Time and convenience in smart home products. An inevitable relationship?

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ABSTRACT
Smart home products are marketed to increase convenience and save time and energy. The study of Strengers and Nicholls reflects on the Australian industry vision and shows that smart home products have unintentional side effects on our life, such as increasing the pace of everyday living. In this paper, we will elaborate on these side effects and the convenience of smart home products in the context of future everyday life.

There is an inevitable relationship between time and convenience. Time is essential when it comes to designing convenient smart home products. These smart home products succeed to save us time, but do increase our pace at the same time. This study showed that people won't wait until a product is done fulfilling its task if this waiting time can be used effectively otherwise.

This means that smart home products will most likely not be able to reverse the unintentional effect of the increased pace of everyday living. Only if people change their planning and use of time, designers might be able to design products that are not necessarily faster but do increase convenience in some way.

Authors Keywords
smart home products; time; convenience; future everyday life.

INTRODUCTION

Smart home products are marketed to increase convenience and save time and energy. Strengers and Nicholls's study reflects on the Australian industry vision and shows that smart home products have unintentional side effects that affect our everyday life. They argue that histories of convenience reveal at least three reasons to be cautious with this vision [9].

First, because convenience is a constantly changing concept, smart home products failed to produce either linearity or stability. For example, modern household conveniences have made life easier and more complicated at the same time as they become entrenched in everyday life. Many of these household conveniences have lost their convenient status in societies as they either become the norm, or because the sum of multiple smart home devices creates complex and difficult to moderate systems. Convenience is therefore an elusive goal that is forever changing in relation to the devices intended to achieve it and the context they are used in.

Second, convenience ambitions and predictions actually turn out to be different in practice, and in some accounts even backfire. For example, the introduction of labour-saving devices failed to relieve women from the time-consuming burden of household chores. An iron is a prime illustration of this as it, at the time of the invention, did save women hours of time, while the act of ironing is considered very time-consuming at the present time. Cowan [1] uses this example to show that these domestic technologies actually raised expectations of cleanliness, thus increasing household labour.

Third, smart home products are intended or at least marketed as devices that save time. However, in reality, they result in an increased pace of everyday living and people feeling more harried and time pressured. Smart home products free up time, ironically resulting in the multiplication of household practices as they leave people feeling pressured to squeeze more tasks into the saved time.

In our paper, we will elaborate on these unintentional side effects and the convenience of smart home products in the context of future everyday life. If we refer to convenience, we mean "the state of being able to proceed with something without difficulty" [4]. The goal of this paper is to find the relationship between convenience and time in smart home products in order to better understand how these products can be designed to influence the pace of our future everyday living.

This will be done by formulating questions intended to gain insights for the future and by sketching a potential future scenario. We developed a research artefact that has been deployed within multiple households in order to provide a thought provoking experience and start a discussion about future everyday life. The insights of the user test were used to pose a bold statement intended to push designers to think about the impact their designs have on society.

RESEARCH QUESTION AND WHAT-IF QUESTION

A significant part of this study was spent phrasing a thought provoking research question that helps designers create products that suit the society of the future. In line with the research question, a what-if question and future scenario were created in order to set up a user study that provides relevant insights for designing for the future.

Strengers and Nicholls studied whether smart home devices that are marketed as products that (I) save time, (II) increase convenience and (III) reduce energy consumption, actually make up to their promises [9]. They concluded that labour saving devices seem to raise expectations and standards of society, which results in a higher workload and increased pace in everyday life.

"*Ironically, convenience devices have freed and can continue to free up time so that people can become busier. [9]*"

Iteration process

At first glance we looked into how smart home devices could be used to influence routines without increasing effort and standards of society, which result in an increased workload. A universal example is the remote control. As more features are put into televisions to increase convenience, we are adding more and more buttons to the remote which deteriorates learnability and user experience. [5] So what if smart devices did not simply automate everything for us, but could execute routines based on specific user intentions or moods? In an effort of trying to overcome this problem we found ourselves looking into solutions rather than finding the rational behind the problem.

In another attempt to formulate a research and what-if question, we started from a brainstorm session with the following result: 'What if smart devices actually stimulated users to save energy rather than just promoting it and doing the contrary?' This question focuses on the unintentional side effects of smart home products but again, was more about finding alternative solutions rather than raising an important question that would be beneficial to society when answered.

Since a gap was observed between the intentions of smart home products and their actual results, another question was formulated: 'Why do the actual effects of smart home products not match with the intended goals?' By exploring this question we could help designers make realistic promises to their customers. The corresponding what-if question was: What if the intended goal of smart home products is to increase the user's pace of future everyday living? As increasing the pace of everyday life even further is not an objective of ours, we changed the formulation to something more broad and open; How can/will smart home devices influence the pace of future everyday living? So; What if smart home devices are deliberately designed to influence the pace of future everyday living?

Final research question and what-if question

After going back and forth between different research questions and what-if questions as can be seen in appendix 3, we landed on the idea of temporality and its link to convenience. The research question that was concluded did not seek to improve life or devices, but is instead focused on questioning convenience. Raising convenience is the main objective of smart home products, but what is the role of time here? Why is it that smart home products are having unintentional side effects like influencing the pace of our everyday life and should this be changed?

If someone talks about a device that is convenient, they may say things like: 'it works in an instant without effort'. Two key elements of such a statement are instant, which relates to time and effort which relates to the energy the person has to put in. Thus, our final research question is: "What is the relationship between convenience and time in the context of smart home products?" This research question will be answered by deploying a research artefact in a user test. This artefact looks into the future by the question: "What if time was taken out of the equation regarding the convenience of smart home products?"

