because her son hears her diagnosis. | Without a device to detect Zack arriving, the system cannot do anything else. It would need more hardware/features. Or having a way for the user to interrupt the voice like "shut up" but this would be embarrassing. |
| PU7 | It didn't work but it was Zack's fault. | how to know Zack was coming in? knock the door! |
| PU8 | Not effective at all. Once the system had started playing Sally's medical history it did not stop when another person entered the room. A human caregiver would have reacted to the door opening therefore this system is risky to use. Sally was upset. | I've marked number 9 low as if I was Yasmin, I would not be confident using the system in case somebody walked into the room. It is simple to use though. |
| PU9 | Not having a method to turn the speaker off at the right moment caused an information leak that was unwanted. | - |
| PU10 | Another privacy violation, Zack heard his mother's private medical data | Maybe the system can check if any not authorised to hear the data is in speaker range before proceeding to read out the data. |
| PU11 | In this scenario, the system is ineffective in preserving the user privacy since it did not recognise a new person on the same environment, resulting leak of sensitive information. | - |
| PU12 | Nothing was preserved since an external person could hear all Sally's medical information. | - |
| PU13 | The least privacy-preserving alternative, all users were upset in the end and highly sensitive data were being shared due to how the system was designed. | - |
| PU14 | Not well at all. It didn't identify who the person was entering the room and the sensitivity of the information to that person. | As I answered to scenario 1. As system where someone with the privacy authority to make the decision in the room can say, "continue Alexa" when deemed necessary. |
| PU15 | This is bad because it violates mom's preference. | - |

**Scenario [C|H]**

|  |  |  |
| --- | --- | --- |
| **Participant ID** | **How effectively did the smart home user interfaces preserve the privacy of the smart home users? Please explain your answer.** | **If you have any comments or suggestions, please write them here** |
| PU1 | The privacy is preserved if Yasmin decides to stop the broadcasting. However, this is a decision that she might not make, invalidating the privacy system. So, it is effective only if Yasmin is consistent with Sally's request. | The decision of whether broadcast or not should not be decided by Yasmin. There is an unnecessary use of two notification devices. Either use the smart watch or the smart phone. |
| PU2 | Depends on the caregiver's personality (human factor). If the video has no sound, then it’s similar to the first scenario (except for the usage of different devices to receive the message). | - |
| PU3 | Fair enough. | It might be unnecessarily to give options to choose an alternate method to deliver information. |
| PU4 | Quite well. | - |
| PU5 | It preserved the privacy, but it had a probably unnecessary middle step. | The system should have a default option to send the information in that case. |
| PU6 | Very effectively, stopping the broadcast so that Zack didn't listen to the sensitive information. | It would be nice if the system switches by default on the smart watch (an active device), to be seamless and easier |
| PU7 | 3 out 4 options so 75%. | We need to inform users if they are going to break the privacy. |
| PU8 | Privacy is protected but with this scenario more options are made available, this makes it possible to override the privacy protection. In the example privacy is protected though. | A more powerful system, maybe too many options and the caregiver may not have smart watch. |
| PU9 | It works effectively but I would have preferred a more seamless approach. | - |
| PU10 | I think privacy would be preserved regardless of Sally's choice. | - |
| PU11 | This scenario preserves the user privacy effectively by switching the manner to communicate the sensitive information after it detects a possible privacy violation. Another important action performed by the system was the presentation of alternative option to display the sensitive information. | - |
| PU12 | The interface preserves the privacy as requested by Sally by limiting the access to her personal information. | In the scenario the interface offers to continue the use of the speaker, but this would give to Yasmin control over Sally privacy preferences. |
| PU13 | I think the system was very effective in terms of detecting a possible breach, notifying the user and avoiding the breach. However, I think it would be a bit limited to the effectiveness of the sensors detecting that another user is approaching. Another way could be to choose some default settings and avoid playing those data out loud in any circumstance I guess. | - |
| PU14 | It preserved privacy fairly well. But as with my answer to the first scenario, by cutting off halfway through the sentence and making the info private for the caregiver, it could make the patient anxious. I think the smart watch helps the caregiver to stay present in the room and maybe mediate the disruption of the entry into the room more easily using her social skills. But there's an added layer of complexity. | I think it would be good if the system paused and sent the notification very discreetly later on. So, it could delay sending the notification until the caregiver has left the room, then they can handle the social dynamics of the situation i.e. the disturbance of the son and the new social presence he brings, and then look at the medial info afterwards. A notification [on the] watch, in-the-moment might be noticed by the son and may take the caregivers attention away from the setting. |
| PU15 | It is good to have options about the action after alerts. The user [has] to react it quickly. | - |

