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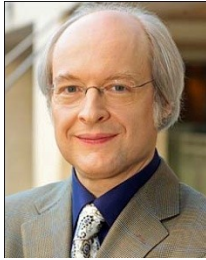
Human-Computer Interaction
Week 4-Lec2

Agenda

- Jacob Nielsen's 10 point rules of thumb
- Discussion on a research paper

Recap

- Cognitive Model
- Gulf of execution and Gulf of evaluation
- 7 stages of actions By Norman
- Mental Vs Conceptual Model



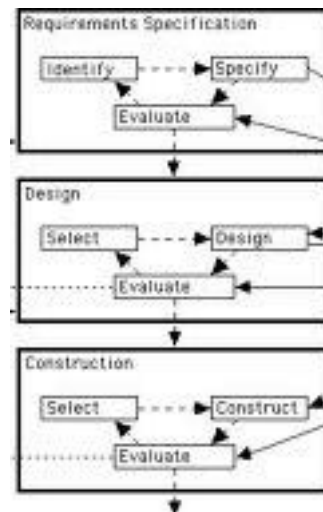
Jakob Nielsen

Usability consultant

Jakob Nielsen is a leading web usability consultant. He holds a Ph.D. in human–computer interaction from the Technical University of Denmark in Copenhagen.



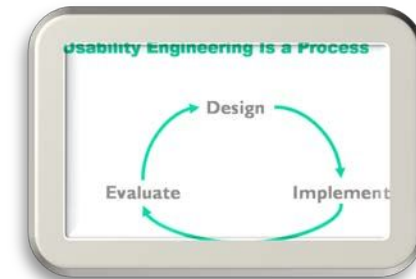
He has authored many books in Usability, HCI, & Experience design. His book titled “ Usability Engineering” 1993 is a textbook on methods to make interfaces easier to use.



Usability Engineering

Usability Engineering involves User Research; Design Research and Validation of Design through Construction & User Testing.

In some institutions it is taught as an independent discipline while in others it is part of HCI discipline.



History of the Heuristics

- Derived
 - Factor analysis of 249 usability problems
- Method are empirically based derivations.
 - Through experiments and observations
- Method suggested by Nielsen is popular because of its
 - simplicity and low cost.
 - It is preferred evaluation technique at the preliminary design stages

The Ten Heuristics as put forth by Nielsen.

1. **Visibility of system status**
2. **Match between system and the real world**
3. **User control and freedom**
4. **Consistency and standards**
5. **Error prevention**
6. **Recognition rather than recall**
7. **Flexibility and efficiency of use**
8. **Aesthetic and minimalist design**
9. **Help users recognize, diagnose, and recover from errors**
10. **Provision of Help and documentation**

Visibility of system status

Users need to be kept informed by the system about what is going on, through appropriate feedback within reasonable time.

Elaboration: This means the user needs to be constantly made aware of his/her interaction with the interface while interacting. The control response ratio (input – output time) need to be as small as possible. Any interface needs to communicate that it is in a ready state to be operated upon – at the start of an interaction cycle.

For example :

A glowing LED / flashing element indicating that the interface is live .

An animated symbol that states that 'saving' act is going on.....



Most important to users is to know "Where am I?" and "Where can I go next?" Internal reference is a must to feel in control.

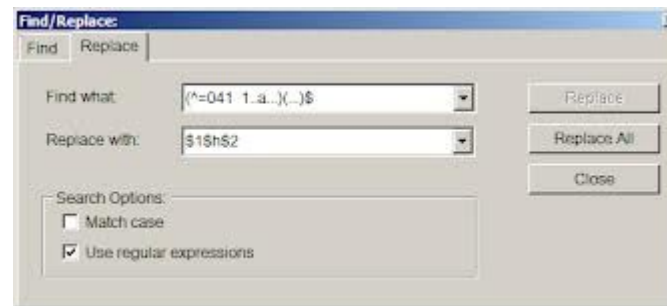
Match between system and the real world

The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

Elaboration: Technical jargon or using terms like ‘Initiate’ or ‘Load’ in place of ‘Start’ contributes to initial mismatch between the users cognitive process and machines feed back dialogue.

An interface need to allow smooth transition from contextual ‘reality’ world to artificial machine world.in other words from ‘ reality’ to ‘digitality’.

Tendency to use programming language and syntax on the display, while understandable to the software programmer, will certainly be a mismatch to the user.