FUTURE SCENARIO

Based on our interpretations of the core paper and further literature research, a scenario was sketched out to imagine a potential future world to which this study could contribute. We believe there will be two movements in the future, which are both part of the same scenario. The first movement evolves around speeding up everyday life. Technologies to increase speed and efficiency are the standard in this lifestyle. The second movement will form in the near future and evolve around the phenomenon of slow living [8], which is a lifestyle that is focussed on slowing down aspects of everyday life.

As can be seen in current everyday life, society is speeding up [10]. Our economy is based on tools, products and services that help us save time which we tend to fill in with other tasks to raise productivity, resulting in an increased pace of everyday living. [9] On the other hand, a growing interest in the slow movement is appearing amongst people that want to consciously steer away from the previously described fast life [10]. These people are willing to adjust their lives to be less rushed and packed with things to do, in order to create a more calm and tranquil lifestyle.

This new occurrence of returning to slow movement can be linked to the theory of the uncanny valley [6]. The uncanny valley theory describes the increase or rise of realism in technology, specifically robots, which then drops or in other words, decreases into a valley, meaning that the previously created effect is reversed. A visual representation of the uncanny valley process as described by Masahiro Mori can be seen in figure 1. Although the theory of uncanny valley is based on realism in robots, it is applicable to a wide variety of situations, technologies and innovations. Think of fashion trends coming back, video game graphics returning to fiction and digital design becoming more simple. What if the same applies to smart home products that up until this point, have only evolved to become smarter and more complex?

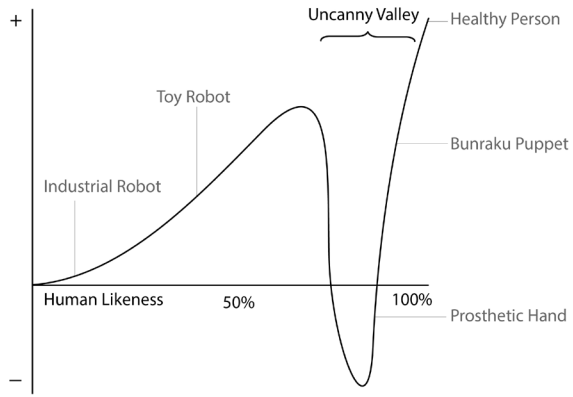

Figure 1: Uncanny Valley

RESEARCH ARTEFACT

This research is based on a physical prototype because we as designers, value physical products that offer a real experience, rather than having them imagined via a future-vision scenario. Wakkary argues that the notion of a prototype may not be fully sufficient to investigate complex matters of human relationships with technology in the context of everyday life. Therefore, he proposes research artefacts as an extension to support inquiries within this research area [7]. In order to create such research artefacts, the four qualities as stated by Wakkery are used as criteria while designing and developing the artefact;

Inquiry driven

TIMCON is explicitly designed to drive a research inquiry. The research artefact is not meant as a solution but a tool to ask questions as part of the study. In this case, the artefact is deployed within five different households for multiple days to explore the following what-if question; What if time was taken out of the equation regarding the convenience of smart home products?

Finish

TIMCON is designed with a high-quality finish and detail to make sure that the nature of engagement for the participants is predicated on what it is and feels like a real product. All the electronics are integrated in the product base and are, because of an external DC connector, not visible. This provides the look and feel of a finished product, rather than a prototype.

Fit

TIMCON is designed to be entrenched within the current household of the participants. It's clean and abstract appearance combined with its size, makes it fit into every modern household without standing out. Because the artefact requires power, it's literally connected to the household, just as all the other power-consuming devices.

Independent

TIMCON is designed such that after a short setup, it is able to operate independently in a participants' household for multiple days. The artefact only requires a 12V power socket and available space for the included lamp. During the deployment, the Arduino is constantly monitoring whether the master- or random card(s) are being used including the number of failed or correct tries.

Concept of the artefact

The research artefact is designed to allow the participants to choose between time and convenience. There should be a very clear distinction between the two to allow users to form an opinion and vision about the relationship between time and convenience. TIMCON is a research artefact that participants use to control a lamp that is indispensable for a space.

TIMCON makes use of six RFID cards that represent either time or convenience, allowing users to choose between the two. One of the cards is always defined as the mastercard which stands for low effort, and always turns on the light with a delay of 35 seconds. When the mastercard is used, one LED at a time lights up giving the impression of a loading status bar, indicating the time that the participant has to wait before the lamp turns on or off. This mastercard is partially blue, and therefore aesthetically different from the random cards.

The other five cards are defined as the random cards that turn on the light immediately but require more effort since it is unclear which of the five cards will actually trigger the light. If the incorrect random card is used, the light will blink red, providing the participant with feedback that another random card should be tried to turn on the light.

Development

After looking for inspiration and executing various brainstorm sessions, the first ideas were translated into a 3D model and simple render to communicate the look and feel of the potential research artefact. This model was redesigned to improve the finish and fit qualities of a research artefact and fit all the required electronics. Part of this redesign was the use of RFID-cards instead of simple buttons to match the finish criteria.

The redesigned model was eventually 3D printed. Initially, the plan was to sand the prototype and then spray paint it to give a realistic 'final product' look and feel with a high-quality finish. However, the 3D print turned out to be flawless and already matched the finish criteria. Therefore, the decision had been made to not modify the aesthetics any further and start with the technical realization.

Technical realization

The inside of the artefact consists of three main components. The first component is an MFRC522 RFID reader, placed right under the grid. The second component is the power connector. This DC connector splits the current to power the LED strip and the Arduino. From the outside, this connector has a solid look that contributes to the finish criteria. The third component is the heart of the artefact. This is the Arduino Nano which connects the power, the separate LED strip and the RFID scanner. The Arduino is running a randomized algorithm that selects only one of the random cards to act as the light switch. It also recognises the mastercard that triggers the light with a delay of 35 seconds.

The challenge in coding the Arduino rests in storing basic data about the number of cards scanned. This needs to happen in the flash memory, without losing the data if the Arduino is powered off. This is accomplished through hardcoding new permanent memory slots in the source of the Arduino.