**Scenario [A | H]**

|  |  |  |
| --- | --- | --- |
| **Participant ID** | **How effectively did the smart home user interfaces preserve the privacy of the smart home users? Please explain your answer.** | **If you have any comments or suggestions, please write them here** |
| PU1 | My only concern is about how the system is connected with the main entrance. I suppose that when somebody rings the doorbell, Alexa stops broadcasting information. If this is the case, I think that interface preserve privacy quite well in respect to Zack presence. However, I doubt about sending the data on the smartphone of Yasmin. Is there any security function in the case the phone [gets] lost? | For how long and how data is stored in the phone of Yasmin? Is it a personal or working phone? Is it constantly carried by Yasmin in her everyday activities? |
| PU2 | It depends on the room and whether it is soundproof or not. | - |
| PU3 | Sufficient for the given scenario. | Nothing much. |
| PU4 | very well. | - |
| PU5 | It preserved the privacy. | - |
| PU6 | The privacy is well preserved, because no sensitive information is left outside of the designed scope. | I prefer this solution to the one asking for confirmation of where to continue. |
| PU7 | it didn't break the privacy, that is OK. | I prefer the first scenario, to have more options. |
| PU8 | The system was able to switch to text when a third party approached the room, this keeps the privacy of Sally. Therefore, this system is effective at preserving privacy. | This assumes that Alexa will only respond to commands to access medical history from caregivers. |
| PU9 | It acted perfectly to preserve the privacy, my only concerns regard the possibility that the caretaker might need the information quickly and this might frustrate her and lead to her disabling the functionality. | - |
| PU10 | Privacy preserved, but fewer options for Sally to receive data than given in other [scenarios]. | - |
| PU11 | In this scenario, the system also preserves the user privacy because the system is monitoring and modifying […] its user interface according to the privacy requirements of the people who live in the smart house. | - |
| PU12 | The interface respected the need of Sally of keeping her medical information private | - |
| PU13 | Even more effectively than the prior scenario since it switched directly to a safer modality. The errors propagating from the camera outside the door could still apply also in this case but there is less decision/burden on the user in this case. | - |
| PU14 | It preserved privacy fairly well. The information was directed to the caregiver and not to the person entering through the door. The information is relevant to the caregiver and they can use it most effectively to provide treatment. However, the patient may be anxious that they don't know their blood glucose level and the caregiver does. They may want to have access to the information discreetly as well. The person entering the building is the patient's son. This is a also a person that the patient may want to disclose the information to. In some situations, the patient may be dependent on other members of their family, like their son, to handle medical information.  There is also a question about the context. Should patients have access to all their health information? I'm not sure what the medical protocol is for the disclosure of health information. | I think it would be good if, when the person controlling Alexa has identified that the person who entered the building is someone who they want to disclose the information to, they can say "continue Alexa" and it will finish the audio. This is an alternative to it switching to the mobile phone, which is a private display. This may avoid unnecessary anxiety on the patient's part. |
| PU15 | It protects privacy of users very well. But the main user has to define who should trigger the alert. | - |