Users can come from different backgrounds, skills levels , specializations & culture. The context on the screen needs to match with the context of the user's mental model

User control and freedom

Users often choose system functions which they did not want . (Mouse click due to haste) . This calls for Support undo and redo.

A user need to have to go through tracing too many steps back to regain control.

Elaboration: Sequential thought process in a user that follows a simple everyday human habit need to be reflected in the dialogue between the device and the user. A good interface facilitates this.

Being in control implies that one can choose to stop interacting an time rather than be forced or trapped by the interface into inaction.

Feeling in the user that he/she is in control at all times must be created.

If the user attempts to gain control and if a message like 404 error occurs the systems is unfriendly & unhelpful !



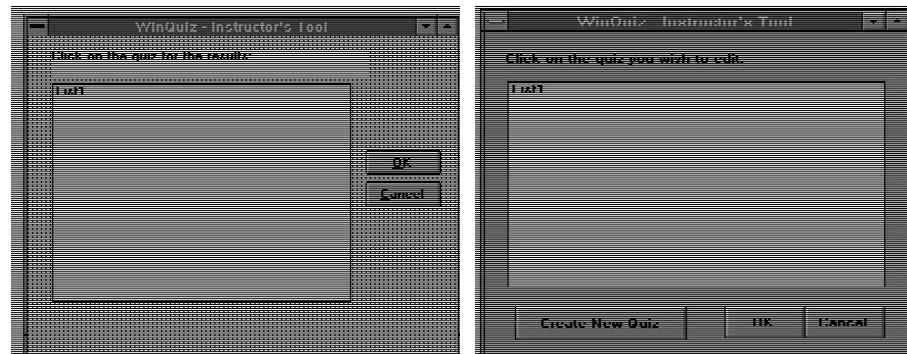
Can users select and sequence tasks? Can they easily re- turn to where they were if they choose an inappropriate /action path? The first example “accuses ‘ them of committing an error. The second one is much better but does not tell the user what to do next ! The third example is inappropriate !

Consistency and standards

Using different words to mean the same action or using different symbols on different pages can be confusing to the user. Users should not have to wonder whether different words, situations, or actions mean the same thing. They should not be in doubt as to what to do next.

Elaboration: Within an interface if multiple words or actions are used to mean the same thing, it only leads to confusion in the user due to perceived lack of consistency. Interaction pattern gets disrupted. When pattern becomes complex, user's cognitive load increases.

Consistency in dialogue as well as in visual elements is achieved by specifying and adhering to a dictionary of words / labels/ symbols/ colors which together form a 'standard' – a prescribed set – compulsorily to be followed.

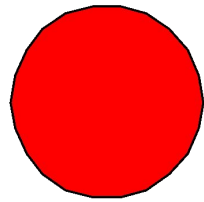


Inconsistent wording & windows / buttons can confuse users when the destination page has a different title from the link. The two screens belong to the same software but appear differently at different places within the website.

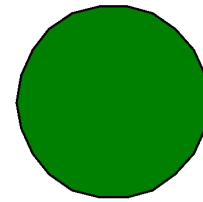
Strive for Consistency

- There are many form of consistency

Example:



Start



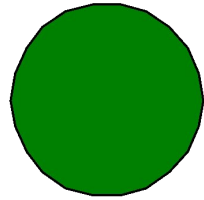
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Inconsistent Interface Design

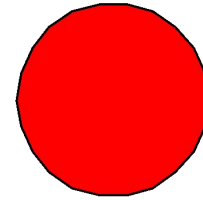
Strive for Consistency

- There are many form of consistency

Example:



Start



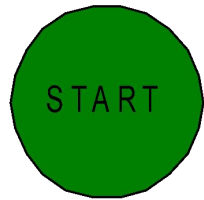
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Consistent interface design

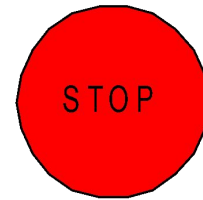
Strive for Consistency

- There are many form of consistency

Example :



Start



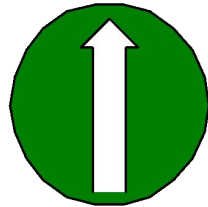
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Better consistency in an interface design

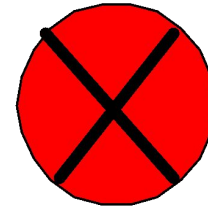
Strive for Consistency

- There are many form of consistency

Example :