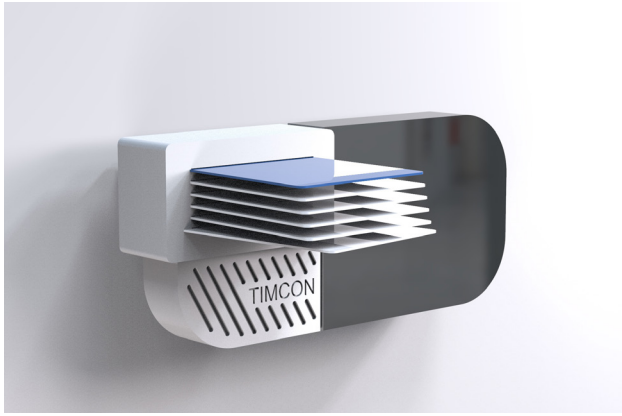

Figure 2: Render exploration of TIMCON

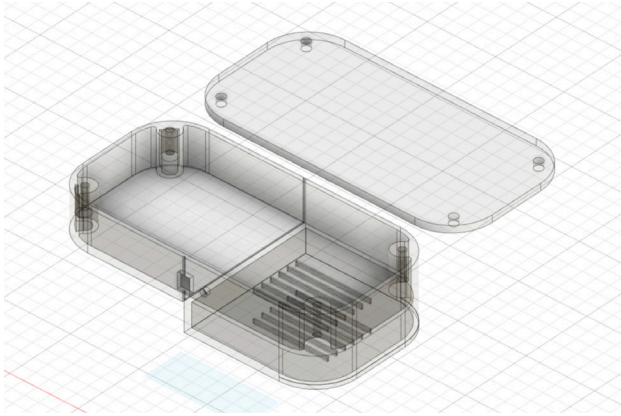

Figure 3: 3D printing model

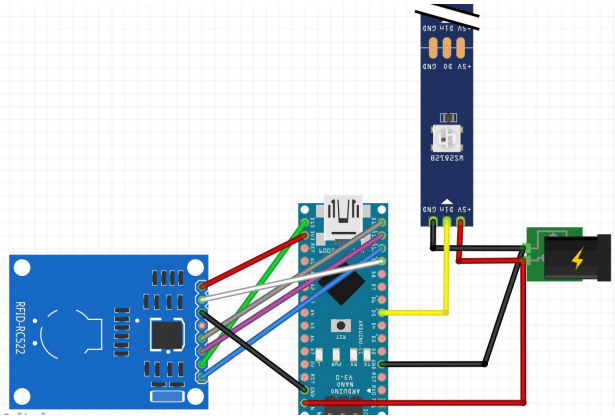

Figure 4: Schematic electric circuit

USER STUDY

Methodology

In order to explore the research question, the artefact was deployed within five different households that each used the artefact for multiple days. Participants were selected based on convenience sampling, with the only requirement that one person of the household would use the artefact. As mentioned before, the artefact gave participants the option to choose between a convenient, easy option or a quick, but more effortful option. The first of which represented by the mastercard, the latter of which represented by the set of random cards. Topics of interest were (I) the preference of participants, (II) if this preference varied over time or in different situations, (III) their experience and thoughts regarding time and convenience after using the artefact.

Participants were introduced to the study by the researcher(s) by explaining what was expected of them and how the artefact works, after which the participants were asked to fill in the consent form. Introducing questions about the participants were asked to gain insights on demographics and the expectations regarding the study and results.

After the introduction, the participants used the artefact for multiple (1-3) days, in the absence of the researcher. After the deployment, an semi-structured evaluation interview with the participants was conducted. The entire protocol including procedure, script and interview questions are available in appendix 1.

In order to conduct responsible and ethical research, multiple things were taken into account. To be certain the artefact was safe to use, the /d.search/Rapid prototyping lab of the TU/e performed a safety check. To discover any possible flaws, defects or issues with the artefact, a pilot test was conducted. The artefact was placed in one of the researcher's home for two days, resulting in no difficulties or problems. The artefact was cleaned before being transferred to a new household because of the current global pandemic COVID-19.

Concerning the participants, no personal information that can be related back to them was collected. They will also not be in any harmful, deceiving or burdensome situations. A full ethical review form based on the standards of the TU/e [2] is available in appendix 2.

Figure 5: Deployment image user test

Results

Actively making a choice

Our study shows that the research artefact forced participants to make conscious decisions between the mastercard or the random cards during the user study, which made them experience the difference between time and convenience. Though the participants didn't state that they felt like they were making a choice between time and convenience, they were just choosing between the different types of cards and the time it took to turn on the lamp.

P3 "*I usually picked the random cards, but when I needed to style my hair or put in my lenses I used the mastercard. So if I needed the mirror, I picked the mastercard. I think this was based on how much time I needed to spend in the bathroom.*"

Prefer using the mastercard

Participants who indicated that they prefer to use the mastercard after experiencing the artefact, did mention they would use their 'extra' time efficiently by doing something else while waiting. Though there are other reasons for preferring to use the mastercard, such as not feeling the need to actively interact with the artefact when focussing on other tasks or not minding if the light takes longer to turn off when leaving.

P1 "*When I'm used to waiting for the specific product or I have something efficient to do in the meantime, I don't mind using the mastercard.*"

P2 "*I said to you in the introduction that I wasn't going to use the Mastercard but I did. I actually used that one the most which I didn't expect. I often didn't have the time or I didn't feel like using the random cards.*"

P3 "*If the activity takes a longer amount of time, the 35 seconds did not really matter anymore. Also when turning the lights off the mastercard got used more often.*"

Prefer using the random cards

Participants who indicate that they prefer using the random cards after experiencing the artefact, argue that the time they will save is of significant importance to them that they don't mind putting in extra effort. Within this group there still are differences for turning off the light, since some feel the random cards cost them more time in this case.