**Scenario [N | M]**

|  |  |  |
| --- | --- | --- |
| **Participant ID** | **How effectively did the smart home user interfaces preserve the privacy of the smart home users? Please explain your answer.** | **If you have any comments or suggestions, please write them here** |
| PU1 | Not at all, the system does not prevent Zack to not [disturb] his mother. | Alexa, should be set to either prevent hard rock music to be played or give choices to Zack that are compatible with the need of Sally of not be disturbed. |
| PU2 | No privacy. | - |
| PU3 | I [don't] think any privacy was compromised as no personal information was exposed. | I wouldn't term it a privacy breach but something that is an inconvenience to me. |
| PU4 | This is tricky to say because if there was a regular sound system, still that would have been disturbing to Sally. In my opinion, the smart speaker is not at fault, rather the sound, so even if it was a regular sound system. |  |
| PU5 | It didn't take into account Sally's preferences. | It could be improved by auto-lowering the volume in meditating hours. |
| PU6 | Not effectively. Sally is disturbed and her preferences are not satisfied. And also, Zack won't be happy after arguing with his mother. | It would be nice that the system known that the mother is meditating, or because she is using a device, or by camera or by knowing her life patterns. |
| PU7 | It didn't detect Sally was meditating, it failed | Zack could check before using the system, how to check if Sally is meditating? |
| PU8 | Not effective at all! The system does not consider privacy and plays at whatever volume therefore Sally's is disturbed. | A very simple system but by default disturbs Sally. |
| PU9 | It didn't because it disregarded the needs of the other people in the household. It also fell out of control of the user as it immediately played loud music. | - |
| PU10 | Sally was disturbed by the music, by definition a privacy violation. | - |
| PU11 | In this scenario, the smart device does not preserve the user privacy since it only focuses on satisfying the functional requirements of one single user and does not consider the privacy of the other users within the same house. | - |
| PU12 | The system did not respect Sally preferences and it did not preserve her privacy. | - |
| PU13 | It was the least privacy-preserving alternative among the provided scenarios. One of the people sharing the same space was disturbed and the other will have to deal with the unintended consequences. | - |
| PU14 | Not well. The meditator wanted the privacy to meditate in peace. She had to tell Zach to turn the music down. | I think the system should turn its volume down and inform the user about the decision. But the human should have to make a choice and influence what decision Alexa makes. So, while, in my answer to question 2, I said that the system should simply inform the user that their music has been. I now think it should say, "Zach your mother is meditating. Would you like to turn the volume down?" In doing so, it helps Zach to learn self-responsibility. And it helps him to learn how to respect people's privacy himself. I'm sure he would also buy into the decision-engine's decisions more, if he had a role in the decision-making. |
| PU15 | I think it did not preserve the privacy of other who is forced to be a user. No control at all. | - |

**Scenario [C | M]**

|  |  |  |
| --- | --- | --- |
| **Participant ID** | **How effectively did the smart home user interfaces preserve the privacy of the smart home users? Please explain your answer.** | **If you have any comments or suggestions, please write them here** |
| PU1 | Alexa should not give the choice to Zack to how or whether play music. So, the system is not effective if Zack decides for option 4. Option 1 could be effective if the volume was set by Sally. However, option 2 and 3 are good. | The system without option 4(and without option 1 in the case the volumes is set by Zack) is good, since it is allowing Zack to listen music without disturbing Sally. |
| PU2 | Depends on the given options (human factor). | - |
| PU3 | Good enough. | I found this scenario more appropriate as it informed me why Alexa is not playing music at high volume. |
| PU4 | Very well. | - |
| PU5 | It leaked the information that Sally was meditating which is not necessary. | Maybe the system should suggest lowering the volume without leaking that information, and also the system has the "Play anyway" option which could lead to a self-defeating purpose. |
| PU6 | Sally is not disturbed, so she can meditate in peace and also Zack can enjoy. A nice way to avoid conflicts. | When selecting the last option, it would be nice if the system asks for a double confirmation like "do you want to argue with your mother?" |
| PU7 | Reduce the volume does not mean the same for everybody. | Order options from low risk to higher risk. |
| PU8 | The system has the options to maintain privacy but also includes an option to override. Therefore, it has a lower level of privacy for Sally. In the example Zack uses the system in a responsible way and Sally's privacy is preserved. | Overall, this system might be enjoyed more by Zach as he has more options. |
| PU9 | It works and also offer the possibility of alternatives, I would like something like this, or at least the chance of a configuration. | - |
| PU10 | Very well, although it did have the option for Zack to listen to music loudly, breaching privacy. | - |
| PU11 | This scenario is more effective since the reason the not playing the music is presented by the system so the user can choose an alternative option. | - |
| PU12 | The system puts the requirements of Sally before the needs of Zack to preserve her privacy. However, Zack can still enjoy the selected activity. | Sally is the owner of the house and the system; however, Zack has the option to override her choice by selecting option 4. This should not be possible. |
| PU13 | Albeit providing very intuitive options to choose from, the interface disclosed sensitive information about another user's activities (i.e., that she was meditating at the moment). Thus, I believe this system was not designed for preserving the privacy of users sharing the same smart home devices. | - |
| PU14 | It retained privacy well. It gives Zach the context which is great. Then he doesn't have to assume things about what his Mother is doing. It also puts him in control, teaching respect of privacy and self-responsibility. | I wouldn't like using this because Alexa takes a while to read out all the options and the user might have forgotten one of the options by the time, they receive the last one. It's not like visual interface where you can see the options and revisit them easily. I'm not sure, the "listen on your Bluetooth headset" is useful. You would never do both at the same time, listening on Bluetooth and through the speaker. So, if the system could detect simply when he switches his Bluetooth headset on and then automatically switch the music over, that would be better. He should be able to make that decision for himself, without being asked to do so. |
| PU15 | This is very good, because it provides some information to persuade the user to choose the following options, it is easier to accept. | - |

