Dynamic website optimization through autonomous management of design patterns

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door

Aniel Bhulai

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Preface

My journey towards this book started about six years ago. With my interest in and passion for the Internet as foundation I started this work. However, passion is not the only ingredient for this thesis. This work has also been supported by several persons. I, therefore, would like to take this opportunity to thank those persons who helped me in one way or another in writing this thesis, realizing that I take the risk of choosing just a few names of many I want to name here.

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Doing PhD research next to a full time job with a family is a challenge. This work would not be possible without the love and extreme patience of my wife, Sharmila, and my daughter, Divya. I am very grateful to them. In various ways I depended on them to keep me trouble free and to keep me focused on my research. I guess they will be very happy to have me back from this journey.

Aniel Bhulai
June 2011
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Chapter 1

Introduction

The World Wide Web (WWW) has accelerated the pace of information transfer throughout the world. The Internet World Stats [16] reports that the WWW has 1.663 billion users as of March 2009 which accounts for almost 25% of the world population. As such the WWW has a tremendous economic value through e-commerce. Moreover, it is estimated that the WWW also grows with 7.3 million new web pages every day [142]. Therefore, before a website truly can become economically relevant, the website first needs to be found and needs to have a navigation structure such that users can find relevant information on it easily. Website Optimization (WSO) is a new research area that addresses these issues and aims to provide more visibility to websites through better web design and management. In Section 1.1 we explain why WSO is important and is gaining momentum. We also discuss its shortcomings and problems and propose a new dynamic and autonomous WSO system to alleviate these issues. In Section 1.2 we describe our research goals and the research approach. We conclude the chapter with Section 1.3 in which we describe how this thesis is organized.

1.1 Website optimization

1.1.1 The importance of website optimization

Since the remarkable use of the WWW in 1991, its growth has been tremendous. Figure 1.1 shows that the world-wide Internet user growth from 2000 to 2009 was 380.3% (see the Internet World Stats [16]). A study by The Kelsey Group and ConStat, Inc. [12] indicates that 70% of U.S. households
in 2005 used the WWW as an information source when shopping locally for products and services. These figures do not only show us the enormous growth of the WWW population, but they also indicate that the World Wide Web has become an integral part of many people’s everyday lives.

Nowadays, it is common that people have a computer with a broadband connection and use it to gain access to information on-line to look up facts, to make on-line purchases, to do business, to entertain, to socialize, etc. With this trend, the WWW has become more and more economically relevant. It is the largest and most cost-effective source of commerce. Therefore, providers, like organizations and companies, consider it a necessity to have a website (see Lazar and Preece [136]). The goals of these providers are to serve people better, to attract people to their website for their products, and to influence people in such a way that they buy their products or make use of their services. To use the WWW for your organization’s benefit, it is therefore crucial that your website is easily found on the WWW, otherwise you can lose potential customers, clients, and prospects. There are many factors (e.g., content, load time, navigation support, appearance, coding of the page) that affect the performance and the findability [243] of a website. Even though a website can be designed nicely and intelligently, it will make no difference if no one knows about it and no one can find it.

Search engines are a primary method of searching for information for almost all WWW visitors. When they arrive on your website it is important to keep the visitors on your website. However, to ensure that visitors do find your website in the search engine, it is important to know how visitors search for information. A search with a well-defined goal (i.e., a goal which is defined precisely) is well supported on the WWW. Search engines, bibliographic databases, and digital libraries provide adequate support for visitors whose goals are well defined [238]. If you are looking, e.g., for the book ‘Web Design in a Nutshell’ written by Jennifer Niederst, then you have a big chance to find this book through a search engine because the goal is well defined. But if you, e.g., want to know where to go on vacation, search engines will not give you any answer to this question. It might help you by presenting you a list of links of several travel websites if you searched with the proper keywords. But from there on you will be on your own. Here is where ‘wild searching’ will help you further. Wild searching means “realizing a user goal which is not defined precisely or which may change, by browsing
Figure 1.1: Internet users in the world.

Source: www.internetworldstats.com
or surfing”\(^1\). Wild searching is useful when the visitor lacks knowledge or contextual awareness to formulate queries to realize his\(^2\) goal. This also occurs when the visitor wants to find something related to a domain in which he has a general interest but not in-depth knowledge.

**Website optimization** (WSO) is the process of improving internal (e.g., layout of webpages, content, navigation support, usability) and external (e.g., promotion of the website, link building, building personality and reputation) aspects of your webpages to increase the traffic the website receives from search engines. Website optimization is a new research area that addresses the above raised issues on findability. Website optimization is the “key ingredient” for successful web promotion campaigns and consists of many different web design techniques (e.g., techniques to program webpages, to optimize the performance of webpages, to design page layouts, and to optimize content and coding). When you combine website optimization with good web design & development and a proper website promotion strategy, you can achieve the following:

- Your website will have a high ranking in the major search engines (e.g., in Google\(^3\), Yahoo\(^4\), Ask.com\(^5\), Bing\(^6\))
- More visitors will visit your website,
- More visitors will recommend your website to others,
- Visitors will return to your website,
- Visitors will turn into customers, and
- Customers will generate revenues.

\(^1\)Note the difference between wild searching and (web-)browsing or surfing. Browsing or surfing is moving around via links between and within documents on the WWW. Browsing, in its nature, ignores the file structure or other formal organization of information [35] (see also Section 6.2), while the organization of the information matters for wild searching (see also Section 7.3).

\(^2\)Generally we are using the masculine gender throughout this thesis without looking down on the female sex. We use both genders in the sections (e.g., results of studies) where it is important to distinguish between the male and the female sex. In all the other cases the masculine gender can be replaced by the feminine gender.

\(^3\)http://www.google.com.
1.1.2 The importance of studying search behavior

In the previous section we have argued that findability heavily depends on how people search for information. A lot of studies have tried to characterize search behavior of people in daily life and also on the WWW [25, 32, 21, 59, 211]. Most of the basic search behavior is captured by search engines. However, there are a few things that are not supported very well on the WWW. People do many things when they are searching in the physical world. One of the things they do is wild searching. The examples below are related to wild searching and illustrate the concept.

- *People change their mind* (i.e., change their goals) because of the influence of situations, events or needs. It often happens that people go to the supermarket to buy some things but come home with other things. This means that something happened in the supermarket that made people behave differently from what they initially intended to.

  Likewise, it happens that when people go to, e.g., the Free Record Shop to buy a particular CD they come home with a different CD than they had in mind. This means that something at the shop made the visitors change their mind. Probably that Free Record Shop had something better to offer to their visitors which made their visitors change their mind or they might have met a friend who told them about a very good CD he bought, or they got the opportunity to have a CD signed by the performing artist.

- *People do not always have a precise goal*. People, e.g., do not always go to the museum to look at the painting of Rembrandt only, they do not go to the cinema to watch a movie only, or they do not go to the gym to do some exercise only. They may enter the museum also to have a cup of coffee or they may also go to the cinema or gym for sociability.

- *People have goals that differ from those ‘expected’ by the provider*. People may go to, e.g., the Museum of London, which is open on Sundays, for a cup of coffee. Or they may go there for sociability or to chitchat with others.

\footnote{See \url{http://www.museumoflondon.org.uk/}.}
People may go to, e.g., the Smithsonian’s National Zoological Park in Washington\(^8\), not only to look at the animals but also to celebrate their children’s birthday, to attend some attractions, to have some food and drinks in the restaurant, to spend some time in the souvenir shop, or to learn about wildlife and its conservation.

Wild searching is not supported very well on the WWW. By optimizing the internal aspects of websites you can support wild searching better. Better support for wild searching leads to a situation in which visitors can find information more easily, visitors will stay longer on websites or come back more frequently, which may result in more revenues as more visitors will turn into customers.

### 1.1.3 Dynamic and autonomous management

In Section 1.1.1 we pointed to the importance of website optimization. In Section 1.1.2 we elaborated on search behavior, which is important to understand before one can apply website optimization. Even then, the successful deployment of WSO, however, is not easy due to the size of most websites. Websites are growing with more pages, especially websites that are based on a Content Management System (CMS) (a system for managing content and providing it in various formats). For example, the website of the Disney store (http://www.disneystore.com) contains 22,900 webpages, the website of the Bijenkorf store (http://www.debijenkorf.nl/) contains 49,100 webpages, the website of bol.com (http://www.bol.com/) contains 1,960,000 webpages, the website of YouTube (http://www.youtube.com) contains 769,000,000 webpages!\(^9\) Not only are websites growing in size, but they are also becoming more and more complex due to dynamic content (e.g., time-dependent content retrieved from databases, such as current weather, local news, stock prices and exchange rates) and server-side scripting (e.g., PHP, ASP, Python). The number of webpages and the complexity make websites very difficult to manage and to maintain.