P1 "*If I would have all my attention to the actual product, I would use the random cards.*"

P3 "*I was often lucky, turning the lights on after the first or second card. That motivated me to keep using the random cards.*"

P5 "*In my opinion, the function with the mastercard took too long, and therefore my preference for turning on the lights was with the random cards. For turning off the lights, my preference was for the mastercard because it doesn't matter and you can just walk away.*"

Expectations versus actual behavior

In the introduction interview that was conducted before the deployment, researchers asked participants for their initial thoughts on preferences. Most participants expected to prefer the mastercard (N=4) whereas one participant expected to prefer the random cards. After deployment, two participants had the same preference while three participants turned out to use the other option more in reality.

P2 "*I will most definitely choose time. But that is my first impression. That the master card would take too much time.*"

P3 "*I expected to always turn off the lights with the mastercard, but it felt like a waste of energy to leave the lights on for 35 seconds. I assume that the device will work, but I caught myself waiting to see if the lights actually turned off after the mastercard.*"

Different use cases

The artefact was used to make participants experience the effect of the artefact and help them imagine different use cases in varying contexts. This way, researchers could discuss these multiple contexts in the interview in order to draw conclusions that would also be interesting in situations other than with a lamp. By making people experience the phenomenon, they could imagine their reaction to the other use cases better.

From the research can be concluded that the choices of participants for the random card or mastercard in different contexts might align, while their reasons to pick one or the other might differ.

P2 "*It depended on time. If I am in a hurry I will use the random cards. Otherwise I would use the mastercard. However, sometimes using the random cards also took quite some time.*"

Side effects

Participants slightly changed routines for activities around the artefact. They made positive use of the fact that turning the lamp off with the mastercard took 35 seconds, giving them time to leave the room or conducting a small activity within this time.

P5 "*For turning off the lights it was actually nice because you only have to do one action and you have some time left to leave the room before the lights turn off.*"

P4 "*When more devices would make use of the same system, this would then definitely change my routines.*"

P1 "*If I would have all my attention to the actual product, I would use the random cards. However, when you for instance burn your hand and you want to cool it on the water tap, you want it to turn on immediately. Therefore I think that safety is also an important thing to keep in mind.*"

DISCUSSION

The presented results show that people are mostly okay with a delay, as long as it doesn't cause too much friction or unsafe situations. Being able to fill in the 'waiting' time with other tasks is essential so that the time is not wasted but used efficiently. If waiting time can't be compensated, people would put in more effort to save time and make a product work instantly.

If the device is not part of the main activity, a delay is acceptable. If the device is part of the main activity, the reaction is preferred to be fast. If people are already used to a product having a delay, like an oven that needs preheating, waiting is factored in when using the product and thus feels less like a burden.

The most important finding of this study is that context is essential to the opinions of users, thus insights that the research provides. The choices of participants depend on the (I) surrounding, (II) time, (III) mood, (IV) activity and/ or (V) the attention that is dedicated to the activity. Further research into these different factors is needed to draw good conclusions on people's behaviour and opinions, that apply to different scenarios.

In summary, we can conclude that smart home products indeed increase the pace of everyday life since people tend to fill in all of their time effectively. Secondly, context is essential to the results of this study, meaning that opportunities for further research lie within this area.

CONCLUSION

"*What is the relationship between convenience and time in the context of smart home products?*"

From our research can be concluded that there is an inevitable relationship between time and convenience. Time is essential when it comes to designing convenient labour-saving devices or smart home products while being convenient means 'in less steps or with less effort'. For example: A product has to either work immediately, or people will fill in the 'waiting' time to be effective. However, a convenient product doesn't have to bring 'waiting time' to zero. It should just be faster than alternatives.

It is important to note that this statement solely applies to the link between time and convenience and doesn't apply to for instance comfort, quality or aesthetics. Naming products that don't save time but do increase convenience is nearly impossible, while giving examples of products that raise quality or comfort with the same condition can be done. Think of a shower and a bath. A shower is more convenient as it is faster, while taking a bath is more comfortable, but also takes more time. This shows that time lies within the core of the definition of convenience, meaning it can't be taken out of the equation when designing convenient products. However, there is a fine line between comfort and convenience which are often intertwined within smart home products.

Smart home products are meant to save us time and will do exactly that, but the time saved will not be used to slow down our pace. This study showed that if a product has a delay in some way, people won't wait until the product is done fulfilling its task. They will fill in this otherwise lost waiting time with other things to do to make the most out of their time and use this effectively.

This means that smart home products will most likely not be able to reverse the unintentional effect of the increased pace of everyday living that has been caused up until now. This will have to come from people themselves and their planning and use of time. Only then, designers might be able to design successful products that are not necessarily faster but do increase convenience in some way.

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APPENDICES

1. Protocol and consent form

2. Ethical review board form

3. Timeline

Research question
What is the relationship between convenience and time in the context of smart home products?

Sub questions
1. Will participants choose speed or convenience?
    a. Does this vary over time or in different situations?
2. What do participants think regarding time and convenience after using the artefact?
3. How did participants experience the deployment session?
4. How would participants expect their experience to be in a different context?

Method
The artefact will be deployed in different households. It will be in every household for two full days after which it will be moved to the next participant. The participant will be introduced to the study by the researcher. The researcher will tell the participant what is expected of him and how the artefact works, after which the participant will be asked to fill in the consent form. He or she will also be asked some introducing questions about the participant him or herself and about the expectations regarding the study and results.

After the introduction, the participant will use the artefact for two days, in the absence of the researcher. After the deployment, there will be an evaluation interview with the participant. The entire procedure will follow the script as described below.

