Master Thesis

Your data is safe: changing mental models of ad systems through transparent communication

Diana Dybok
diana.dybok@campus.lmu.de

Abstract

The collection of personal data and creation of user profiles to monetize products is a common business model in the online world. Comprehending how and why their data is processed is often impossible for users, often resulting in the feeling of privacy violation.

The presented master thesis investigates MyOffrz, a privacy-preserving advertisement system developed by Cliqz. MyOffrz is based on client-side data processing and thus does not track the users and does not create personal profiles. The challenge arises when it comes to mental models. Users who already faced so many advertisements online, transfer this knowledge to the new systems as well.

In this thesis we define a framework for educating users about MyOffrz, which consists of three stages: pre-interaction, interface properties and informational content. We focus on informational content and evaluate a prototype explaining value, business goal, data flows and underlying algorithm of MyOffrz. Our results indicate that the tested design was effective in terms of changing users' mental models about the system. Moreover, we found that gamification elements in explanations are well perceived by users, they like to be in control and they want explanations to be as concise as possible. We could also observe a connection between technology proficiency and privacy attitudes: Users who have more knowledge about technology tend to be more privacy-concerned, those who are less proficient tend to also be less concerned. We derive several product-related findings, that are implemented later on.

Zusammenfassung

Das Sammeln persönlicher Daten und das Erstellen von Benutzerprofilen zur Monetarisierung von Produkten ist in der Online-Welt ein verbreitetes Geschäftsmodell. Wie und warum Daten verarbeitet werden, ist für Benutzer häufig nicht nachvollziehbar und kann zur Verletzung ihrer Privatsphäre führen.

In dieser Masterarbeit wird MyOffrz, ein von Cliqz entwickeltes System zum Schutz der Privatsphäre, untersucht. MyOffrz basiert auf client-seitiger Datenverarbeitung und verfolgt daher keine Benutzer und erstellt keine persönlichen Profile. Die Herausforderung besteht darin, die mentalen Modelle der Benutzer so zu verändern, dass sie der Funktionsweise von MyOffrz entsprechen. Dies wird vor allem durch bereits vorhandenes Modelle zu Online-Anzeigen erschwert.

In dieser Arbeit definieren wir ein Rahmenwerk um Nutzern die Funktionsweise von MyOffrz zu erklären, das aus drei Stufen besteht: Pre-Interaktion, Schnittstelleneigenschaften und Informationsinhalte. Wir konzentrieren uns auf Informationsinhalte und evaluieren einen Prototypen, der den Wert, das Geschäftsziel, den Datenfluss und den zugrunde liegenden Algorithmus von MyOffrz erläutert. Unsere Ergebnisse zeigen, dass das getestete Design wirksam war, um die mentalen Modelle der Benutzer hinsichtlich des Systems zu ändern. Darüber hinaus haben wir herausgefunden, dass Gamification-Elemente als Erklärungshilfen von den Benutzern gut wahrgenommen werden, dass sie gerne die Kontrolle behalten und dass Erklärungen so kurz wie möglich sein sollten. Wir konnten auch einen Zusammenhang zwischen Technologiekompetenz und Einstellungen zum Datenschutz feststellen: Benutzer, die mehr über Technologie wissen, sind in der Regel eher um ihren Datenschutz besorgt, während diejenigen, die weniger kompetent sind, eher dazu neigen weniger besorgt zu sein. Wir leiten mehrere produktbezogene Erkenntnisse ab als Empfehlung für zukünftige Implementierungen.

Ich erkläre hiermit, dass ich die vorliegende Arbeit selbstständig angefertigt, alle Zitate als solche kenntlich gemacht sowie alle benutzten Quellen und Hilfsmittel angegeben habe.

München, 4. November 2018

. . . .

Contents

1   Scope

Put the user first: Everything we do at Cliqz follows this simple principle. It sets us apart from the large companies that currently dominate the Internet. They shape the web according to their own interests and the interests of the advertising industry. While ads are also the revenue model at Cliqz, we believe in an Internet where values, such as transparency, privacy, openness, and security, matter. An Internet where personal data remains in the possession of users.

Therefore, we developed a smart advertising system called MyOffrz that takes all these values into account. It provides relevant ads to users at the right time, without sacrificing their privacy. However, this important difference to other ad systems is hard to explain to users due to its complexity and the mental model that users already have on how ads in the Web work. The goal of this thesis is to explore different ways to address these challenges.

The thesis comprises the following tasks:

- Find related work

- Understand the mental model of users (general: ads, particular: MyOffrz)

- Explore different concepts to transparently communicate what MyOffrz is and how it works

- Conduct user study to evaluate concepts and analyse the results

- Write thesis and present results

2 Introduction

Nowadays, many companies working with digital products earn money through online behavioral advertisement (OBA). OBA functions in a way that user information is collected online in order to create profiles about individuals. The purpose of this tracking is to enable advertisers to target groups of people with ad campaigns expected to fit their interests. The more accurate ad targeting is, the more profits advertisers are able to receive from their campaigns. This strategy has been and continue working well, however concerns about privacy became more and more important for the users. That is why new methods for monetizing digital products were invented. One of these methods is described in the presented work—MyOffrz, browser-based marketing. MyOffrz target the user the same way as OBA does, but processes the data on the client-side, so that no data ever leaves user's PC. Additionally, MyOffrz uses anti-tracking technology to assure total privacy for anybody using the system.

Current challenge of MyOffrz originates from mental models or the way people think about and understand intelligent systems[1]. The regular user is accustomed to the way online advertisement works and holds an opinion that it can only be targeted by collecting private data about oneself. Because these erroneous mental models are so strong, it is a big issue to explain to the user how a new system functions. That is the issue addressed in this master thesis.

There is a lot of discussion about mental models going on in the Human-Computer Interaction (HCI) science. Some say that it is very hard to elicit users' mental models and it is even harder to change them. Others state that proper ways to define them exist and propose different strategies to correct the way people think. Research in psychology presents several theories to base design processes of intelligent systems and user experience field provides a lot of practical implementations of explanation screens, design guidelines, interaction cues and many more.

In the presented thesis we would like to focus on a particular product—MyOffrz. MyOffrz is the first technology which combines elements of OBA, coupon platform, search engine and at the same time does not collect any personal data about the user. As this kind of technology is only emerging on the market and there was no prior research about similar systems, the work presented in this thesis is novel and timely.

2018 was memorable year for online data privacy issues: Mark Zuckerberg gave his testimony to the US Congress and General Data Protection Regulations (GDPR) were introduced in Europe. These two major events made people more concerned about their online privacy and evoked more interested about hidden algorithms behind intelligent systems. Hence, the research addressing the question of how to transparently communicate privacy policies is relevant in order to build intelligent systems that are understood by the user.

In the course of this work we both address particular issues of MyOffrz and derive findings applicable to intelligent systems in general. The thesis firstly consists of an extensive research of the related literature about online privacy, OBA and transparency of intelligent systems. Secondly, the thesis analyses the product through existing mental models of users and experts. Thirdly, in the course of work we define a framework for educating users about intelligent systems. Additionally, we develop a design of an interface that explains MyOffrz in particular and helps to educate the user by correcting her/his mental model. Finally, the received information is gathered and analyzed. We provide not only particular findings about the product, but we define generalized insights, that might be applied to other intelligent systems as well.

Although the theory about mental models is still ambiguous and intelligent systems only start to play an important role in people's lives, there are already some design guidelines

and frameworks to transparently communicate inner processes, such as [1], [2], [3], etc. This master thesis expands research field by investigating a novel intelligent system and reaches the main goal by building a prototype that effectively transforms users' incorrect mental models about MyOffrz.

The next chapters describe the whole work flow in detail and summarize the findings of the research. The structure is as follows.

Chapter 3 gives an overview on the related work. It consists of two parts: background of the product and related literature.

Chapter 4 descries the framework used for participatory design process. It gives a short overview of user studies conducted in the course of work and techniques applied for analysis of the qualitative data.

Chapter 5 is dedicated to the first part of the participatory design framework and answers the question: What to explain? In this chapter we define User Mental Model, Expert Mental Model and Target Mental Model.

Chapter 6 answers the question: How to explain? In this chapter we show iterative user-centered design process, which was used to develop the prototype of explanation screens.

Chapter 7 is aimed at evaluating the final prototype and describing the final results.

Finally, we summarize all the findings in the conclusion, state main limitations of the work and define perspectives for the future work.

3 Background and Related work

The topic of this thesis is quite broad and includes different fields of research. Thereby, this section presents extensive description of related literature and research. The structure of this section is as follows:

- Background on company and product

- Related literature

    Privacy

    Online advertising

    Mental models

    System transparency in HCI

    Explanation screens

3.1 Research context

3.1.1 What is Cliqz?

Cliqz is a company, which develops the browser and the search engine. The first official version of the browser and search was released in 2015. Cliqz is mainly owned by a German media corporation Hubert Burda Media. The main focus of the company is privacy protection. All the products developed by Cliqz do not collect any personal data about the users, additionally they have such features as ad-blocker, anti-tracking and anti-fishing implemented [4].

   While a lot of the companies creating digital goods earn money through advertising, i.e. collecting private data, creating profiles, targeting ads, Cliqz does not do it due to ethical issues. Here comes a challenge of how to earn money to support company's daily operations. Cliqz business strategy team was able to solve monetization problem in a creative, innovative and challenging way. In order to earn money with the product which is completely free and safe for the user, browser-based marketing was invented. MyOffrz is a new advertisement technique which also brings beneficial value for a user [5].

3.1.2 What is MyOffrz?

Browser-based marketing is a new way of online advertising, which brings a particular benefit to the user. MyOffrz, located in the Cliqz browser and Cliqz extensions for Firefox and Ghostery, offers customized discounts, promotions and useful information, processing all the data on the user's computer, preserving total privacy as no data ever leaves the PC [5].

   MyOffrz works in a following way. Managers at the Cliqz office look for companies to partner with. When they find one, they try to negotiate special conditions for Cliqz users. The benefit Cliqz users receive might be different: a discount, complimentary product, an advice or whatever might be helpful for them. When the terms are negotiated, the partners can choose the placement they prefer for their offer, it might be promo bar, reward box, drop down menu or Cliqz start page. When all these decisions are made, the time to define the triggering rules comes. Here, the keywords and urls are chosen to trigger the offer. When everything is ready - the offer goes live, i.e. the set of triggering rules together with the offer itself is sent with the browser extension to the user's PCs.

   At this point the question about privacy issues might appear. How does Cliqz earn money with MyOffrz if no data leaves user's PC? In fact, there is one signal sent back to

Cliqz, that is a confirmation of an offer being used. The signal however goes through a proxy network, and reaches Cliqz being completely anonymous.

Moreover, the types of MyOffrz presented in the current work might be placed in two different locations: promo bar and reward box as shown on the pictures below.
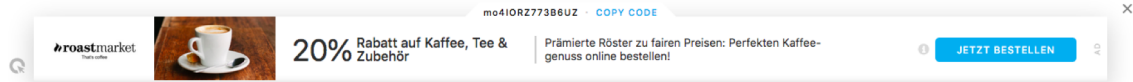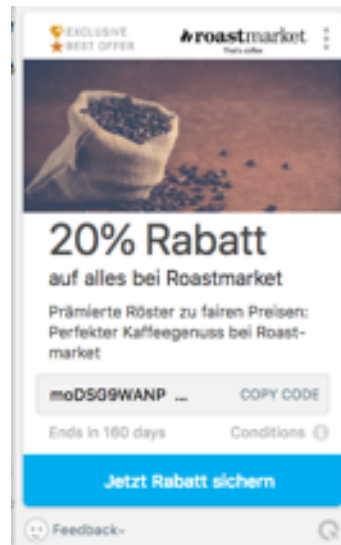

Figure 3.1: Offer in the promo bar

Figure 3.2: Offer in the reward box

In that way, MyOffrz represents a new way of monetizing digital products and at the same time preserving users' privacy, while providing additional value.

3.2 Literature review

At this point the understanding of the company values and the new product is clear. However, it is not clear yet how to help users create the right perception and understanding. Thereby, on this stage the analysis of the related work is necessary. In this chapter, we would like to look at theories and studies about explanations of intelligent systems, psychological foundations which form users' opinions and privacy concerns in general. Let's look at different topics related to our future work.

3.2.1 Privacy

In the modern world, full of new inventions, technology develops very fast and changes drastically. There are a lot of trends which, a couple of years ago, people could not even think of, such as: virtual reality, machine learning, artificial intelligence and many more. Intelligent systems became a normal thing for any software or computer-related product. Thereby, new challenges appear in the world of technology and one of the vital issues at the moment is security. Technology has to be developed to serve people, make their lives easier and support in different kinds of tasks, which are boring, monotonous or just unpleasant [6]. But what happens when technology becomes so advanced that a normal user can not understand it completely and, hence, might harm himself through excessive or erroneous use of new machines? That is where one of the biggest issues comes from, which is online data privacy.

According to [7], any Internet user is tracked by companies, which collect private data. 99% of the top 200 news sites contain at least one tracker, and at least 50% of them contain more than 11 trackers [7]. The research unravels proof that 84% of sites contain at least one tracker sending private data[7]. Data elements that are only and always sent by a single user, or a reduced set of users, are considered unsafe with regard to privacy[7]. However, tracking is supposed to be necessary for advertisers to be able to accurately target their audience.

As for German users, more than 95% of websites visited by Germans contain trackers and only 22% of the page loads do not attempt to transfer unsafe data to third-parties [7].

According to [8], when a first-party page contains elements implemented by a third-party company, that company has an access to some data on the page through the HTTP referrer. In case there is a script tag on the web page, more companies will be able to get access to different information items. Not only the third-parties will get an access to the data, but in some cases the first-party will freely share even more information than can be accessed.

In addition to having access to URL, title and some other data, web browsing history is often shared as well, which might become an important issue as most of the time it is personally identified[8].

Research of [9] describes algorithmic gate-keeping - another threat, caused by data collection without informing the user. Algorithmic gate-keeping is the process when algorithmic tools filter, highlight, suppress or play editorial role, thereby determining information flows through online platforms or other media [9]. Such harms mostly negatively influence social movements, civic sphere and elections [9].

As [10] found out, personal information holds the value for the parties which collect it. Value of each piece of information depends on other accessible data, in combination with which it might be used. E.g. your state and date of birth may not only identify your personality, but in combination might predict your Social Security number [11].

Unfortunately, according to [8] in today's world, there are several trends and business models, which are based on third-party tracking, i.e. collection and usage of personal data about users:

- Advertising companies

- Analytic services

- Social integration

- Content providers

- Front-end services

- Hosting platforms

In the research of [12], it is stated that most services using third-party tracking are operating on the background, which means there are no visual signs to inform the user about the fact the data is collected. Due to the non-transparency of the tracking ecosystem, it is difficult to identify how organizations collect personal data from users, and how they store and share it with each other [12].

In that sense, due to lack of transparency in intelligent systems, a lot of mismatched privacy expectations appear as described in the work of [13]. As most of the privacy policies are too long and unclear, people simply do not read them. Thereby, on the picture below different mismatches of the users expectations according to the type and purpose of the website are presented.
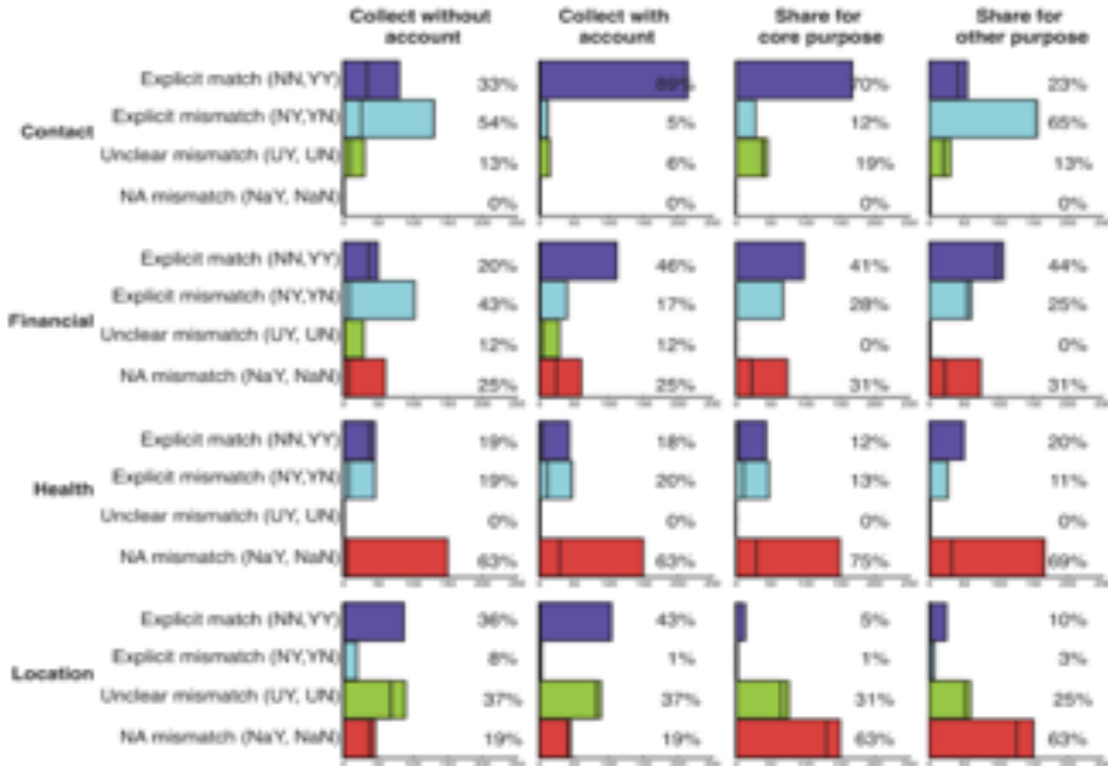

Figure 3.3: Matches and mismatches in user expectations.[13]

Researchers made a conclusion that the process of informing users about privacy policies might be simplified by reducing the amount of information displayed and highlighting the data that mismatches user's expectations [13]. Simplification of data privacy notices could improve the odds of users actually understanding important elements of data policies [13].

8

From the user's point of view, sharing personal information often brings a valuable benefit immediately, while usually they do not realize the costs and often they appear only in the future [10]. As [14] found out, public is generally concerned about their data privacy, at the same time the benefit they receive from sharing private data is quite valuable for them. Some of the participants of the focus groups conducted in the study of [14] mentioned several reasons for data sharing: *Free is a good price", "Sharing helps lubricate commercial and social interactions" and "Certain realms are not inherently private and different rules about surveillance and sharing apply".* Alan Westin has created an index to identify people's attitude towards privacy. He divided them into three categories [15]

1. **Fundamentalists** - the most privacy-concerned part of the population. They don't trust online services and organizations that ask for personal data as they are worried that companies might find additional use for their data. They would like to have more laws preserving their privacy and regulations to introduce proper penalties for those who use private data without consent. Usually such users prefer high privacy controls to the benefits they could get from the service. About 25% of the public are privacy Fundamentalists [15].

2. **Pragmatists** - this is the biggest part of the population nowadays, it counts for about 57% of public [15]. People in this category seek for benefits they could get from the service by sharing their personal data. They try to weight the benefit against loss in the procedure of sharing the data. They prefer to have a choice to opt-in or opt-out the data sharing, however in general they are willing to share their data in case they see a clear benefit. At the same time, they believe that business organizations that are involved in the tracking processes need to get a consent from the user if they want to somehow use their data later on.

3. **Unconcerned** - these are people who trust organizations completely. They are very comfortable with sharing their data online and are ready to give away their data for any beneficial service. They are also not in favor of new regulations to limit the collection and usage of private data by organizations. Around 18% of public can be assigned to this category [15].

Although a lot of people are well-informed about how businesses are based on collection of private data, the overall awareness about tracking prevention is low according to [16]. Participants of the research conducted had clear preferences on which data they would like to share and were concerned both about first and third party tracking[16]. There was also found a proof of differences in sharing willingness based on privacy attitudes – Westin's index, with Fundamentalists being the most concerned [17]. At the same time, research of [18] concludes that people become more privacy-aware when the purpose for data collection is vague. Moreover, concerns about privacy appear when data collection is done in an unexpected context or for a purpose they did not expect before [18]. This kind of experience often even becomes a reason for loss of trust in the system as well as sense of 'creepiness' [18].

In conclusion, [19] gave a definition of privacy as follows:

A right to privacy is a right to control access to and uses of—places, bodies, and personal information.[19]

This right has to be granted to every individual in any context and all the conditions have to be communicated clearly, openly and transparently.

3.2.2   Online advertising

A lot of business models and trends have at its core collection of private data about users [8]. Above all, there is one business model, which especially count on private data to produce revenues - online behavioral advertising (OBA). However, not all the people who are exposed to OBA are well-informed about it. According to [16] only around half of the people understand OBA completely, while majority of users demonstrates concerns about their online privacy only to some extent. Unfortunately, the overall awareness about online privacy is still relatively low [16].

Firstly, let's define what OBA actually means. As [20] defined it: *Online behavioral advertising is a form of advertising in which advertising networks construct profiles of users as they navigate various websites.* As [21] states, by collecting private data, three kinds of the predictions about new features in advertising will improve Internet advertisements:

- *Targeting*, i.e. presenting each user with an ad related to their specific interests.

- *Measurement*, which most important question is effectiveness of an advertisement, i.e. understanding what is the reason advertisement work in general and in what manner they function [21].

- *Interactivity*, that is based on the idea that ads do not have to persuade the user to buy a product they do not need, but give necessary information at the right moment.

[22] Identified clear demand for algorithmic transparency. The process of matching a particular ad to the user has to be transparent as well as data practices, which have potential to violate user privacy.

Research discovered that vague language made many existing ad explanations impossible to understand, at the same time users do not want to see too much information, especially the one they find "creepy" [22]. Users preferred explanations with specific information which was used to target them and especially related to an important part of their identity [22].

Users clearly benefit from the transparency about ad algorithms of targeting, however, at the moment the icons to access explanations are not intuitive enough to find in the user interface (UI). Moreover, people usually avoid clicking on these icons. In that sense, explanations might become a central focus of the advertisement. This kind of design will additionally help to create more trust and engagement with the ad [22].

It is important to state, that there were several intents to create more transparency in OBA. One of the examples is AdChoices, program for self-regulation of OBA through more transparent communication with the user [23]. It consists of an icon, which advertisers have to include in their ad banners[23], agreeing to The Digital Advertising Alliance (DAA) principles listed below [20]:

- Education Principle: DAA itself has to stay an educational website, to teach users about digital advertisements.

- Transparency Principle: Companies are obliged to show information about themselves and about ads they display. This information has to be clear and complete.

- Consumer Control Principle: Companies should provide user with the choice. Any ad should contain a transparent algorithm to opt-out, when user does not want it.

- Security Data Principle: The data collected from the advertisers must be secure and should not be shared with other parties without users' consent.

- Material Changes Principle: Companies are obliged to ask for a user's consent before they introduce changes into their privacy practices.

- Sensitive Data Principle: Companies must have additional security algorithms when they handle sensitive data.

- Accountability Principle: There should be a compliance program developed for the industry in general.

Although the principles were well-defined and beneficial for the user, study [24] proves that the implementation was not as successful. The real ratio of ads which display AdChoices icon is very small compared to the number of overall ads shown on Internet everyday [24]. The reason for that is that at the moment proposed system lacks consistency in how the icon is presented, positioned as well as its overall design.

There was another initiative in order to provide users with more online privacy protection—HTTP fiels "Do Not Track"(DNT). Do Not Track is a personalized documentary series about privacy and the web economy, which basically requests that a web application to disable tracking of the user or sometimes cross-site tracking[25]. Unfortunately, as there are no legal or technological requirements for DNT, some companies might just ignore its requests. E.g. according to [24] 32 of 64 Network Advertising Initiative (NAI) companies kept tracking cookies in place after opting out.

One of the reasons for such behavior is that privacy regulations most of the time make OBA less effective. The study [26] found evidence that online advertising in Europe became less effective after the introduction of the Privacy Directive and that not all websites and all types of advertising were affected equally.

To sum up, there is a strong need in transparency of algorithmic processes of OBA. As of now, several initiatives to make privacy policies of the advertisers more understandable for the users were made, however, unfortunately they were not feasible in the context of number of advertisements on internet, that do not comply to any regulations. This behavior might partly be caused by reduced effectiveness of OBA related to privacy regulations, however benefits and costs of both advertisers have to be balanced fairly and according to the laws, thereby effective privacy notices and explanations have to be implemented.

3.2.3 Mental models

One of the fundamental theories behind explanations and users' perception of how systems work is a theory of mental models. As research supposes, it is important to understand how users perceive intelligent systems in order to attain user's trust [27]. *"Mental models are a hypothetical construct defined as a mental representation of a real or imagined situation"* [27]. Along with mental models, there is another definition of so called folk models, which were defined by [28] as *"mental models that can be incorrect representations of reality but are used by people in practice"*. In that sense, it turns out that to create trust, assure data privacy, and help users make intelligent decisions as well as create more attractiveness of the intelligent system - the mental models should be aligned with the conceptual models through transparent communication.

Some prior research was already done to find out existing folk models of OBA. Research of [29] for example found out that many people associate OBA with something "creepy and scary", because of the tracking, although there were users who said that OBA are "smart and useful". [30] in their research defined several incorrect folk models in the society describing OBA:

,

1. Browser-pull model - when browser detects the usage patterns and based on them pulls the ads to the user.

2. First-party-pull model - the tracking is also done by the browser, but here users thought that first parties pull the ads.