\(^8\)See http://nationalzoo.si.edu/default.cfm.

\(^9\)The numbers are gathered from Google.com on 23 July 2009, at 14.57 hours. As the WWW is growing constantly, these numbers may be different from minute to minute. The numbers are an estimate, because not every webpage of a website may be indexed by search engines. Nevertheless, the numbers give us a good impression of the number of webpages a website contains.
A lot is known about web visitors, as websites generate a lot of data (e.g., which browser is the visitor using, what webpage did the visitor previously visit, which path did the visitor follow on the website, what links/products did the visitor click on, how long did the visitor spend on a webpage, how many times did the visitor visit the website, what operating system is the visitor using, personal data like name, age, location, interests, and gender). Website owners collect these data for business purposes, e.g., business intelligence and analytics. Web designers use the data to optimize websites by, e.g., developing design patterns.

The size of current websites and the complexity of the content prohibit the straightforward use of WSO. Dynamic content leads to time-dependent behavior of visitors. Therefore, you need website optimization that takes this dynamic nature of the website into account; the techniques to handle this complexity in the content are called dynamic website optimization techniques. Moreover, to deal with the size of current websites, you also need autonomous systems that act and react to changes in content and search behavior. Note that a typical system that is dynamic and autonomous needs to carry out four steps.

1. Data gathering: the system needs to collect data on how visitors behave on the website, which links are clicked, which paths are followed, etc.

2. Model estimation: the data gathered in the first step needs to be processed and analyzed. This will result in model parameters for the website optimization system.

3. Analysis: the model estimation step yields a website optimization system that captures and reflects the current state of visitor behavior given the content of the website. With this model you can detect potential problems in findability of content. The analysis phase can be summarized as a problem detection phase.

4. Optimization: in the analysis step potential problems with the website structure or navigation might have been identified. In this step the website optimization system can change the website to deal with the identified problems.

The fourth step is not the end of the four-step process. From a mathematical viewpoint (in particular systems control theory), after the website has been altered, this provides feedback to the data gathering step. Every change
to the website triggers a potential change in behavior of visitors and that needs to be monitored. This creates a feedback loop so that the website optimization system monitors its own changes and reacts to changes caused by it. In this way the website optimization system become dynamic in nature and autonomous.

Little research has been done on dynamic optimization of websites\textsuperscript{10}. That is why our research will focus on dynamic website optimization through autonomous management of design patterns. This objective will be further explained in the next paragraph.

1.2 Research

1.2.1 Research goal

In Section 1.1.3 we mentioned that little is known about dynamic website optimization. Findability is important and heavily depends on how people search for information. In Section 1.1.2 we saw that wild searching is part of the human search process and is not very well supported on the WWW. One way to improve wild searching on the WWW is by optimizing websites. However, optimizing websites in a static and non-autonomous way is a time consuming and laborious process, which is often not feasible in practice. Therefore we focus in our research on dynamic website optimization and on an autonomous management system of design patterns. The central goal of this thesis is to develop a model for implementing dynamic website optimization through autonomous management of design patterns. This goal can be reached by investigating the following research issues:

1. What can we learn from searching in a “non-web” setting vs. searching in a web setting for improving search on the WWW?

2. Formulation of design patterns for static website optimization.

3. Development of models for dynamic website optimization.

The first issue is presented in Chapters 3, 4, 5, and 6. The second one is presented in Chapter 7, and the third issue is presented is Chapters 8 and 10.

\textsuperscript{10}Do not confuse dynamic website optimization with optimization of dynamic websites. Dynamic websites are database driven websites where content and design live separately. The content lives in a database and is placed on a webpage only when needed or asked for.
1.2.2 Research approach

Findability of information on websites is largely determined by the way people search for information. Therefore, it is important to study how people search, and if searching in a “non-web” setting shows search opportunities that people appreciate and that currently are not supported on the WWW. This study is useful in supporting the general search process, but also in particular wild searching on the WWW. The first research goal addresses this question. In Chapter 2 we will give an overview of user goals, and search and navigation behavior. This overview will give us insight into what is known in the literature on search behavior and on wild searching.

To further investigate the difference between searching in a “non-web” setting versus searching in a web setting, we will use three techniques:

1. observations of natural and WWW search behavior,
2. task-based experiments on searching,
3. interviews on search behavior, goals & problems.

We will do a pilot study first (see Chapter 3) to find out what problems may arise in observing people. In the pilot study we will observe people in “non-web” settings. The results of the pilot study will also identify factors that are essential in the search process. These factors can be used in WSO. After analyzing the results and adapting the methodology for the study, we will observe people and do task-based experiments in “non-web” situations (see Chapter 4). We will particularly focus on the factors which we found in the pilot study. Along with the observations and experiment, we will also conduct interviews with the participants to cross-validate the search behavior observations. The next step is to investigate search behavior on the WWW (see Chapter 5). To compare the results of both settings, we will keep the methodology of observing people on the WWW identical to observing people in a “non-web” setting. The observation results of both settings will be compared to each other to find out whether there is a fundamental difference or not (see Chapter 6). We call this phase the problem detection phase, since we explore what the problems are in the search process and web design.

In Section 1.1.1 we have mentioned that there are many factors that can influence the performance and findability of a website. In order to find out which factors we should change to optimize the website, we should study the
effects of every factor in isolation first. The factors that have the greatest impact on the performance and findability should be optimized first. In the problem detection phase we will identify the factors that should be optimized. The next step is to find design patterns that deal with the detected problems. These design patterns will be the basic components that can be used to optimize the website. We call this phase the solution phase. We will collect examples of design patterns that have been applied previously (see Chapter 7).

The problem detection phase and the solution phase are static methods that can be applied frequently. However, due to the size of websites doing this manually is a tedious process. Moreover, as content is dynamically added to the website, the characteristics of the website change with it. Consequently, visitors to the website display different behavior as the website evolves. It is thus imperative that any website optimization model is dynamic in nature. We will develop mathematical models, in particular Markov decision problems, that can support website optimization (see Chapter 8) in a dynamic manner. These models will be further extended to models for dynamic website optimization through autonomous management of design patterns (see Chapter 10). The observation results of people on the WWW will be used to estimate model parameters. Subsequently, the results of the estimate will be analyzed to optimize websites. Below we give a schematic overview of the chapters and their relations.

1.3 Outline

The remaining part of the thesis is organized as follows:

Chapter 2 provides a literature overview on user goals, and search and navigation behavior. The overview gives us insight into the general search behavior of people, and in particular, into wild searching. This chapter also provides us some factors which will be used in the pilot study in Chapter 3.

Chapter 3 presents the pilot study. In the pilot study we conduct experiments in which we observe people in “non-web” settings. We start with an introduction to ethnography. Then we describe the methodology and the results of the pilot study. The pilot study provides us additional factors on which we will focus during the observations in Chapters 4 and 5.
Chapter 4 presents and discusses the results of the search behavior observations in “non-web” situations. Based on the results of the pilot study we adapt the methodology from our pilot study for the search behavior observations in this chapter.

Chapter 5 presents and discusses the results of the search behavior observations on the WWW. The methodology used in this chapter is identical to the methodology used in Chapter 4.
In **Chapter 6** we compare the observation results of Chapters 4 and 5. In this chapter we detect the problems to optimize websites and give an answer on the first research issue ‘What can we learn from searching in a “non-web” setting vs. searching on a web setting for improving searching on the WWW?’.

**Chapter 7** provides solutions for the problems detected in Chapter 6. In this chapter we formulate design patterns for static website optimization.

In **Chapter 8** we develop and show how mathematical models, in particular Markov processes, can support website optimization. We apply the formulated model on some examples to show how the model works.

In **Chapter 9** we provide an overview of some techniques that are applied in practice for website optimization. We show some concrete examples of tools that use those techniques to optimize websites. The applicability of the techniques are discussed in this chapter.

**Chapter 10** describes a model for dynamic website optimization through autonomous management of design patterns. The observation results of Chapter 5 are used to estimate model parameters. Then the results of the estimate are analyzed to optimize websites.

**Chapter 11** summarizes the main points of this thesis and discusses future research directions.
Chapter 2

User goals, search and navigation behavior

In this chapter we provide a literature overview of scientific studies on user goals, and search and navigation behavior. The overview provides us insight into how achieving user goals are linked with the search and navigation behavior of users. In particular, when a user goal is not specified clearly, this leads to a distinct search behavior that is also known as wild search. The insights obtained from this chapter will be the basis for empirical investigations in Chapter 3.