Start



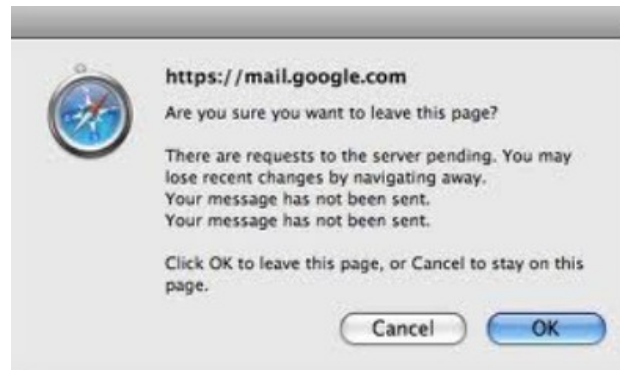
Stop

Another better consistency in an interface design

Error prevention

By research it is possible to pinpoint the typical errors that users normally tend to commit. Prevention of error is best approach. However recovery from error prone actions through a well designed error message should be adopted.

Elaboration : To err is human. Errors can happen regardless the level of expertise of the user or familiarity of the interface. A good principle of design is to seek out error prone interactions , build in error prevention within the dialogue. Forewarning, restricting , prompting , retracing or recovery routes , etc are means of addressing errors. Errors lead to a situation wherein users feel subdued by a machine. Anticipating for errors and incorporating preventive measures ensures fear free and ego free user thereby giving importance to 'H' in HCI through 'I'

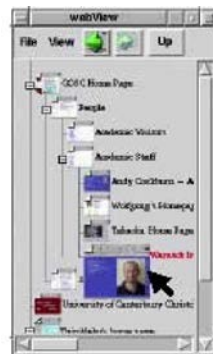


GUI-style widgets cut down on the errors but may still have to be double checked before confirmation

Recognition rather than recall

*Loading the STM- short term memory of the user beyond a limit has negative consequences. Given a navigation path, a user need not have to remember or recall all the instructions. Users are better at **recognising** things they have previously experienced. Prompts , visibility , sequential direction, pop-ups etc should come to the aid of the user. Help needs to be easily retrievable.*

Elaboration : Reduction on cognitive load during the interaction ensures that the user is not asked to rely on means and methods that extract human cost. If an interface requires specialised training and use of memory to operate - it will be quickly abandoned by the user. Analogy, metaphor, symbols, sounds, etc are used as design elements in an interface to ease recall thereby eliminating the need for ' thinking while interacting' and memory loads for the user.



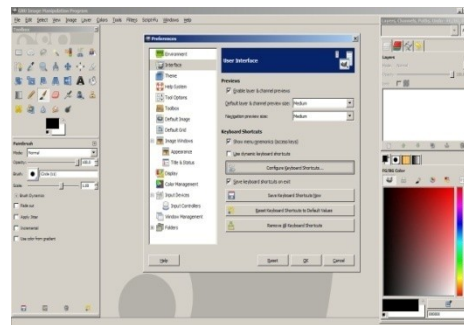
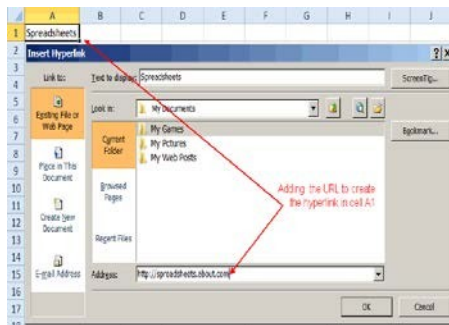
Good labels and descriptive links are crucial for recognition.

The first two icons are difficult to recognise or to recall. The third helps the user recognise where they are and recall which file is currently open.

Flexibility and efficiency of use

The system can cater to both inexperienced and experienced users. As the user becomes proficient - shortcuts can be encouraged. Thereby increasing the efficiency. Allowing the rearranging of the screen elements by the user can also be adopted.

Elaboration : Once a user becomes adept at using an interface , he/she upgrades into a higher level user from a novice. Such users will always seek to complete the task faster . Such users seek out shortcuts. An interface need to allow this. It needs to be flexible and make it possible for the user to adopt quicker dialogues through shortcuts. The user feels efficient as well as proficient. The feeling of having mastered the software is a flexible sign of being in control thereby.