**Scenario [A | M]**

|  |  |  |
| --- | --- | --- |
| **Participant ID** | **How effectively did the smart home user interfaces preserve the privacy of the smart home users? Please explain your answer.** | **If you have any comments or suggestions, please write them here** |
| PU1 | Who set the level of volume? I suppose that Sally wants complete silence when meditating. So, I think that the system is good but not completely effective f the music is allowed to play. Zack is a quest and I think it is fair if Alexa prevents music to be played when Sally meditating. | If the volume is set by Sally and she is ok with that level, the system is effective. |
| PU2 | The music volume is low when Sally is meditating, but it might not reflect the user. | - |
| PU3 | Fair enough. | I cannot comment on the complexity of using or learning the system by just looking at the scenario. The scenario wasn’t complex, its actually configuring the system to provide this output which can be complex for a layman. |
| PU4 | It did preserve the privacy. however, from Zack's point of view, the interaction with the smart speaker can become annoying as it is not giving any feedback to Zack as to why the volume is low. | - |
| PU5 | There are no issues with the privacy or the user preference for meditating hours. | - |
| PU6 | Very effectively for Sally, she is not disturbed. For Zack it can be a bit less effective if he cannot hear enough the song. | For transparency I would like the system to say to Zack that the volume needs to be low not to disturb his mother. |
| PU7 | What is the definition of low? | I still prefer to [be] asked like Scenario 2 |
| PU8 | The system allowed both Zack to hear music and at the same time not to disturb Sally therefore both users’ privacy is preserved. | - |
| PU9 | Highly effective. With the music being played at an appropriate volume, the other people in the house are not affected by the use of the smart home interface. | - |
| PU10 | I think privacy was maintained, although Zack could have had more options after his 'play music' request. | - |
| PU11 | In this case, the system preserves the user privacy effectively since it takes in the consideration the other user privacy within the house before playing the music. | - |
| PU12 | [Sally’s] need of silence during her meditation is preserved and Zack cannot, in any way, override his mother's preferences. | - |
| PU13 | Even easier to use system than in the prior scenario but in this case no sensitive information was disclosed and the features were seamlessly integrated to adapt to both users in an unobtrusive way. | This option could be accompanied by preference settings to allow the user to choose its own go-to modality when playing to not disturb others (e.g., send to speaker in different room), to leave some of the room for options that was there in the first scenario, but without disclosing any data. |
| PU14 | Not so well. Zach now has to make some assumptions about why his music has been turned down. He could start to suspect that someone in the house is doing something that they are not actually doing. He has to imagine why the music turned down. | I think the system should inform Zach why it lowered its volume. He's unlikely to be [able] to assume that it is because his Mother is meditating. |
| PU15 | It is good for some cases, sometimes it is tricky to define the priority of people's preference in one context. | Maybe the device can be schedule with the time slots. |

## Post-study questionnaire and answers

This section provides the three questions (refer to Table 2) asked at the end of each study and the transcriptions of those interviews.

|  |  |
| --- | --- |
| Question tag | Question |
| Q1 | Could you explain the reasons for the usability ratings that you gave for the different scenarios? |
| Q2 | Can you think of any other scenarios that violate privacy of users in a smart space? |
| Q3 | What would you suggest to improve the usability and privacy protection capabilities of the smart home interfaces? |