Equipment
- Pen/ paper or a laptop to take notes
- Smartphone to record the interview
- Smartphone or camera to take pictures of the artifact setup.
- Consent forms

Procedure / Logistics
Step 1: Recruit participants and schedule the usertest
Step 2: Explain the research to the participant
Step 3: Get consent and approval for the user testing.
Step 4: Clean the artifact due to Covid-19 standards.
Step 5: Install the artifact in the bathroom/toilet.
Step 6: Leave the artifact for two full days.
Step 7: Retrieve the artifact and the data stored within the artifact.
Step 8: Interview the participant
Step 9: Clean the artifact due to Covid-19 standards.

Target group and scope
Participants are selected based on convenience sampling. There is no age criteria but living alone is a condition that must be met. Preferably an apartment/studio with 1 bathroom/toilet.

Script

Introduction before deployment

Hi, we are ID students of the University of Eindhoven and are currently working on the course Researching the Future Everyday. Therefore we are conducting research regarding smart home products. More specific the relationship between convenience and time. In order to research this we designed and created an artefact that will be your light in the bathroom for the following two days. In order to turn on or off the lights you have two choices, the first is the master card. Recognizable by the blue tape, the master card will activate the light very conveniently, but with a delay of 35 seconds. If you would like a faster option you can opt for the random cards. There are five random cards and as the name says a randomly selected card of this set will actually turn on the lights. Instantly. Only one of the five cards will work, so the other cards will give you a short red light to indicate that you have to choose a different random card.

There is no right or wrong during this research, you are unable to make mistakes. It also does not matter which of the two you choose. It is all up to you. And again, you can stop the research at any given moment if you are not comfortable continuing.
Is everything clear, or are there any questions left?

Consent form

Questions before deployment

1. Can you shortly introduce yourself?
2. How do you expect the product to work?
3. Which option do you expect to use the most? The master card or the random cards? Why?

Questions after deployment

1. What are the first thoughts you want to share?
2. Did you feel like you were making a choice between time and convenience? If so, how did you experience this?
3. Which option did you use most (the mastercard or the random cards?) and why?
4. Did you choose the other option sometimes? If so, in what cases did you go for the less used option?
5. In which situations did you pick the mastercard? (and vice versa)
6. Do you think the artefact was influencing your thoughts or behaviour? If so, how?
7. When will your current opinion or behaviour change?

Scenarios (different context and product)

1. Imagine your vacuum to work with this system. You can only turn the device on or off with the cards.
    - Would you use the mastercard or the random cards?
    - What is different as opposed to the situation you tested with the lamp?
2. Imagine your tv, radio or game-console to work with this system. You can only turn the device on or off with the cards.
    - Would you use the mastercard or the random cards?
    - What is different as opposed to the situation you tested with the lamp?

3. Imagine your water tap to work with this system. You can only turn the device on or off with the cards.
    - Would you use the mastercard or the random cards?
    - What is different as opposed to the situation you tested with the lamp?
4. Imagine your stove to work with this system. You can only turn the device on or off with the cards.
    - Would you use the mastercard or the random cards?
    - What is different as opposed to the situation you tested with the lamp?
5. Imagine your shower to work with this system. You can only turn the device on or off with the cards.
    - Would you use the mastercard or the random cards?
    - What is different as opposed to the situation you tested with the lamp?
6. Imagine your door lock to work with this system. You can only lock or unlock your door with the cards.
    - Would you use the mastercard or the random cards?
    - What is different as opposed to the situation you tested with the lamp?

7. Are there any situations that might change your opinion or behaviour drastically? Why?
8. Imagine every device working like this in ten years. What do you think?
9. Imagine every device working very fast in ten years. What do you think?
10. Imagine every device working slower in ten years. What do you think?

Closing questions

1. Is there anything else you would like to mention or discuss?
2. What are your thoughts on the research itself?

Data analysis

Appendix

Subject Consent Form
Project: TIMCON

Dear Sir/ Madam,

You are asked to take part in a scientific study. Participation is voluntary. Participation requires your written consent. Before you decide whether you want to participate in this study, you will be given an explanation about what the study involves. Please read this information carefully and ask the investigator for an explanation if you have any questions. You may also discuss it with your partner, friends or family

1. General information

This study is designed and carried out by the researchers Anika Kok, Niels van Gils, Sander Pouw, and Remco Levenbach. The researchers are currently Industrial Design students, working on the course Researching the Future Everyday.

2. Purpose of the study

The main purpose of the study is to find out the relationship between convenience and time in the context of smart home products. Secondly it is to discover how users would react to the choice time or convenience?

3. What participation involves

During the study, the following will happen;
- Interaction with the artifact will be stored within the artifact
- A semi-structured interview will be held
- The interview will de audio recorded
- Data is collected in the form of notes.

4. What is expected of you

In order to carry out the study it is required that you use the artifact whenever you turn on or off the lights within that room. During the interview it is required that you answer honestly and let the researchers know if there is anything that makes you uncomfortable. The study can be stopped at anytime.

5. If you do not want to participate or you want to stop participating in the study

It is up to you to decide whether or not to participate in the study. Participation is voluntary. If you do participate in the study, you can always change your mind and decide to stop, at any time during the study. You do not have to say why you are stopping, but you do need to tell the researcher immediately. The data collected during that time will not be used for the study.

6. End of the study

Your participation in the study stops when

- You choose to stop
- The end of the study has been reached (all questions asked and two days of testing are over.)
- The investigator considers it best for you to stop

7. Usage and storage of your data

The collection of personal data is not a part of the data gathered for research purposes. Before the interview your name and email address are collected in order to contact you. However, this contact information will not be stored anywhere, directly deleted after the interview and always kept separate from the interview pseudonym.

Confidentiality of your data

To protect your privacy, your data will be given a code. Your name and other information that can directly identify you, will be omitted. The data that is stated in the research paper will only contain the code, not your name or other data with which you can be identified. The data cannot be traced back to you in reports and publications about the study.