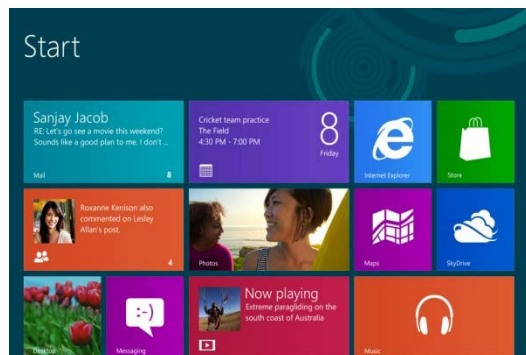
Advanced users can opt for shortcuts in the spreadsheet example in the first picture.

Flexibility of keeping the required buttons / sections in view or hiding them gives the option to the user to rearrange GUI as needed as shown in the second picture.

Aesthetic and minimalist design

Relevancy, simplicity, minimum amount of labels, uncluttered graphics result in efficient communication dialogue between the user and the interface. All unnecessary superfluous elements need to be dropped.

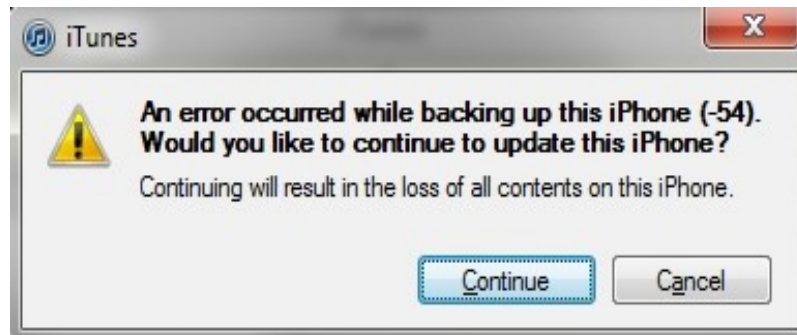
Elaboration : Visual clutter in the interface only adds to inefficiency however impressive it is visually. Simplicity is equal to efficiency is equal to elegance is equal to beauty is the aesthetic algorithm in minimalism. Use of least number of elements (minimalism) is more 'scientific' rather than 'artistic'. **Visual noise needs to be completely eliminated.**



Help users recognize, diagnose & recover from errors

Preventing a user who is about to make a error would be a good approach. Gentle wording of error messages, constructive suggestions, reeducating the user- all can contribute to a happy self confident user who is not afraid of being caught unawares or penalized.

Elaboration : No body likes to be loudly informed that he/ she has erred. Error messages need to be disused as suggestions / prompts and precise instructions so as to be able to correct the error and recover. The learning component in errors so that the user recognizes the error as it is being made, or recognizes the reason why the error happened in the first place – helps the user learn.



There is no way to understand the consequences of canceling. The onus seems to be on the user who will be held responsible for what ever is opted for. proper diagnosis & how to possibly recover is not clear. Very unfriendly interface./

Help and documentation

Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Help queries need to be answered promptly without the user having to go through an elaborate eliminating list.

Elaboration : This again is to assist the user *learn* and understand the dialogue between the user and the machine or understand - where what went wrong - or aid recall during memory-lapses due to long usage time gaps. Adequate 'Help' support system when the user wants and at the point where the user wants it - is a good principle of Interface design.



The screen shots (1&2) attempt to Train the user by offering information on the consequences of their decision

Conclusions:

- These ten heuristics of usability help in refining a potential design into a good design. They ensure that interfaces evolve in the right direction.
- These rules of the thumb act a check list to evaluate a design.
- They also can be used as check list while evaluating any GUI.

<https://medium.com/@elizabeth.nicholas.14/10-examples-of-great-usability-on-airbnb-e47d2ebd0111>

Paper discussion

What If Conversational Agents Became Invisible? Comparing Users' Mental Models According to Physical Entity of AI Speaker

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Proceedings of ACM Interactive Mobile, Wearable Ubiquitous
Technology, ver 4, issue 3, Article 88 (September 2020),

Context of the problem

- Invisible intelligence
 - Physical disappearance of computers from users' view
 - Miniaturization of devices and their integration into other everyday artifacts or the home environment
 - to act as intelligent agents that use prediction algorithms to predict behaviors
- How can people perceive and interact with invisible devices?
- What other advantages do invisible CAs have compared to CAs with physical entities?
- How can sensor-based, invisible interfaces be designed for implicit interaction with humans?