3. Connected-first-party model - first-party websites are connected and collaborate with each other and all the parties track and store the information about user.

4. Third-party model - first-parties who collect the data share it with third-parties.

Although mental models are never perfect, research proves that it is possible to alter them through explanations and change of the perception. Process of changing mental models is called transformation, which refers to successful modification of an erroneous mental model [31]. As mental models reflect the mental level of perception it is proved that holistic confrontation can lead to the successful transformation, one way to provide such a confrontation is to have users examine visual explanation [31]. Another option is to present them in a text-based manner. When explanations are presented sentence-by-sentence, the two possible scenarios exist. First is when the information presented in the explanations does not overlap with the prior knowledge, then it just helps to extend the already existing mental model. In that case, if the person had a correct mental model before, it will stay correct and will be extended by the explanations. If the prior model was erroneous, then it will also stay incorrect and will only be extended by new correct facts after explanations are presented [32]. Second scenario is when the explanations do overlap with the user's existing mental model. In this case, the correct model will be confirmed by the explanations and the wrong one will be contradicted and, thereby changed to an extent dependent on every person's peculiarities [31].

Transformation of mental models through contradiction and sentence-by-sentence explanations is able to correct up to 60% of users' mental models [32]. Thereby, through combining different methods, which both refute the incorrect models and add useful information to existing one, the models can be corrected for more users.

Crucial question in the field of mental models is how to define and measure them. The study [33] identified several methods for eliciting mental models, which are oral, diagrammatic and combined procedures. Studies by [34] suggest that cognition is based on both verbal and visual systems together, thereby combined oral and imagistic approach helps the user to better map and elicit their own mental models.

To sum up, mental models represent an integral part of Human-computer interaction (HCI), although there are different opinions on the significance of mental models as well as value of the users with accurate mental models. Anyway, theory of mental models help researchers and product developers to understand how people use systems and improve products in a way that they will be most helpful to people. Moreover, according to [22] complete and correct mental models can help create more trust towards the product.

3.2.4   System transparency in HCI

There was quite extensive research done in the area of Human-Computer Interaction(HCI) and algorithmic transparency. It is normally very hard to identify how well-informed users are about algorithmic processes and how this awareness influences the use and functional effectiveness. In the work of [22] researches identify some challenges and interesting areas in relation to what level of transparency is optimal for intelligent systems with hidden algorithms. For instance, the study found high levels of ignorance about algorithmic processes in social media platforms. At the same time, arguments to support both displaying and hiding processes happening behind the intelligent systems were found. On the one hand,

some argue that in order to have seamless experience the black box of the processes have to be invisible, which leads to the effortless feeling, thereby users never need to know how the system works [22]. On the other hand, in order to allow innovative use of the product as well as to see clear response of the system, the processes must stay highly visible [22]. Some, additionally argue that there are cases when transparency of the system led to success of certain computational processes [35]. So, the question is what is the most optimal level of transparency, which allow users to have enough understanding but not overload them with too much information?

In answering this question, two definitions have to be taken into account, that is [36]: *"Soundness is how truthful each element in an explanation is with respect to the underlying system."* [36]

"Completeness is the extent to which an explanation describes all of the underlying system." [36]

Users prefer more complete explanations, with high level of both soundness and completeness, although completeness plays more important role for them [36]. High levels of both helped to create more trust in the intelligent system. Benefits of each treatment are presented in the picture below:
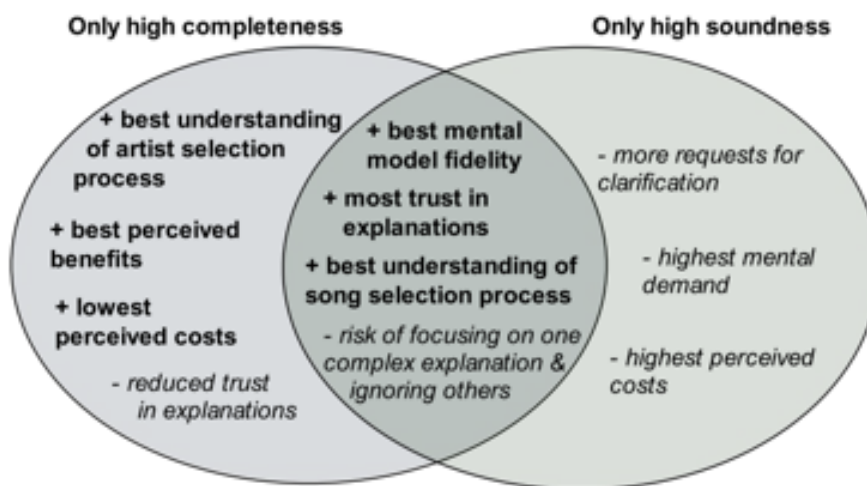

Figure 3.4: Benefits and costs of highest completeness and soundness treatments [36]

According to [3], the system needs to transparently communicate to the user its algorithms happening in the black box and explain why a particular item was chosen and matched for them. Moreover, [35] define another important concept – cognitive bias. Cognitive bias is a term taken from behavioral psychology and indicates *"a systematic pattern of deviation from norm or rationality in judgment"*[35]. In that sense, research has found that people perceive a smart system to perform better when it unravels its inner logic [35]. From this statement it follows that intelligent systems need to provide meaningful explanations for its' algorithms.

Research of [27] proves that when the user has a correct perception of the intelligent system, he has more trust in the system he is using. [37] supports this finding and states that feedback from the intelligent system, which might also be communicated through some interface features, helps to gain more user trust in the system. [38] found out that to create trustworthiness, humans analyze the systems in comparison to normal human behavior.

[39] state four substantive and methodological questions:

1. How to proceed when access to the actual algorithm is limited?

2. Where, when, and how are users made aware of algorithms?

3. How does perception translate into cognition and knowledge of the process at hand?

4. How important is accurate cognition to use?

In the presented work, we try to take these questions into account and answer them for the particular intelligent system.

3.2.5 Explanation screens

As it was already stated in the literature overview above, transparency is a vital element of any intelligent system. Not only does it help users to understand complicated processes happening in the black box of modern innovation, but also it creates more trust in product, helps to engage user more and to teach her use the system in a most effective way. As of now, we realized the necessity and influence in transparency. However, what we did not do is to investigate what elements have to be explained and what the design space for this explanations.

[2] summarized some prior findings on explanations of intelligent systems in a table presented below:

Table 3.1: Findings from related work about explanation screens [2]

Proposition	Studies
Explanations will be used when the user experiences an expectation failure, or perceives an anomaly.	Dhaliwal (1993), Mao and Benbasat (1996), Ye (1995).
Explanations will be used more when the user has a goal of long-term learning (learning that transfers to a non-KBS context).	Gregor (1996).
Explanations will be used when the user lacks knowledge needed (terminological knowledge or problem-solving procedures) so he or she can contribute to problem solving.	Everett (1994), Gregor (1996), Mao (1995).
Explanations that require less cognitive effort to access and assimilate will be used more and will be more effective with respect to performance, learning, or user perception. The types of explanation for which effect is expected include: • automatic explanations • hypertext explanations • intelligent explanations • case-specific rather than generic explanations.	Everett (1994), Moffitt (1989), Gault (1994), Mao (1995), Berry and Broadbent (1987), Dhaliwal (1993).
Use of explanations improves the performance achieved with a KBS as an aid.	De Greef and Neerincx (1995), Dhaliwal (1993), Gregor (1996), Mao (1995), Wognum (1990).
Use of explanations helps in learning (transfer of knowledge to non-KBS contexts).	De Greef and Neerincx (1995), Eining (1988), Everett (1994), Gault (1994), Gregor (1996), Moffitt (1989), Murphy (1990)
Novices will use explanations more for learning (short- and long-term) than experts.	Mao (1995).
Experts will use explanations more for resolving anomalies (disagreements) and for verification than experts.	Mao (1995), Ye (1990).
Explanations conforming to Toulmin's model (justification explanations) will give rise to more positive user perceptions of a KBS than other explanations (trace and strategic explanations).	Everett (1994), Ye (1990).

According to the work of [40], layout is very important for users and to be able to gain their trust it has to be personalized, easily operated and aesthetically designed. Research

also proved that these different elements combined could help optimally create users' trust
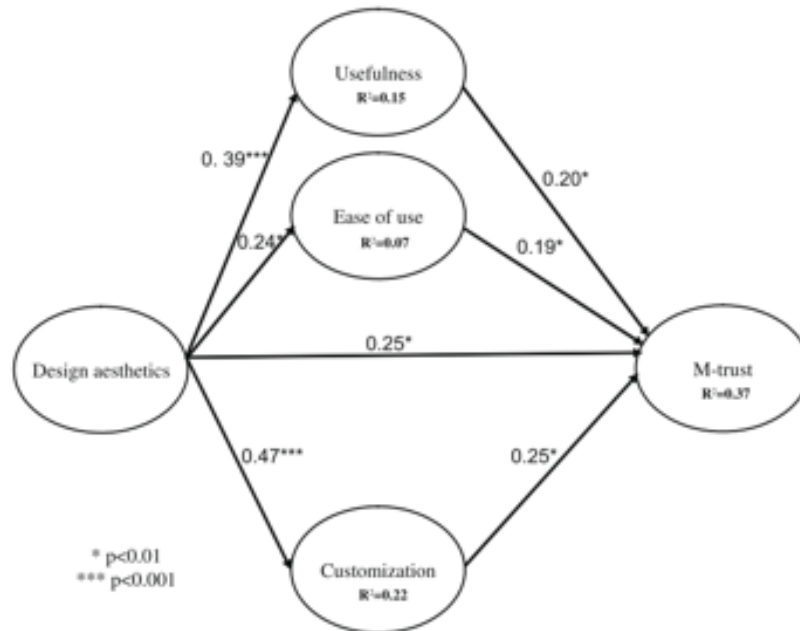with usefulness and ease-of-use, which could have significant impact.

Figure 3.5: Standardized model of structural trust in mobile applications[40]

Relating to the question of trust, [41] created a Model of Trust for Electronic Commerce,
which identifies two steps of forming user trust. First, are pre-interactional filters, that
basically mean prior knowledge before starting to use the product, e.g. friends' recom-
mendations, social media etc. Second, are interface properties which reflect design and
aesthetics of the product when used for the first time. Third is informational content, i.e.
when a person uses a product and gets actual content. The model is summarized in the
scheme below:
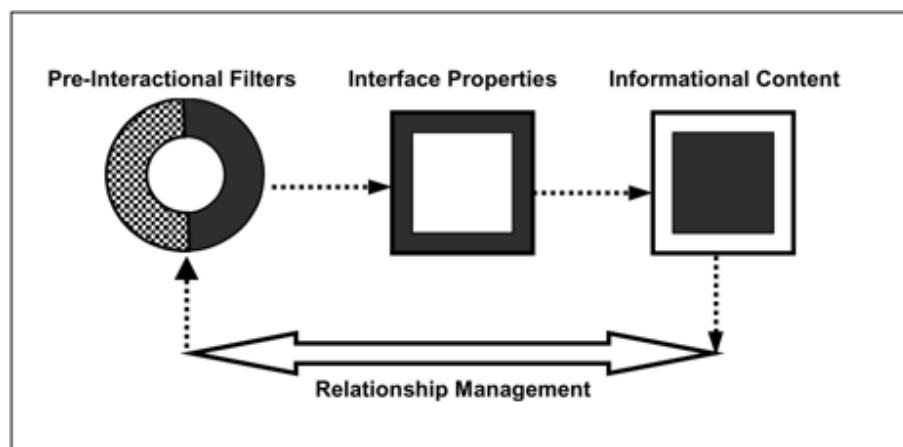
Figure 3.6: Model of Trust for Electronic Commerce[41]

As one of the important concerns about intelligent systems nowadays is privacy, it is
important to be transparent about privacy policies as well. According to [42], effective

privacy notices should be relevant, actionable, and understandable. In another work [1] 4 elements for the design space for privacy notices were defined:
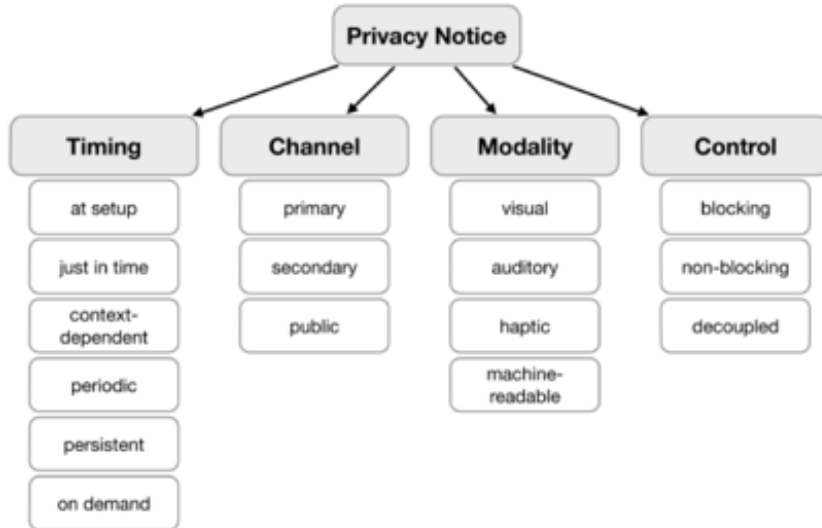

Figure 3.7: Design space for privacy notices[1]

For intelligent systems, the two items that have to be explained are input, output and the conceptual model itself [43]. In the works of [43], the conceptual model for explanations in general was designed and contains 5 elements:

1. *Why* did the application do X?

2. *How* (under what condition) does it do Y?

3. *Why* did it *not* do Y?

4. *What (else)* is it doing?

5. *What if* there is a change in conditions, what would happen?

Why and why not explanations proved to be the most important for the user [43]. In that sense, these two kinds of explanations are related to the mental model theory, so that 'why' explanations would add lacking knowledge that user has and 'why not' explanations would contradict the erroneous prior knowledge.

Conclusion. To sum up, in the current section the product is analyzed, the description is given and the related work is presented. At this point, the conclusion might be derived that although changing mental models and creating trust towards the product is done in three stages: pre-perception (through social media and word-of-mouth), first impression (design and appearance) and actual content (explanation screens), the product developers have the most influence towards actual content. Thereby, explanation screens have the biggest potential to successfully transform erroneous mental models through contradiction to the existing wrong models and additions to the existing correct knowledge.

Hence, the aim of the presented master thesis is to answer the questions stated by the related work specifically for MyOffrz, explore possible ways to correct mental models, and create a prototype to test the chosen option. In the following chapter, we will look at the concept and approach that is be used for research and design.

4 Framework and Methodology

After analyzing the related work and researching the product, the clear need in transparency was identified. In the previous step, an extensive analysis of the related work is conducted. As there is a lot of information that has to be taken into account, there is a clear necessity in a framework for organizing the design process. To transparently communicate inner processes of MyOffrz and organize the work flow, the participatory design framework was chosen [44].

The framework is presented below:
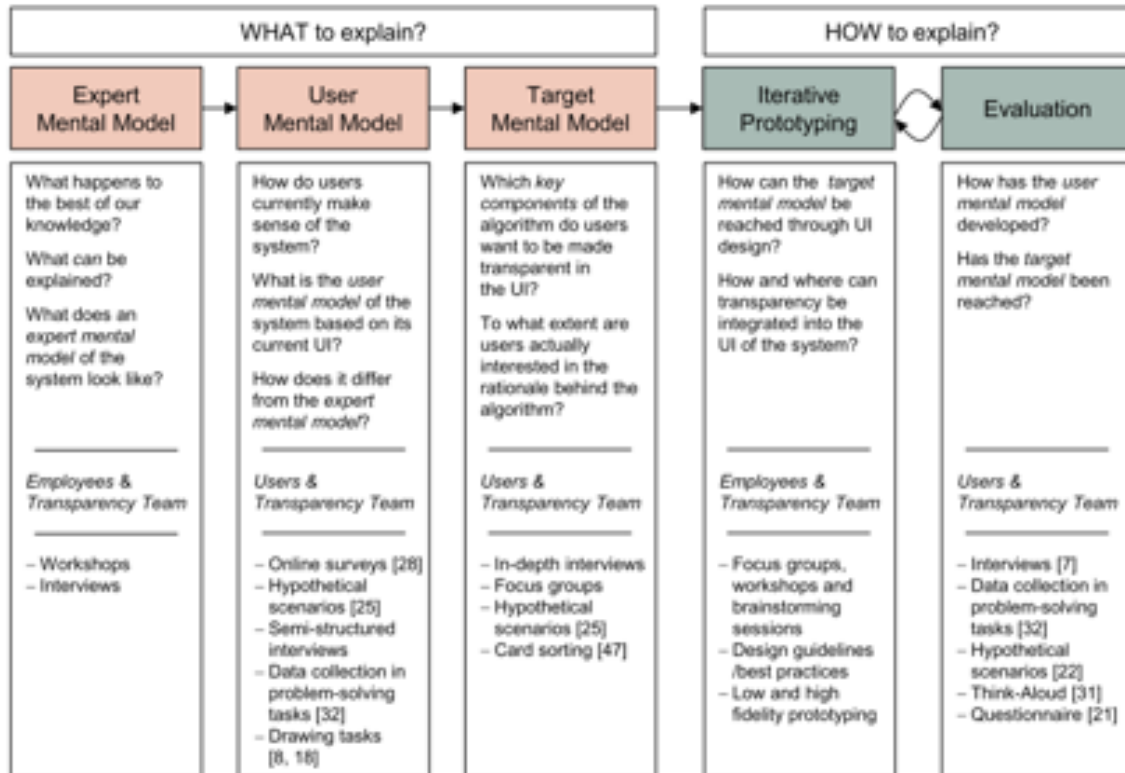
Figure 4.1: Participatory design process framework [44]

In that way, the exploration and design is done in two main stages. The first stage is aimed at identifying what kind of information items have to be explained and consists of eliciting expert mental models (EMM), users' mental models (UMM) and target mental model (TMM). The second stage's objective is to find the right way to present the explanation. It means at this stage, design and evaluation is done in an iterative manner to find the most effective option.

4.1 What to explain?

As stated abobve the work is structured in two stages. First stage includes elicitation of three types of mental models: expert's mental model, user's mental model, target mental model. This chapter will answer the question: *'What to explain?'*.

4.1.1 Expert Mental Model

Expert mental model was defined using semi-structured interviews with main stakeholders: director of strategy and KPIs and director of engineering. UX specialists and designers

were included in all the stages of the research and design in order to get expert input and sufficiently understand the product. Interviews were chosen as a primary data collection method, because along with the needed depth of information received, the requirement was to determine what kinds of explanations to focus on, which is more appropriate to do through interviews than focus groups or surveys [45]. Moreover, in the interviews the participants are not influenced by group dynamics and in contrast to surveys are able to have an opportunity to express their opinions in person. Additionally, in the circumstances of analyzing the product, different points of view had to be taken into account, hence the contents of interviews differed from participant to participant.

Questions asked in the interviews were mostly exploratory and aimed to get overall idea and develop the conceptual model of the product. In that sense, different experts were asked about their field of expertise, such as strategy, business model, technology, user experience and design. To define the conceptual model more accurate, they were also asked to conduct a drawing task, answering question: "Can you explain, through a picture or diagram, how you understand functionality of MyOffrz and data flows when the offer is shown to the user?", taken from research of [33]. In that way, both verbal and visual procedures were used to identify experts' mental models. In addition to the interviews, other MyOffrz employees were asked to do a short task to find out how they define the product. The task consisted of 3 small sub-tasks:

1. Describe MyOffrz in 1 picture.

2. Describe MyOffrz in 2 sentences.

3. Describe MyOffrz in 3 words.

This part of the research was conducted in a form of a small survey, as depth analysis was done in the previous step with experts and there was no need in it at this point anymore. The drawing task was also part of the survey and helped to get a general idea about elements, that people working with the product include in the explanations.

4.1.2   User study 1: User Mental Model

User mental models were identified through a series of usability tests, which included a semi-structured interview, think-aloud tasks, a drawing task, and a survey to define their attitude towards online privacy through Alan Westin's classification [15].

For the first study we used usability testing mixed with couple of other techniques. Usability testing is one of the most popular methods in HCI. It allows researchers to investigate the way people use the product, get insights about some of the design flaws and get an idea about users' first impression of the product [33]. Drawing task as described in [33] helps to elicit more accurate mental model, while survey by Alan Westin might show some of the dependencies in the models according to users' attitudes towards privacy. Semi-structured interview procedure helps to define main points and emphasizes on how users understand privacy online in general and how they relate it to OBA and MyOffrz product.

For qualitative analysis of the results, thematic analysis is chosen. This method is aimed on identifying and analyzing themes within qualitative data [46]. The steps of this method are presented in the table below:

Table 4.1: Steps of the thematic analysis [33]

Phase	Description
1.Familiarizing yourself with the data	Transcribing the data (if necessary), reading and re-reading the data, noting down initial ideas.
2.Generating initial codes	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3.Searching the themes	Collating codes into potential themes, gathering all data relevant to each potential code.
4.Reviewing themes	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis.
5.Defining and naming themes	Ongoing analysis to refine the specifics of each theme, and overall story the analysis tells, generating clear definitions and names for each theme.
6.Producing the report	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back to the analysis to the research question and literature, producing a scholarly report of the analysis.

As [47] states, thematic analysis is an effective method for qualitative data analysis that is often underestimated and as a result is not often used. Thematic analysis does not only represent an independent and reliable method for qualitative analysis, but also helps researchers to gain skills to perform other types of qualitative analysis in the future [47]. In the current work, thematic analysis was chosen as a main methodology for qualitative data analysis for several reasons. Firstly, the objective of the presented research is to gain a general knowledge about a new product presented on the market. Secondly, the amount of data collected is not extensive enough to include quantitative methodologies for analysis. Thirdly, the themes had to be identified over the whole interviewing and usability testing process, which was conducted with a high level of freedom, i.e. relevant questions could appear at different stages of the process [47].

4.1.3 Post-study: Target Mental Model

The target mental model was derived through comparing the results received from elicitation of EMM and UMM. Gaps between the existing folk model toward the new product and concept mental model created by experts were identified. The list of elements were identified as themes from the thematic analysis and every element was compared in the two models. The themes were ranked through sorting task, conducted with the primary set of participants of the user tests. Users who took part in the post-study were the same as the ones in the User Study 1. Participants were presented with the list of themes via email and were asked to choose their top five elements, that were most important to them and rank them according to the level of importance and interest of the information presented by the

element. Results of this study were used to define elements which have to be included into explanations.

4.2   Design and User Study 2: How to explain?

On the second stage, the question *'How to explain?'* was answered. Objective of this stage was to fill out the gaps and correct erroneous mental models through design of explanation screens. The exploration of the designing opportunities was conducted, the concept was created and the design was conducted according to user-centered design process with several iterations and usability tests on every stage. Study design was composed as similar as possible to the first study to reach the best results in final analysis and evaluation.

User-centered design was chosen as a procedure for the creative part as user perception was found to play an integral role in the whole process of mental model transformation. Advantages of the UCD, which were crucial for the presented work are [48]:

- Products created through such a process are more efficient, effective, and safe

- The process assists with managing users' expectations

- Users are able to develop a sense of ownership of the product

- Products require less redesign and integrate more quickly in the environment

- The process generates more creative design solutions

As stated above, final evaluation was conducted similarly to the first study, through semi-structured interviews, usability testing, think-out-loud tasks, drawing tasks and question-naire to indicate dependencies with the attitude towards online privacy. The qualitative data was again analyzed through thematic analysis procedure. All the results were compared and the conclusions were given.

Conclusion. To sum up, different methods and procedures were used along the working process in order to collect, analyze and draw conclusions from qualitative data. In the next chapters, every study will be described in more detail. The following work is structured as follows. Firstly, the EMM, UMM and TMM are defined. The results received from the first study are analyzed and a list of information items is formed, which answers the question: *"What has to be explained?"*. Secondly, the explanations are created using user centered design process. The design created on this stage answers the question: *"How to explain?"*. Finally, all the results are summarized, compared and overall conclusions of the work are presented.

5 What to explain?

In this section, the research is answering the first question of participatory design framework: "What to explain?". Using different methods of primary data collection three mental models are defined and the section is structured as follows.

Firstly, expert mental model are defined using interviews with main stakeholders and survey with other MyOffrz employees.

Secondly, the user mental model is elicited through series of usability tests together with semi-structured interviews and surveys included in the User Study 1.

Thirdly, the target mental model is defined through comparison of the models received on the precious steps.

Lastly, additional study will be conducted to accurately define information items and their ranking, answering initial question: "What to explain?".

5.1 Expert Mental Model

On the first step, semi-structured interview was conducted with the director of strategy at MyOffrz. This was a first step of the research, thereby one of the main research objectives was to get an overall knowledge about how the product works. In the list below main research questions are stated:

1. **How to officially define MyOffrz?**

2. **How MyOffrz differ from OBA?**

3. **According to company strategy how should MyOffrz be perceived by users?**

4. **How did product develop till now?**

5. **What is your mental model of MyOffrz as most informed person about both strategy and technology?**

Summarized answers to the research questions are given in the table below.