Access to your data for verification

The data is stored locally in a password protected environment which only the researchers can access.

Retention period of your data

Your data must be kept for 5 years.

Withdrawing consent

You can withdraw your consent to the use of your personal data at any time. This applies to this study and also to the storage of data. The study will collect data until the moment you withdraw your consent will still be used in the study.

8. Any questions?

If you have any questions, please contact one of the researchers. If you have any complaints about the study, you can discuss this with the researcher as well.

Researcher: Remco Levenbach
Email address: r.f.levenbach@student.tue.nl

Researcher: Niels van Gils
Email address: n.h.t.v.gils@student.tue.nl

Researcher: Anika Kok
Email address: a.k.kok@student.tue.nl

Researcher: Sander Pouw
Email address: s.j.pouw@student.tue.nl

9. Signing the consent form

When you have had sufficient time for reflection, you will be asked to decide on participation in this study. If you give permission, we will ask you to confirm this in writing on the consent form (below). By your written permission you indicate that you have understood the information and consent to participation in the study. The signature sheet is kept by the researcher. Both the researcher and yourself receive a signed version of this consent form.

Thank you for your attention.

Subject Consent Form Research

Title: **TIMCON**

I have read the subject information form. I was also able to ask questions. My questions have been answered to my satisfaction. I had enough time to decide whether to participate. I know that participation is voluntary. I know that I may decide at any time not to participate after all or to withdraw from the study. I do not need to give a reason for this. I give permission for the collection of my data to answer the research question in this study. I want to participate in this study.

I want to participate in this study.

Name of study subject:

Signature: Date: __ / __ / __

I hereby declare that I have fully informed this study subject about this study.

If information comes to light during the course of the study that could affect the study subject's consent, I will inform him/her of this in a timely fashion.

Name of investigator (or his/her representative):

Signature: Date:__ / __ / __

Ethical Review Form

(Version 27.06.2019)

This Ethical Review Form should be completed for every research study that involves human participants or personally identifiable data and should be submitted before potential participants are approached to take part in the research study.

Part 1: General Study Information

1	Project title and project number	TIMCON Course: DCM170
2	Researcher name and email	Niels van Gils n.h.t.v.gils@student.tue.nl Remco Levenbach r.f.levenbach@student.tue.nl Sander Pouw s.j.pouw@student.tue.nl Anika Kok a.k.kok@student.tue.nl
3	Supervisor(s)	Lenneke Kuijer s.c.kuijer@tue.nl Ron Wakkary r.l.wakkary@tue.nl
4	Faculty/department	Industrial Design
5	Research location	The participants personal living space
6	Research period (start/end date)	28-05-2020 / 25-06-2020
7	Funding agency	N/A
8	[If Applicable] Study is part of an educational course with code:	DCM170 Researching the Future Everyday
9	[If Applicable] Proposal already approved by external Ethical Review Board: Add name, date of approval, and contact details of the ERB	N/A
10	Short description of the research question	What is the relationship between convenience and time in the context of smart home products?
11	Description of the research method	Mixed method: sensor data, diary study, in-depth interview
12	Description of the research population, exclusion criteria	We will select participants based on convenience sampling from the researchers network. Participants should be 18 years or older and live individually.
13	Description of the measurements and/or stimuli/ treatments	Participants will use the research artefact as a product in their daily life. This product will substitute the current product that is used by the participant. We will measure the use of the product by sensors in three categories. The number the wildcard is used, the number a random card got a false and the correct response.
14	Number of participants	6

Ethical Review Form

15	Explain why the research is socially important. What benefits and harm to society may result from the study?	The research findings could help improve the design of smart home products in the future. There are no expected harmful situations to occur as a result of this study.
16	Describe the way participants will be recruited	Convenience sampling, the participants get a requiring message from the researcher that they know. If they accept they will receive the informed consent form and have time to think about if they want to participate. If they agree, the consent form is signed and a moment for the placement of the artefact is determined.
17	Provide a brief statement of the risks you expect for the participants or others involved in the research or educational activity and explain. Take into consideration any personal data you may gather and privacy issues.	Data not treated properly. (e.g. publicly saved)

Part 2: Checklist for Minimal Risk

		Yes	No
1	Does the study involve participants who are particularly vulnerable or unable to give informed consent? (e.g. children, people with learning difficulties, patients, people receiving counselling, people living in care or nursing homes, people recruited through self-help groups)		X
2	Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator (such as own children or own students)?		X
3	Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g. covert observation of people in non-public places)		X
4	Will the study involve actively deceiving the participants? (e.g. will participants be deliberately falsely informed, will information be withheld from them or will they be misled in such a way that they are likely to object or show unease when debriefed about the study)		X
5	Will the study involve discussion or collection of personal data? (e.g. name, address, phone number, email address, IP address, BSN number, location data) or will the study collect and store videos, pictures, or other identifiable data of human subjects?. Please check the FAQ's on the intranet. If yes: please follow the procedure. Make sure you perform a Data Protection Impact Assessment (DPIA) and make a Data Management Plan if necessary and let the data steward check it. Please attach these documents with this form (see part 5; enclosures)		X
6	Will participants be asked to discuss or report sexual experiences, religion, alcohol or drug use, or suicidal thoughts, or other topics that are highly personal or intimate?		X
7	Will participating in the research be burdensome? (e.g. requiring participants to wear a device 24/7 for several weeks, to fill in questionnaires for hours, to travel long distances to a research location, to be interviewed multiple times)?		X

Ethical Review Form

8	May the research procedure cause harm or discomfort to the participant in any way? (e.g. causing pain or more than mild discomfort, stress, anxiety or by administering drinks, foods, drugs)		X
9	Will blood or other (bio)samples be obtained from participants (e.g. also external imaging of the body)?		X
10	Will financial inducement (other than reasonable expenses and compensation for time) be offered to participants?		X
11	Will the experiment involve the use of physical devices that are not 'CE' certified?	X	

Important:
If you answered all questions with ''no'', you can skip parts 3 - 4 and go directly to part 5. Check which documents you need to enclose and continue with signature and submission.