2.1 User goals

Most scientific studies point out that website visitors do not visit websites without a reason; they have a specific goal in mind [44, 61, 211]. Website visitors often visit the site with a goal and they try to achieve that goal. Spool [212] did a study on what happens after visitors have achieved their goal on a site. He wanted to know how he could direct the visitors to the valuable content that they did not know was there. He found that the way you get to the target content affects whether you will continue looking or not. His research has shown that visitors are three times more likely to find the valuable content if they use the category links of the home page instead of going straight to a search engine to do a search. Visitors who started with the category links ended up looking at almost 10 times as many non-target content pages as those who started with a search engine to do
a search. Search engines only let visitors see what they are looking for: if you ask for Nike shoes, you get Nike shoes. When visitors are exposed to categories, they become unknowingly educated in the other content available on the site (e.g., advertisements that trigger new goals). In this way people get interested in other things. They may change their minds and create new goals, or completely change their goals. With search engines there is no opportunity to see what else the site has to offer. A search engine does not offer the visitor the opportunity to do a ‘wild search’.

2.2 Effectiveness of search engines

Search engines, basically, map keywords that are in the query to keywords that have been collected on web pages. Therefore, search engines are very effective when we are looking for something that is well-defined. Jansen & Spink [119] determined that queries with search engines are short sessions with session durations of typically 15 minutes. Search engines usually provide limited searching assistance to the visitor. The interaction with search engines is almost always with keywords and/or Boolean operators (like ‘AND’, ‘OR’, and ‘XOR’), or an option ‘match case’. However, search engines are less effective in situations where queries become more complex because visitors lack domain knowledge or contextual awareness to use the system effectively. Jansen & Spink [120] found that approximately 15% of visitor sessions on the WWW use more advanced search options than the ones specified above. Spool [210] found the following problems when visitors search on keywords in search engines:

- partial matches; individual keywords can be matched against keywords that are part of a bigger group of words (in which the meaning of the keywords might be different as well, e.g., searching on “Hilton Hotel in Paris” in Google\(^1\) yields among others the Wikipedia page of Paris Hilton).

- misspelled keywords; mistakes in spelling can lead to unsuccessful search results.

- vague relevance; the query can result in a list of results, of which it is not clear at first glance which ones are irrelevant to the visitor.

\(^{1}\)http://www.google.com.
It is also useful to know how effective a search process is when no search engine is used. The User Interface Engineering Group in Bradford (MA) showed that visitors receive a lower percentage of relevant search results when they search on-site on keywords than when they search by browsing on the website [210].

### 2.3 Factors influencing the search process

Whether users are successful in reaching their goal(s) depends on many things. We mention a few important factors that influence an effective approach to realizing user goals.

1. **The number of clicks**
   
   When users are searching on the Web they follow a certain path to accomplish their goal. In this navigation behavior it is essential to know which steps and how many steps users need to find the required information. Rosenfeld and Morville [197] found that four or five clicks in a website is the maximum number of clicks that a user will complete before giving up. Favier [85] found that more than 50% of the web visitors leave a website after two mouse clicks. After five mouse clicks, 95% of the web visitors have left the web site already. The reason for this behavior is that web visitors do not find the information on the website easily or quickly enough to realize their goal. Lazar and Preece [139] obtained similar results. Therefore, once a user starts browsing a website, the user should be able to access all the pages on the site by going through no more than four or five clicks.

2. **Accessibility of information**

   Simply stated: “usability rules the web” [168]. If a customer cannot find the product he is looking for, then he will not buy it. Krug [132] says that the number one rule of usability is to not put the burden of thought on the user. A webpage should be self-evident. In order to design usable websites, guidelines are needed. Nielsen [168] has identified and named a few of these guidelines.

   In a usability study, Favier [85] showed that merely 10% of web visitors rated web services in 2003 as ‘excellent’, 20% were ‘impartial’, and almost 30% indicated that they ‘disliked’ web services.
3. *The structure of the website*

According to the studies of Berg [41], Hardman, Bulterman, and Rossum [101], and Shneiderman [203] the success of navigation is determined by how the information is structured on the website and how the link mechanisms are designed and presented on the menu of the website.

Nielsen [168] found that one of the fundamental problems of Information Architecture is structuring the website to mirror the way the organization is structured. Wodtke [246] says that a principle for designing good information architecture is ‘you (information architect) do the thinking, not the user’. She mentions eight principles in [246], which can be seen as rules of thumb for good information design.

4. *The first impression of the website*

In the blink of an eye, web surfers make nearly instantaneous judgments of a website’s “visual appeal”. According to Lindgaard, Fernandes, Dudek, and Brown [140] web users form first impressions of web pages in 50 milliseconds (1/20th of a second). They claim that these quickly-formed first impressions last longer because of what is known to psychologists as the “halo effect”. If people judge a website to look good, then this positive quality will spread to other areas of judgement, such as the website’s content. Consequently, they will continue to use the website that made a good first impression, as this will further confirm and reinforce that their initial decision was a good one.

The “halo effect” can color subsequent judgments of perceived credibility, usability, and ultimately influence purchasing decisions. Creating a fast-loading, visually appealing site can help websites succeed.

5. *One-size-fits-all approach*

Today designers are faced with the huge challenge of designing websites for a large number of different users. Perfetti [187] observed that many designers tackle this problem by making the functionality of the website as extensive as possible. This one-size-fits-all approach worked for designers in the past. In those days the functionality of websites was simple with users confined to a very limited set of goals. Today’s websites are vastly more complex and present web designers with the unwieldy problem of trying to include functionality for thousands of
users with different goals. Perfetti also observed that by trying to satisfy the needs of all users, designers often fail to satisfy the needs of any single user.

2.4 Search behavior in the physical world

There is a lot of literature on search behavior in the physical world. Many papers focus on the buying behavior of people in the marketing sector (e.g., [106, 87, 186]) (when people are buying products they implicitly show search behavior) or on searching in the library (e.g., [34, 36, 224]). Both domains show comparable search behavior that are relevant to our research. Below we provide some results on these behaviors.

2.4.1 Impulsive search behavior

Hausman [106] states that a lot of people are buying products impulsively as an alternative to a more time-consuming rational search behavior. Impulsive buying is a spontaneous and immediate purchase behavior [87] in which the consumer buys a product that he was not actively looking for and had no prior plans to purchase [39]. Recall that wild searching (see Chapter 1 for the definition) shows something similar. People may change their mind when they get new information in their search process while realizing their goals. Imagine that someone is looking for a science fiction book in a bookstore. While he is there, he notices that one of his favorite authors, J.K. Rowling, is present to sign Harry Potter books. Presuming that this is a one time opportunity the user may change his mind and buy a Harry Potter book (an adventure genre) instead of a science fiction book. The example shows a combination of two different behaviors: a behavior in which the user changes his mind (not buying a science fiction book as intended), and a spontaneous behavior (buying a book he did not intend to buy).

2.4.2 Epistemic and hedonic search strategies

The consumer’s retail search process (CRSP) framework of Titus and Everett [223] employs epistemic search strategies and hedonic search strategies.
**Epistemic search strategies**

Epistemic search strategies include strategies that rely on consumer’s spatial knowledge (or cognitive map) of the shopping environment [186], or strategies that require the assistance of others (e.g., store employees, other patrons) when consumers get lost [237]. According to Babin, Darden, and Griffin [25] consumers who utilize epistemic search strategies are problem-solvers and are susceptible to “utilitarian” shopping trips. These consumers are concerned with efficiency and want to complete their shopping trips at the soonest possible time. Therefore, they plan their purchases and move through the store as quickly as they can [96].

**Hedonic search strategies**

Hedonic search strategies comprise the experiential aspect of the retail search activity [108]. Bloch, Ridgway, and Sherrell [51] claim that consumers often resort to a browsing activity for obtaining recreational benefits. Consumers who want to shop likely use hedonic search strategies when they are unfamiliar with their shopping environment and, thus, proceed more slowly while valuing environmental sensory stimulation. They have a higher tendency to make impulsive purchases [96].

### 2.4.3 Navigation types and navigation aids

Benyon and Höök [69] identify three types of navigation: wayfinding, exploration, and object identification. Svensson [216] has added social navigation to this list.

1. **Wayfinding**

   Wayfinding is the activity of going from one place to another in which the following 5 navigation activities based on Satalich [200] are equally important:

   (a) Orienting oneself in the environment,

   (b) Choosing the correct route,

   (c) Monitoring the route,

   (d) Recognizing that the destination has been reached, and

   (e) Choosing or formulating a destination.
A user who is navigating has to orient himself in the environment, choose a route, monitor the route, and finally, recognize that the destination has been reached.