Question	Answer
How to officially define MyOffrz?	MyOffrz is a new browser-based marketing category, aimed at bridging users and information they need through providing highly-targeted offers bringing additional value to the user without collection of the private data, bounded to the end of the funnel with the payment safe model for advertisers.
How MyOffrz differ from OBA?	- Offers actually bring value to the user, thereby they shouldn't be considered ads, but rather a platform connecting users to the necessary information from partners, charging a fee for its' services. - The algorithm is different in the sense of privacy. The product aligns with the company mission and values data protection the most. For this reason, all the analysis is conducted on the client side and there is no possibility to access any private data. At the same time offers are still very targeted. - The visual representation differs as well. The locations of the banners are not the standard locations of the online advertising and offers are always explicitly affiliated to Cliqz browser.
How offers should be perceived by the user according to company strategy?	Users have to perceive it as a feature, that can give them something good. In the future, MyOffrz should be one of the reasons why people want to use Cliqz. User are expected to say something like: "Damn I'm so happy I didn't miss this opportunity!", "Wow I really need to rent a car and I have such a great offer!", "That's the best offer I've seen and I'm not afraid that they collect my private data".
How did product develop till now?	Offers for special days, like mother's day, valentine's day, Christmas etc. were the most successful, because of very effective targeting. Results of the A/B test showed that the offer shown in the promo bar was more effective without picture, than with the picture. Main strategy objective is to get as many offers as possible for different categories and significantly improve targeting algorithm.

5   WHAT TO EXPLAIN?

Question about overall mental model was answered through drawing task. The question asked was: "Could you explain the way MyOffrz work through a simple scheme or a picture?" [33]. The model received is presented on the picture below and represent two schemes with the data flows for OBA and MyOffrz:
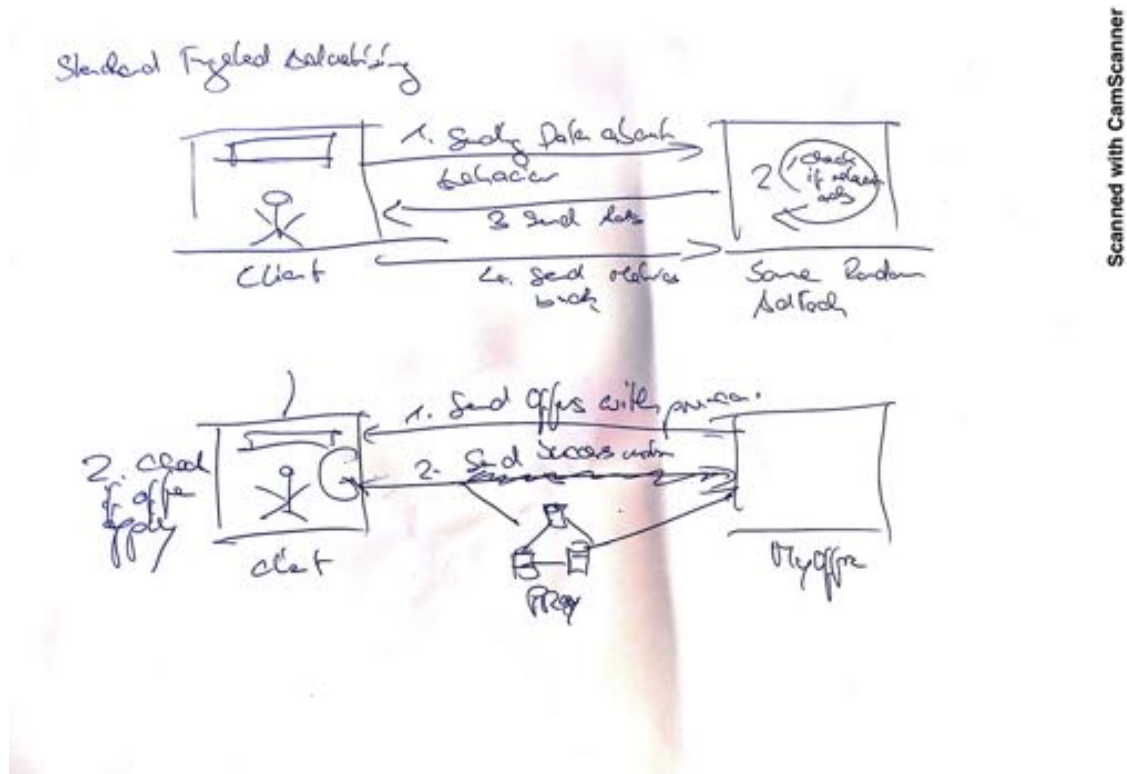

Figure 5.1: Expert mental model showing information flows in MyOffrz

The second interview was conducted with the director of engineering of MyOffrz. The goal of this talk was to get a deeper knowledge of the technology and algorithm. Research questions raised in the interview are listed below:

1. **Is the mental model described by director of strategy aligns with the technology foundation of the product?**

2. **What are inputs and outputs of the intelligent system?**

3. **How does algorithm work on client-side?**

General results of the interview are presented in Concise answers to the research questions are stated in the table below:

Question	Answer
What are inputs and outputs of the intelligent system?	Information stored in the extension on your browser is used on your computer to show you relevant offers. This kind of information might overlap with the one standard OBA uses, e.g. browser use, search queries, location, history etc. The difference is that all the analysis is done inside the browser, which means no information leaves user's PC.
How does algorithm work on the client-side?	The rules are defined by account managers. The algorithm at the moment consists of basic if-else logic. All the rules and offers are sent to the user's laptop and each offer has a unique id. This unique id is the only piece of data which is sent back to Cliqz for purposes of billing business partners.

As a result, the conceptual model provided by director of MyOffrz was proven right. In that sense, interview with director of engineering extended the expert mental model created before and gave some insights about algorithm.

Additionally to interviews, short survey was conducted with other MyOffrz employees. Three tasks were given:

1. Describe MyOffrz in 1 picture.

2. Describe MyOffrz in 2 sentences.

3. Describe MyOffrz in 3 words.

Answers to the survey form are presented in the Appendix A.

As a result, we see that MyOffrz experts have a very positive perception of the product as they know a lot about it. From the drawings, we conclude that the value has to be transparently communicated to the user. If perceived in the right way, offers should rather described as offers or deals than as online advertisements.

In this way, the conclusion might be drawn that the conceptual mental model of new product MyOffrz might be based on the mental model of OBA. However, it is very important to alter users'mental models towards perception of the value of the product.

To sum up, it is possible to point out several requirements for representation and explanations of MyOffrz. The following guidelines were identified from expert interviews:

- As little intrusive as possible. Offers should not be annoying in any sense, should not disturb the user and should not look like ads.

- It has to be clear that an offer brings value to the user.

- It has to be clear no private data is collected.

- It has to come at the right moment.

- It has to motivate the user to click.

- It has to make the user want more.

- As little steps as possible should be done to receive the proposed benefit.

- It should be clear it comes from Cliqz.

The explanation screens should differ for different players of the two-sided market: users and advertisers. The explanation for users should be concise and very interactive. It should explain the value it brings to the user, state that thanks to MyOffrz, Cliqz browser is free and that no private data is collected to make it work. The explanation for advertisers should be more informative, but also quite interactive. It should state the power of targeting, the possibility to fight banner blindness and general ad haters. It should highlight safety for advertisers due to CPA model. It should state that through this new way of advertising, companies could build trust and positive image as no private data about the user is collected for targeting.

In conclusion, the expert mental model is defined by the scheme created by the director of strategy of MyOffrz. It aligns with the opinions of other experts and is extended by two more main elements, which are algorithm, described by director of engineering and general perception and definition defined by all the participants of the study. Perception plays a very important role and basically defines MyOffrz as a product.

In the next chapter the current user's mental model is defined.

5.2   User study 1: User Mental Model

In order to be able to transform users' mental models, it is important to first define how they understand the product at the moment and where their model fails to reflect true mechanism used by intelligent system.

5.2.1   Study design

After analysis of the related work and overview of EMM, there were main areas of interest concerning users' perception identified. There were five main research questions which had to be answered at this stage of the research:

1. **How users understand privacy?** From the related work, it was discovered that people understand data privacy differently in a way that some believe that when your data is safe it means that no third parties are able to use the data for their analysis, while others understand that the third parties cannot even access the data. Thereby, the research question would be what user's general attitude towards privacy is and how much they are concerned about it. To answer this question the questionnaire for Westin's index for online privacy concerns was included as well as questions in the form of semi-structured interview were asked.

2. **How users understand information flows of MyOffrz? What is their mental model?** To answer this question the drawing task was used. After users saw an offer during the task scenario they were asked to draw what in their opinion is "happening behind the curtains" when the offer is shown to them.

3. **Understand if offers shown in different locations are perceived differently by the user?** To find out if different locations are perceived differently thinking-out-loud task scenarios were used, when users saw offers in two locations in a counter-balanced manner.

4. **Do they differ information flows of online ads and specifically MyOffrz?** This research question is answered by analysis of the words people use to describe offers as well as by evaluating the mental models from drawings and comparing them to mental models of OBA.

5. **Do they trust messages Cliqz show them?** Before the pre-study testing, there was the exemplary transparency message created: *Why do I see this? We don't know because no personal data leaves your device. Your browser automatically identifies what you might be interested in based on your previous use.* In the course of the test, the users were asked how they understand this message and how they feel about it.

In order to find out how users currently perceive MyOffrz, User Study 1 was conducted in the form of usability testing with task scenarios, questionnaire and semi-structured interview. The whole script of the usability test can be found on the USB stick. The set up was as follows. First, participants were presented with the short introduction about Cliqz, in which privacy features were emphasized. Second, they were asked to get familiar with the browser in general. Third, users were asked to shop for coffee online and two offers (in reward box and promo bar) were shown to them in a counter-balanced manner. They all were asked to think-aloud and give any feedback they have about what they see on the screen. To capture users' mental model, they were asked to conduct a drawing task explaining how the product works. After the usability test, short semi-structured interview was done in order to understand their attitude towards online privacy. After the tests were

over, participants had to fill out short questionnaire with general demographic questions and questionnaire for Westin's index. The questionnaire form is presented in the Appendix B. The results for the Westin's index were analyzed according to [17].

1. Privacy Fundamentalist: 'Strongly Disagree' on Q3 OR ('Strongly Agree' on Q1 and 'Strongly Disagree' or 'Somewhat Disagree' on Q2);

2. Privacy Unconcerned: Q3 is not 'Strongly Disagree' AND ('Strongly Disagree' or 'Somewhat Disagree' on Q1);

3. Privacy Pragmatist: All other participants.

Figure 5.2: How to define categories of Westin's index [17]

Results of the questionnaire are presented in the Appendix C.

5.2.2 Participants

All the participants were recruited through LMU Infodienst service. Recruiting email is presented in the appendix ... In total there were 13 participants aged from 20 to 60 years, 8 of them were females and 5 were males. 1 participant was invited for the pilot test, i.e. to test the study design and see how long the whole procedure takes and what is the best order of the tasks. The other 12 participants were presented with the offers in different order. Half saw the offer in the reward box first, and other half saw the offer in the promo bar first. All the participants were rewarded with either 10Euros or 1 MMI point, depending on their own choice. The reward was always given before start of the test to make participants feel as comfortable as possible.

One whole test took approximately 45 minutes. It was conducted on-site in the Cliqz office. All the tests were recorded, using Quick Time player. Activity on the screen and the voice was recorded. The recorded videos and notes of the tests can be found on a USB stick. All the mental models drawn during the tests are in the Appendix D.

5.2.3 Results

After the user tests were conducted, the results were gathered and analyzed. Across the tests several main topics were identified. The data thereby was gathered in a table with all those topics and overall results are available on the USB stick.

Several findings were discovered, while analyzing the received data. Some of them were only product-related and some were contributing to scientific research. We present the findings according to their source.

This chapter consists of three parts: findings from usability test and interviews, findings from the thematic analysis, and findings from the drawing task.

Usability test and interviews
We will start with describing results related to the usability of the product received from testing and interviews.

Finding 1: Offer disappears for no reason. Users do not understand the reason why the offer in the promo bar disappears. After the offer is triggered and shown to the user, if there is no interaction with the banner it disappears in 40 seconds. After its disappearance, the offer is gone completely and will not be triggered again. This seems counter-intuitive to the user, because they might accidentally not notice it or want to see what else is presented on the page before coming back to the offer. 7 out of 13 people did not expect the promo bar to disappear. Participants say:

"Oh, now I'm confused! I just saw it and now it's gone! Maybe I should reload the page to see it again?" (User)

"It disappeared now. But how do I get it back?" (User)

Finding 2: Promo bar looks like any other ad banner. It was found out that users perceive offer in a promo bar more as an as than the one in the reward box. 9 out of 13 participants start using word 'ad' when they see promo bar banner or explicitly say that offer looks like an ad. 3 out of 13 do not notice offer in promo bar at all. 3 out of 5 participants who saw promo bar first changed their wording from 'ad' to something positive ('offer', 'deal') after seeing reward box. 3 out of 8 people seeing reward box first changed their wording from positive 'offer' etc. to 'ad' after seeing promo bar. 7 out of 13 used word 'ad' explicitly to describe offer in promo bar. 3 out 13 said the placement in the promo bar makes an offer look like an ad. Some quotes from participants:

"Oh! I didn't even notice this banner here, cause it looks like all these other ads on amazon and I tend to ignore it." (User 7)

"I don't know what was in this banner, cause I though it was an ad and didn't look at it." (User)

Finding 3: Transparency message is confusing. When tested inside the Cliqz office, the transparency message: "Why do I see this? We don't know, because no private data leaves your PC." received very positive feedback. Cliqz employees found it very funny and witty. However, during the tests with the users who saw the product for the first time and did not know anything about the product, it was perceived negatively and confusing. 8 out of 13 people had problems understanding the message and as a consequence did not trust it. Some quotes what people said were:

"If you don't know then who knows?"(User 1)

"This is confusing, because I thought it's something like Google has, when you can choose the topics you want to get ads for!" (User 9)

Finding 4: If a user goes to a specific website, she looks for a particular product. 10 out of 13 people said that if they go to the particular website, they want some product from this website. Thereby, they would like to first explore the options from this website and after that maybe they would look into other offers they get there. Some of the quotes form the users were:

"I guess it's from roastmarket. I don't know if it's fair to show offer of different website on the other website." (User 12)

"It seems like it's a particular website, which I knew before. If I go to specific website it means I want to buy something here, so I would be disturbed by seeing an offer from another store." (User 11)

Finding 5: Sometimes users just can not or do not want to care about privacy. There were several participants, who clearly stated during the semi-structured interview

that they know their personal data is collected online, but they can not do anything with it, so they just do nothing. In total 7 participants out of 13 said that, although it's not nice that the data is collected, they either can not do anything or do not want to put additional effort into data protection. Exemplary quotes from the users:

' *"I don't want people to have access to my private data, but now we don't have much choice"* (User 5)

"We are all used to it (advertising companies collecting personal data online), *but I don't have time to think about it"* (User 11)

Finding 6: Users don't notice grey 'About' button. The grey 'About' button is very hard to notice, because it's almost the same color as the background. 8 out of 13 participants could not find it, even though were explicitly asked to search for it.

Finding 7: Users want to be informed and in control. Some of the users mentioned that they were not informed in advance that they will get the offers, that's why they reacted to it as ads. For example, some users said:

"I didn't know that I will get these offers here, could be better if you would let me know in advance and I could choose if I want it or not. (User 9)

"What is it? How can I get more? Why there is no information about it?" (User 1)

Thematic analysis

The data received from interviews and usability tests was mostly qualitative and the decision was made to use thematic analysis as described in the chapter "Concept and Approach". This method was chosen, mostly because it is suitable for beginners in qualitative analysis and fits for relatively small data sets.

The main topics extracted from the data were:

- Reaction to the offer in promo bar

- Reaction to the offer in reward box

- Comments on mental models (from drawing tasks)

- Reaction to seeing the offer for the second time

- Reaction to offer disappearing on its own

- Comments on existing explanations, i.e. transparency message and about page

- Definitions of MyOffrz given by the users at the end of the test and interview

As a result of the thematic analysis there were created theme maps for the topics within the qualitative data. Theme maps are presented on the schemes below:

Reward box/ Promo bar
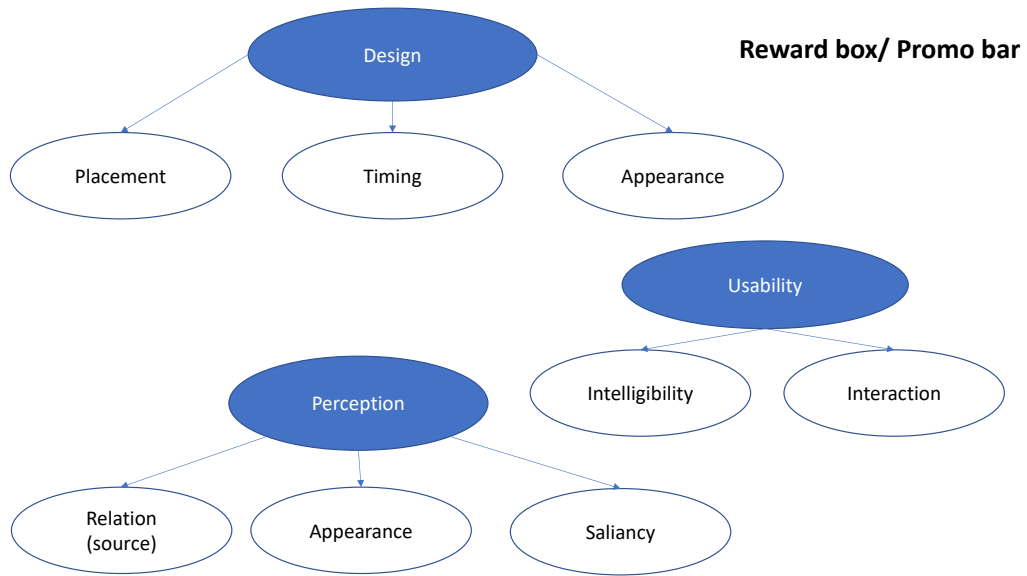
Figure 5.3: Thematic analysis for promo bar and reward box

From this theme map, it can be concluded that the first thing people notice about the product is design. Usually people create their own perception of a product very quickly and it comes from the appearance, saliency and relations to other products. Usability is another important point, that comes from how fast people can understand how the system works and how easily they can interact with it. This map shows the first impression about the product and also refers to interface properties of the system. This stage in general plays a very important role in the future intention to use the product. If on this stage users are not satisfied or confused with something, they might never come back to the product again.
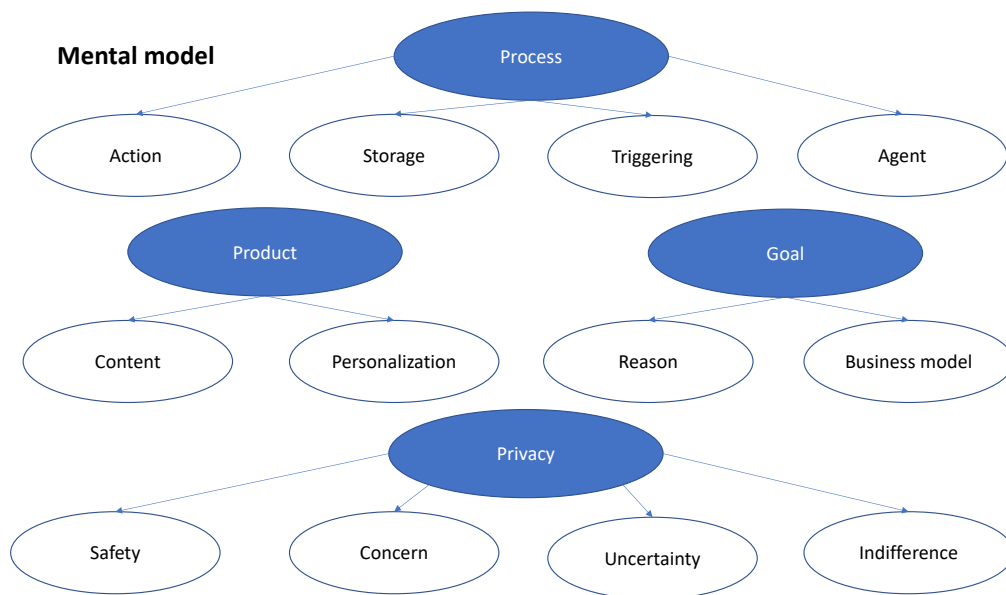
Mental model

Figure 5.4: Thematic analysis for mental models

The word map presented above reflects the first idea about users' mental models. At this point participant of the study are explicitly asked to think about how the system works and draw their own mental model. Here, people start thinking about deeper technology behind the product, such as process, consisting of action, storage, triggering and agent, then Product with it's content, goal of the company, i.e. the initial reason and business model. Privacy also comes up at this stage. As participants were informed that the company focuses on online privacy, they express their concern or state that with Cliqz they feel safe, or they are not sure if it is possible to provide privacy with this kind of product, or they simply say that they do not care about it.

Definition of MyOffrz

Wording   Business

Privacy

Content   Appearance

Location   Design
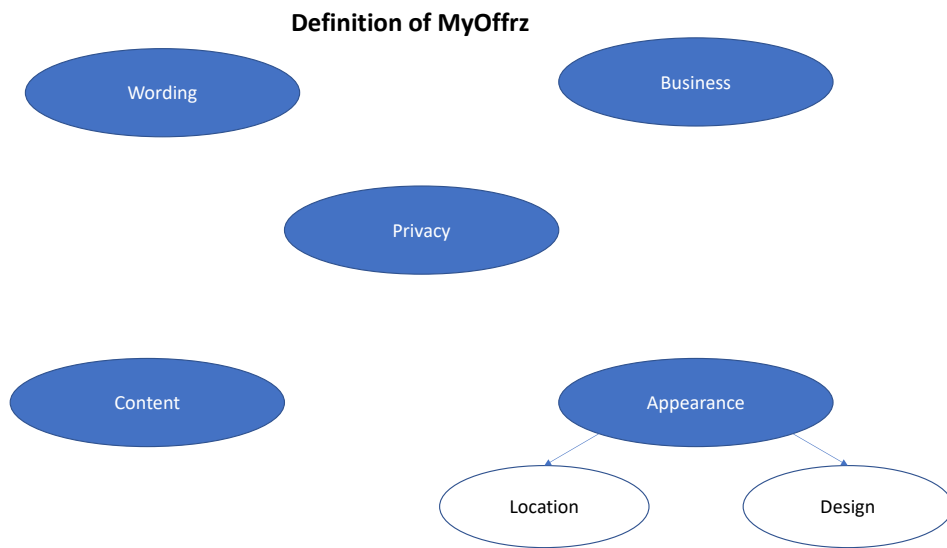
Figure 5.5: Thematic analysis for definitions of MyOffrz

Finally, on the word map presented above, we can see representation of users' understanding of the product after they used it for some time, discussed how it might be working and read through actual explanations. In that sense, we can see that overall idea of a product becomes deeper after diving into the inner processes of the intelligent system. At this stage people talk more about business model and privacy aspect, the wording changes form the single product like: 'ad', 'offer', to the whole system like: 'add-on', 'app' etc. Appearance is still mentioned on this stage, which means it has strong influence on users' understanding of the product.

Finding 8: Users improve their own mental model when forced to think about functionality of an intelligent system. By analyzing results from the thematic analysis, it is made clear that when people are explicitly asked to think about how the system functions, they are able to improve their own model even without additional knowledge. It is proved by the theme maps, which show that understanding of the elements included into the intelligent system improves with every step when participants are asked to dig deeper into internal processes of the system.

Finding 9: First of all users react to how the product is presented. As it was stated in the overview of the related work, perception plays an integral role in the process of building correct mental model. Thereby, first impressions and overall reaction is very interesting for the research as well as users' process of thinking. It was discovered that first reactions after seeing the offer were related to design and usability. After users were explicitly asked to think about how the system works through the drawing task, the topics

of algorithmic process came up as well as business goal. After seeing the transparency message, users start mentioning privacy concerns as well. On the higher level, when asked to give a definition for MyOffrz in general, people tended to use higher level wording, e.g. using word 'ad' or 'offer' when they saw it for the first time and using words 'platform', 'software' or 'addon', while describing MyOffrz at the end of the tests.

Drawing task

From the testing there were received 13 drawings for the mental models, they were divided into categories according to Westin's privacy index and analyzed. Full list of the drawings is presented in the appendix . . .

Finding 10: Fundamentalists have deeper understanding of the technology, while Pragmatists are not concerned, because they do not completely understand how the system works. Results of the drawing tasks clearly correlate with the Westin's category, as well as with the participants' backgrounds. In the study of [49] knowledge gap between privacy pragmatists and privacy fundamentalists is discussed. The researchers state that knowledge obtained by the people will influence their privacy category. In that sense less knowledgeable people are most of the time privacy pragmatists, as they do not have extended knowledge about technology and online privacy in general, they would trust intelligent systems more per se. While privacy fundamentalists are more informed about related topics, they would understand better how system works and thereby will be more concerned about online privacy. Results of our study confirm this finding. Really, participants who are defined as privacy pragmatists are usually the ones who have very primitive mental models. On the contrary, fundamentalists are the ones who draw very extensive mental models and often have additional background in computer science or hold a general interest in technology.

In that sense, by analyzing the drawing tasks, common elements of the mental models might be defined for different categories of privacy concern.