If you answered one or more questions with "yes", please continue with parts 3 – 5.

Part 3: Study Procedures and Sample Size Justification

1	Elaborate on all boxes answered with "yes" in part 2. Describe how you safeguard any potential risk for the research participant.	The product will be built by designers, in such a way that is safe for the users. The product is made out of elements that are CE certified and safe to use. Next to the elements the product is also approved by the ID d.search lab as 'safe to employ'.
2	Describe and justify the number of participants you need for this research or educational activity. Also justify the number of observations you need, taking into account the risks and benefits	The choice of 6 participants is a mix of the time available and a minimum of participants that are needed in order to generate conclusions.

Part 4: Data and Privacy Statement

1	Explain whether your data are completely anonymous, or if they will be de-identified (pseudonymized or anonymized) and explain how.	The data will be anonymous. We will have personal data that will be used to contact the participants. Besides that, there is no personal data needed or recorded as part of the study.
2	Who will have access to the data?	The researchers and supervisors of this project.

Ethical Review Form

3	Will you store personal information that will allow participants to be identified from their data? See VSNU draft.	☒ No ☐ Yes, and I declare I will follow the general data protection regulation (GDPR).
4	Will you share de-identified data (e.g., upon publication in a public repository)?	☐ No ☒ Yes, and I will inform participants about how their data will be shared, and ask consent to share their data. I will, to the best of my knowledge and ability, make sure the data do not contain information that can identify participants.

Part 5: Closures and Signatures		
1	Enclosures (tick if applicable): ■ Informed consent form; ☐ Informed consent form for other agencies when the research is conducted at a location (such as a school); ■ Text used for ads (to find participants); ☐ Text used for debriefings; ☐ Approval other research ethics committee; ☐ The survey the participants need to complete, or a description of other measurements; ☐ Any other information which might be relevant for decision making by ERB; ☐ Data Protection Impact Assessment checked by the privacy officer ☐ Data Management Plan checked by a data steward	
2	Signature(s) Signature(s) of researcher(s) Sander Pouw Date: 11/05/2020 Signature research supervisor (if applicable) Date:	

Start group assignment

Week 4

Analyzing the core paper

- What is the core argument of the paper
- What theoretic lens is it using to make this argument
- What everyday practices / activities / routines does it concern
- Does it speak about particular artefacts
- Does is speak specifically about the future
- What concerns or questions does it trigger about future everyday life

Feedback first ideas

- Become more inquisitive
- Try and step away from the design orientation
- What if this is not so easily corrected, what other aspects do we want to know that can help us.
- Focus on the research question and then on the what if question
- The future isn't clear in the question
- Think about interesting scenarios we have to adapt to, not specifically improve them
- Reexamine the expectations the technologies create

Artefact workshop 14-05-20

- Summary
  Time is an important factor in our artifact. We would like to measure during deployment and interview after deployment, to combine quantitative and qualitative data. This results in information on how the product is used and will also result in insights that are more reflective on the user's end.
- Research question
  Why do the actual effects of smart home products not match with the intended goals?
- What if question
  What if the intended goal of smart home products is to increase the user's pace of future everyday living?
- Possible artefacts
  Dashboard that links all products and creates routines

Choosing a core paper

- Convenience and energy consumption in the smart home of the future: Industry visions from Australia and beyond

First 'What if' questions

- What if smart devices did not simply automate everything for us, but could execute routines based on specific user moods, using several artifacts?
- What would society look like if smart home systems would help us by executing routines based on specific user moods?
- What if smart devices actually stimulated users to save energy rather than just promoting it and doing the contrary?
- What if smart devices would increase convenience without increasing effort and standards of society?
- What if people will start to re-appreciate non-digital products rather than smart home devices?
- What if smart devices could not only help us to be more efficient, but also help to relax

Week 3 brainstorm

- Possible research questions
  - How do product manufacturers need to change their strategy to ensure the use of smart home products in the future?
  - How can smart devices influence the pace of everyday living?
- Possible What if questions
  - What if smart products can take over everything we do?
  - What if productivity was not the main goal?
  - What if the environment is already saved?
  - What if smart home devices create a base standard, before they intervene in the home.
- Possible artifacts
  - Sensor that measures the number of tasks someone has to do
  - Clock that doesn't show the time but …
  - Switch that influences the way smart home products function to increase or decrease the influence on the living pace of the user

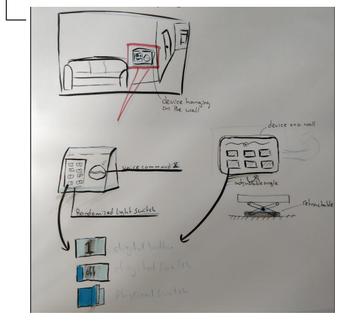
Week 4 Brainstorm

- Rethinking the research question
  - How can/will smart home devices influence the pace of future everyday living?
- Iterating the what if question
  - What if smart home devices are focused on decreasing the pace of future everyday living?
  - What if smart home devices are deliberately designed to influence/decrease/increase the pace of future everyday living?
- Placing the research in a context
  - Morning routines

Week 4

Week 6

First visualisation of a artefact



Brainstorming the artefact

Feedback week 5

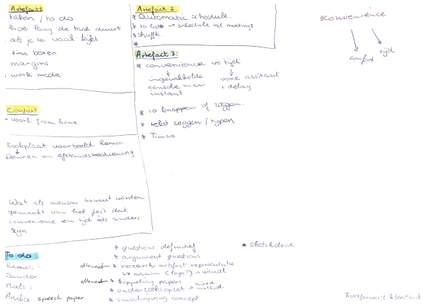
- What is the relationship between convenience, time, and energy consumption?
- Designers meet the goal of convenience but there is an unintended consequence. What if you can turn this unintended consequence to something favourable?
- Identify increased pace as a consequence of convenience
- Increase > blank in the question (don't immediately go with increase)
- What if all smart home products were all time-based? How does that affect our behaviour?
  does awareness change our behaviour? > not necessarily.
- Think of examples in the paper > how are these designed for convenience and how are they influencing for time
  Clock > time is a productivity unit > should be filled with a task
  Right direction. Awareness (think about this more)
  convenience is a time issue. People are connecting to temporarily.
  increase > blank in the question (don't immediately go with increase)
  what dimensions > what elements am I working with?