Table 2: post-study questionnaire

|  |  |  |
| --- | --- | --- |
| **Participant ID** | **Question** | **Participant Answers** |
| PU1 |  |  |
|  | Q1 | Depended on if I thought that the system was good, but also it was easy to use. There was a system that was good, but I put four because I don't like Alexa it does this thing. So, my preference you know, yeah but […] then later I think I gave a 5, although Alexa is used because I said okay by the system. it's okay it's good, although I don't like to use Alexa system, it's usable in its usable in the sense that is very easy to access the kind of system, but this is not attached to the fact that the system is good or bad. |
|  | Q2 | - |
|  | Q3 | Well, I put in a suggestion that in the scenario where Jasmin get the alert in the phone good, but there is a risk that he feels […], oh what's that? it's a personal phone it's a professional phone that phone going to a drawer locked every night or she carried, so there is the risk of losing the phone. So, what happened in that case. so that was my only concern for that scenario. that was quite good, but I was like, the phone is something that you can use. |
| PU2 |  |  |
|  | Q1 | Generally, it is a good addition to have privacy preserving capabilities in user interfaces. Privacy violating scenarios were fixed using adaptive user interfaces. They were much better usable systems. Privacy was preserved in the adaptive user interface scenario. [Non adaptive UI] continued playing the conversation, so the system is faulty.  I would not use the non-adaptive user interfaces as it broadcasts information without considering the privacy concerns of the user. Automatic adaption is good, but it comes with one option. It is good if the option is good. it's not that bad. [choice-based adaptation] might have some options and there is a risk of privacy being violated. It is based on the human factor. someone used this system, and he wants to actually broadcast private information, or it can be done by mistake, so it is prone to violating privacy.  In [automatic adaptation] receiving message as a text message will protect the privacy. if one of the options can violate the privacy of the other person it will be a problem. again, it depends on human choice. In [automatic adaptation], If the default choice is good for the user, then it's good. |
|  | Q2 | - |
|  | Q3 | If you can provide multiple options, you can provide some prioritization to say that one option has the highest priority which gives you the most efficient privacy maybe another one a little less privacy. Another one though, if the system can detect choice be made by the user has lower privacy strength with respect to other choices, you might give him a warning and say be careful if you choose this option, it might affect other people in your area or in your house. so, are you sure you want to continue? It's like a message telling him just make sure that they have chosen the right option.  It might be a mistake, maybe he might want to choose option one and he chose option two by mistake as the option were adjacent to each other. So, it would be a good thing to ask, are you sure the user wants to choose this option?  If you choose yes, it's the decision but if you choose No, it might be a mistake. So having a message will help to avoid mistakes. |
| PU3 |  |  |
|  | Q1 | For automatic adaptive scenarios it was quite convenient. I think it was good, it didn't compromise any information. The usability was quite effective and convenient because everything was automated and the preferences of each was preserved.  In meditation scenario, I preferred [choice-based adaptation] better than automated adaptation. Because when Zack started listening to music, the volume was reduced, he doesn't know why the volume was reduced. Zack might question why Alexa is not playing in the full volume. It is excellent if Alexa informs why the volume is low. it's a better usability know, because the user of the system is aware that why it reduced the volume. In meditation scenario she was disturbed, and it was an inconvenience.  In [choice-based adaptation], I found it unnecessary in the runtime scenario to get an option. The caregiver can set a default channel beforehand. So, if the broadcast needs to stop it can switch to my smartphone video - but at the wrong time getting a notification to switch it to stop the broadcast while he's coming you might not […] be active enough. In meditation scenario, I like the [choice-based adaptation] as Zack is aware of the reason for the reduction of volume.  In meditation scenario and the health information scenario, in the [non-adaptive user interfaces] the privacy was violated. |
|  | Q2 | I use Alexa to handle my shopping list, when my daughter comes, she says add toys to the list Anybody in the house can change it. When we go shopping, I can find random items which were put by other people. I access train booking via Alexa Skills. I have also added my credit card details to the payment option. It does not have any authentication, and anybody book tickets using my credit card. Kids, other family members and strangers can use this feature without my authorization. This could be a financial loss. I tried this to try it out and it is convenient.  I am afraid to use this feature in front of kids as they could imitate me and use my credit card.  I had my, I have my smartphone touch enabled and my daughter's uses the phone to download apps.  When I'm busy and she just takes my thumb and use my authentication to pay for apps. It is fine for free apps, but for paid apps kids are not aware of the consequences. |
|  | Q3 | - |
| PU4 |  |  |