Identify users' mental models and determine the design direction of the invisible CA.

Method

- Conducted a drawing study
 - to understand the differences between the two CAs with different physical entities
 - how their physical visibility affects users' mental models and interactions.
- 30 participants interacted with CAs with a physical presence and an invisible CA
- Differences :
 - Mental models and interactions
- Aim to
 - Understand users' perceptions
 - Expectations of the role of the agent

Visible CA with physical entity

Invisible CA without physical entity



Fig. 1. Equipment used Clova

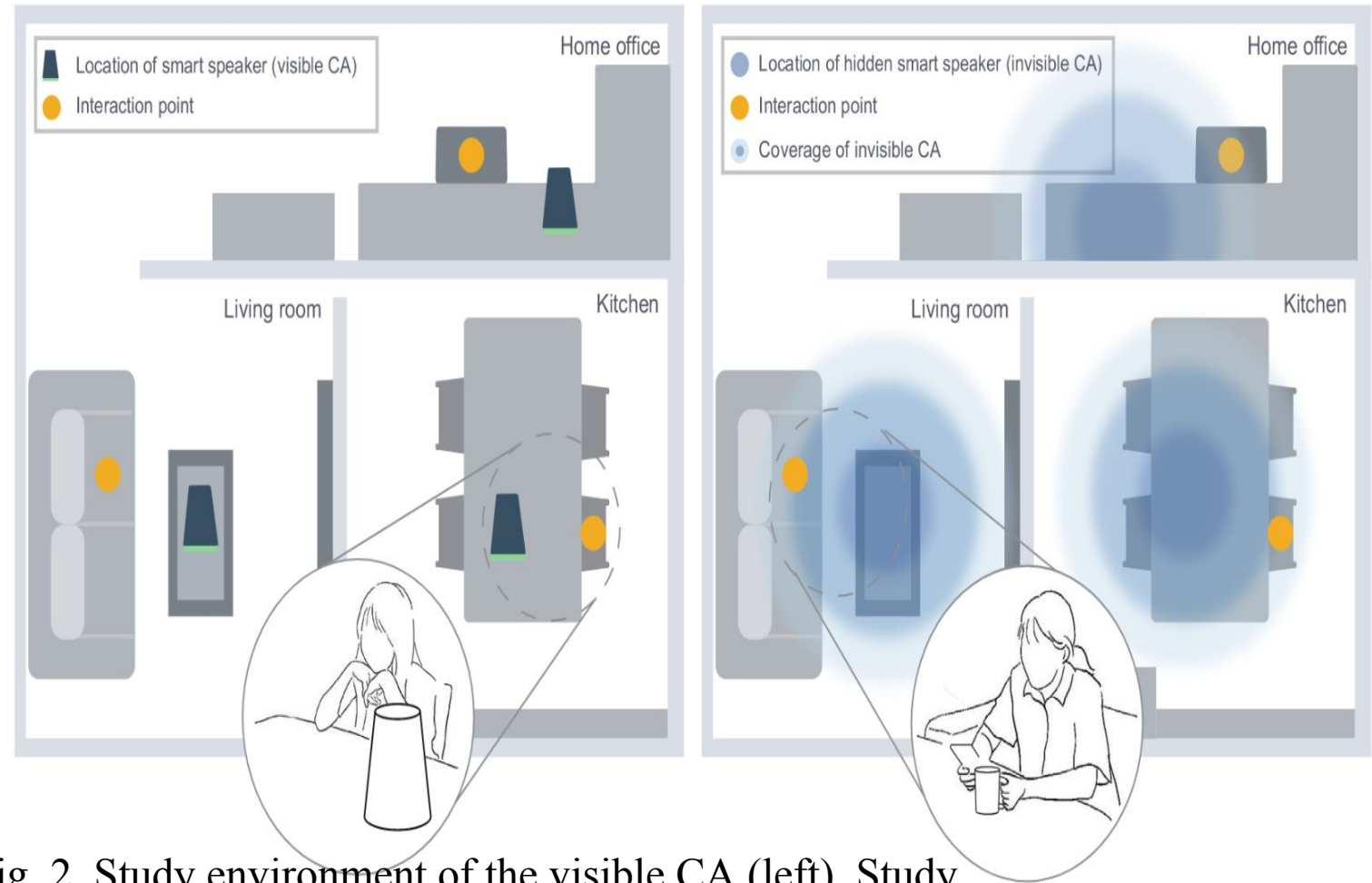


Fig. 2. Study environment of the visible CA (left). Study environment of the invisible CA (right).