For pragmatists, main elements include:

- Website

- Process of choice of the offer usually done by

    Browser

    People in the cliqz office

    Undefined system

    Cloud

- Keywords

- Ad/pop-up/coupon

For fundamentalists, the models are usually more detailed and include more elements. The common elements for this category are:

- Data Base/List of offers/Classifier/Filter

- Choice of the placement

- Some kind of third-party involved: company/merchant/business partner

- PC/Browser

As seen from these elements, they are also represented somehow easier in the drawings done by pragmatists and more complicated in the drawings by fundamentalists. In the picture below presented the mental model drawn by participant number 10 as an example for Fundamentalists' models:
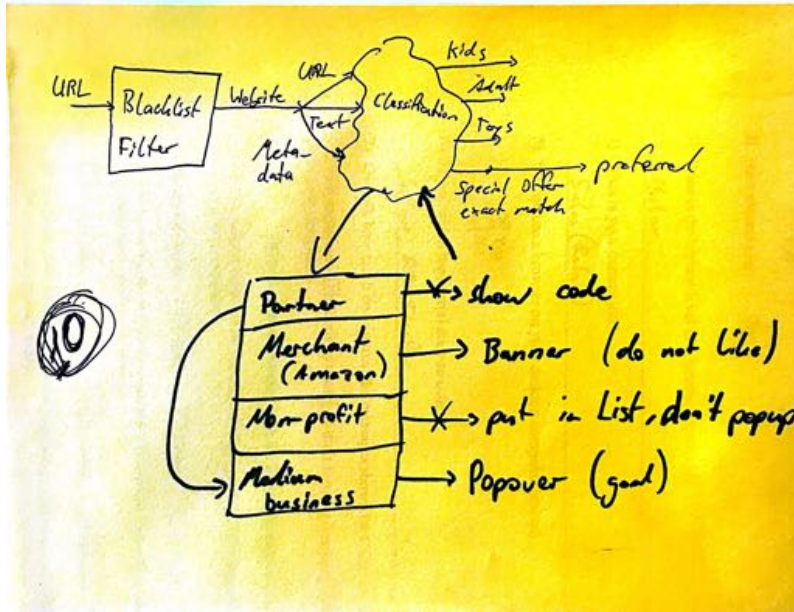
Figure 5.6: Advanced mental model drawn by Fundamentalist participant number 10

This models contains a lot of advanced elements like classifier, filter, blacklist and data base with rows, which it includes.
As an example for a simplified model drawn by pragmatists, the drawing by participant number 12 is presented below:

Figure 5.7: Simple mental model drawn by Pragmatist participant number 12

This model looks more creative with the curtain understood literally from the stated question: "What do you think is happening behind the curtains when the offer is shown to you?". Additionally, the participant supposes that decisions about the choice of the offer and its placement is done by actual people in the Cliqz office. This participant does not have any prior knowledge about online advertising and is not in general interested in technology.

After combining all the categories, common elements for both groups are defined as:

- Reason why the offer is shown, i.e. keyword or url

- Some kind of algorithm that makes decisions about placement and the exact offer shown

- Some kind of data base that stores the data and offers themselves

- Offer itself

- Browser or PC

To sum up, after analyzing the results, we found out that privacy categories are related to the knowledge users have about technology in general and specifically about intelligent systems. However, most of the users include the same kinds of elements in their models, which might just be represented differently. Perception is an important part of the process of building the correct mental model. Perception is mostly influenced by design and appearance. The more people use the system, the deeper they dive into understanding of its core technologies.

In that sense, in this chapter the first study aimed at elicitation of users' mental model was described and main elements of the UMM were given.

5.3 Target mental model

In this chapter we would like to focus on defining target mental model (TMM). TMM represents how the mental model of the user should look like after a successful transformation. Thereby, in order to identify how mental models should be changed, let's first compare EMM and UMM. To structure the comparison in more ordered way, we would use the themes defined from thematic analysis.

The table summarizing differences between two models is presented below.

Element	EMM	UMM
Perception	Experts perceive the product as a new marketing tool and mostly see positive sides of it. They usually highlight features like personalization, quality of offers, and unique ability to connect users to the beneficial information.	A lot of the users perceive offers as ads, thereby problems appear related to saliency and first reaction. For example, people perceiving an offer as an ad tend to close it before they even realized that it had beneficial content.
Usability	Experts mostly mention precise targeting as the biggest usability treat for the users and risk-free payment model for partner companies.	For users usability mostly contains interactions and intelligibility. They strive for the system which is easy to understand and easy to use, thereby as soon as they face some problems of misunderstanding they become confused and feel more negative about the whole product.
Design	Design in the opinion of experts has to be aligned with Cliqz corporate design in order to make it clear where offers come from.	User's feedback on design is more general and mostly related to appearance and placements.
Process	Obviously, experts have a deep knowledge of how the system works with all the details about algorithm. When asked to explain it in short and simple words they focus on the differences between OBA and My-Offrz. In other words, the algorithm itself is kind of a black box, but the data flows are explained in detail as that is where most differences come from.	When users are asked about the way offers work they usually base their assumptions on what they already know about OBA. Generally, their explanations have several main parts, which include: • *Triggering* (through webpage or keyword) • *Storage* (the place where offers and keywords stored) • *Algorithm* (which most of the time is a black box) Sometimes they also would include business agents.
Agent	Expert view on the agent is clear. It has to be obvious that the offers come from Cliqz browser.	Users sometimes were unsure where the offer comes from and apart from Cliqz browser were relating it to the websites they were at or other search engines.

Storage	The data is not collected and not stored anywhere. There is a package with offers and triggering rules, that is sent to the client side, where all the analysis is done on the user's laptop. However, there is data about usage and confirmation of purchases, which sent through proxy server to Cliqz in order to bill the business partners.	Users usually mention idea about storage: it might be a database or a list. However, it usually exists separately from their computers or search engines.
Business goal	Experts highlight importance of My-Offrz for the Cliqz browser in general. For Cliqz, MyOffrz is a monetization strategy, which means that it allows to them deliver high-quality product for free.	Some of the users don't care about business strategy, although there are also ones who are aware of it and point out themselves that this is a way to make the browser free.
Content	Experts point out a clear values of offers for the user. At the same time they also differ types of benefits user get: it might be a discount, a system that helps to make a better decision or offering of just offering something on top of what user already wanted.	Users understand content differently, depending on the perception of the offer. In case they see it as an ad, they assume by default that it contains only advertising. Apparently, when users pay more attention to the content, they notice that an offer has some benefit for them. In that case, they mention beneficial content in their definition of MyOffrz.
Privacy	Experts put privacy very high on the scale of importance. As it is one of the main company values, they highlight that offers are private every time they explain MyOffrz.	Users mention privacy mostly after they had some information about it before. So they would be concerned about privacy, because it was mentioned to them before that Cliqz is a private browser or after seeing transparency message. When they read explanation screens, they sometimes don't believe it as they don't understand the technology.

In this respect, it can be concluded that the process itself is the biggest uncertainty for the user and the model of experts and users differs the most here. At the same time, as it was stated in the research, algorithmic transparency is very important for all intelligent systems, hence that's the topic that has to be explained in detail. Storage is another point that differs a lot in two mental models. Storage is a topic closely related to privacy, as it's a way to assure online privacy, and to process, as it is part of the algorithm. Privacy itself should be included into process of transformation, because it is part of company vision and can not only make the intelligent system more transparent, but also help to create trust in the product and brand in general. Perception is another crucial point in the explanations as mostly, the continuation of the use of a product depends on the first impression. In case when the user does not perceive offer as something valuable, she might not even pay much attention to it, hence close the offer right away or ignore it without looking into the

content. While experts mostly think of offers as something valuable and beneficial, users often think of it as an annoying ad. That partly happens because of the appearance of the banners, that is very similar to online advertising. There is a significant gap between perception of experts and users, that also has to be addressed in the process of mental model transformation. Instead of an ad, people should think of it as something beneficial, e.g. 'shopping-assistant', 'offer' or even 'friend'.

5.3.1   Post-study: So, what to explain?

Through analyzing different kinds of mental models, we found a lot of elements that have to be explained. But, normally explanations as well as privacy notices have to be as concise as possible [1]. Then how can we decide which elements to include? Which ones are the most important?

To answer these questions, the decision was made to conduct a short additional study.

The study design was as follows. Participants of the previous test were presented with the list of elements of target mental model via email. They were asked to choose five of them and rank them according to how interesting and how important these elements are personally for them. Full email with the task is given in the Appendix E. Participants were the same people who took part in the previous test. Participation in this test was voluntary, hence people chose themselves if they want to answer or not and they were not rewarded with anything.

To make elements clearer they were transformed into questions with short explanations. One element - "Process" was divided into smaller items due to information received from expert interviews, that is: 'Algorithm', 'Data flows', 'Agent', 'Proxy server' and 'Storage'. All the questions and explanations are presented in the list below:

All the information items are presented below:

1. **What is MyOffrz?** ? Defining offers and explicitly identifying what value you will get from it, e.g. deal, discount etc.

2. **How to use MyOffrz?** ? Mainly explaining how you can interact with offers, e.g. how to copy the code, how to trigger offers or how to close it.

3. **Where can you see MyOffrz?** ? How and why you see offers in a pop-up or a banner.

4. **Algorithm?** ? How every offer is chosen for you, e.g. you have a coffee deal, because you looked for ?buy coffee? on google.

5. **Data flows?** ? How the confirmation that you used an offer is sent, where is it stored and how is it used.

6. **Proxy server?** ? How does the proxy server work, how does it assure complete privacy.

7. **Agent?** ? Where does an offer come from, how it was found and how the terms of the deal were negotiated.

8. **Storage?** ? Where are the offers stored and where does the analysis happen.

9. **Business goal?** ? Why do we show it you, how do we earn money with offers and what we use this money for.

10. **Privacy?** ? Detailed explanation on how we assure your privacy.

In total, out of 13 people participated in the initial test, 9 responded to the additional study. In the table below, results of the study are presented:

Participant Item	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1		1	1					1		1	4	1
2					4				2		2	5	
3					5						3	3	
4	2	5	5	2					5				
5		4		4	2		3		4				5
6					3				3			2	
7		3					2						4
8	5		3				4				4		
9	4	1	4	3			5						3
10	3	2	2	5	1		1				5	1	2

Figure 5.8: Results of the post-study

In that sense, the rank was created with five top elements:

1. **What is MyOffrz?** - the value for a user

2. **Privacy?** - detailed explanation on how we assure your privacy.

3. **Business goal?** - why the money are needed.

4. **Data flows?** - how and where the data is sent.

5. **Algorithm?** - logic behind the intelligent system.

To sum up, in this section, elements that have to be explained were identified as well as their ranking according to the importance for the user. By conducting additional study with the ranking task, we already started using user-centered design process by directly asking the user what they want to be explained. In the next section, design for the explanation screens will be defined and created.

6   How to explain?

This part of the work concentrates on answering the question: "How to explain?". The framework for process of changing mental models is defined and explanation screens are designed and evaluated through user-centered design process.

This section is structured as follows. Firstly, the framework for explanations of intelligent systems is defined. Secondly, the concept for explanations is created. Thirdly, several iterations are conducted to define final design.

6.1   Framework: changing mental models for intelligent systems

As a foundation for a framework for the process of explanations of intelligent systems was taken the model of trust in electronic commerce described in the related work before [41]. These steps were proven to be relevant for explanations of intelligent systems and specifically online advertising products.

From the first study, qualitative data proving that the steps, described in the model are applicable to explanations as well was received. The steps are: pre-interactional filters, interface properties and informational content. Examples of the quotes that participants said:

1. Pre-interactional filters:

   "Oh I didn't expect this to happen" (User1)

   "This was a surprise for me, because I wasn't warned about this feature before" (User11)

2. Interface properties:

   "I closed this pop-up, because it just looks like any other ad" aa(User9)

   "The placement and picture makes it look like an ad and I usually ignore ads" (User4)

3. Informational content:

   "I think it's great to know that my personal data is safe and they should inform me about it" (User5)

   "We don't know – something I wouldn't expect from the company, they should know (User7)

Thereby, some assumptions we can make from users' feedback are:

1. People want to be informed beforehand that they will get notifications/pop-ups/ads etc. Supported by Finding 7.

2. First impression of design and interface properties define users' behaviors and attitude towards the product. Hence, if offer looks like an ad, they will close it or ignore it if they do not like ads in general. Supported by Finding 9.

3. Users want to have explanations and be informed not only about how the system works, but also about how the company actually earns money, how it keeps the values and promises etc. Partly supported by Finding 7.

Thereby, it is possible to match elements of the trust model to elements of explanations of the intelligent systems. Firstly, people get informed about the new product and start creating their own mental model through pre-interactional filters. It might be social media,

friends' recommendations or on boarding process, when they just start using the product. Secondly, the interface properties, such as design and appearance define how users react when the first face the intelligent system at work. Thirdly, informational content is perceived when previous stages were able to make the user interested in the product and, hence, learn more about it through actual content.

6.2   Scope and Concept

As the scope of presented work is limited, it has to be focused on one of the stages of the framework. The decision is made to focus on the last stage, informational content. The main reason is that the goal of this thesis is to change users' mental models and according to the research this is possible through explanations, which directly confront the mental model users formed themselves [32]. Second reason is that by the time users come to informational content, they already have some kind of mental model which can be confirmed or disproved. In that sense, first two stages form the initial mental model, but mostly are based on users' prior knowledge. Thereby, by the time users come to explanations, they have already formed an initial mental model. In that sense, explanations are the final step and the last chance to correct users' mental models. Thirdly, the explanation screens have more space for creativity and allow to find fourth-rate solution.

After making decisions about the focus of the thesis, there was a design brainstorming conducted with the UX-specialists from the company. During this brainstorming session, concept based on laddering technique was developed. Laddering is mostly used and known as a technique for conducting in-depth interviews [50]. The idea is that interviewee is asked to first identify some special attributes of a product, and then consequently is asked several "Why"-questions to define initial motivation and attitude towards product attributes, the process is fully described in a work of [51]. We decided to use this "why"-approach for our explanation screens as well. Users will be guided through different levels of explanations, that will explain one or two topics about the product. Although laddering is used in many different fields of research, it is not that popular yet in product development. Levels are defined as the ranks from the post-study. Some input is also taken from the related work about explanation screens. The concept of W-questions used in the design is called "W-onion" approach. Just like levels in the onion it reveals different themes for explanation of the intelligent system.

The following section describes the whole design process in detail.

6.3 Design

After defining the concept and exploring options for explanation screens, first iterations were made. The laddering concept applied towards explanation screens was called "W-onion" approach, as by answering W-questions it explained deeper layers of the mental model just like layers in an onion.

6.3.1 Design space

The design was done according to user-centered design approach. The prototype was developed in an iterative manner and tested after every iteration. There were several testers for intermediate evaluation, who were mainly recruited in the Cliqz office. Additionally, we conducted several brainstorming sessions with designers and UX specialists.

Before the start of actual development, we had to make several important decisions.

Firstly, there were two options for representation of the explanations: textual or visual. Thereby, we started with creating two paper prototypes for this options, which are presented on the pictures below.

Paper prototypes were created for both representations and they are presented below.

(a) Prototype with plain text explanations

(b) Prototype with schematic explanations
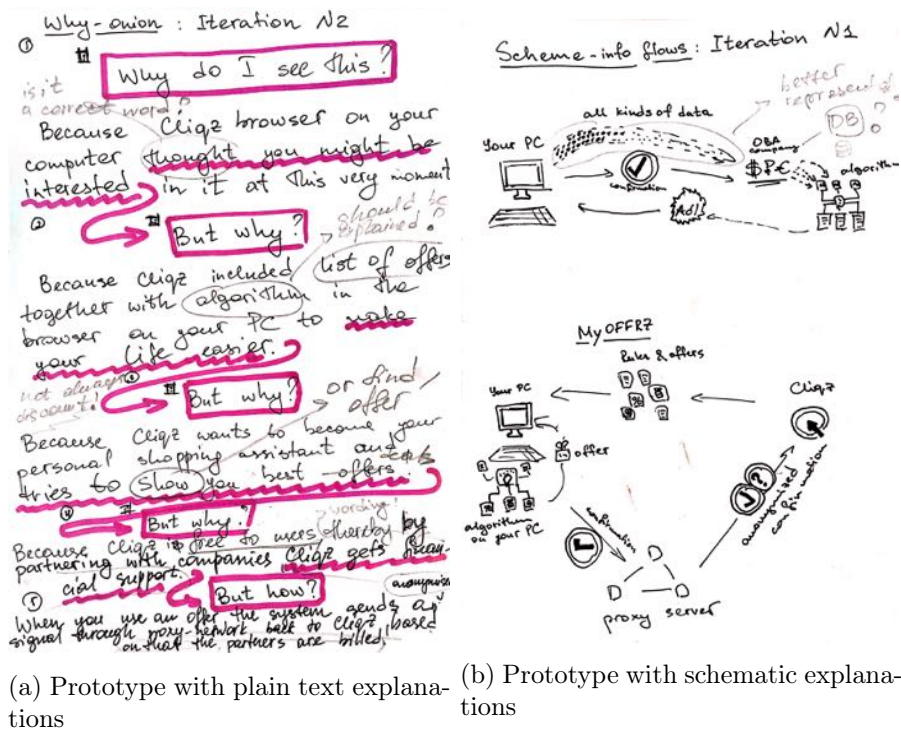
Figure 6.1: First paper prototypes

As a result of short feedback from the users we found out that plain text explanations were a bit too long and sometimes too boring to read. At the same time schematic explanations were nice to look at, but not always clear, e.g. users could not understand what kind of data is actually sent and how does the proxy server work. Participants stated a preference to have mixed explanations, where images would be supported by a short text to make it as transparent as possible.

We decided to combine imagistic and textual approach and create explanations that contain both. This kind of design is also supported by related work, such as [32]. By implementing schematic elements, we can easily contradict users' erroneous mental models, while by including text elements, we can reach a higher level of transparency.

We did several iterations to test content and especially wording and through this iterative process we came up with the final prototype in Word.

1.   Value

You are in Myoffrz hub! Here we try to offer you the best deals from our business partners on something that is interesting for you, such as: discounts, coupons, comparison tools etc.

2.   Privacy

At Cliqz we value privacy a lot!
We make sure your private data is completely safe and never leaves your PC.

3.   Business goal

As you know, our products: browser, search engine and Ghostery are completely free of charge. That's why we need offers to support our daily operations and keep Cliqz up and running.

4.   **Data flows**
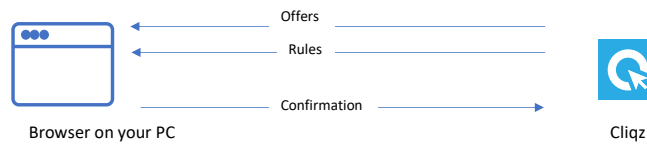
5.   **Algorithm**
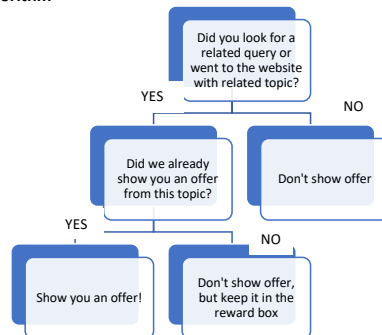
Figure 6.2: Paper prototype with graphic explanations

Next question to answer is where to place the call-to-action button. We mocked four options for the call-to-action button, shown on the picture below.

(a) First option

(b) Second option

(c) Third option

(d) Fourth option

Figure 6.3: Option for placement of the call-to-action button

We showed these mock-ups to the people in the office in order to get quick feedback from them. We recruited different kind of employees, including designers and UX researchers. We asked them two questions: Which screen do you like the most? Which placement in your opinion will be the most noticeable?

As a result of a study 3 people voted for option 1, 0 people voted for option 2, 5 people voted for option 3 and 1 person voted for option 4. In that sense 3rd option was a leader and it was decided to combine it with option one. It was decided to present the explanations inside the reward box and present levels on different screens through which users can click through. In that sense, the option 3 was the first step of the user flow and at the second step we were presenting option 1, which was already matched to the value topic. We decided to situate call-to-action button not at the bottom of the window how it it don in the option 3, but on top of the reward box. This small change allowed us to make the button more noticeable and recognizable.

Now we have all the content we need ready for development of the prototype and we know where to place the call-to-action button. Still there is one more question to answer: how to present the explanations?

We have two main options. We could create a separate page with the instructions or we could present it in the existing UI. As we wanted to give the user easiest access to explanations we decided to present them in the existing UI and give users choose themselves if they want to go through them and how deep they want to dive into different levels. Our idea was to use W-onion approach to structure different themes we want to address, thereby we decided to present it in the reward box on different screens.

The concept we used at the end is presented in the paper-version below:
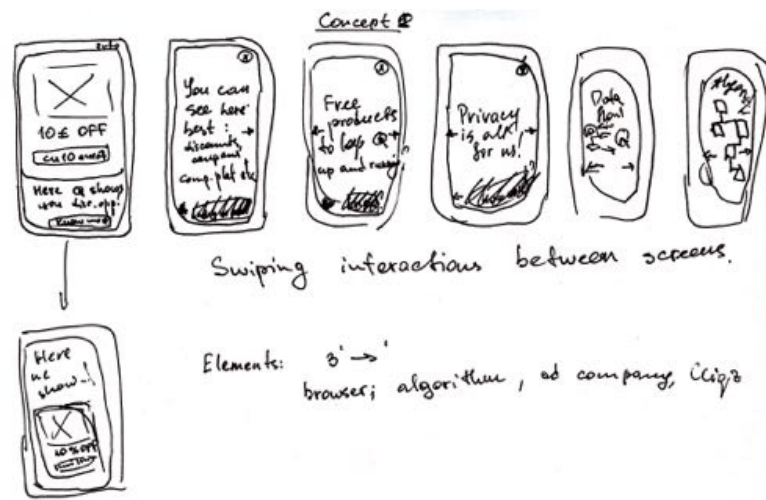
Figure 6.4: Concept for levels of the W-onion approach

In that sense we used W-onion approach to structure the explanations into levels. Each screen is dedicated to a certain level and topic of the explanation. We decided to situate call-to-action button on top of the window and use combined text and image explanations. We have 5 main levels of the W-onion approach.

1. What? - product level, explaining what kind of offers user will see here.

2. How? - privacy level, describing how Cliqz supports its company values in this particular product. This level is also aimed to create more trust and assure the user that he is safe.

3. Why? - business goal level, which explains that company does it because it needs money to support it's daily operations.

4. How it works? - data flows level, showing what kind of data is exchanged and how it is done.

5. What if? - algorithm level, which shows which events led to which kind of result.

On the first step we created a clickable prototype in InVision. On the later stages we decided to use Principle to create high fidelity prototype. Later on we will only describe iterations done in Principle.

During the iterative design process we decided to combine screen 2 and 3 into one. In the next chapter we will shortly describe 4 main screens included in the final prototype and will show the main changes we did to the texts and design.

6.3.2   Screen 1

First screen of the prototype was dedicated to the value of the product. It was very important to first show the user what they could get out of it and why they should user the product.
The process of improvement of the first screen is shown on the pictures below:

(a) First iteration

(b) Second iteration

(c) Third iteration
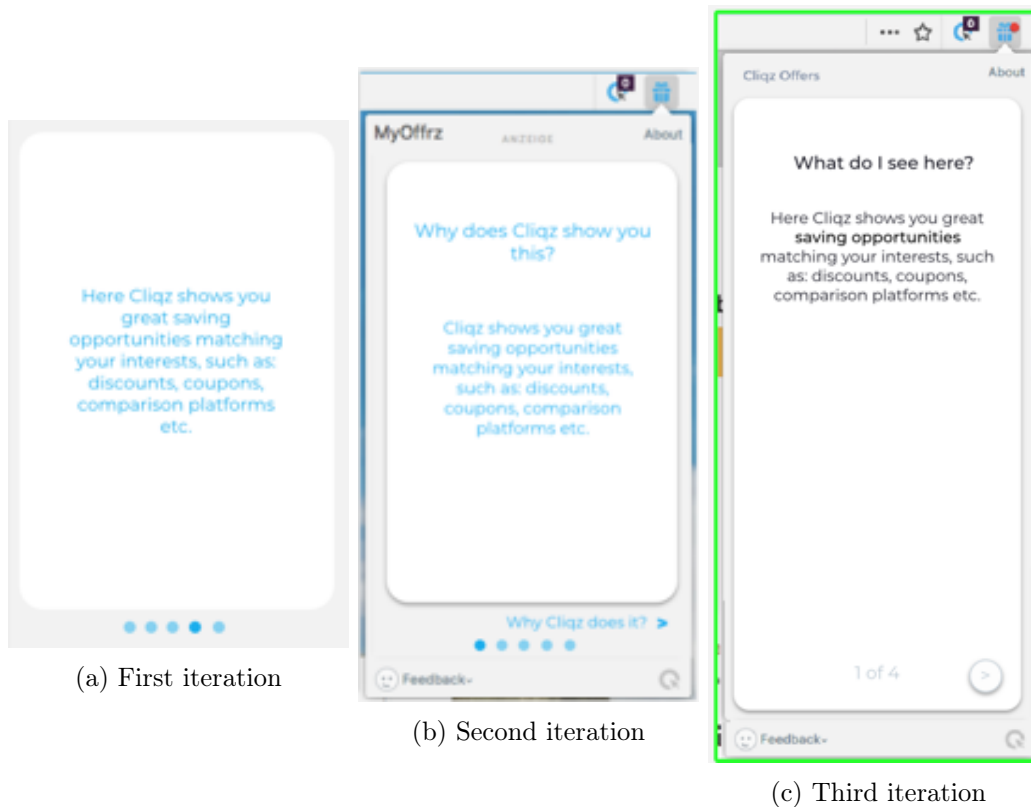
Figure 6.5: Evolution of the prototypes for the first screen

Changes on the first screen were mostly related to changes in the design and appearance of the whole prototype. We changed the color of the text to be easier to read, as well as the look and feel of the back and forth buttons.
One major change was the question in the title of the screen. We tested the prototype without any title, but it was a little bit unstructured as users were not right away informed what kind of information they are getting. Screen also looked better when it had a title. In that sense it was decide to add questions in the title of every screen. Firstly, we tried to fit everything under why-questions, however the content presented on the screen did not always matched the question right. After all, we decided to change the question to "What do I see here?". This decision was also partly made, because in the initial transparency message we had the same question and it would be easier for the users who already saw it to adapt to a new version.