|  | Q1 | Alexa is a pain to use in general. My general issue with a smart speaker device [is] that, voice interaction might not be easy to use. But if you get used to it, that is fine.  In [automatic health scenario], no need to have an extra notification as Yasmin is already getting a notification on the phone. I like the [choice-based adaptation], as it tells why the adaptation happens.  Automatic meditation scenario will be very annoying you might think that the device is not working properly, why is it keeping the volume low? Could be frustrating for the user even. |
|  | Q2 | When I am travelling in my car, I would keep my phone connected to the Bluetooth. If someone calls me their name would be broadcasted out aloud. If I have saved their name in a funny [or] offensive way or if the people in the car should not know that I am getting call from that specific person. It would be embarrassing and also lead to problems. |
|  | Q3 | In scenarios where you get a call from someone, rather than saying their name the device can mask the name by [saying] that is a call and check your phone. Passive interactions are much better than active interactions. |
| PU5 |  |  |
|  | Q1 | I use Google home, so it is very easy to use. A solution for privacy violation is to get the information directly from the phone rather than the smart speaker. A solution for [non adaptive meditation scenario] would be to suggest Zack that his mother is meditating and ask him to play the music at a low volume.  From Yasmin’s point of view, the [automatic adaptive UI] is easy to use, it might not be easy for the developer to build the system. [Choice based automatic adaptive UI] is not better than automatic adaptation as it has an unnecessary step when switching to a different modality. It is like the saying “Less is more”. So, I don’t like the [choice-based adaptation] as it makes things complicated.  Maybe it is better to have a default option. If son wants to be annoying, he can use the last option and it could disturb Sally’s meditation. Maybe people like to have too many options. |
|  | Q2 | When we use a smart speaker, it is set to the default user (main user) and if some outsider comes and uses the smart speaker. They would be able to access the default user’s information. Such as their music playlist.  My travel information can be leaked to someone else who is using the system. One day I used Google maps to go to the supermarket and when I came home and asked Google Home to tell the weather, Google broadcasted the weather in the location of the supermarket. |
|  | Q3 | [non-adaptive] is good to use, automatic is good comprise. [choice-based adaptation] has too many options, and sometimes people like too many options. Maybe the [choice-based adaptation] should have a default option. |
| PU6 |  |  |
|  | Q1 | Having a default option in the Choice based adaptation is good. Using adaptive user interfaces can avoid a lot of arguing between Zack and his mother. In [choice-based scenario], if there is a choice which violates someone else's privacy, it is better to give another reminder if he is sure about that decision, mentioning the possible privacy violation.  I prefer automatic adaptation over [choice-based adaptation]. I like having control. In automatic adaptation, I would like to have transparency “why” the adaptation happens. If my volume is lowered, Zack should know his mother is meditation. It was problematic when Sally’s health data was leaked to Zack. My smart assistant [does] not have the automatic adaptation feature for private information. If someone else asks for personal information, it would get leaked. I wish I had the option to say “shut up” to Alexa, so it would stop halfway, but I don’t have that feature. |
|  | Q2 | - |
|  | Q3 | I think it is the balance between smoothness and control. Because I also don’t want to feel like there is something deciding for me. There should be a way to always override the system. For example, If I want to disturb my mother, I should also have the option to override the system and play music loudly. It is a problem between people, you should be given the options and tools dealing with the problem but not take a decision, they just should facilitate.  There is the problem of talking with the speaker and if someone is around, they might think I am stupid. Even I feel like that sometimes. |
| PU7 |  |  |
|  | Q1 | In [choice-based adaptation scenario], there is an option for Sally’s privacy being violated. So, my concern is, if that option is available. As that could violate the privacy. four options [do] not sound complex. […] I still prefer to be asked, so I prefer the [choice-based adaptation].  I like [choice-based adaptation] but I don’t think it should have the choice to break the privacy of the other user. If it exists it should remind the person using the UI that [another] person’s privacy will be violated. Ask him “are you sure you want to do this?”. |
|  | Q2 | - |
|  | Q3 | You should always be able to configure. If I need adaptation or not. |
| PU8 |  |  |
|  | Q1 | [non-adaptive AUI health scenario] made family feuds because unable to preserve the privacy. In a real-life scenario where there is a nurse or a doctor, if they hear or see someone else entering the room. They would stop mid-sentence to stop the privacy violation. It should happen with smart home user interfaces as well.  Rebellious teenager would use an option which would disturb his mother if given the choice. |
|  | Q2 | If your financial services are linked to your smart home devices, other people can access them. This is a privacy violation. It is the same on my laptop, but home devices are sitting around, and unwanted people can access them readily. |
|  | Q3 | Using more sensors would be able to have more intelligent adaptations in the smart home. |
| PU9 |  |  |