Interaction Tasks

- The study consisted of four sessions:
- 5-minute tutorial
- 30-min interaction
- 40-minute drawing,
- Debriefing interview

Catergory of instruction	Command examples
Music/Audio	"Play a song that suits on a rainy day" / "Read a book"
Daily information	"How's the weather today?" / "Tell me today's news"
Shopping / Delivery	"Please order paper towel" / "Please deliver pizza"
Schedule management	"Wake me up at 7 in the morning every day" / "Tell me about today's schedule of mine"
Search	"Give me your US country code" / "How old is the earth?"
Smart home	"Turn on or off the TV" / "What is the current temperature of the air conditioner?"
Others	"Hi!" / "Sing me a song"

Table 1. Printed instruction in seven categories

Findings from Drawings – visible CA

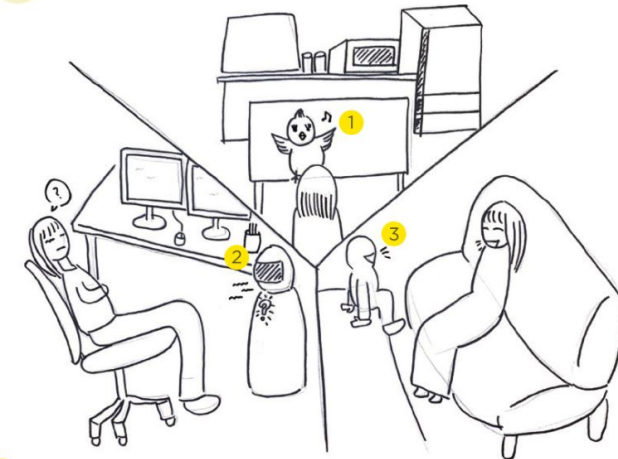
- Participants perceived that interacting with the three AI speakers
 - As talking to three individual agents
 - because even though the devices had the same form, wake-up words, and voice in the experimental setting, the users perceived each agent differently

D1 Three agents with different appearances for each space.



- 1 The triplets are wearing different clothes depends on the each role.
- 2 The triplets are connected to a box with a question mark.

D8 Three agents with different appearances for each space.



- 1 Agent in the kitchen is singing bird in the kitchen
- 2 Agent in home office is Mechanical robot
- 3 Agent in living room is a person who speaks happily

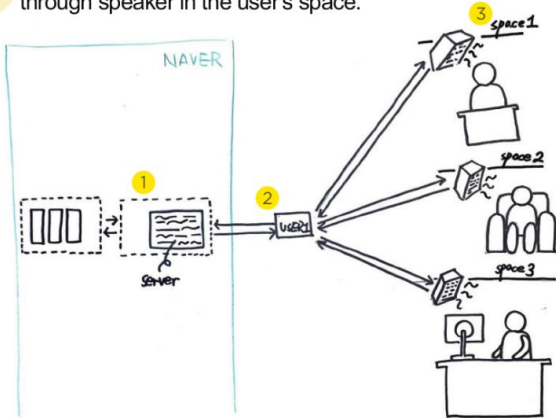
Although there are three devices of the same shape, each one seems to be different depending on where they are placed individually. (P8)

The devices were separate, so I perceived them as different beings. (P10)

Invisible CA

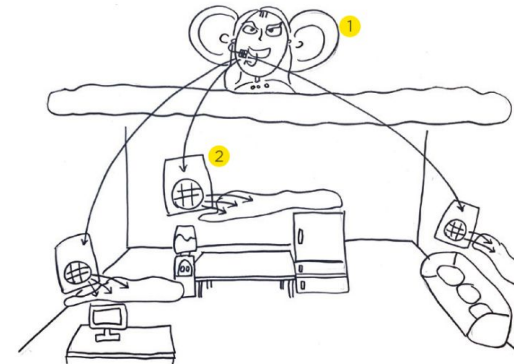
- Perception: Even though 3 diff agents as a single agent
- Drawings depicted One agent controlling the entire space.
 - Because the voice of the agent was the same everywhere
 - Device was not visible in any of the spaces
 - Focus was more on the consistency of the voice regardless of the number and location of the interactions.