2. *Exploration*
   Exploration is navigation without a specific destination. People are not so much interested in a specific location, but they are more interested in exploring the space they are in. They are more open to following a crowd of people or randomly choosing a route; destination and correct route are of less importance.

3. *Object identification*
   Object identification deals with new spaces. Spaces consist of objects. In new spaces the first thing people do is to identify the different objects and their respective attributes such as identifying the reference points (the so-called landmarks). Then people generalize from past experiences.

4. *Social navigation*
   Svensson [216] has named another navigation type: *social navigation*. This navigation type is based on what others have done in the past or on the advice provided by others (e.g., follow people, ask a friend). Svensson [215] and Dieberger [77] make a difference between *direct social navigation* and *indirect social navigation*.

   - In *direct social navigation* the communication is two-way (e.g., talking) between the user (i.e., the seeker) and others (e.g., a person or artificial agent). A user can ask questions like “Where am I?” or “Where can I find location X?” to someone. This person answers the user and, perhaps more importantly, can ask the user to clarify his questions. The person can, thus, help clarify a user’s goal or even change it. When a user is uncertain of where he wants to go, the adviser can support him in formulating a destination [216].
• In indirect social navigation the communication is in one direction only. This means that advisers (e.g., a shop assistance, an employee)\(^2\) do not have to be aware of the fact that they are giving advice (e.g., by showing the user a path to a department) [216].

Navigational aids

When users do not have complete knowledge of a space, and hence, they have to use various navigational aids (or external sources of information) to find their way. We can group the navigational aids into three main groups: landmarks, signs, and maps.

1. **Landmarks** are objects in a space (e.g., “just behind the shopping mall” in geographic space, but these are analogies in information space) that serve as reference points to people [143]. They form the basic building blocks of our mental representations of a space. We use landmarks as a means to structure space because we seldom have complete knowledge of a space. They are key points that we can turn to when we are lost, or when we have to re-orient ourselves in the environment [216].

2. **Signs** are often used as a navigational aid in complex environments. Airports and railway stations frequently use signs as a means to aid users in finding their way in the environment. Signs are an effective way to guide people in the right direction [57].

3. **Maps** are survey representations of an environment. We typically find two variants of the basic map: you-are-here maps (a map that marks the position of the person looking at it), and route maps (maps with an explicit route marked) [216]. Maps are used in all sorts of navigational situations. The problem with maps is that they are often complex as they require a lot of training to become a good map-reader.

\(^2\)A good example of indirect social navigation is “Follow the Skoda driver” on Youtube (http://www.youtube.com/watch?v=FOM7zpEDa0c). In this video clip you see a man buying an electric drill. When this man notes at the cash desk that the man before him, who also is buying an electric drill, is a Skoda driver, he changes his electric drill and gets the same one as the Skoda driver.
2.5 Search behavior on the World Wide Web

Spool [211] mentions that according to the User Interface Engineering Group 54% of the users find their information by surfing. This is due to the many search attempts the users make during surfing compared to a search with a search engine. Users keep surfing even when they have found the information they were looking for.

Search behavior and navigation behavior are not only determined and influenced by the number of clicks but also by some other factors, like perception, vocabulary, thesaurus, spatial cognition, organizational structure, organizational schemes, cultural differences, education, cognition, memory, and senses (see also McCracken and Wolfe [153]). However, there are some commonalities in how people think and perceive that provide a useful set of considerations for web design and, in particular, for the design of navigation systems. Studies in cognitive psychology and social sciences can provide us more insight into how people perceive, learn, remember, and behave in certain circumstances.

Alvarado, Teevan, Ackerman, and Karger [21] did a study to understand what people do with their electronic information. They focused, in particular, on situations in which people reported exerting effort in locating information. They found that people often had an association between the information they looked for and the related contextual information. For example, a participant might know she could find the phone number of a restaurant in a particular email from a colleague. In many of these cases, people were able to associate their information target with a particular source. People often oriented themselves to targets they had seen before, and apparently used different contextual information than in cases when they had not seen their target previously.

Nordlie [177] has found that users have some preferred information sources like personal contacts, meetings, conferences, database searches or the library. She also found that users have a preference for verbal media or verbal communication. Therefore, most of the problems are mainly solved by asking colleagues, peers or perceived subject experts. Users also try their personal files or access external data sources to find a solution for their problem. Nordlie observed that when users search on-line, they do simple searches. Users perform short and general queries. Searches on the WWW are also short and simple. When users use search engines they use the well-known web search engines. Nordlie found a few problems in on-line searching which
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include lexical problems (spelling and typing), syntactic problems (failure to comply with the system’s formal rules) and semantic problems (failure to express the problem in appropriate terminology). Fifty percent of all the errors were of semantic nature. According to Nordlie, users prefer an uncluttered presentation of the search results. The search results should be presented in a meaningful ranking, in an appropriate number, and it should be easy to interpret.

Bates [32] describes twenty nine search tactics which are ordered in four categories: monitoring, file structure, search formulation, and term. Furthermore, she distinguishes four different sorts of models of search strategy: models for idealizing searching, models for representing searching, models for teaching searching, and models for facilitating searching. The purpose of these models is to suggest tactics that are likely to improve the effectiveness or efficiency of a search. A tactic may be good in one situation and not in another. In general, it may be assumed that the most efficient search involves using sources for their intended purposes. But when such approaches fail, answers may still be found by putting in the harder work to ferret out information incidentally provided (i.e., to use a source for other than its intended purpose).

Like Nordlie [177], Bhavani and Bates [44] also found that searchers use short and simple queries on the Web. Users build little on previous experience and learn slower with age. According to a study of Lazar [136] and Nielsen [168] users do not learn from visit to visit because most users spend a small amount of time on a large number of websites.

Kelly and Cool [129] considered two types of information search behavior indicators: reading time and efficacy. Their results indicate that as one’s familiarity with a topic increases, one’s searching efficacy increases and one’s reading time decreases. There are several variables that effect reading time which Kelly et al. have not taken into account such as individual reading effort. In our opinion this should have been taken into account as it is an important aspect which influences reading time.

Dahlbäck, Höök, and M. Sjölinder [70] did a study on spatial cognition and its relationship to hypermedia navigation. Their results show that a distinction can be made between two kinds of spatial cognition. One that concerns the concomitant acting in the physical world, and one that is a pure internal mental activity.

Benyon and Murray [40] found that spatial ability determined how well users performed with different interfaces to a database system. Users with
low spatial ability performed better with an aided navigation interface with a constrained dialogue, while users with high spatial ability made better use of a non-aided navigation interface with a flexible command-based dialogue.

Vicente and Willeges [233] have shown that users with low spatial ability are helped by a system where parts of the previous state of the interface are visible after the user has made an action at the interface.

Maglio and Barrett [146] sketched a model of how people search for information on the WWW. They focused on the cognitive properties and internal representations used in the search for information. They first collected behavioral data from individuals searching for answers to specific questions on the WWW, and then analyzed these data to learn what searchers were doing and thinking. One finding was that individuals focus on key nodes when recalling their searches, and that these key nodes help structure memory. A second finding was that people tend to use the same search patterns over and over, and that they recall their searches in terms of their standard patterns - regardless of what they actually did. Overall, their results suggest that people form cognitive maps of web space in a similar way that they form cognitive maps of physical space.

Catledge and Pitkow [61] and Tauscher and Greenberg [218, 219] analyzed several weeks worth of normal web usage gathered from dozens of college students. Both studies found that web users do not often traverse the same long sequence of nodes more than once. As Maglio and Barrett [146] have shown in their study, participants were unable to recall and therefore repeat specific sequences of URLs (Universal Resource Locator) even when explicitly asked to do so. Tauscher and Greenberg also found that web users have about a 60% probability of revisiting web pages they have previously visited. In Maglio and Barrett’s study, participants were more apt to re-find anchor points than to re-find sequences. People do not follow the same trails because they do not remember their trails: they remember generic procedures and particular anchor points.

Bates [37] argued that searching becomes one behavior within a general model of human information-related behaviors (see Table 2.1). Human tendencies to use the principle of least effort, and more generally, to be quite passive in information seeking, may come about because so much needed information has come automatically from the social milieux of most people throughout the history of humanity.

Many goals of users, who are seeking for information, may be long-term in nature. These goals may not be easily decomposed into sub-goals that
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<td>Being Aware (d)</td>
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Table 2.1: Modes of information seeking [37].

can be translated into immediate actions. Suitable courses of action may not have been available at the time those goals were formed. It could also be that the user may have decided that the effort required to pursue the goal at this time outweighs the benefit of its achievement (see also Chapter 8). In this respect Zeigarnik [250] showed that uncompleted tasks are remembered better than completed ones. A glimpse can trigger the awareness of a possible solution to a problem, coupled with the typical abundance of latent interests stored in a user’s long-term memory. De Bruijn and Spence [73] define two classes of browsing for this serendipitous activity.