|  | Q1 | It is really [a] nice idea, privacy aware user interfaces. It is something missing at the moment. I think it needs to be seamless. Possibility of choosing is nice, but only people who aware about privacy would care about it. Some people might find it annoying after a while. Because some people could get interrupted.  At the same time the system should give the user control. For example, if Zack wanted to piss his mother off, he should be able to do it. If I don’t give that possibility to the user, they would find ways around it. Then it goes against usability. |
|  | Q2 | Alexa might allow other people to know what I ordered. And I don’t want that to happen. Alexa also would notify me of deliveries. If I am ordering a surprise gift to my girlfriend, I don’t want her to know that a delivery has come. This could also apply to personal music tastes and others [will] know my music taste if they share the same device. |
|  | Q3 | It is very hard to design system which are privacy aware at the same time mange the usability aspect of it.  I like the examples given in the scenarios and they are possible to be made in the future. Current status of smart devices [is] not futuristic as sold in the commercials. They are limited in things that they can do.  I wish I could connect my front door camera to the Alexa to have a feature like the scenario given. But writing rules are not that straight forward. I am a programmer, but I found it difficult to write rules in the existing IoT devices in Smart Homes. A basic use would not be able to do it. |
| PU10 |  |  |
|  | Q1 | I thought everything super easy to use and I did not find anything major usability issues in any of them. Some of them violate the privacy but it was easy to use.  Even the complicated ones were not that complicated enough to rate them badly. |
|  | Q2 | If you are logged in to your computer and you leave it unattended and someone living the home can access your personal information. |
|  | Q3 | In [choice-based] systems, it is best to remove options which would violate the privacy of other people. It is okay to enough options as long as there are no privacy violating options.  Managing privacy and usability should be considered depending on the situation. There are situations where the usability should come first and there are scenarios where privacy should come first. If there is an emergency fire, the doors should open irrespective of the privacy rules. Privacy is not always mandatory so it should be considered based on case. |
| PU11 |  |  |
|  | Q1 | I would not use devices like Alexa for medical purposes as they are not secure. |
|  | Q2 | - |
|  | Q3 | I like in the [choice-based adaptation] the user was aware and there was transparency. |
| PU12 |  |  |
|  | Q1 | [Non adaptive UI] had the highest usability, it was very easy. When there is less action required from the user, the usability is high. It was the same level of usability in the automatic adaptation.  In some scenarios [choice-based adaptation] was okay but some scenarios like adding multiple layers to the interaction made it not easy to use. |
|  | Q2 | Some people are a bit touchy with their music taste. So, if it is exposed to other people who are living in the smart home it could be a violation of their privacy.  Through a smart speaker as well as paired public screens I could get personal notifications and the system should be smart enough to avoid those kind of privacy violations. |
|  | Q3 | I think [user interface] adaptation can solve the privacy violation scenarios. I also think when I pair a personal device to a public device it should be aware of the privacy implications. For example, if I asked for my phone to play music via the smart speaker it should not broadcast other notifications on my speaker. I can even define what I want to be public on my services [or] data and everything else is private. |
| PU13 |  |  |
|  | Q1 | All scenarios were easy to use but I would not feel comfortable using non adaptive user interfaces as they were not preserving my privacy. I found automatic adaptation was much better in usability point of view compared to ‘choice-based’ even though the control taken away from the user. It felt much more integrated. |
|  | Q2 | Having access to my watch history on a smart TV could violate my privacy  Just like music.  Heating levels can be a problem because it affects multiple people who are living in the smart home. When couples are living together, the husband would change the heating levels from outside the home to save money but if the wife is in the home and it is cold.  If I use Netflix or YouTube app on a smart TV, it would show the recent history and it would be annoying. If I share the smart TV in a dorm with other flatmates, it would be uncomfortable. It could be cumbersome as well, because if I have to log out all the time. And the usability goes down.  Areas where you use conferencing devices, it could break the privacy as it could show sensitive information and even show the last conversation the account used to have. This is a privacy violation. Even for devices like [web-conference device] where you can see the last calls that had been taken can be a privacy violation when the device is shared. If I am keeping a smart speaker and if it overhears my sensitive information, it would be a privacy violation. |
|  | Q3 | It would be interesting to have a hybrid option where the system would take users input initially but adapt according to how satisfied with the automatic adaptation. |
| PU14 |  |  |