6.3.3   Screen 2

Initially the second screen was supposed to explain the business goal of MyOffrz. From User Study 1 we found out that people were very interested in why Cliqz needs money and how to earn them with MyOffrz.

Through iterative process, we discovered that users prefer to have their explanations as short as possible and going through 5 screens was a little too much for them. For that reason we decided to combine the second and the third screens. Screen 3 was supposed to explain privacy policy at MyOffrz. Privacy was an important part of the explanations as it is the main company value and the most important selling point of the Cliqz browser. From related work, we also found out that highlighting the company values in the explanations creates more user trust towards the product [52]. Hence, we needed a sentence to assure personal privacy from Cliqz and make users understand although it was already a slightly different product, the values supported by Cliqz will be also assured in MyOffrz. Thereby, we combined screen 2 and 3 in order to shorten the explanations, but we kept all the necessary content.

Through several iterations of user-centered design process we improved the wording. We also divided the text into two sentences, because that way it was easier for the user to perceive the information.

Three iterations of the design for the second screen are presented on the pictures below.

(a) First iteration

(b) Second iteration

(c) Third iteration
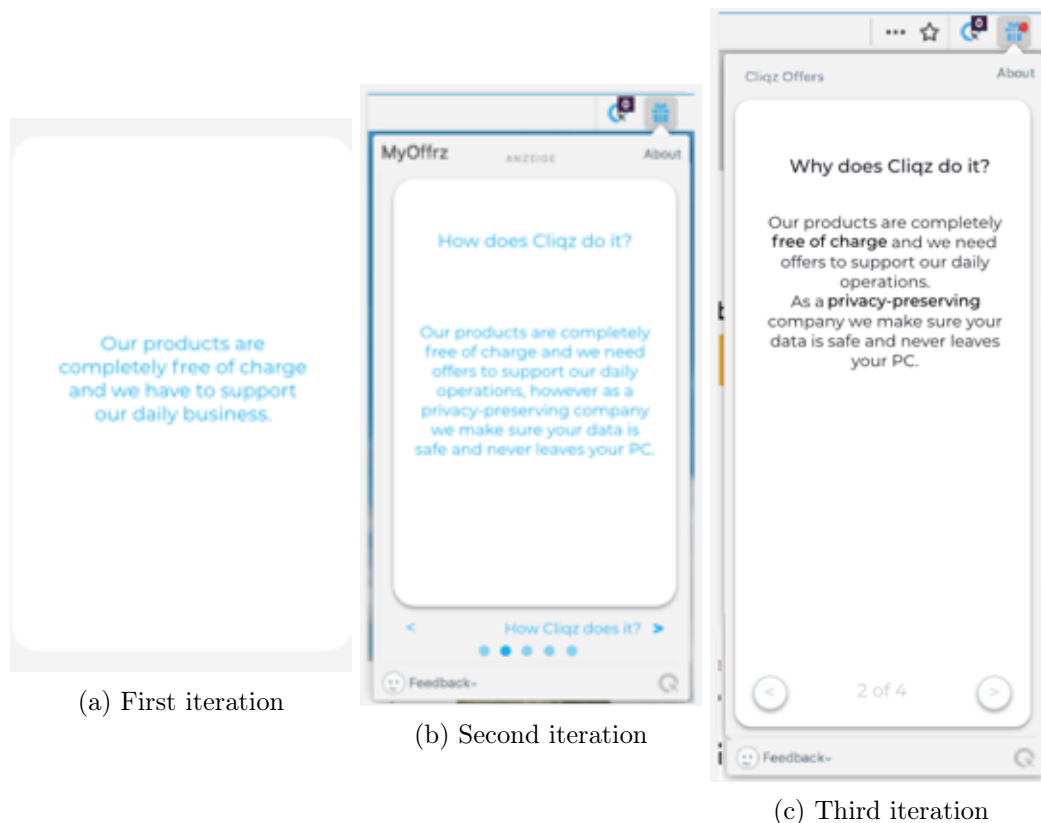
Figure 6.6: Evolution of the prototypes for the second screen

6.3.4   Screen 3

The third screen was meant to explain data flows happening inside MyOffrz. It was an important part of the design as it explained the technology standing behind the system that worked in a similar way as OBA, but was preserving online privacy of the user.
The three iterations for the third screen are presented on the pictures below:

(a) First iteration

(b) Second iteration

(c) Third iteration
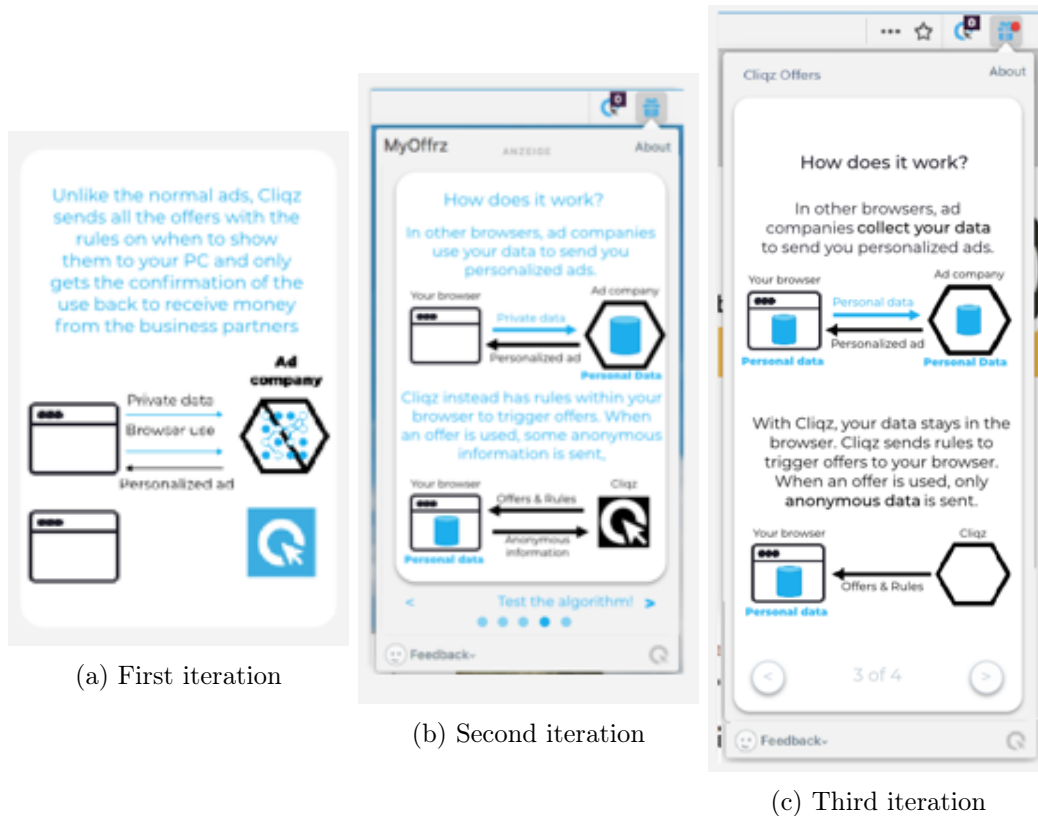
Figure 6.7: Evolution of the prototypes for the third screen

This part consists of both text and a scheme. We have to be very careful with designing this combined approach for the explanations. It should not be overloaded with the text, but at the same time should perfectly explain what user sees on the picture. The same can be derived about the scheme as well. It should be very clear and consist of as little number of the elements as possible, although explain the main idea. We decided to base explanation on the comparison of two systems which are often mixed up by the user: normal OBA and MyOffrz.
On the first stage we tried to make the screen more interactive and created an animation: when user hovers over the schemes, the private data flows move and show how they go in MyOffrz in comparison with OBA. At the second stage we turned this idea down, because it was not intuitive for the users to hover on the screen and they also were not able to have both schemes at the same time to properly compare them.
After the second iteration, we discovered that two arrows on the scheme about MyOffrz are quite confusing for users and because of them users don't understand what kind of data is sent first and last. In that sense for the final prototype we eliminated one of the arrows, although we kept information about the signal that is sent back in the text.
Through iterations, we additionally tried to improve the appearance of the schemes. As they consist of several elements, sometimes it seems a little overloaded. That is why we tried to eliminate as many elements as possible and refined the final schemes to look neat.

6.3.5   Screen 4

The last screen aimed to explain how the underlying algorithm works to the user in a straight-forward way. On the first stage we used approach of a decision tree, however we realized that in the window we use for explanations it is very hard to read through the whole tree. Thereby, we decided to go for another approach with some gamification element. We designed a quiz, which users were able to take and go through different options as many times as they want.

The iterations for the fourth screen are presented on the pictures below:

(a) First iteration

(b) Second iteration

(c) Third iteration
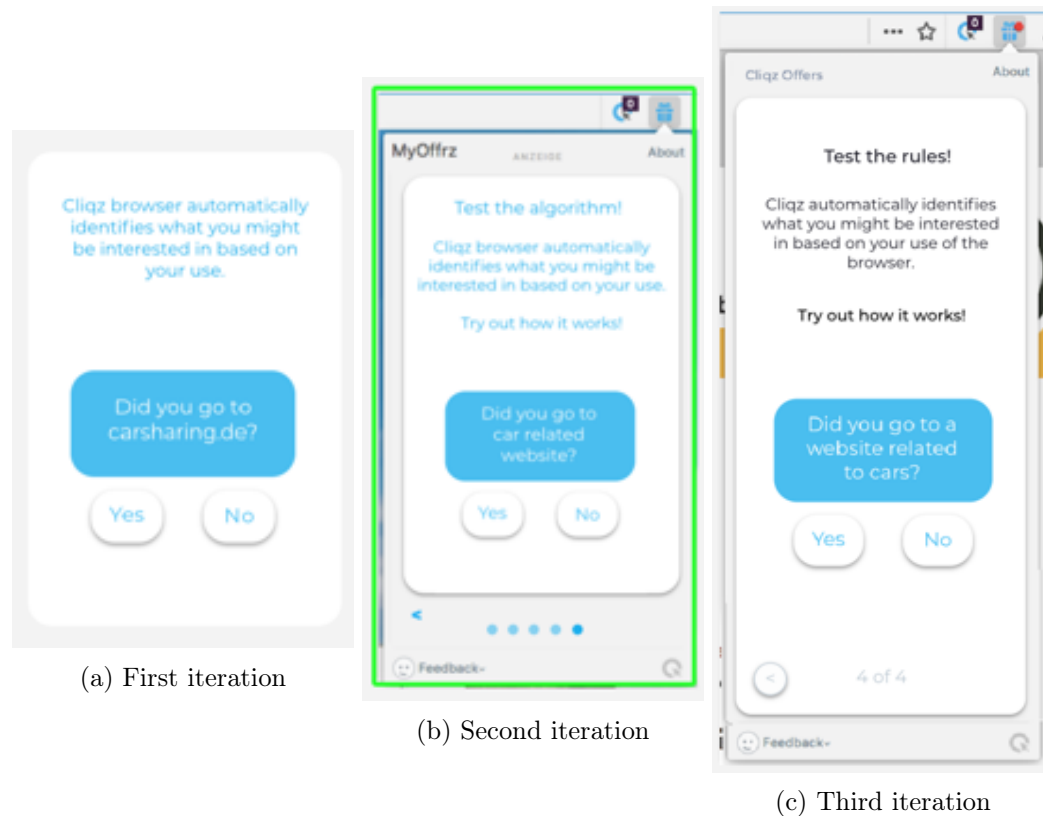
Figure 6.8: Evolution of the prototypes for the fourth screen

The concept of the quiz for explanation of the algorithm helped us to not only to make the process more entertaining and interactive, but also to answer important questions derived from the related work. From [43] we found out that "why?" and "why not?" explanations are the most important. By introducing the quiz, we allowed users to see by themselves what will happen when they do some particular actions in the interface.

One important change we have made through the iteration was redefinition of the questions, as some of them turned out to be not as transparent as it seemed. For example, second question was: "Did you see the car-related offer before?". Users could not understand if the offer meant was the one they just saw or some other offer they were supposed to see in the past. Thereby, we changed this question into: "Did you see car-related offer before this one?". That made the process more transparent and made people think less on the answers.

6.3.6 Final prototype

Using user centered design process we iterated on our Principle prototype. In this chapter we present the final prototype and list some of the findings that helped us to improve the protitype after the first and the second iterations.
Findings discovered after the first iteration were:

- Back and forth buttons are not visible.

- Some texts are not at the same levels.

- The progression line was not intuitive for desktop version, it's a better fit for mobile.

- On the data flows schemes, it is not intuitive enough that you have to hover to see the change of the arrows.

- Screen with the data flows is too overloaded with information. It is also not that easy to compare OBA and MyOffrz, because the schemes are never presented together on the screen.

At this point the prototype was tested with 4 users recruited through LMU Infodienst service. There were 2 males and 2 females aged 24-27 years. There were several obvious flaws in the prototype, that were changed after another session with the UI and UX designers:

- Users did not correctly perceived the arrows on the scheme with the data flows.

- Users did not know how to close the screens.

- Back and forth button were not noticeable.

- Second and third screen were kind of with the same topic and participants said they will prefer to have less screens.

- The second question in the algorithm quiz was not clear: participants could not understand if the offer they just saw now is meant or the other one even before the current one.

- Every screen has different amount of text and thereby, centering in the middle was not percieved well.

- Design wise color of the text was not consistent with the rest of the interface.

As a result the prototype was improved and the final version which was evaluated later on is presented on the picture below:

Figure 6.9: Final prototype used for the evaluation

Figure 6.10: Test the rules quiz in the final prototype

As a result, through several iterations of user-centered design process, the high fidelity prototype was developed. It is based on developed earlier "W-onion" approach, includes elements of gamification to engage the user more and contains both text and graphic explanations combined, which were proved to be the most effective in the related work. In the next chapter the evaluation of the final prototype will be conducted through a User Study 2, which is similar to the one done in the first step of the research.

7   User Study 2: Evaluation

In this chapter the final prototype was tested and evaluated. Usability testing was used as a method for the final study. Study design was similar to the one conducted in the first part of the work, the full study design is presented available on the USB stick.

7.1   Study design

The goal was to make a study as similar as possible to the pre-study in order to keep the structure clear. Hence, we used the same methods to answer research questions and analyze the results.

In general, the study consisted of 3 parts. First was a think-aloud task with the offer represented this time only in the reward box. After that users were presented with the prototype and were asked to go through the explanation screens. Participants were asked to draw their mental model two times: after they first saw the offer and after they read through explanation screens. After the test was over they had to fill out the same questionnaire from the first study to define Westin's privacy attitude category.

Main research questions that had to be answered in the test were:

1. **How does mental model change after people see explanations?**

2. **How deep do they go into explanation screens?**

3. **How correct are users' mental models after explanations?**

4. **What is their attitude towards online privacy?** (through Westin's index)

7.2   Participants

Participants were recruited through LMU Infodienst service and Facebook. In total, 19 people took part in the final evaluation study aged 18-39 years old. Out of them 11 were females and 8 were males. Out of 19 people, 6 were Fundamentalists, 2 were Unconcerned and the other 11 were Pragmatists. After the first 4 tests we had to slightly alter the prototype, because we found some obvious usability issues, e.g. the back and forth button was not intuitive enough out that the scheme with 2 arrows is not intuitive for the user and the prototype was slightly changed.

The whole test took on average around 30 minutes. It was conducted in the Cliqz office and the set up was similar to the first study. Participants got 5 Euros for a test. The money was given to them before the test started to make them feel more comfortable and relaxed.

7.3   Results

Overall results of the test with videos and notes can be found on the USB stick. Drawings of the mental models are presented in the Appendix D.

The results are presented in a similar way to the User Study 1 and will cover findings from usability tests together with interviews, thematic analysis and drawing task.

Usability test and interviews
Finding 1/previously Finding 4: If user goes to a specific website, she looks for a particular product. Half of the participants said that if they are going to a particular website, they want to buy something specifically there. Couple of quotes are:

"If I go to a website, then I know for sure what I want and these ads are annoying!" (User 4)

"If I look for something specific, I would want to see it first and maybe after I would be interested in looking at other options" (Users 10)

Finding 2/previously Finding 7: Users want to be informed and in control. 12 participants out of 19 pointed out that they would be less annoyed if they would have been informed about offers in advance or asked if they want to get it or not. Exemplary quotes are:

"This is something unexpected for me! Because it is something I didn't ask for in advance" (User 2)

"I expect that I can configure the rules somehow, because I like to control types of ads I get." (User 9)

Finding 3: Gamification of the explanation of the algorithm is entertaining. Users reacted very positively to the last screen with the short quiz about triggering rules. 12 out of 19 participants said that the quiz to learn more about the rules is cool. 5 participants went back to the quiz start several times and tried all the possible options. They said:

"This questionnaire is kinda funny! I find it very cool!" (User 5)

"I like that they explain why they show this offer. And these interactions on the last screen are nice and very clear." (User 6)

Finding 4: Users prefer screens containing more than just plain text. All 19 users said that they liked either screen 3 or 4 the most out of all of them. Users' quotes were:

"I really like the concept used on the 4th screen! It was funny and I would say it's my favorite!" (User 2)

"I am very visual person and I understand schematic explanations better, that's why screen 3 was my favorite! (User 16)

Thematic analysis

The data received from the usability testing and interviews was again analyzed using thematic analysis as was described in the chapter "Concept and Approach" and used for the first User Study.

As a result of the thematic analysis, two theme maps were created: about seeing the offer and about the prototype with the explanation screens.
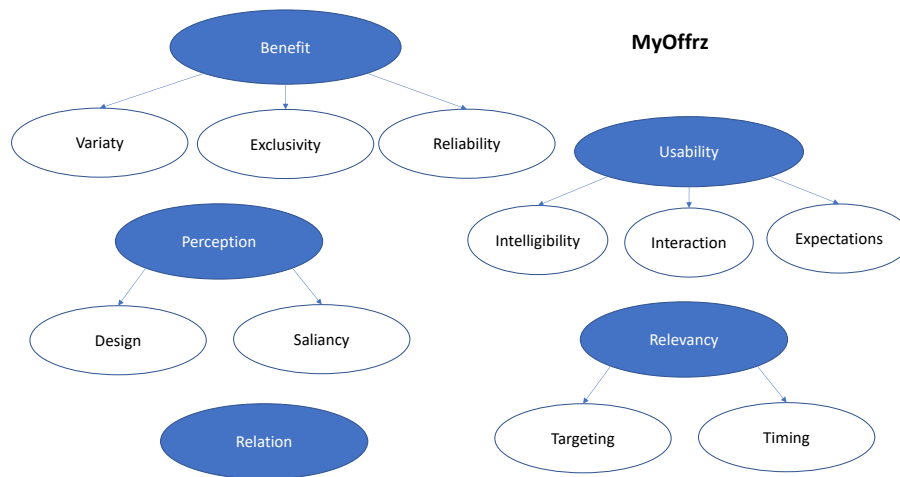
Figure 7.1: Thematic analysis for first impression about MyOffrz

As seen from the scheme, main topics users touch after seeing MyOffrz for the first time are benefit, Usability, Perception, Relevancy and Relation.

Users understand benefit that offers bring to them from variety, exclusivity and reliability. That is firstly if the user has a choice and if he is presented with the proper number of offers. Secondly, if the offer is exclusive and can not be found anywhere else. Thirdly, if the offer is reliable, which is understood by the user as the offer being truly the best on the Internet.

Perception plays a very important role as it helps the user to notice the offer on the first place. The design as well is an important part as it forms the first impression of the product and gives a foundation to form the first mental model.

Usability is firstly defined by how well people understand in what way they have to interact with the system. Secondly, it is important for the system to meet users' expectations. Thirdly, the interactions with the system should be intuitive and enjoyable.

In the specific case of offers, relevancy is an important issue. In order to catch user's attention it is vital that targeting works properly and the offer is shown at the right time. Relation comes up in the topic as well. Which means users still do not completely understand when the offers come from.
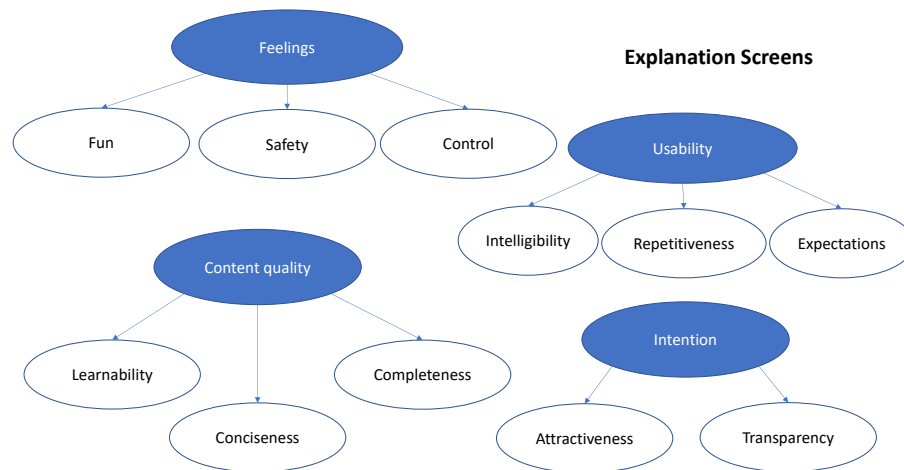
Figure 7.2: Thematic analysis for first impression about MyOffrz

The theme map presented above describes users reaction towards prototype with the explanation screens. The themes appearing in this research are: feelings, usability, content quality and Intention.

When users go through explanations they have different feelings they like. They are having fun by explanations with visuals and gamification elements. They feel more safe after the screen describing privacy policy and they like to feel in control about what kind of offers they are getting.

As it is an informational content its quality is quite important. It has to be easy to remember what was explained, the information given has to be concise and complete.

Intention of the user, which might be to go through all the screens or close them at some point is formed by attractiveness and transparency of the user interface.

Drawing task

Finding 5: Final mental model is either presented by data flows or decision tree from the explanations. As there were two visual representations of how the system works, users were refining their mental models based on either scheme of the data flows or the algorithm decision tree. Thereby, in all cases the mental model improved after users were presented with the explanations.
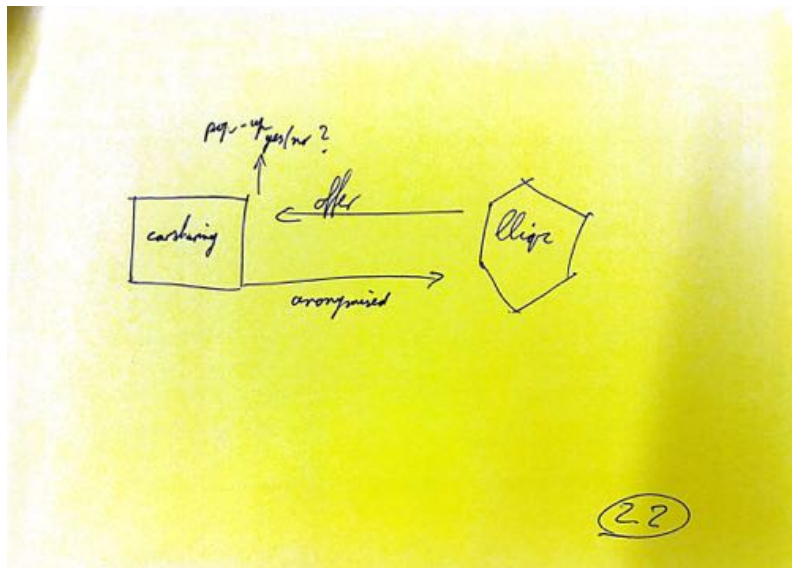
Figure 7.3: Mental model imitating scheme of the data flows from the explanations
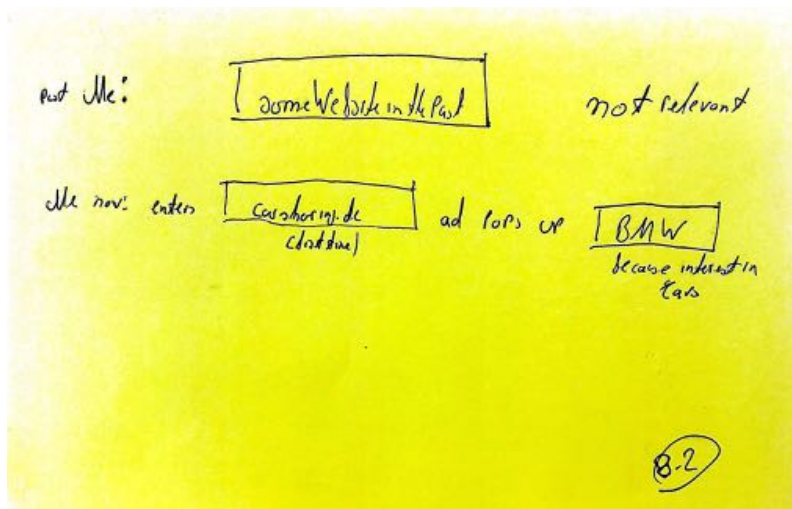
Figure 7.4: Mental model imitating scheme of the algorithm decision tree from the explanations

Finding 6: Users are interested to see all the screens. 10 out of 15 users said that they would go through all the screens. The other 5 said they would close it after the first one because:

"I would stop at the first screen, because I didn't notice the arrows to go back and fourth." (User 15)

"I am not that interested in this information, so I would either not click on this button at all or I would close the explanations after the first screen" (User 14)

Finding 7: It is easier to improve already correct mental model, than transform a completely wrong one. By looking at the drawings of the mental models it is possible to notice that the correctness of the transformed models depends on the level of correctness of the initially defined mental model. Thereby, all the models improved through the explanation screens, but not all of them were completely correct at the end.