D16 The agent is in the headquarter server and interacts through speaker in the user's space.



- ① Agent in the server at the headquarter.
- ② The agent interacts with the hub containing user data.
- ③ Users communicate through speakers designated for each space.

D21 Response of agent with large ears is delivered to the speaker through the microphone.



- ① Agent is beyond the ceiling of the house and has big ears to listen to the user
- ② The answer delivered through the speaker was expressed in a transparent cloud shape.

I feel like there is a single agent connected to the server in the sky. Actually, rather than having three agents, I feel like one agent can go anywhere. (P17)

I think this is one person. Because it doesn't change the tone, it doesn't change the voice, and the personality is not different (....) The reason I drew the big ears is because I feel like she is listening to me very carefully with huge ears. (P21)

Mental Model – Visible CA

- Perceived three agents that each play a role with own expertise depending on the space
- Smart agents in the home office and as more active and bright agents in the living room.
- Users' perceptions of individual agents for each device were naturally connected to different personas, roles, or functionalities
- Negative impressions of interacting with multiple agents.
- If environment were a real home
 - a mental load would be required to talk to several agents in their private spaces.
 - Interaction was similar to communicating with people
 - where more effort is required to get to know several people than it is to know one person.

I feel like I have to try to get to know this [agent] through conversation, but if there are several of them, it is a huge burden that I have to try to get to know three or four people. (P8)

Even if different agents communicate with each other through something like a hub, it's likely to be creepy or less reliable because I'm afraid that these agents will communicate my private information that I don't want to share with other people.

Mental Model – Invisible CA

- Only one agent
 - No change in tone/voice
 - User's location of communication irrelevant
- Could detect a user's behavior and status
 - without space limitations
 - Expected the agent to provide the most appropriate information based on its awareness of the user's context
- Some Users took personalized responses from agents for granted.
 - Contrary to the mental model for the visible agent, where participants were concerned that their conversation records were shared with agents in other spaces.

On the sofa, when I said to the agent, “I was having a hard time today,” and then when I moved and sat at the desk and asked it to play music, the agent said, “I’ll play music that feels good.” That is so touching even though it was a brief moment, I felt like I was emotionally interacting with this agent. (P28)

This [agent] knows all of the things I do, but I don’t want my information to be shared with the next-door neighbor or headquarters like Google. Then, I will never believe this agent and will never use it

Interaction Styles

Visible CA

- Direct – eye contact
 - Device installation location
- Visual Cue – LED
 - Start of device , ready to listen
 - Learnability Increased
 - User knew when to speak
 - Discoverability of the Voice UI

Invisible CA

- ambient interaction without space constraints
- No physical presence
 - Only auditory cues
 - Less affordances
 - Initial interaction issues
- Did other tasks while communicating with agent – Talk and listen anywhere

I felt comfortable because I had someone to talk to. (P9)

This form makes me feel like I'm having a conversation with someone. If this disappears, it would be awkward because I would be talking to nothing, which would definitely not be a natural conversation (P10).

When the light comes on, I can see that the agent is listening to me, and if there is no visual feedback, I wouldn't be really sure. (P8)

Ambient Interaction

- Invisible agent has the advantage of
 - enabling parallel task execution,
 - because in the case of an agent without a device, it is not necessary to look at it, so subtasks can be carried out while the user continues to do his or her previous or main work.

When I can see it, I have to consciously stare and talk, and keep checking to see if the agent is listening to me or not, and I guess this will interfere with usability. But, if I don't need to see the agent, then I can do two things at the same time.

I felt uncomfortable and a sense of cognitive discrepancy with talking to an invisible agent because there's a sound, and something is coming from somewhere, but there is nothing—just empty space. (P21)

This is uncomfortable because Siri lights up but this one does not. I have no idea how loud I should speak and where to speak. If this is visible, I can know how I should talk to the agent, but I don't know where it is... (Is it under there or up there?) I don't know how loud I should speak. (P16)

Conclusions

- the physical entity's visibility influenced
 - the mental model of the user,
 - Played an important role in the User Experience.
- ambient interaction naturally connected to a user's perception
- expectation was
 - Interaction could be with personalized agents everywhere,
 - Similar to the goal of ambient intelligence
 - Example: JARVIS