|  | Q1 | I generally thought it was easy to use and didn’t require much effort, it did a lot of the work for you such as switching to different modalities. Non adaptive scenario, it didn't do anything, so I don't know it was expected to do something, if it was expected to leave something. In those scenarios then I would say yeah, it's complicated, it doesn't work. you haven't worked out how to switch it on or change the settings of anything but if it wasn't supposed to do anything then it was okay. The one where you had to go between choose options, I thought they were much more complex and more difficult to use so was it the [..] one [where] you have medical health information  It was like, okay ask the question, do you want to send the information to a visual display of this or carry on the audio display and various options? and this was on the Smartwatch. So, you have to like, so I'm going to tap and switch and then it's going to be shown on another interface. Yeah, I just thought that was a layer too many. I mean I thought you could probably avoid having to do that. Either send and then with the Alexa telling you, asking you whether you want to lower the volume or switch to a Bluetooth headset and, yeah, they're like four options I just thought that's gonna take forever and you forget the first one and then, you just, you're just gonna be so far not quite complex. I would like to just be one question which is, do you want to turn […] down? Yeah, and then the other ones, the person makes their own decision if they want to switch their Bluetooth headset, they should be responsible and making decisions for themselves, in fact thing is detrimental if it does because if the person's not thinking. |
|  | Q2 | Yeah, I suppose I can imagine in the workspace, I mean we're in a workspace maybe that's why I'm thinking about this but at the moment we […] don't really use that kind of system to manage calls and Skype and things like this but I can imagine in the future if we did, you know, we have shared office spaces and it's hard enough already, people […] uttering, the social rules and hidden unwritten rule, the unwritten social rules of what you should do, when and in that space, I think it's gonna be pretty challenging if that doesn't occur so, we didn't mean like taking, cause what exactly, I know, I may be, but this kind of thing is probably gonna be done with a Bluetooth headset, I mean some office [spaces it] is probably already happening, yeah you know business people.  You see them walking down the street talking on the phone with Bluetooth headset so it could by its nature be pretty private but are we going to have a situation where a number of different people are going to be having part of the same conversation with Bluetooth headsets on can you actually interact with people around and say you've got a Bluetooth headset and you're listening and talking and you think you're being private yeah but you are less aware of what is in your space cuz you're in a personal zone via your conversation so I think this sort of like personal boundaries in officers are gonna be like blurred in the future and yeah smart interfaces and privacy with them can be really important you know […].  Yeah, there are many times of, come across in my life, is just literally when  somebody has said something and then a lecture is coming he'll accept and it's  like it's listening just like whoa! You know somebody in my house would say something like no have you got a [Beer]? Yeah, like a bit now that sounds like a Alexa and then they would like to go big and then they were aware that there's something in the house which is listening to assist the command call for the device we're sure but actually I don't use it in such a way, […] that could create […] privacy violation because I literally just listening to music and so my wife has a radio and I have to control the volume and turn it up and down as though and sometimes it's quite cumbersome where I might turn the volume down like  “Alexa turn the volume down, Alexa turn the volume down” and it takes a while and because my wife's trying to listen to radio in the other sort of area so I think that's disturbing her personal space a little bit and I have a Phillips hue light right in my bedroom and there's an issue because we have it on one side of the bed and I am in control of when the light goes on and off and all this kind of stuff because I have it on my phone and we don't have a button Or put a physical button on the wall sometimes my wife she asked me to turn it on or turn it off and things like that and I have to control this machine |
|  | Q3 | I would just say more physical control, publicly anybody can use to alter what the system is doing and maybe not so much for the personal handset and more transparency on the settings. So, you walk into a space you can see Alexa is on or off like, I might like to have a little light on the top of it My personal Alexa, it's got a light and if I press on the light, I can turn the microphone on, but you can't see that, I very rarely know if it's on or off because it's in one part of the room, it's on top, it's very small I can't see what it's doing,  tell us what the system is doing and also have an emphasis on […] the person you know, It shouldn't take over our decisions that should be helping us to optimize our own decision-making. |
| PU15 |  |  |
|  | Q1 | I like […] the automatic adaptation is good, because people take time to react. When involving humans, you can’t have that kind of speed. I don’t like to use [choice-based adaptation] in health scenario but I like the options in the meditation scenario. Smart home is nice to give me the reason for the adaptation. I feel connected to the smart home as it is talking to me explaining the reason for the adaptation. |
|  | Q2 | I think, when you share devices in a home, I see the problem of who is having priority. There could be conflicts arising because these devices are shared and not every person agrees with the setting a specific device has. |
|  | Q3 | I think having the devices connected would be helpful and at the same time rules should be hard rules but should be flexible enough to change as change our preferences as we evolve. |