It is interesting to point out that some of the participants did not pay enough attention to the text. Although they have read all of them, they did not always perceived the idea about data flows in a right way.
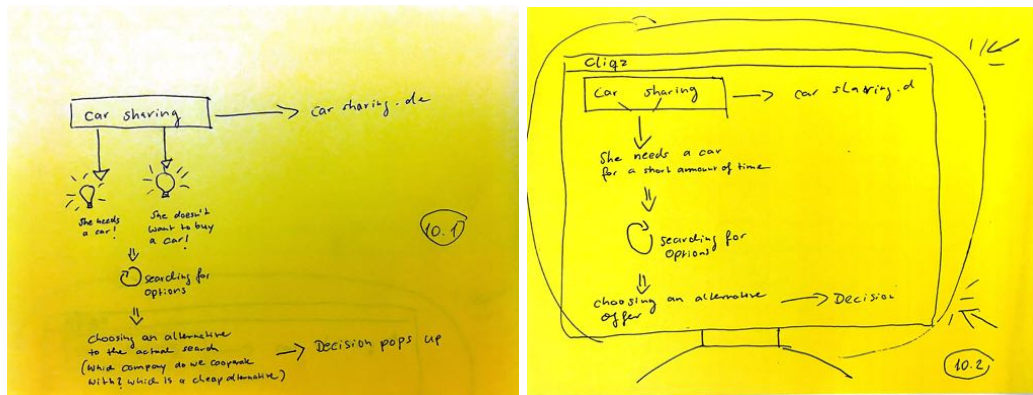
(a) Pragmatist mental model of User 10 before seeing the explanations

(b) Pragmatist mental model of User 10 after seeing the explanations

Figure 7.5: Mental models drawn by the User 10

On the drawing above transformation of a mental model of a Pragmatist is presented. The one of the most important points of explanations is privacy. It is very important that user realizes that the data is processed on the computer of the user. In that sense this model is a perfect example of efficiency of the explanations. Although the participant does not bear any deep knowledge about technology, she realizes that all the analysis is happening inside the browser. The participant schematically shows it by drawing screen edges around the decision tree of an algorithm.
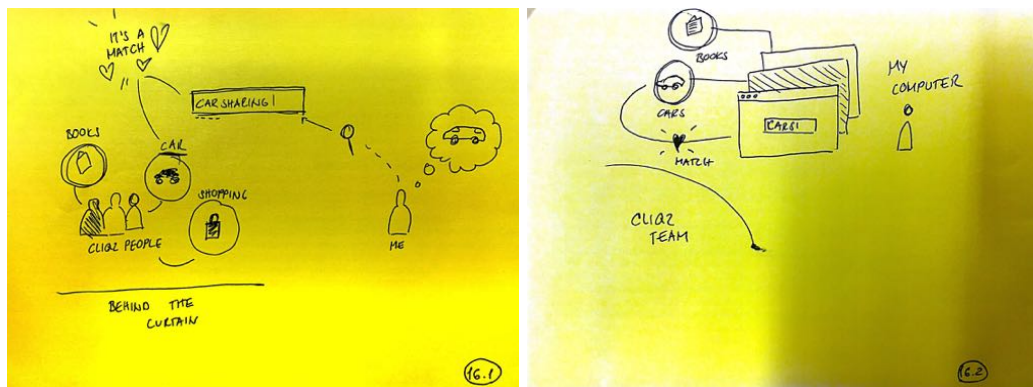
(a) Fundamentalist mental model of User 16 before seeing the explanations

(b) Fundamentalist mental model of User 16 after seeing the explanations

Figure 7.6: Mental models drawn by the User 16

The presented above model is a good example of mental model transformation. As the participant was very tech savvy and had a lot of prior knowledge about intelligent systems in general (she studies computer science), she adopted new knowledge easier and faster. The model was very precise initially, however after explanations she acquired additional information about the algorithm and technology. Schematically on the second drawing, Cliqz team is shown separately from the system, which emphasizes privacy aspect and reflects how the data flows work. This model proves effectiveness of the explanation screens. **Finding 8/previously Finding 10: Fundamentalists have deeper understand-**

ing of the technology, while Pragmatists are not concerned, because they do not completely understand how the system works. Westin's index questionnaire confirmed results received in the first study and proved that Fundamentalists in general have more detailed models and deeper knowledge about technology. Pragmatists are less informed about intelligent systems and technology in general, thereby they are less concerned about privacy.

8   Discussion

In the course of work on the presented thesis, several findings were discovered. Some of them were product-related and thereby benefited by improving usability and design of the intelligent system MyOffrz. Product-related findings and its implementation include:

1. Offer should not disappear without any informing message.

   Currently MyOffrz does not disappear on its own and if the user really does not want to see it, she has to explicitly close it.

2. Promo bar looks like any other ad.

   Most of the offers are moved from promo bar location into reward box.

3. Transparency message is confusing.

   The project on implementing transparency message was stopped. Currently the UI designers team is working on developing the on-boarding. It is planned to implement the prototype presented in this thesis in the future.

4. Users do not notice grey 'About' button.

   The 'About' button was taken away from the UI. Currently, users can find more information about the product in the help center.

5. Users want to be informed and in control.

   The UI designers team is currently working on the new on-boarding, where users will be informed about MyOffrz and will have a choice to opt it out.

Several scientific findings were discovered as well. Firstly, the theory about Westin's privacy index was confirmed by both studies and showed a clear tendency for the Fundamentalists to be better informed about technology and Pragmatists having limited knowledge about intelligent systems. This means that Pragmatists are not concerned about privacy for the reason that they don't completely understand how intelligent systems work.

Secondly, the framework for the process of changing mental models of intelligent systems was developed. Framework consists of 3 stages: on-boarding or/and social media, user interface and explanation screens. These steps can be applied to any other intelligent system that is new and unknown for the users. By using these three stages it is possible to create more trust in the intelligent system and develop the right mental model.

Thirdly, as a result of the usability testing, there were defined several general tendencies in the use of MyOffrz, which can be transferred to other intelligent systems as well. For example, users tend to prefer explanations that combine several approaches, such as text and visual representation. Users also prefer to have some gamification elements in the explanations.

Additionally, it is discovered that if users are forced to think about what is happening behind the curtains of a particular system, they tend to build better mental models, even though sometimes it is very hard for them to even imagine what is happening in the black box.

Moreover, design properties have proved to play an important role in the understanding of a product. First impression of the UI basically defines users behavior and it is very important to catch their attention with the design first.

It is also important to mention that users are first of all humans and they like to be in control. Thereby, it is important to give a choice to the people who use the product and make them feel like they have complete information and can influence the results at any

time. Although user choice is often hard to implement, it has a clear potential to make the product more enjoyable and catchy.

In conclusion, the product-related finding of the current work are valuable and were already partly implemented. More general results can be applied to other novel intelligent system with some adjustments. Scientific results did confirm the prior research on intelligent systems and online privacy perception.

9   Limitations

In the course of work, the goal was reached and the way to transform erroneous mental models was found. However, it is important to point out several limitations of the research. First of all, the amount of participants cannot be used for statistical analysis as the number of users who took part in the final evaluation does not reach n=30 needed to apply normal distribution. Thereby, the data and results received can only be used for qualitative analysis and describe tendencies in user behaviour.

Secondly, the product used in the presented work is very specific. And although findings can be generalized to other intelligent systems, it has to be done with caution. In case of applying results to other products, peculiarities of those products have to be taken into account and additional research has to be done in advance.

It is also very important to point out that mental models is a very fragile concept in human-computer interaction science. It is often hard to elicit completely accurate mental model, because sometimes humans themselves can not understand what exactly they are thinking. Hence, we have to count for some level of inaccuracy in the approach for mental model elicitation.

It is worth mentioning that in best practices of user experience, it is supposed that usability testing cannot be conducted by the same person who developed the prototype. However, for the reason of lack of the resources in the current research prototype design and usability testing was done by the same person.

All the participants for the studies were recruited through LMU Infodienst service or/and Facebook. It can be thereby derived that the target group used in the research is somehow specific. All the participants are people who already have or currently pursuing higher education degree, they are on average more informed about technology than others and all live in Munich, a very developed and highly innovative European city. This target group fits well to the Cliqz product as most of the Cliqz users are highly educated, interested in technology and thereby privacy concerned. At the same time, sets of participants might not be generalized to other products with different target groups.

The prototype itself is developed specifically for MyOffrz. It means that the information items and their rankings is developed according to the specific functionality and technology used in the product. It means that in case the framework and concept is applied for other products, information items have to be defined separately and specifically for that product. In conclusion, although there are some limitations of the presented work, the results hold high practical value and might be applied to other similar products with similar target groups. Additionally, the developed design will be used for MyOffrz in future and the presented research proves that it can effectively correct users' mental models.

10   Conclusion

The main objective of this master thesis was to find a way to correct users' mental models about MyOffrz—an intelligent advertisement system. MyOffrz is a novel system which from the users' point of view works as OBA, but in fact is based on a different technology. As a result of the conducted work, the prototype with 4 explanation screens was developed and tested through an iterative user-centered design process. The goal was reached and final evaluation proved that the users' mental models change after they read explanations. Additionally, in the course of work, the framework for changing mental models of intelligent systems was defined and supported by findings from the qualitative analysis.

All the tasks defined before the research were successfully completed:

- Related work was found and analyzed

- The current mental models of the users about ad systems and in particular MyOffrz were defined through literature research and User Study 1

- Different concepts for transparency were explored as well as different ways to explain privacy in an intelligent system

- The User Study 2 was conducted in order to evaluate the final prototype and the proposed concept for transparency communication

Through analyzing related literature, we chose a participatory design framework to firstly find out what mental model users currently have and then discover how the system has to be designed in order to educate users and correct their mental models.

In order to find what should be explained, we have conducted User Study 1 and identified that there are specific information items that has to be included in explanations. We conducted a short post-study and defined ranking of the items as presented below:

1. Value

2. Privacy

3. Business goal

4. Data flows

5. Algorithm

After literature research and pre-studies, we have defined the framework for changing mental models of intelligent systems, which consists of pre-interactions, interface properties and informational content. We decided to focus on the informational content and develop explanation screens for MyOffrz. We have explored options for designing explanations. After conducting a brainstorming session with the experts we have defined a concept of W-onion explanations, which was based on the laddering technique. Explanations were presented in a form of 4 screens, each describing specific information item from the ranking received from a short post-study.

Through a user-centered design process we have developed a prototype of the explanation screens for MyOffrz in Principle. The prototype was tested and evaluated through User Study 2. The study showed that explanations are able to effectively correct users' mental models. Additionally, we found out that gamification elements in the UI are perceived positively by the user. In general users prefer explanations that combine textual and visual elements.

We found connection between proficiency in technology and attitude towards online privacy. Users who understand technology on a deeper level tend to be more privacy concerned, while the ones who have limited knowledge about intelligent systems tend to not care much about online privacy.

In conclusion, although there are several limitations of the work, such as limited amount of participants and high specificity of the product, the results of the work have a high practical value. The prototype developed in the course of work is ready for implementation and proved to successfully correct users' erroneous mental models. Scientific findings and the framework can be applied to other systems with adjustments for peculiarities of the particular system.

11 Future work

As a result we managed to develop the framework for changing mental models of intelligent systems and a specific prototype for explanations of MyOffrz. After final evaluation the prototype was proved to effectively correct mental models of users. Although the concept worked the way it supposed to, there are several areas for future improvement.

The prototype itself was design and tested in an iterative manner. It is ready to implement, although it might still be improved and altered on the later stages of implementation.

The focus of the current research was specifically on the explanation screens. This stage allows the best way to confront and correct users' mental models. However, the first two steps might make a significant change as well. In that sense, future work should be focused on researching UI properties that might help to form correct mental model of an intelligent system. One idea could be, for example, adding ribbed edges to the banner, which will make it look more like a coupon and, hence, change the perception about it. Another useful idea could be to make all the elements of an offer more visible: coupon number, expiration time, discount number etc.

As it was mentioned in the discussion, the information user has before facing the system in real life plays an important role in preparing users' mental models for the correct interaction with the system. In that sense, future work should investigate the influence of pre-interactional filters on the correctness of the mental models. Research might be focused on the development of the on-boarding user flow or on investigation of influence of social media exposure on the correctness of the users' mental models.

As it was stated in the Limitations, the number of participants in the study was not high enough, thereby academia might benefit from a study with the bigger scale that will bring some statistical measures. As well as from all the studies conducted with products from different segments and with different target groups.

We also can not say that there are no other factors influencing correctness of the mental models. Thereby, future work can research completely different ways of changing mental models.

In conclusion, the research on intelligent systems is at its very beginning. There are a lot of areas for future work that have to be investigated. Current work presents only part of the research about explanations of the intelligent systems and in particular ad services. Thereby, the results might be improved and extended by future work.

Appendices

A   Survey: how employees understand MyOffrz
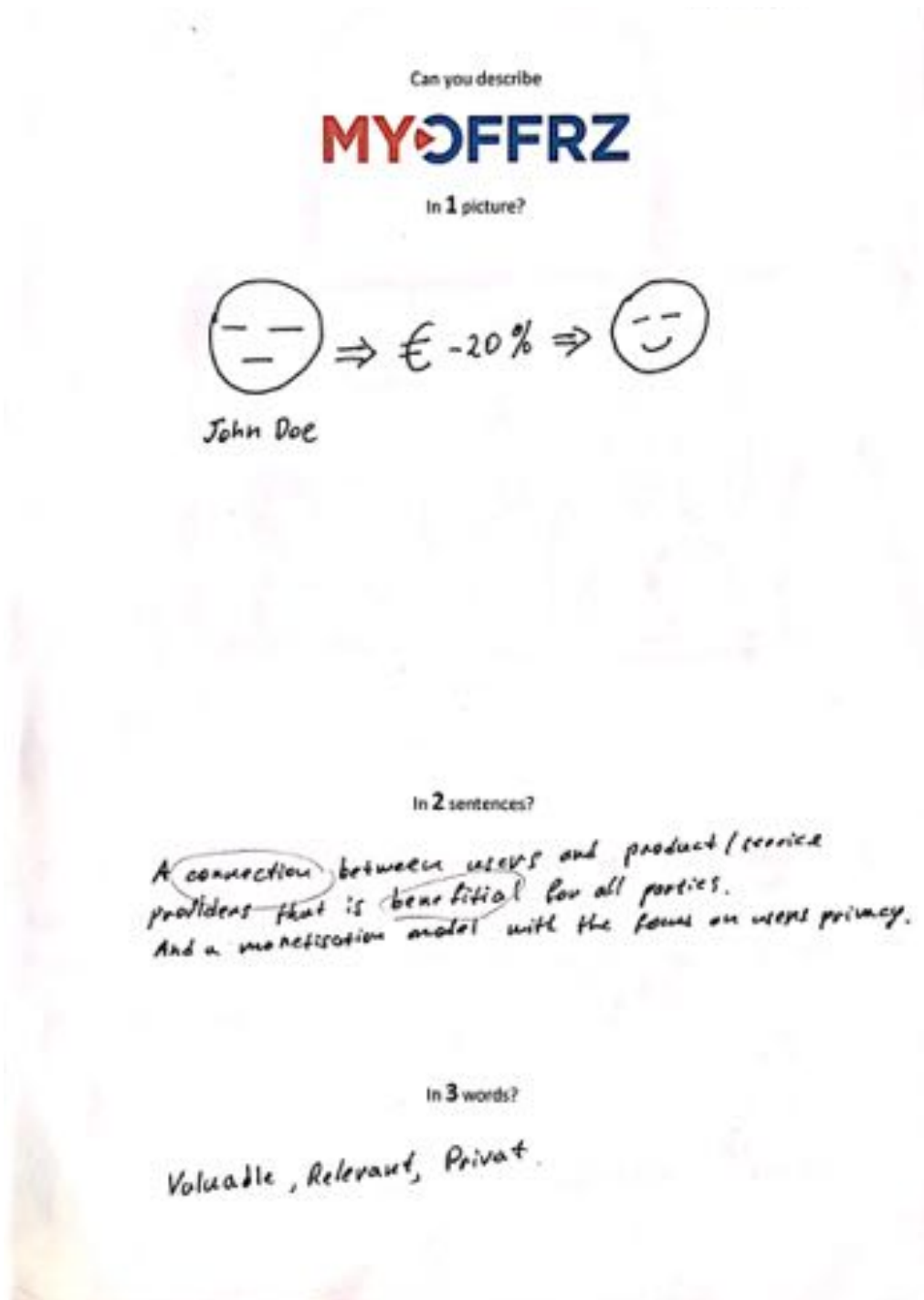
Figure A.1: Survey from employee 1

Cony

Can you describe -

MY❯OFFRZ

In **1** picture?

FREE

fingerprint

In **2** sentences?

In browser /addon embedded ~~e-fomey~~ ~~compliant~~ website-independent tool ~~that~~ whose innovative technology allows a | very granular targeting only when an offer ~~≠~~ might be relevant to a user.

In **3** words?

Individualized Private Marketing
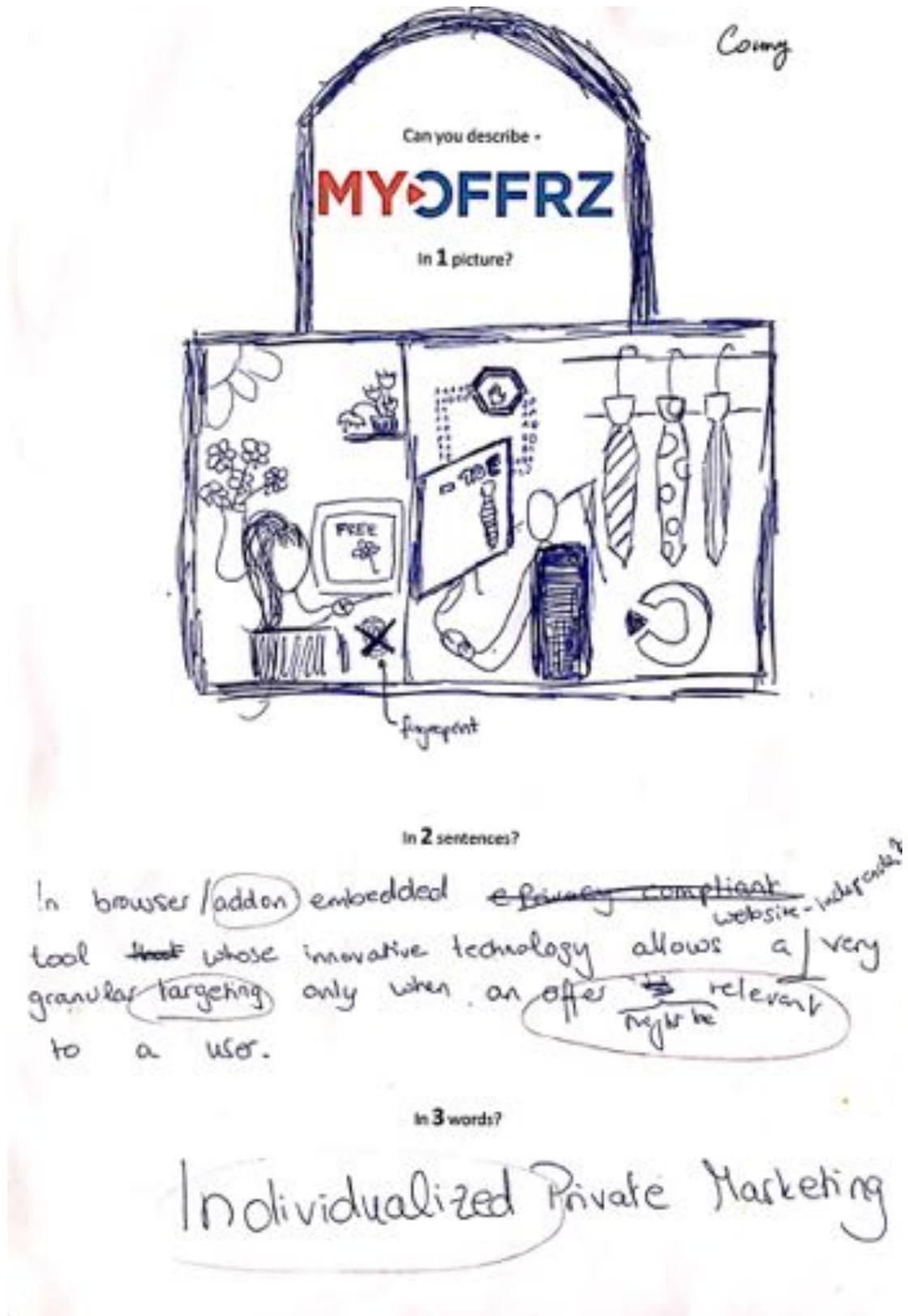
Figure A.2: Survey from employee 2

72

Figure A.3: Survey from employee 3
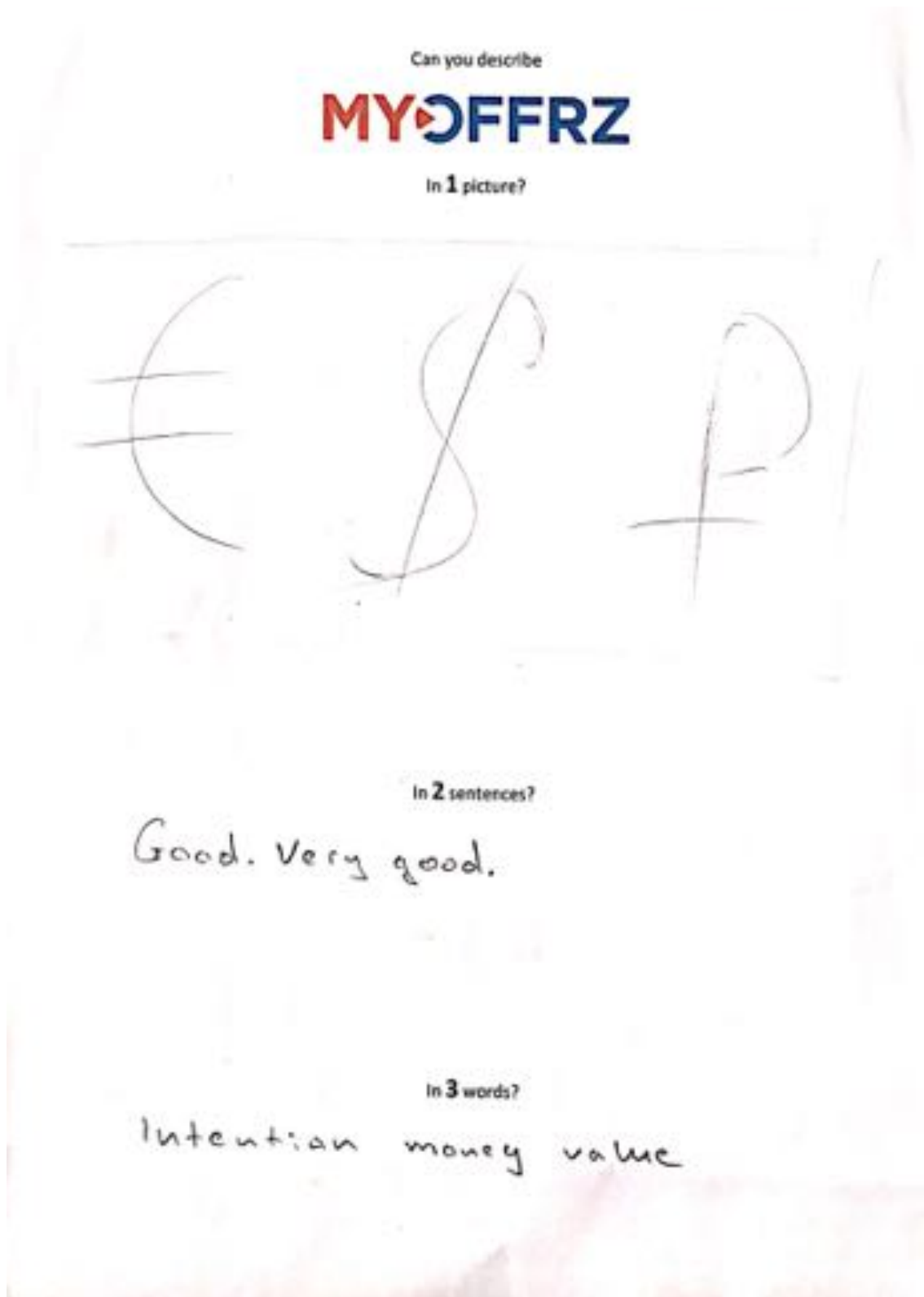
Figure A.4: Survey from employee 4

B   Questionnaire form

Questionnaire:

1) What is your gender?
   ☐ Male
   ☐ Female
   ☐ other

2) How old are you? _____

3) What is the highest level of education you have?