- **Opportunistic browsing** is an intentional browsing behavior in which the user is unaware of any goal being pursued. The user’s attitude is “let’s see what’s there”.

- **Involuntary browsing** is an unintentional browsing behavior in which the user is unaware of any latent goal that might be pursued.

De Bruijn and Spence defined a third type of browsing which is called *search browsing* and is not serendipitous in intent. Search browsing is an intentional browsing behavior in which the user is aware of the goal being pursued. The goal is defined precisely or otherwise.

### 2.6 Usability and user experience

Many aspects of the preceding sections can be summarized with the terms ‘*usability*’ and ‘*user experience*’.

What is *usability*?

Usability is a property of websites (and other systems and products) that
relates to ease of use. For websites it means that usability is making your site easy for your visitors to find the exact information they need when they need it. Anything that makes the process slower (like Flash animation served to a dial-up visitor) deteriorates usability. Conversely, easy, intuitive navigation and strong, informative text enhance usability [14]. Usability is commonly defined as having three core components: effectiveness (how well can a task be completed), efficiency (how easy or quick is it to complete the task), and satisfaction (the user’s perception or opinion of the system) [13].

What is user experience?
User experience focuses on the users’ feeling when they are visiting a website. The aim of user experience is to give users a good feeling. User should have a good feeling before, during, and after visiting a website. Different aspects should be taken into account when talking about user experience like the environment, color moods, touch, audio feedback, visual feedback, trust, branding, show-off effect, usefulness, practicality, coexistence, emotional effect, etcetera [191].

2.6.1 Usability versus user experience

Thomas Baekdal [26] clarified the difference between usability and user experience by means of roads: “A usable road is one that is wide and straight (less mental effort), with no oncoming traffic (less mistakes, less mental effort). One that enables you to get from A to B as fast as possible (more powerful) and one that has a consistent and clear use of signs (high learnability)” (see also Figure 2.1). “In short the most usable road is a freeway. But, a freeway is also directly boring in terms of user experience.”

“A road with a high level of user experience is completely different” (see also Figure 2.2). “It is a twisting mountain road (visual) with great scenery (visual, emotional). You got little friendly signs put out by the local, who sells fruits along your way (show-off effect). Every city is slightly different (branding, emotional, environment). You feel happy when you see the locals wave when you pass by, and you stop to let a sheep pass (emotional, trust, coexistence)”.

“But a mountain road is far from a usable road. It is much harder to drive on, it is difficult to learn, you can not go as fast and the risk of making a mistake (taking a wrong turn or crashing into a sheep) is much greater. But, a mountain road will give you a much better user experience than any
Our opinion is that usability and user experience can not be seen separately. Usability is a subset of user experience and a key aspect of user experience. Usability answers the question, “Can the user accomplish his goal?” while user experience answers the question, “Did the user have an as delightful experience as possible?”.

One can speak better of ‘less’ or ‘more’ user experience or usability in the example of Thomas Baekdal instead of a difference. In Figure 2.1 you could say that the usability is high while the user experience is low. In Figure 2.2 it is just the opposite, low usability and high user experience.
2.7 Conclusion

This chapter gave an overview on user goals, and search and navigation behavior, and insights on wild searching. The chapter provided us with some factors, which we will use as (observation) categories in the next chapters.

One of the insights we gained from this chapter is that search engines are good for keyword search, the case in which the visitor has a well-defined goal. But they are less effective for wild search, the case in which the visitor has a vague goal and does not have a well-developed plan of action.

Goals may be influenced by usability and user experience factors. By influencing goals one can influence the search behavior in ‘non-web’ situations as well as in web situations. On the WWW this can be achieved by optimizing websites for wild search. To find out how we can optimize websites for wild search, we need to know how people are searching in ‘non-web’ situations and how their goals are influenced. This can be done by observing people in ‘non-web’ situations. In Chapter 3 we will first do a pilot study to identify which problems may arise when observing people. After that we observe people in ‘non-web’ situations (see Chapter 4) and on the WWW (see Chapter 5). The categories navigation aids, orientation, epistemic and hedonic search strategies, and social navigation are used in the observations in Chapter 4 and Chapter 5. The following WWW-specific categories are used in Chapter 5: search engines, search options on the website, browser find option, Uniform Resource Locator (URL), bookmarks, and the browser back button.
Chapter 3

Pilot study: Behavior observations in “non-web” situations

The primary goal of the pilot study, described in this chapter, is to identify potential problems that may arise in empirical studies of observing people or performing experiments. A second goal of the pilot study is to get a first impression of how people search in “non-web” situations and how their goals are influenced. This chapter will provide us additional factors which we will use as (observation) categories in Chapters 4 and 5. In Section 3.2 we give a short description on ethnography to get insight in observation methodologies. In Section 3.3 and 3.4 we respectively develop the methodology and describe the approach.

3.1 Introduction

In this chapter we describe the pilot study that we did to find out what problems may arise in the experimental design for observing people. The solutions for those problems are described in Chapter 4. The observations in this section were done in a variety of “non-web” situations like shopping in a shopping mall or finding the right bus at the bus station, etcetera. We choose for “natural”, i.e. “non-web”, situations to find out how people reason, how their reasoning leads to a particular approach in realizing their goal, and how additional information makes them deviate from their approach. The
results will be used to investigate whether searching in a “non-web” setting shows search opportunities that people appreciate but that currently are not supported on the WWW.

In Section 3.3 we develop the methodology for the pilot study. Section 3.4 describes the approach for the observations in a task-based (i.e., experiments on searching) and a natural setting. Before that, in Section 3.2, we give a description on ethnography to get insight in observation methodologies, especially in observing participants. Section 3.5.1 and 3.5.2 describe the results of the observations and the interviews which we have taken of the participants. In Section 3.6 we discuss the results and discuss the relevance of these results for web design in Section 3.7. This is followed by conclusions in Section 3.8.

3.2 Ethnography

In this section we give a short description on ethnography to get insight in observation methodologies. We discuss different approaches and their pitfalls, and describe how to record the results of ethnography.

3.2.1 What is ethnography all about?

“Ethnography is the scientific study of human social phenomena and communities, through means such as fieldwork or field research. It is considered a branch of cultural anthropology, the branch of anthropology which focuses on the study of human societies” [207]. Ethnography can be considered as a basic form of qualitative social research. The term ethnography refers to the descriptive study of people [221]. In fact, the ethnographic method to acquire knowledge, is a variant on everyday methods to get to know something of the life of other people; it is a mixture of looking at, participating in, and talking to others. This is also called participating observations [152].

3.2.2 The approach

Blomberg [52] mentions that the term ethnography refers both to the process of conducting field research and to the written text produced as a result. According to Blomberg, in the Human Computer Interaction (HCI) and system design communities, ethnography most often refers to an approach used to develop understandings of everyday work practices and technologies.
Ethnography in use. While there is a great deal of variability subsumed within the practice of ethnography, most practitioners share a few basic premises. These include:

- a commitment to studying activities in the “natural” settings in which they occur,
- an interest in developing detailed descriptions of the lived experience,
- a focus on what people actually do, not simply on their accounts of their behavior, and
- a concern with understanding the relation of particular activities to the constellation of activities that characterize a setting.

Blomberg also mentions that it is difficult for individuals to articulate the tacit knowledge and understandings they have of familiar activities when they are practicing ethnography. “Because of this, it is essential that the things people say about their own activities and about the activities of others be supplemented with firsthand observations of behaviors. It is equally important that these observations be made in the actual settings in which the activities typically occur since to remove an activity from its everyday setting is to alter it in fundamental ways (...). It follows, therefore, that there is a strong conviction that field studies form the basis of an ethnographic investigation”.

Observations and interviews can complement each other’s strong and weak points. One can get more information from a goal-oriented interview than from a random chat session. On the other hand a ‘careless’ way of observing subjects may provide you exactly that information of which you were unaware.

A lot of important developments took place in the field of ethnography in the passed two decades. One of those developments is to make recordings or shootings (photos, audio or video) of episodes of social lives or interviews [221, 122]. This makes a detailed study of social life possible.