Feedback session 18-05-20

- Can/will is important but the research question is too vague
- How would you know if you answered the question and what would be the benefit of the answer.
- What was our response to the paper
  - Stay with the problem, unpack the problem
    - assumptions, intentions, the what if question will give context
  - Why is it that the goals are so off from the results?
  - What are the intentions?
  - What is driving those intentions.
  - Try to understand why or how it is a problem
- Why does the result/effect of smart home products not match with the goals of the product?
- Artefact: What if the goal is different, what would be the result?

Scoping the artefact

- Conveniece versus time.
- Disasembling pace of living
- Using a Delay for 1 to 2 minutes.
  - Alexa, Google Home, Siri?
    Keyboard > different lay-out?

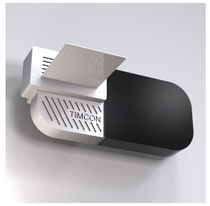


Week 5 brainstorm

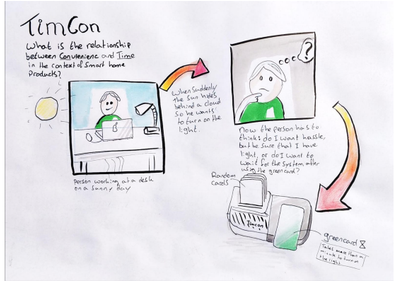
- New Research question & What if question
  - Why do the actual effects of smart home products not match with the intended goals?
  - What if smart home products are not designed to increase convenience? > convenience vs. energy efficient
- A Designer's perspective
  - Why do the actual effects of smart home products not match with the intended goals of the designer?
  - What if designers would be aware of the actual effects of the smart home products they designed (before releasing the product to the user)?
- Product's perspective
  - How can smart home products be repositioned in the market to match their actual effect rather than the desired effect?
    How will society react to a constantly increased pace of everyday living?
  - What if smart home products are deliberately designed to increase the user's pace of future everyday living?
  - What if users were more aware of the actual effect of smart home products?

Week 6 Virtual exhibition

- Final research and What if question
  - What is the relationship between convenience and time in the context of smart home products?
  - What if time was taken out of the equation regarding the convenience of smart home products?
- Completing the artefact



- Placing the artefact in a scenario



Week 6

Feedback Virtual exhibition

Lenneke:
I really like your focus and the way in which you have translated a relatively abstract question into a concrete research artefact. What I miss a little bit in your story is the link to future everyday life. in what sense is the study about the future? And what will your deployment look like?

Ron:
I like the research product - its strangeness and abstraction yet it looks very purposeful and clear about what it is about. Though what it is actually about is not so clear so that adds to it. I also like the decoupling - I think you can go further with the unpacking of time in relation to convenience. As others have suggested you may want to reconsider this to not be a light switch but something more complicated and seen as inconvenient.

Giving more of a back story to the artifact would help us imagine the future context better and see the rationale behind how this and why this might be a device in a future home.

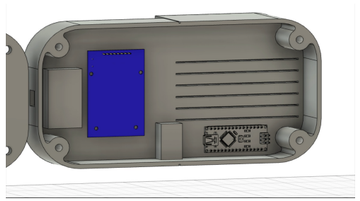
Feedback Virtual exhibition

Slava:
I like the idea behind your concept, it's an interesting and provocative proposition that helps to challenge some of our assumptions about comfort and convenience, and explore possible alternative. The design of your artefact already looks solid and professional... but here is the catch; perhaps it's a bit too complete and polished. What's more, this device is missing a broader context: who's using, how, where, when etc. With a few lines you could 'place' this interesting artefact in some sort of setting and ideally also add how we would interact with it. Your sketch shows some of that but because your design is soo good we tend to miss this contextual picture.

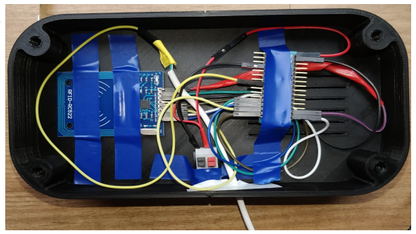
Holly:
The concept of decoupling is a nice one. I think it's a problematic assumption that we tend to have around a lot of technologies. It reminds me of some advice I got once from a fellow swimmer. Learning to make a better swim stroke may make you faster, but doing it inefficiently will give you a better workout and maybe even stronger. That blew my mind. So, I like this idea of introducing trade-offs that may not necessarily be a loose-loose. What I am not entirely clear on from this presentation is is this for lighting, or do you imagine different use cases? Also, I am also curious why time and convenience? My first assumption was that you were talking about efficiency and convenience.

Realizing the artefact

Technical drawing



Coding



Deployment plan

Planning
- Two days
- Living alone
- Interviews

Approval D.search safety of the artifact.

Ethical Review Form

Week 8

Results

It is all about efficiency. Waiting time has to be filled in efficiently
- Confirmed: increased pace of living

If a product provides convenience, time is essential. If a product provides comfort, time is not essential

Smart home products will most likely not be able to reverse the effect of our increased pace of everyday living. This will have to come from people themselves and their planning and use of time.