   _____

4) What is your current job?

   _____

5) Do you use a browser on your desktop computer/laptop?

   ☐ Yes
   ☐ No

6) If yes, which browser(s) are you using?

   _____

7) Overall, how much do you trust the messages shown by Cliqz browser?

☐ I trust completely ☐ I likely to trust ☐ I did't form an opinion ☐ I likely not trust ☐ I don't trust completely

Do you agree or disagree with the following expressions:

1) Consumers have lost all control over how personal information is collected and used by companies.

☐ Strongly agree   ☐ Agree   ☐ Neutral   ☐ Disagree   ☐ Strongly disagree

2) Most businesses handle the personal information they collect about consumers in a proper and confidential way.

☐ Strongly agree   ☐ Agree   ☐ Neutral   ☐ Disagree   ☐ Strongly disagree

3) Existing laws and organizational practices provide a reasonable level of protection for consumer privacy today.

☐ Strongly agree   ☐ Agree   ☐ Neutral   ☐ Disagree   ☐ Strongly disagree

Figure B.1: Questionnaire form for User Study 1 and 2

C   Results of the questionnaires

Participant	Gender	Age	Education	Job	Browser	Trust in Cliqz	Westin's 1st	Westin's 2nd	Westin's 3rd	Westin's category
1	F	22	Pursuing M. Sc.	Supply chain	Chrome	no opinion	2	3	3	3 Pragmatist
2	M	22	Abitur	Bankkaufmann	Chrome	no opinion	1	4	4	2 Fundamentalist
3	M	24	Pursuing B. Sc.	Student	Safari	likely to trust	3	3	3	2 Pragmatist
4	F	30	Statsexamen	Tierarztin	Firefox	don't trust completely	1	4	4	2 Fundamentalist
5	F	23	statsexamen	student	firefox	didn't form an opinion	4	3	3	4 Unconcerned
6	M	60	Phd	journalist	Firefox	didn't form an opinion	2	5	5	4 Pragmatist
7	F	22	A-levels	college student	Ecosia	likely to trust	2	2	2	5 Fundamentalist
8	F	20	Gymnasium diploma	student	Chrome	likely to trust	2	4	4	3 Pragmatist
9	F	27	Bachelor's degree	working student	Chrome	trust completely	1	3	3	3 Pragmatist
10	M	20	Abitur	Sale(Retail)	Safari, Firefox	likely to trust	1	4	4	3 Fundamentalist
11	M	28	German federal exam	student	Firefox, Safari	likely to trust	2	3	3	5 Fundamentalist
12	F	22	Abitur	student	Mozilla	likely to trust	3	3	3	4 Pragmatist
13	F	26	BA	student	Firefox	likely to trust	1	4	4	5 Fundamentalist

Figure C.1: Results for the questionnaire form User Study 1

Participant	Gender	Age	Education	Job	Browser	Trust in Cliqz	Westin's 1st	Westin's 2nd	Westin's 3rd	Westin's category
1	F	24	Bachelor's degree	stock associate	Google	likely to trust	2	4	4	Pragmatist
2	M	24	BA + B.Sc.	student	Safari, Firefox	likely to trust	2	3	3	Pragmatist
3	F	27	M.Sc.	student	Chrome, Firefox, Internet Explorer,	likely to trust	2	3	4	Pragmatist
4	M	26	B.Sc.	student	Firefox, Safari	didn't form an opinion	2	3	4	Pragmatist
5	F	18	Abitur	student	explorer, Firefox, Internet	likely to trust	1	4	4	Fundamentalist
6	F	21	A-levels	student	Chrome	likely not to trust	3	5	4	Pragmatist
7	M	20	Abitur	Sales	Cliqz, Safari, Firefox	trust completely	1	5	2	Fundamentalist
8	M	28	BA	student	Firefox	likely to trust	2	3	4	Pragmatist
9	M	32	Bachelor's degree	Pricing manager	Chrome, Internet	trust completely	2	3	4	Pragmatist
10	F	25	pursuing state exam	student	Chrome	likely to trust	2	4	4	Pragmatist
11	M	39	M.Sc.	Business intelligence consultant	Chrome, Internet explorer	didn't form an opinion	1	4	2	Fundamentalist
12	F	22	BA	BCG (working student)	Chrome, Safari	likely not to trust	2	3	3	Pragmatist
13	M	25	Bachelor's degree	Unemployed	Firefox	didn't form an opinion	1	5	4	Fundamentalist
14	F	25	Bachelor's degree	Architect student	Chrome	likely to trust	1	5	4	Fundamentalist
15	F	23	Pursuing master	student	Chrome	trust completely	2	4	4	Pragmatist
16	F	25	BA	student	Safari, Firefox, Cliqz	trust completely	1	5	3	Fundamentalist
17	F	28	M.Sc.	data analyst	Chrome	didn't form an opinion	4	4	2	Unconcerned
18	F	22	Bachelor's degree	graphic design intern	Google, Naver	likely to trust	5	2	3	Unconcerned
19	M	28	Medical specialization	surgeon	Chrome	don't trust completely	2	4	4	Pragmatist

Figure C.2: Results from the questionnaire of the User Study 2

D   Drawing tasks: mental models from User Study 1 and 2
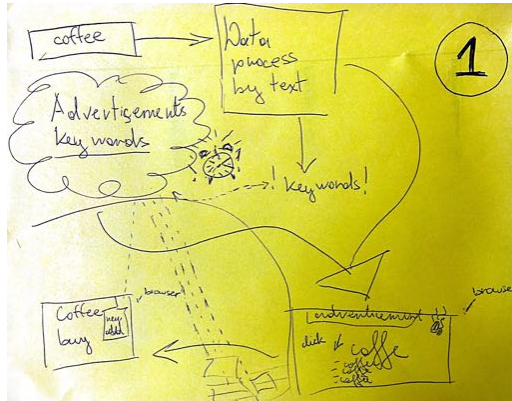
(a) Participant 1
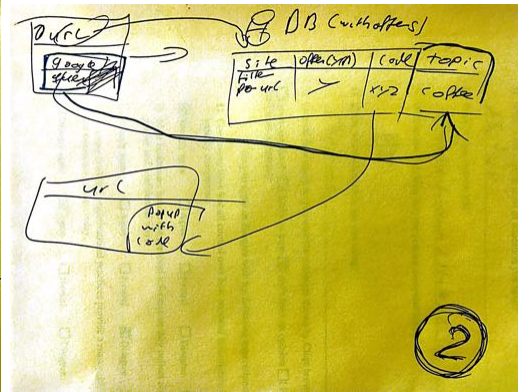
(b) Participant 2
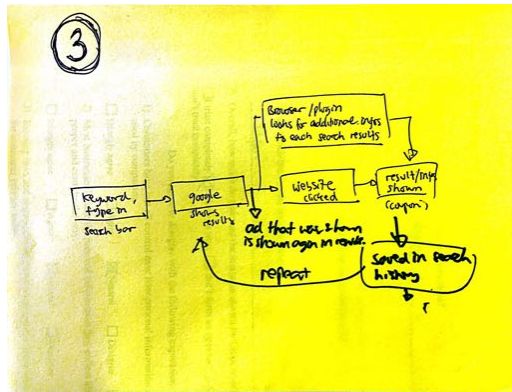
(c) Participant 3
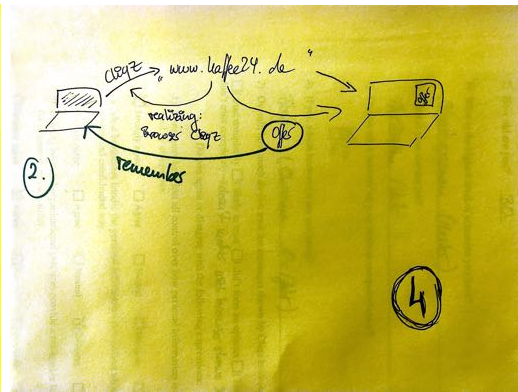
(d) Participant 4
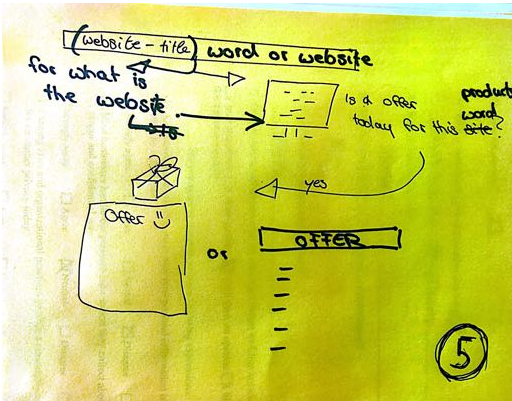
(e) Participant 5
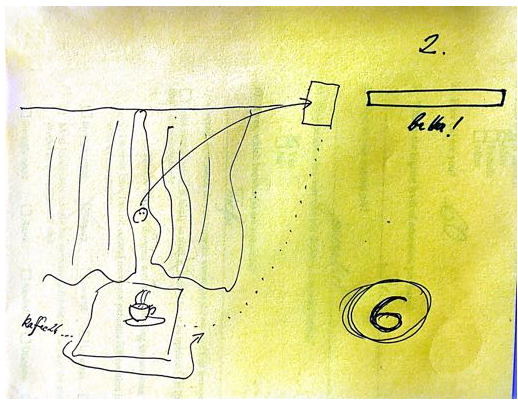
(f) Participant 6

Figure D.1: Mental models drawn by the participants of the User Study 1
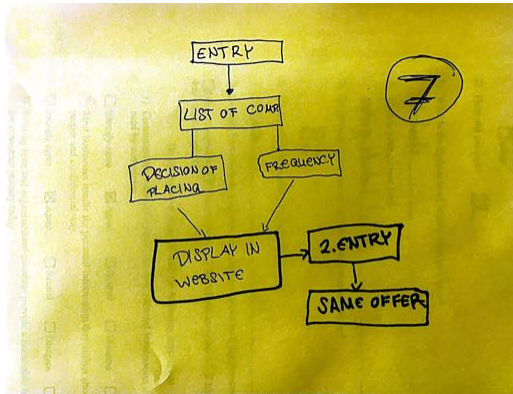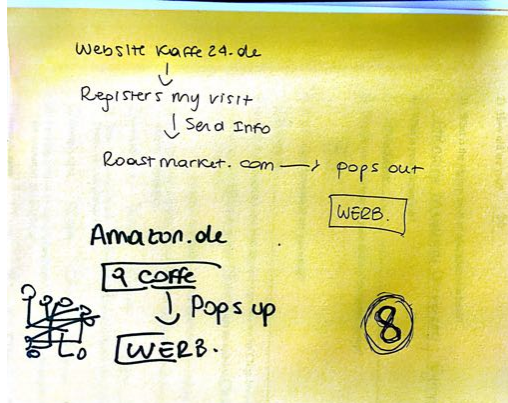
(a) Participant 7

(b) Participant 8
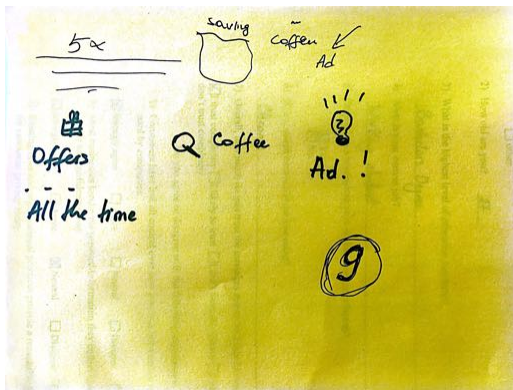
(c) Participant 9
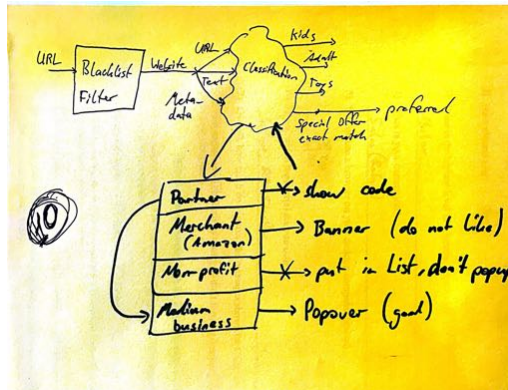
(d) Participant 10
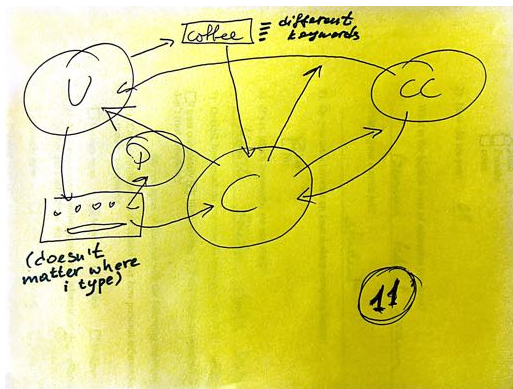
(e) Participant 11

(f) Participant 12
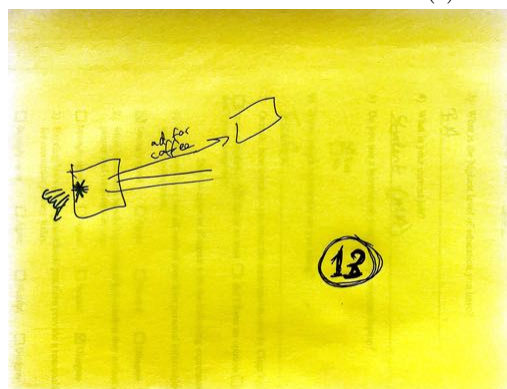
(g) Participant 13

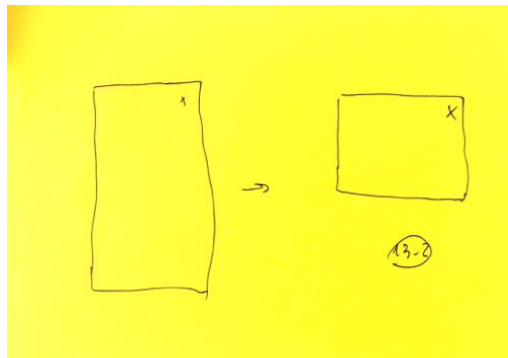Figure D.2: Mental models drawn by the participants of the User Study 1
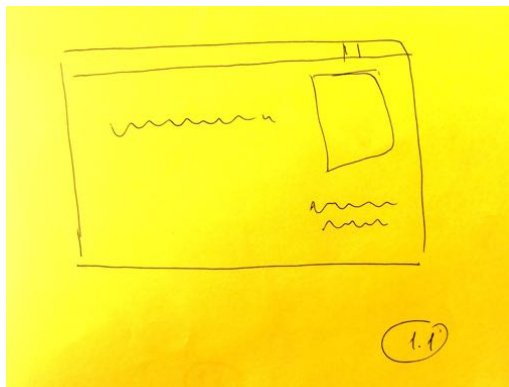
(a) Participant 1 before explanations
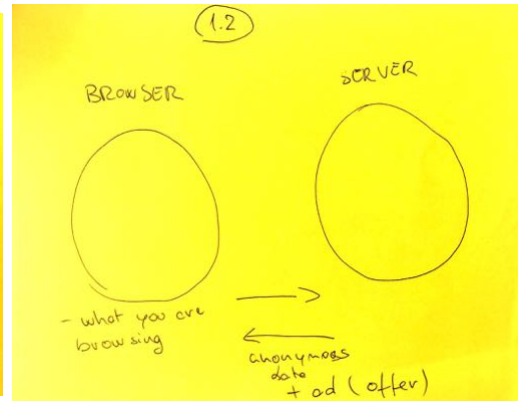
(b) Participant 1 after explanations
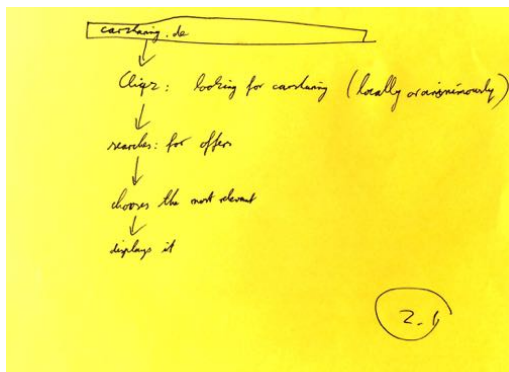
(c) Participant 2 before explanations
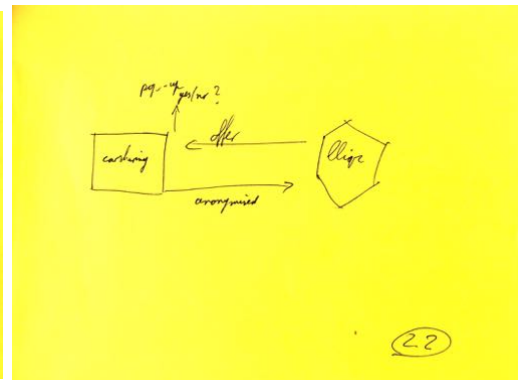
(d) Participant 2 after explanations
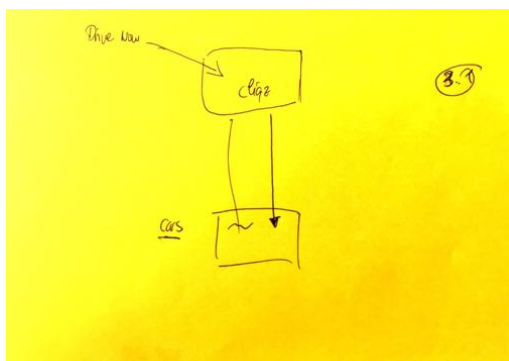
(e) Participant 3 before explanations
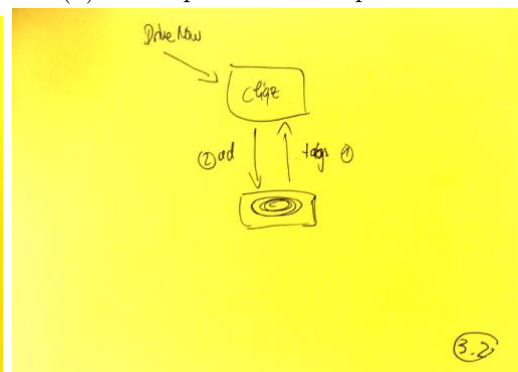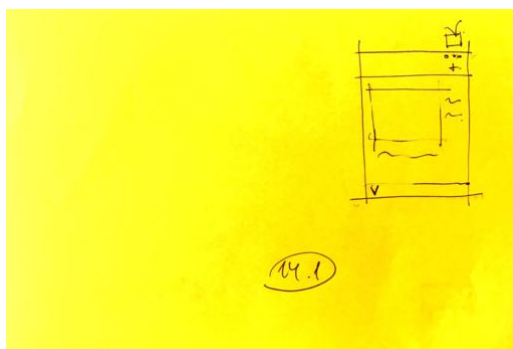
(f) Participant 3 after explanations
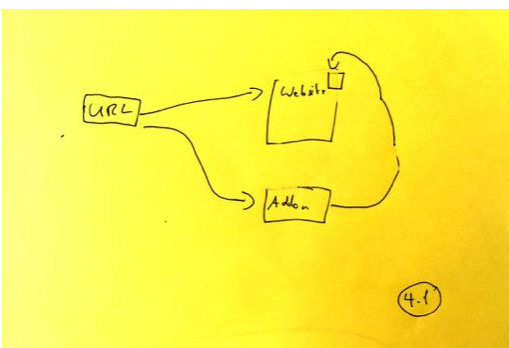
(g) Participant 4 before explanations
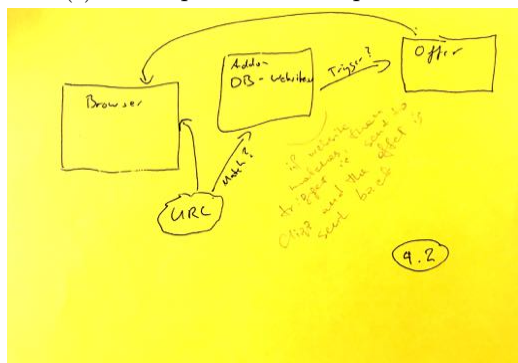
(h) Participant 4 after explanations

Figure D.3: Mental models drawn by the participants of the User Study 2 before and after seeing explanations

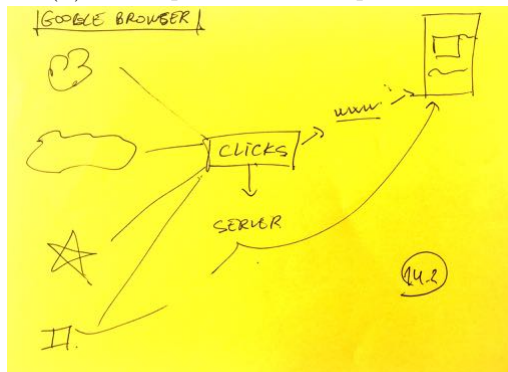(a) Participant 5 before explanations
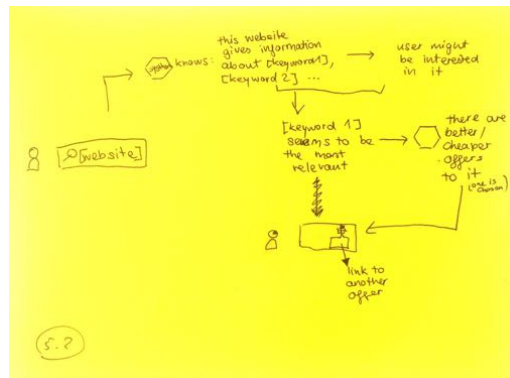
(b) Participant 5 after explanations
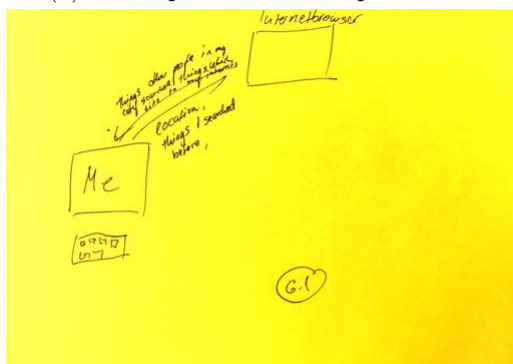
(c) Participant 6 before explanations
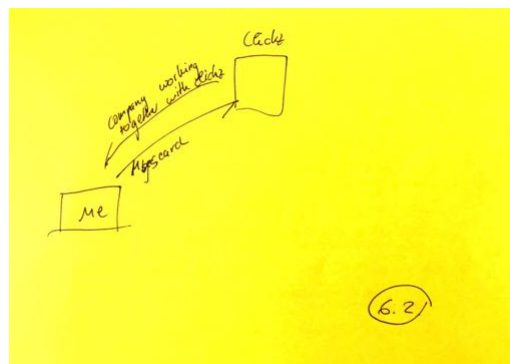
(d) Participant 6 after explanations
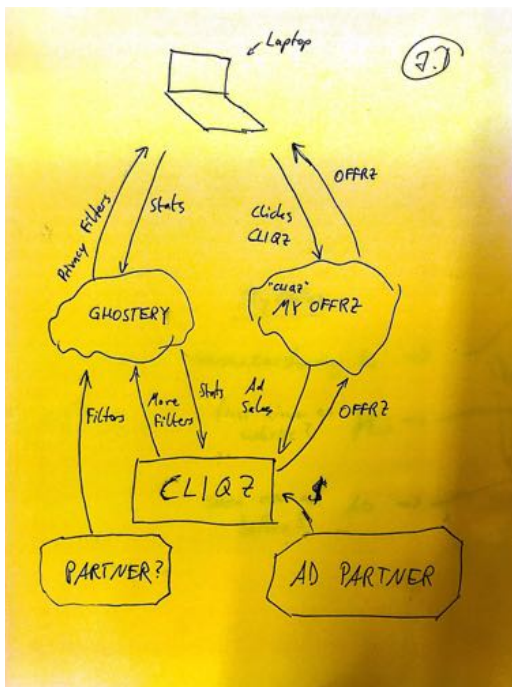
(e) Participant 7 before explanations
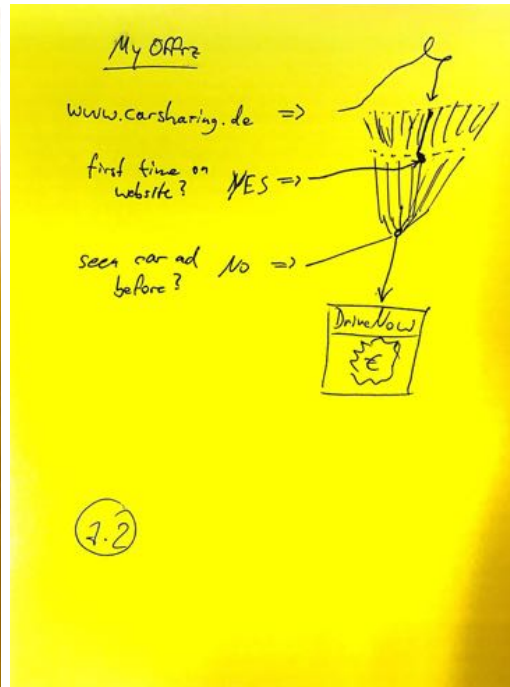
(f) Participant 7 after explanations