3.2.3 Pitfalls

Initially, ethnography looks simple: participating a little bit, looking at and talking to others. But in practice it is more difficult than it looks like. A lot has been written on field research or on participating observations (among others by Bogdan and Taylor [53], Douglas [79], Hammersley and
Atkinson [99], Ten Have [220], Lofland and Lofland [141], McCall and Simmons [152], and Schatzman and Strauss [201]). All of them focus mainly on the relational side of the work, e.g., how to enter somewhere, how to make good relationships with the informers, etcetera. They also pay attention on the selection of information, the methodology, and the importance of making notes of observations.

It is human nature to describe the observed information in terms of the knowledge one already has, e.g., of the social circumstances of the observed persons, what all kinds of ‘words and actions’ mean, and what the physical environment socially means. New impressions will always and inevitably be placed in your own cognitive, emotional, and moral framework with which you already are familiar. You will automatically act from your presupposition about what is going on, what you could expect, and about what all the kinds of things (like words, gestures, and actions) are worth in the situation where they came across. The challenge is of course to replace such presuppositions slowly with the interpretation frameworks, which are used in the field of research by the observed persons themselves.

3.2.4 Making notes of observations and interviews

Making field notes is an essential part of field research as such. The essence of field research lies in the combination of observing and writing, of looking at and listening to on the one hand, and expressing and recording the results of the field research on the other hand. Lofland & Lofland [141] propose the following process of note taking:

A. *Mental Notes*: Focus one’s attention on the things you should note later, like the basis information of the scenes and the episodes, and the remarkable events in it.

B. *Jotted Notes*: Making short notes during or immediately after the observations; use short words or quotations as reminders. Sometimes there are opportunities to make detailed notes or to work out earlier notes.

C. *Full Field Notes*: Working out the notes to complete reports. This should not be done later than the morning of the next day because new experiences push the old ones to the background. That is why one should note the last ones first. Writing stimulates the reflection on the events which should be noted too.
Note taking is thus a way to report chronologically of what happened in the field and what you as researcher have experienced. It is a continuous description of people, events, what you heard, conversations of and with people in the field, and also descriptions of the physical environment.

One important development in the field of ethnography is to make recordings or shootings by means of photos, audio or video [221, 122]. These means give, besides a chronological report, the opportunity to study in detail what happened in the field. One should note that these means interfere with the situation if they are not put discreet or if the observed participants are not used to it.

Our study is based on field studies and interviews which we describe in Section 3.3 and 3.4. We decided not to use video, since we could not afford to accustom our observants to this situation for the relatively short duration of the actual observation. We followed the process of note taking of Lofland & Lofland [141] as much as possible for noting the observations of and interviews with the participants.

3.3 Methodology

It should be obvious from Section 3.2 that ethnography is a good way to observe and understand people. Nevertheless, we use a ‘quick and dirty’ ethnography in this pilot study as we primarily want to identify what problems may arise in empirical studies when observing people: are we asking the right questions to get the right answers for the tasks, are we using the right setting, are we approaching the people right, etcetera. Different from observing in a natural setting, to observe people in a task-based setting is in fact not ethnography; it is an experiment where we observe in a manipulated setting (i.e., people have to fulfil some tasks).

The pilot study consisted of two kinds of observations: ethnography and task-based observations. We observed people in their natural setting (group N) and in a task-based setting (group T). We added the task-based setting because sometimes people are forced to search because they are triggered by a task. After the observations the participants were interviewed to cross-validate and to understand the search behavior observations.
3.4 Approach

3.4.1 Participants in task-based setting (group T)

We observed five participants completing different tasks. Those tasks are described in Section 3.4.3. Each participant had to complete two tasks (see also Table 3.1). Three participants were computer science students (one in the fourth year and two in the third year) from the department of computer science from VU University Amsterdam in Amsterdam, the Netherlands. They were approached by email in which they were asked whether they wanted to take part in this research. When they were willing to participate in the research they were invited for an introductory meeting. In this meeting they were explained in detail what the research was all about and what tasks they were supposed to do. During the meeting an appointment was made to do the tasks. The other two participants were from the circle of friends of the author. They were approached personally. Table 3.1 shows the participants and the tasks they completed. The participants are called $P_{t1}$, $P_{t2}$, $P_{t3}$, $P_{t4}$, and $P_{t5}$ because of the anonymity.

All the participants were informed about the following:

1. The goal of this study. The participants were informed about the goal of this study and that it was a part of a major research project.

2. The observation procedure.

3. The interviews. The participants were informed that they would be interviewed after the observations and that the interview would take 5-10 minutes.

4. Their privacy. The participant were informed about the procedures to guard their privacy. No names were recorded. In the observation results the participants were referred by $P_{t1}$, $P_{t2}$, $P_{t3}$, $P_{t4}$, and $P_{t5}$.

The participants were interviewed after they had completed a task. We did this to find out why they took a certain action and how their reasoning led them to a particular approach in realizing their goal.

In section (Section 3.4.3) we give a description of the tasks the participants had to complete.
3.4.2 Participants in natural settings (group N)

We observed fifteen participants in different natural settings. All the participants were first asked for their permission to be followed and to be observed. As in the task-based setting all the participants in the natural setting were informed about the following:

1. The goal of this study. The participants were informed about the goal of this study and that it was a part of a major research project.

2. The observation procedure.

3. The interviews. The participants were informed that they would be interviewed after the observations and that the interview would take 5-10 minutes.

4. Their privacy. The participant were informed about the procedures to guard their privacy. No names were recorded. In the observation results the participants were referred by $P_{n1}$ up to and including $P_{n15}$.

Subsequently the observation session started. An observation session ended when the participant had realized his goal or when he indicated that he had finished. After the observation session some of the participants were interviewed. Table 3.2 shows the number of participants in the different cities. The number of observations, which in this case is equal to the number of participants, is given by $N$.

3.4.3 Task description for task-based observations (group T)

1. CD-search 1

For this task the participant had to answer three search questions.
<table>
<thead>
<tr>
<th>City</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utrecht</td>
<td>4</td>
</tr>
<tr>
<td>Amsterdam</td>
<td>7</td>
</tr>
<tr>
<td>Dubai</td>
<td>2</td>
</tr>
<tr>
<td>Brussels</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 3.2: Number of participants observed in different cities. \( N = 15. \)

These questions were formulated at three levels of difficulty, namely: basic, intermediate, and difficult. The observations were done in a video shop in Amsterdam that sold movies as well as CDs. This video shop had two CD boxes with approximately 300 CDs. One CD box contained CDs with movie songs and the other one contained CDs with non-movie songs. The participant did not get any explanation about how the CDs were organized in the CD boxes nor did he get the information about the difference between the two CD boxes. The participant had to find out himself.

(a) At the basic level the question was formulated as follows: Look up the CD of ‘Pretty Woman’.

(b) The formulation at the intermediate level was: Who sung the song ‘Where Are You Tonight?’ from the movie ‘Dirty Dancing’?

(c) At the difficult level the formulation was: Who sung the song ‘In the plane’?

The participant was handed all the three tasks on paper. He got three separate sheets with one task at a time. There was no time restriction to perform the tasks. The only restriction was that the participant had to use the CD boxes to look up the CDs in order to answer the above questions. The participant had to show the particular CD. In this way the possibility of giving an answer without looking up the CD in the CD box was eliminated (this might happen when the participant would know the answer by heart). For level c the participant had to figure out the movie name first in order to find the performing artist of the song. The participant was free to ask any questions to the shop assistant.
2. **CD-search 2**

This task was a modification of the first task, CD-search 1. The differences with task one were that the participant got an explanation of how the CD boxes were organized and what the differences were between the two CD boxes. Because both tasks one and two (CD search 1 and 2) were carried out by the same participant the titles of CDs and songs for this task were different from the ones used in task one. The search questions were formulated as follows:

(a) Basic level formulation: Look up the CD of ‘The Matrix’.

(b) Intermediate level formulation: Who sung the song ‘Walking On Sunshine’ from the movie ‘Daddy Day Care’?

(c) Difficult level formulation: Who sung the song ‘The Trouble With Love Is’?

3. **Book search in study**

This task consisted also of three search questions increasing in the level of difficulty like in task one (CD-search 1). The assignment was given in a teacher’s study in Amsterdam. The teacher’s study had one bookcase with four bookshelves with about 100 English and Dutch books in total. The books were arranged on disciplines instead of alphabetically by author. Two main disciplines could be distinguished at first sight: computer science and social science. The search questions were formulated as follows:

(a) Basic level formulation: Look up the book named ‘Web Design with XML’. (An English book)

(b) Intermediate level formulation: Who wrote the book named ‘Success door groot denken’. (A Dutch book)

(c) Difficult level formulation: On what page does the chapter ‘De magie van de stem’ start in the book named ‘Spreken is goud’? (A Dutch book)

The questions were given on paper. The participant got three separate sheets with one task at a time. No explanation was given to the participant about the organization of the bookcase. There was no time restriction to answer the questions. The participant was not allowed to ask any questions to the teacher. All information needed could be found on the bookshelves.
4. *Book search in the library*

In this task the participant was supposed to find two books, a chemistry book and a computer science book, in the faculty library of his university in Amsterdam. The title, author, and the ISBN number were given on paper. The books the participant was supposed to find were:

Title: Organic chemistry  
Author: Jones, Maitland  
ISBN: 0-393-97405-7

Title: The Java™ programming language  
Author: Arnold, Ken  
ISBN: 0-201-63455-4

The computer science book and the chemistry book were intentionally chosen because the participants were from the computer science department. In order to find out whether they were able to find books from other disciplines a chemistry book was chosen as well. The participants were free to consult the digital database of the library which was accessible through any computer with an Internet connection. There was no time restriction or restriction to ask questions to the assistant at the counter of the library. The participants were allowed to use any pointers available in the library, like manuals for searching a book in the faculty library.

5. *Book search in a bookstore*

This task resembles the task mentioned in *‘Book search in the library’*. The participants were presented three situations (see below) with little differences. In all these situations the participants were supposed to buy a book for their friend’s birthday at the bookstore of their university. The participants were supposed to select the best gift (i.e., book) based on the information they received at that moment in all the situations. The three situations are listed below:

(a) In the first situation the participants were presented the title of the book that their virtual friend wished for. The author, and the ISBN number of the book were known.
(b) In the second situation the participants were given the virtual friend’s favorite genre, “psychology”. No title, author or ISBN number were given.

(c) In the last situation the participants were given the virtual friend’s favorite author name, “Scott Vintrella”.

All the three situations were presented one by one to the participants. There were no restrictions for completing this task.

3.4.4 Observation locations for natural settings (group N)

The observations were done in shopping malls and street markets where people had the possibility to choose different things or substitutes for the things they were looking for.

Some observations were done in Utrecht (the Netherlands) because of the very big shopping mall, Hoog Catharijne. Hoog Catharijne is located at the central station of Utrecht where people can do their shopping, eat some food, have some drinks, take trains, buses, trams, and taxis for transportation, do their bank business, and many things more. Hoog Catharijne is the shopping heart of the Netherlands with around 160 shops (see Corio Nederland Retail [195]). People can choose from a big variety of fashion and food, multimedia, personal care, and specialist shops. With its elevators and the broad passageways Hoog Catharijne is easy accessible for many people. Hoog Catharijne offers a lot for a whole day of shopping.

A few observations were done in the City Center of Amsterdam (the Netherlands). The City Center has a lot of shops and some big department stores. The observations were mainly done in the big well-known shopping streets (Kalverstraat, Rokin, and Damrak) of the City Center. These streets have many souvenir shops as a lot of tourists visit this area.

Other observations were done during a visit to the Golden City in Dubai (United Arab Emirates) and the City Center of Brussels (Belgium). The Golden City is the biggest shopping mall for gold jewelry in Dubai. A lot of tourists visit this location. One of the famous tourist attractions in the City Center of Brussels is the Grote Markt. The Grote Markt has a lot of
outdoor cafes, restaurants, and hotels. In the City Center one can also find souvenir shops and sights like *Manneken Pis*.

### 3.4.5 Interviews

Almost all (some participants did not have time to be interviewed) the participants were interviewed after the observations. We interviewed the participants to cross-validate the search behavior observations about the participants (How accurate are our observations?). The interviews were also taken to find out how the participants were reasoning, how their reasoning led to a particular approach in realizing their goal, and how additional information made them deviate from their approach (What is the meaning behind our observations?). As all participants were Dutch native speakers, the interviews were held in Dutch. The answers of the participants were written down.

### 3.4.6 Recording observations and interviews for group N and T

We followed the process of note taking of Lofland & Lofland [141] as much as possible for noting the observations of and interviews with the participants.

### 3.5 Results

It was not easy to find participants who wanted to participate in the pilot study. This was probably because, in general, this kind of observations demands a lot from the participants. Another reason is that participating in the pilot study was a volunteer job. People were not rewarded in a material way for their cooperation. Many people did not have the time and therefore did not want to spend time on the pilot study. Some of them did not want to participate because of privacy reasons. Others did not like to be observed. In Chapter 4 we have adapted the methodology to get as many participants as possible. In Section 3.5.1 we describe the results of the observations and interviews of participants who had to complete a task. Section 3.5.2 describes the results of the observations and interviews of participants in their natural settings.
3.5.1 Observation of group T and their interview

In this section we describe the observation and the interview results per task (see also Table 3.1) for group T.

CD-search 1 and CD-search 2 (see page 35 and 37).

Observation
Participant $P_{t4}$ did the CD-search 1 and CD-search 2 tasks. For the question of the basic level (see also page 35, CD-search 1, level $a$) of CD-search 1 the participant walked to the first CD box and inspected the CD box from top to bottom. After a while he asked the shop assistant whether the CD-title referred to a movie or not. The shop assistant answered with ‘yes’. The participant asked one or more times for help to the shop assistant in order to be successful, i.e., to complete the task. In particular this was the case for the question at the difficult level. The search time to complete the CD-search 2 task was shorter than the time to complete the CD-search 1 task (6 versus 8 min.).

Interview
In the interview the participant indicated that he was initially exploring the two CD boxes to find out how it was organized. Subsequently he sought the first letter of a CD-title (this was done after he had decided from what movie the song was). He read the whole CD-title when the first letter of the movie matched the first letter of the CD-title. The participant indicated that he learned from question one and two of the CD-search 1 task: he discovered that the CDs with long titles were at the top of CD box one.

Book search in study (see page 37)

Observation
This task was done by participant $P_{t5}$. Before looking up the books the participant stood in front of the bookshelves for a few minutes. He inspected the bookshelves from top to bottom. After that he looked up the books. To answer question c of this task he consulted the table of contents. The participant spent 13 minutes to find all three books.

Interview
In the interview the participant said that he could not discover any pattern or structure in the bookshelves. He had expected that the books were ar-
ranged in alphabetical order by author. Because this was not the case it was difficult for him to find the requested books. Question c was easy to answer for him (after he had found the book) because of the tables of contents. According the participant it is a natural thing that chapters are listed in the table of contents.

Book search in the library (see page 38)

Observation
This task was done by $P_{t1}$, $P_{t2}$, and $P_{t3}$. Participants $P_{t1}$ and $P_{t2}$ walked from the bookshelves in the library to the computers to look for information. They went to the counter to ask the employee for help when they could not find the information they were looking for. They did this several times. When they finally got the book code they had problems with finding the location of the book in the library. They found the location with the help of the employee at the counter and the signposts in the library.

Participant $P_{t3}$ consulted the digital database of the library. This participant did a search on the ISBN number instead of the title. Participant $P_{t3}$ did not ask anyone for help. The search time of this participant was remarkably shorter than the search time of participants $P_{t1}$ and $P_{t2}$. He found the book within 5 minutes.

Interview
Participants $P_{t1}$ and $P_{t2}$ indicated that they were not familiar with their faculty library. They expected that the books were arranged by author’s name instead on book codes. Participant $P_{t1}$ did not know how to use the digital database of the library while participant $P_{t2}$ did not know the difference between ISBN and ISSN numbers.\(^1\)

Participant $P_{t3}$ was familiar with the library. This participant mentioned that a search should not take too long. Participant $P_{t3}$ did a search on the ISBN number because the ISBN number is a unique number. A search on the ISBN number reduces the number of hits to one or none. According to participant $P_{t3}$ a search should be short and simple.

\(^1\)ISBN stands for International Standard Book Number and ISSN stands for International Standard Serial Number.
Book search in a bookstore (see page 38)

Observation
This task was done by four participants, $P_{t1}$, $P_{t2}$, $P_{t3}$, and $P_{t5}$. Participants $P_{t1}$ and $P_{t2}$ initially tried to look up the book in the bookshelves (situation a of this task, see also page 38). When they could not find the book they asked the assistant at the counter for the book. Participant $P_{t3}$ and $P_{t5}$ did not try to look up the book themselves, but they asked the employee directly for the book.

For situation b (see page 38) all four participants asked the assistant where they could find the particular genre and looked up a book of the particular genre themselves.

For situation c (see page 38) participants $P_{t3}$ and $P_{t5}$ asked the assistant for a list of titles of the particular author. Subsequently they made their choice from that list. Participant $P_{t1}$ on the other hand asked the assistant were he could find some books of this particular author. He then looked up a book at the indicated location by the assistant. Participant $P_{t2}$ walked in the bookstore and looked around. When he found a few books of the author he selected one.