Figure D.4: Mental models drawn by the participants of the User Study 2 before and after explanations

(a) Participant 8 before explanations
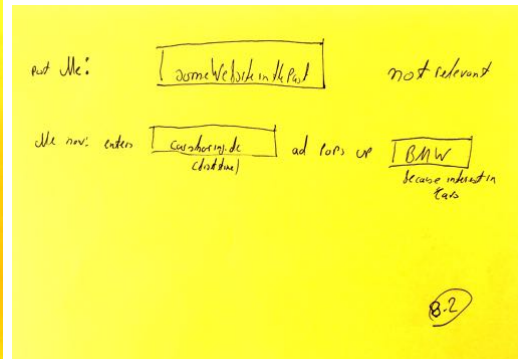
(b) Participant 8 after explanations
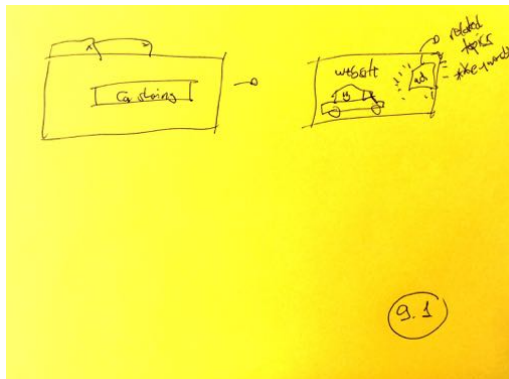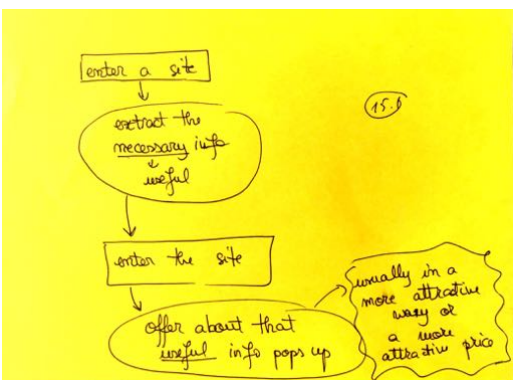
(c) Participant 9 before explanations
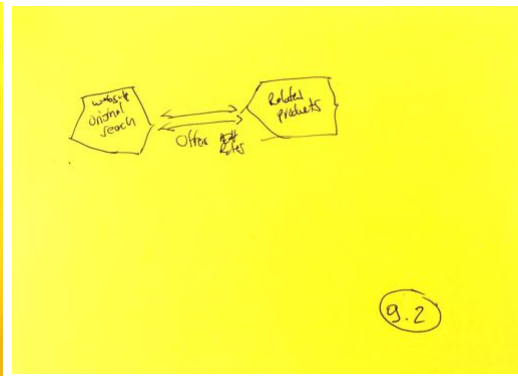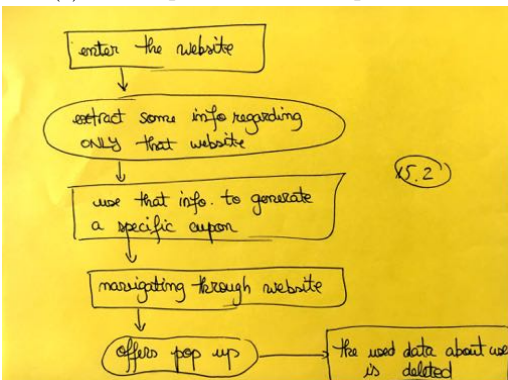
(d) Participant 9 after explanations
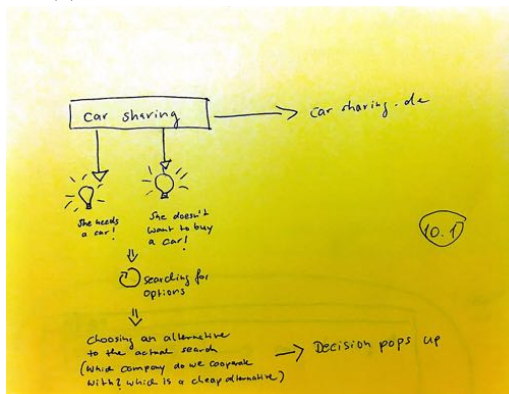
(e) Participant 10 before explanations
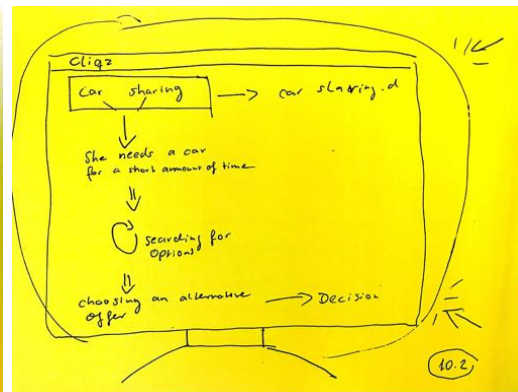
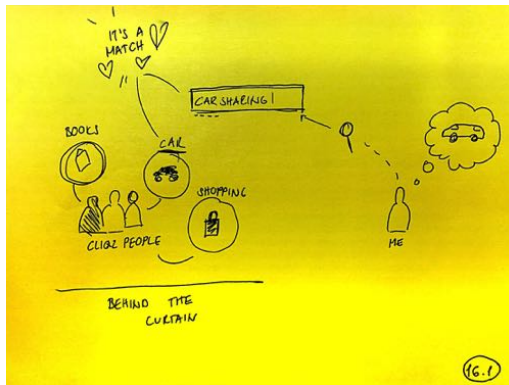(f) Participant 10 after explanations
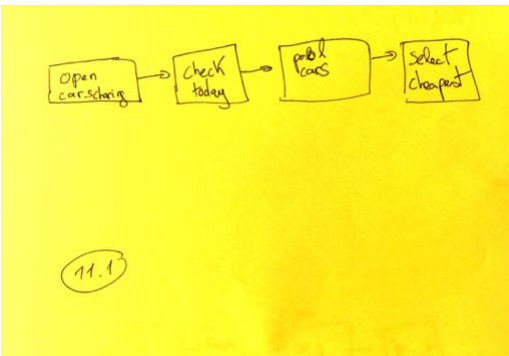
(g) Participant 11 before explanations
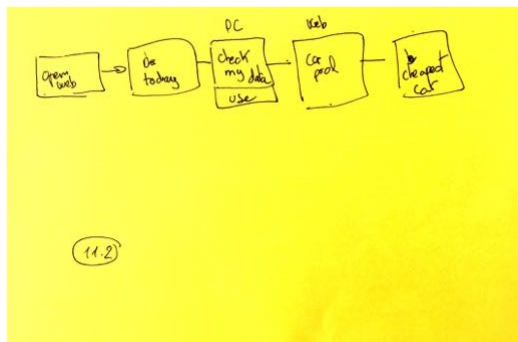
(h) Participant 11 after explanations

Figure D.5: Mental models drawn by the participants of the User Study 2 before and after explanations

(a) Participant 12 before explanations
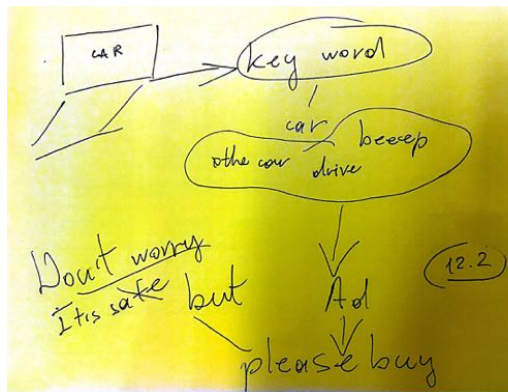
(b) Participant 12 after explanations
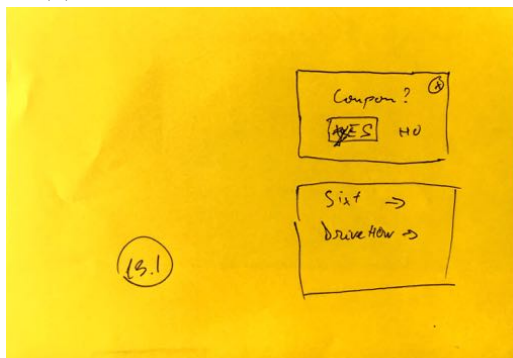
(c) Participant 13 before explanations

(d) Participant 13 after explanations

(e) Participant 14 before explanations

(f) Participant 14 after explanations
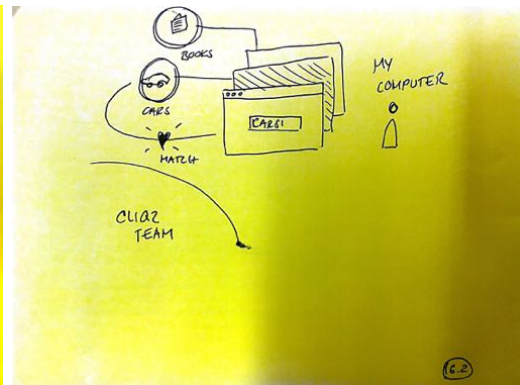
(g) Participant 15 before explanations

(h) Participant 15 after explanations

Figure D.6: Mental models drawn by the participants of the User Study 2 before and after explanations
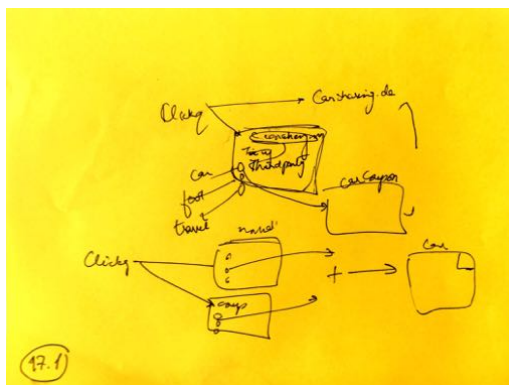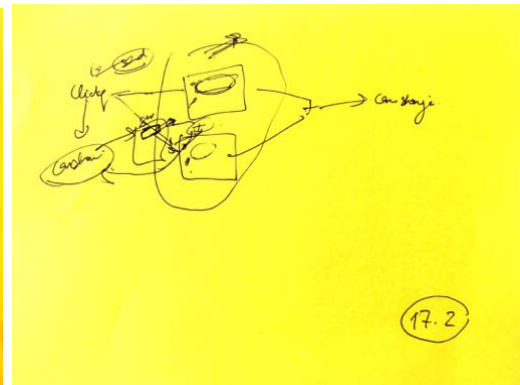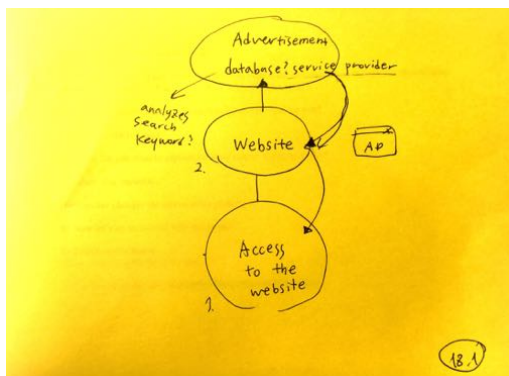
(a) Participant 16 before explanations

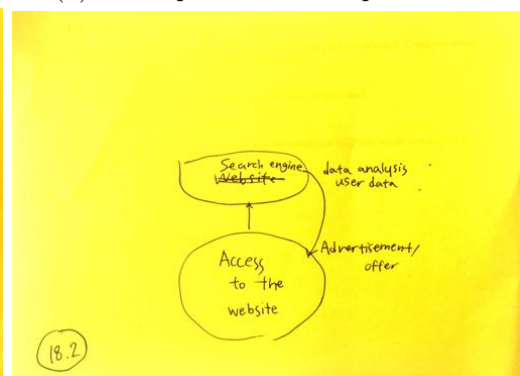(b) Participant 16 after explanations

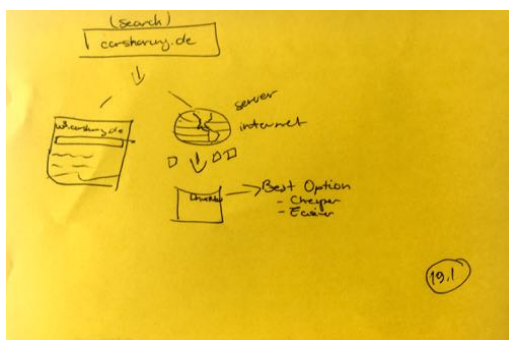(c) Participant 17 before explanations
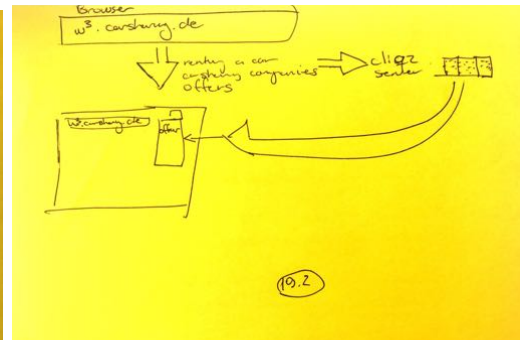
(d) Participant 17 after explanations

(e) Participant 18 before explanations

(f) Participant 18 after explanations

(g) Participant 19 before explanations

(h) Participant 19 after explanations

Figure D.7: Mental models drawn by the participants of the User Study 2 before and after explanations

E   Post-study email

Dear participant!

I am contacting you, because you have participated in a user test for master thesis project: "Your data is safe: changing mental models of ad systems through transparent communication". I would kindly ask you to take part in the additional study presented in this email 😊 It will take you just couple of minutes and will help me enormously!

You are already familiar with MyOffrz from the tests. We're currently working on explanations for this feature. Thereby, I would ask you to rank information items below in order of it's importance personally for you, i.e. what would you want to know about the product first and what would be less important for you. Some information items might have the same rank if they are equally important for you.

Here is the list of the items:

1. **What is MyOffrz?** – defining offers and explicitly identifying what value you will get with it, e.g. deal, discount etc.
2. **How to use MyOffrz?** – mainly explaining how you can interact with offers, e.g. how to copy the code, how to trigger offer or how to close it.
3. **Where can you see MyOffrz?** – how and why you see offers in a pop-up or a banner.
4. **Algorithm?** – How every offer is chosen for you, e.g. you have a coffee deal, because you looked for 'buy coffee' on google.
5. **Data flows?** – How the confirmation that you used an offer is sent, where is it stored and how is it used.
6. **Proxy server?** – How does the proxy server work, which provides complete privacy.
7. **Agent?** – Where does an offer comes from, how it was found and how the terms were negotiated.
8. **Storage?** – Where are the offers stored and rules for triggering are stored.
9. **Business goal?** – Why do we show it you, how do we earn money with offers and what we use this money for.
10. **Privacy?** – Detailed explanation on how we assure your privacy.

Please as a reply send me a list of numbers, ranked according to importance of every explanation item for you.

Diana Dybok
Cliqz GmbH | Arabellastrasse 23 | 81925 München | Germany
Phone: +49 89 9250 1055 | diana.d@cliqz.com | cliqz.com
Managing Director (Geschäftsführer): Dr. Marc Al-Hames, Jean-Paul Schmetz Commercial Register (Registergericht): Amtsgericht München, HRB 173779 | VAT-ID: DE260117842
Visitor address (Besucheradresse) Cliqz GmbH | Rosenkavalierplatz 10 | 81925 München | Germany

Figure E.1: Recruiting email for the post-study

Content of the USB stick

1. Videos from the User Study 1 and User Study 2

2. Notes from the User Study 1 and User Study 2

3. Principle prototype for the final evaluation

4. Tables with the results from the tests

5. Consent forms from the participants

6. Mental models from the drawing tasks

7. User study scripts

8. PDF version of the master thesis

9. Latex file with the master thesis

References

[1] Florian Schaub, Rebecca Balebako, Adam L Durity, and Lorrie Faith Cranor. A Design Space for Effective Privacy Notices. *Eleventh Symposium On Usable Privacy and Security (SOUPS 2015)*, pages 1–17, 2015.

[2] Shirley Gregor and Izak Benbasat. Explanations from Intelligent Systems: Theoretical Foundations and Implications for Practice. *MIS Quarterly*, 23(4):497, 1999.

[3] Rashmi Sinha and Kirsten Swearingen. The role of transparency in recommender systems. *CHI '02 extended abstracts on Human factors in computing systems - CHI '02*, page 830, 2002.

[4] Cliqz. Cliqz - Secure browser with built-in quick search, 2018.

[5] Cliqz. MyOffrz – Browser Based Performance Marketing, 2018.

[6] Golden Krishna. *The best interface is no interface.* Peachprint edition, 2015.

[7] Zhonghao Yu, Sam Macbeth, Konark Modi, and Josep M. Pujol. Tracking the Trackers. *Proceedings of the 25th International Conference on World Wide Web - WWW '16*, pages 121–132, 2016.

[8] Jonathan R. Mayer and John C. Mitchell. Third-party web tracking: Policy and technology. *Proceedings - IEEE Symposium on Security and Privacy*, pages 413–427, 2012.

[9] Zeynep Tufekci. Algorithmic Harms beyond Facebook and Google: Emergent Challenges of Computational Agency. *Journal on Telecommunications & High Tech Law*, 13(23):203–216, 2015.

[10] Alessandro Acquisti, Curtis Taylor, and Liad Wagman. The Economics of Privacy. *Journal of Economic Literature*, 54(2):442–492, 2016.

[11] Alessandro Acquisti and Ralph Gross. Predicting Social Security numbers from public data. *Proceedings of the National Academy of Sciences of the United States of America*, 106(27):10975–10980, 2009.

[12] Abbas Razaghpanah, Rishab Nithyanand, Narseo Vallina-rodriguez, Srikanth Sundaresan, Mark Allman, Christian Kreibich, and Phillipa Gill. Apps , Trackers , Privacy , and Regulators. (February), 2018.

[13] Ashwini Rao, Florian Schaub, Norman Sadeh, Alessandro Acquisti, and Ruogu Kang. Expecting the Unexpected: Understanding Mismatched Privacy Expectations Online. *the Proceedings of the Twelfth Symposium on Usable Privacy and Security (SOUPS 2016)*, (Soups):77–96, 2016.

[14] Lee Rainie and Maeve Duggan. Privacy and information sharing. Technical Report December 2015, 2016.

[15] Kovila P L Coopamootoo and Thomas Groß. Mental Models of Online Privacy: Structural Properties with Cognitive Maps. *Proceedings of HCI*, pages 287–292, 2014.

[16] Farah Chanchary and Sonia Chiasson. User Perceptions of Sharing, Advertising, and Tracking. *Symposium on Usable Privacy and Security (SOUPS) 2015, July 22–24*, pages 53–67, 2015.

[17] Oezguel Kafali. Privacy Perceptions : Westin Categories. *North Carolina State University Department of Computer Science*, 2017.

[18] Fuming Shih, Ilaria Liccardi, and Daniel J Weitzner. Privacy Tipping Points in Smartphones Privacy Preferences. *Proc. of the 2015 ACM conference on Human factors in computing systems*, pages 807–816, 2016.

[19] Richard B. Parker. A definition of privacy. *Routledge*, pages 83–104, 2017.

[20] Saranga Komanduri, Richard Shay, Greg Norcie, Blase Ur, and Lorrie F Cranor. AdChoices? Compliance with Online Behavioral Advertising. *I/S : A Journal of Law and Policy*, 1:603, 2011.

[21] Bharat Anand. *The Content Trap.* Penguin Random House LLC, New York, 2016.

[22] Motahhare Eslami, Sneha R Krishna Kumaran, Christian Sandvig, and Karrie Karahalios. Communicating Algorithmic Process in Online Behavioral Advertising. *CHI 2018, April 21–26, 2018, Montréal, QC, Canada*, pages 1–13, 2018.

[23] Digital Advertising Alliance. AdChoices.

[24] Jovanni Hernandez. Understanding Web Advertising Privacy Through Browser Instrumentation.

[25] Brett Gaylor. Do Not Track, 2015.

[26] Avi Goldfarb and Catherine E. Tucker. Privacy Regulation and Online Advertising. *Management Science*, 57(1):57–71, 2011.

[27] Joe Tullio, Anind K. Dey, Jason Chalecki, and James Fogarty. How it works: a field study of non-technical users interacting with an intelligent system. *Proceedings of the SIGCHI conference on Human factors in computing systems - CHI '07*, page 31, 2007.

[28] Paolo Legrenzi Philip Johnson-Laird, Vittorio Girotto. Mental models: a gentle guide for outsiders. *Sistemi Intelligenti 9, 68*, 1998.

[29] Yang Wang Blase Ur, Pedro Giovanni Leon, Lorrie Faith Cranor, Richard Shay. Smart, useful, scary, creepy: perceptions of online behavioral advertising. *Proceedings of the Eighth Symposium on Usable Privacy and Security (SOUPS'12)*, (ACM):4–19, 2012.

[30] Yaxing Yao, Davide Lo Re, and Yang Wang. Folk Models of Online Behavioral Advertising. *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing - CSCW '17*, pages 1957–1969, 2017.

[31] Michelene T H Chi. Three Types of Conceptual Change: Belief Revision, Mental Model Transformation, and Categorical Shift. *Handbook of research on conceptual change*, pages 61–82, 2008.

[32] Michelene T H Chi. Cognitive understanding levels. *Encyclopedia of psychology*, Vol. 2.(A.E . Kazdin):146–151, 2000.

[33] Perez Pascal Jones Natalie, Ross Helen, Lynam Timothy. Eliciting Mental Models: a Comparison of Interview Procedures in the Context of Natural Resource Management, 2014.

[34] S. Kaplan A. R. Kearney. Toward a methodology for the measurement of knowledge structures of ordinary people: the conceptual content cognitive map (3CM). *Environment and Behavior*, 1997.

[35] Pedro García García, Enrico Costanza, Jhim Verame, Diana Nowacka, and Sarvapali D. Ramchurn. Seeing (Movement) is Believing: The Effect of Motion on Perception of Automatic Systems Performance. *Human–Computer Interaction*, 00(00):1–51, 2018.

[36] Todd Kulesza, Simone Stumpf, Margaret Burnett, Sherry Yang, Irwin Kwan, and Weng Keen Wong. Too much, too little, or just right? Ways explanations impact end users' mental models. *Proceedings of IEEE Symposium on Visual Languages and Human-Centric Computing, VL/HCC*, pages 3–10, 2013.

[37] Joseph B Lyons. Being Transparent about Transparency : A Model for Human-Robot Interaction. *Trust and Autonomous Systems: Papers from the 2013 AAAI Spring Symposium*, pages 48–53, 2013.

[38] J. Desteno, D.; Breazeal, C.; Frank, R.; Pizarro, D.; Baumann, J.; Dickens, L.; Lee. Detecting the trustworthiness of novel partners in economic exchanges. *Psychological Science. In press. Dzindolet,*, 2012.

[39] Kevin Hamilton, Karrie Karahalios, Christian Sandvig, and Motahhare Eslami. A path to understanding the effects of algorithm awareness. In *Proceedings of the extended abstracts of the 32nd annual ACM conference on Human factors in computing systems - CHI EA '14*, pages 631–642, 2014.

[40] Yung Ming Li and Yung Shao Yeh. Increasing trust in mobile commerce through design aesthetics. *Computers in Human Behavior*, 26(4):673–684, 2010.

[41] Florian N Egger. Affective Design of E-Commerce User Interfaces : How to Maximise Perceived Trustworthiness. *CAHD: Conference on Affective Human Factors Design*, pages 317–324, 2001.

[42] Florian Schaub, Rebecca Balebako, and Lorrie Faith Cranor. Designing Effective Privacy Notices and Controls. *IEEE Internet Computing*, 21(3):70–77, 2017.

[43] By Lim and Ak Dey. Assessing demand for intelligibility in context-aware applications. *Proceedings of the 11th international conference on Ubiquitous computing*, page 195, 2009.

[44] Malin Eiband, Hanna Schneider, Mark Bilandzic, Julian Fazekas-Con, Mareike Haug, and Heinrich Hussmann. Bringing Transparency Design into Practice, 2018.

[45] Margaret C. Harrel and Melissa A. Bradely. *Data collection methods semi-structured interviews and focus groups.* 2009.

[46] Victoria Braun, Virginia;Clarke. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(1):77–101, 2006.

[47] Mojtaba Vaismoradi, Hannele Turunen, and Terese Bondas. Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing and Health Sciences*, 15(3):398–405, 2013.

[48] Chadia Abras, Diane Maloney-krichmar, and Jenny Preece. User Centered Design. *Design*, 37(4):1–14, 2004.

[49] Jennifer M. Urban and Chris Jay Hoofnagle. The Privacy Pragmatic as Privacy Vulnerable. *Symposium on Usable Privacy and Security*, 2014.

[50] V Vanden Abeele and B Zaman. Laddering the User Experience! *User Experience Methods, Interact 2009,*, (July), 2009.

[51] Jonathan Reynolds, Thomas J. Gutman. Laddering theory, method, analysis and Interpretation. *Journal of Advertising Research*, 28:11–31, 1988.

[52] Yakov Bart, Venkatesh Shankar, Fareena Sultan, and Glen L. Urban. Are the Drivers and Role of Online Trust the Same for All Web Sites and Consumers? A Large-Scale Exploratory Empirical Study. *Journal of Marketing*, 69(4):133–152, 2005.