Interview
Participant $P_{t3}$ indicated in the interview that it was more efficient to ask the assistant directly for help than to search himself first. The reason the participant gave was that the shop assistant knows better where the books are located and what books they have in house. Participant $P_{t1}$, $P_{t2}$, and $P_{t5}$ agreed that it is sometimes better to ask the shop assistant first than to try yourself. Participant $P_{t5}$ said that this is certainly the case when you are in a hurry or when you have little time.

Task-based observations tabulated
To get an overview of the participants’ search behavior, we put the observed results based on the tasks the participants had to complete in a table (see Table 3.3). In the table we make a distinction between searching without help, searching with direct help, and searching with indirect help. We do this because we observed mainly these behaviors during our observations. In Table 3.3 “searching without help” means that the participant did not need any help from a person, while “searching with direct help” refers to that the participant asked for direct help or information from a person. “Searching
with indirect help” refers to that the participant has tried himself first to complete the task. But when he was not successful he asked a person for assistance in order to pursue his search. In the last column of Table 3.3 all the sources, e.g., information desk, signposts, flyers, books, computers, manuals, etc, the participant used to complete the task are summarized. The number of observations is given by $N$

### 3.5.2 Observation of group N and their interview

In this section we describe the observation and the interview results per participant in their natural setting (see also Table 3.2). Most of the participants had little time to participate in the experiment. For this reason we kept the interviews very short. We did not ask more than one or two questions. Some participants were not interviewed at all because of lack of time.

<table>
<thead>
<tr>
<th>Participants (and their tasks)</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Searching without help</td>
</tr>
<tr>
<td>$P_{11}$ (book search in library)</td>
<td>X</td>
</tr>
<tr>
<td>$P_{11}$ (book search in bookstore)</td>
<td>X</td>
</tr>
<tr>
<td>$P_{12}$ (book search in library)</td>
<td>X</td>
</tr>
<tr>
<td>$P_{12}$ (book search in bookstore)</td>
<td>X</td>
</tr>
<tr>
<td>$P_{13}$ (book search in library)</td>
<td>X</td>
</tr>
<tr>
<td>$P_{13}$ (book search in bookstore)</td>
<td>X</td>
</tr>
<tr>
<td>$P_{14}$ (CD-search 1)</td>
<td>X</td>
</tr>
<tr>
<td>$P_{14}$ (CD-search 2)</td>
<td>X</td>
</tr>
<tr>
<td>$P_{15}$ (book search in study)</td>
<td>X</td>
</tr>
<tr>
<td>$P_{15}$ (book search bookstore)</td>
<td>X</td>
</tr>
</tbody>
</table>

Table 3.3: Task-based observations tabulated. $N = 10$. 
Results

Observations in Utrecht

Four participants were observed in Utrecht at different locations in Hoog Catharijne. In this section the observations and interview per participant are described. The participants are denoted by $P_{n1}$ up to and including $P_{n4}$.

Participant $P_{n1}$

Observation
This female participant was shopping in a big department store. She was looking for a ladies’ jacket. When she entered the department store she looked up the ladies department at the signpost. She went to the ladies’ department. There she tried to find the jacket section. But she could not find it. Then she asked a shop assistant for the jacket section. The shop assistant told her how to get there. While she was going to the jacket section she was distracted by ladies’ underwear. After a while she went to the jacket section. She was not so long there because she could not find a nice jacket. After that she left the department store.

Interview
We asked the woman why she stopped at the ladies’ underwear section while she was looking for a ladies’ jacket. She said that she was distracted by the ladies’ underwear because her mother-in-law sews ladies’ underwear.

Participant $P_{n2}$

Observation
This participant wanted to go to Rotterdam by train. The participant has just arrived at the bus station in Hoog Catharijne and had to buy a train ticket. At the bus station the participant asked one person where to buy train tickets. The person told the participant that he could buy tickets in the central hall of Hoog Catharijne. The person also showed the participant where the entrance was to Hoog Catharijne. When the participant entered Hoog Catharijne he did not know where to go. He asked another man the way to the central hall. This man told him the way. The participant walked in the indicated direction. But the participant did not succeed in finding the central hall. Then the participant asked another man. This man was going to the central hall. He told the participant that he could walk with him to the central hall. The participant bought a train ticket in the central hall at the ticket office. Then the participant looked up the time and track number.
at the big display with the train schedules in the central hall. After that he walked to his train.

Participant \(P_{n3}\)

*Observation*

This participant was in a food court with her child and wanted to buy a meal. She ordered French fries and a coke for herself. Her child wanted the kid’s meal. The child only consumed the drink from the meal and a few fries. The rest of the fries and the hamburger were consumed by his mother.

*Interview*

We asked the woman whether the child always has a kid’s meal. She answered that her child indeed always has a kid’s meal because of the toy one receives when one orders a kid’s meal.

Participant \(P_{n4}\)

*Observation*

This participant wanted to buy a nightdress for her mother-in-law. She knew her mother-in-law’s taste. She also knew in which shop her mother-in-law often bought her dresses. The participant went to that particular shop. It was a small shop. She looked at the different dresses and the sizes. She knew what size her mother-in-law was wearing. She got this information from her father-in-law. In the shop the participant’s husband saw a nightdress which he liked for his wife, the participant. The participant and her husband were discussing with each other about the dress. Finally, they agreed to buy that particular dress. The participant continued to look for the nightdress for her mother-in-law. She found one with long sleeves and beautiful designs. She was sure that her mother-in-law would like this one. She bought both dresses.

**Observations in Amsterdam**

Seven participants were observed in Amsterdam in the shopping streets of the City Center. This section describes the observations and interviews per participant. The participants are denoted by \(P_{n5}\) up to and including \(P_{n11}\).
Participant $P_{n5}$

Observation
This participant was a lady. She was looking for a long dress in a big department store. When she entered the store she looked at the perfumes on the ground floor. She visited a few perfume stands and after that she went on to the section with ladies clothing. There she looked around between the other clothes. The lady did not find the long dress she was looking for in this shop. She did not ask any person for any assistance nor did she visit the other floors.

Interview
We asked the participant what she was looking for at the perfume stands. She said that she was just looking at the new things and the prices to compare to the prices in other shops.

Participant $P_{n6}$

Observation
The second participant was a man who wanted to buy a bus and tram card at the tobacconist. While he was walking in a busy street he looked left and right for a tobacconist. In his search he met someone he knew with whom he had a little chat. After that he continued his search. When he found the tobacconist he entered the tobacconist. There the shop assistant asked the participant whether she could help him. He said ‘yes’ and asked for a bus and tram card. He also bought a packet of cigarettes. After that he paid the shop assistant and left the tobacconist.

Interview
We asked the man why he bought a packet of cigarettes while he just needed a bus and tram card. He answered that he needed the cigarettes anyhow as he is smoking a lot. Therefore he bought it as he was at the tobacconist anyway.

Participant $P_{n7}$

Observation
This participant was shopping in a big department store. She was looking at the clothes in the ladies section. The woman was not looking for a particular dress. She was just looking at the different lady dresses. After that she went to the shoes section where she tried on one pair of shoes. Then
she went to the children section. There she looked at pants and pyjamas. She liked one of the pyjamas and removed that from the shelf. She looked for size 146 on the shelf. After that she continued to the sweaters, looked at a few sweaters and went on to the cashier. There she paid for the pyjamas.

*Interview*

The woman was asked why she bought the pyjamas while she was not intending to buy anything in this store. She answered that when she saw the pyjamas she liked it for her little son. That is why she bought it.

*Participant P₉₈*

*Observation*

This participant was a tourist with three other men. They were going to a Chinese restaurant in the City Center of Amsterdam by tram. They asked the tram driver were they should get off. The tram driver explained to them at which stop they should get off and that he would announce it. When the tram driver did so, the participant and his companions got off. The participant walked in the direction the tram driver told him to. After a while the participant asked a pedestrian for the restaurant as he could not find the street. The participant showed the pedestrian the name of the restaurant and the address. This pedestrian did not know the restaurant but he knew the street. He showed the participant in which direction he had to walk. The participant did so. During his search the participant was looking at the street corners for the street names. The participant found the restaurant by following the instructions the pedestrian had given him.

*Participant P₉₉*

*Observation*

This female participant was in a big bookstore. She was looking for the book “Inkspell” written by Cornelia Funke. When she was in the bookstore she was looking around. At a certain moment she walked to the section with newly arrived books. There she saw the book “Harry Potter and the Half-Blood Prince” written by J.K. Rowling. She took the book and glanced over the book. She said that she was going to buy this book as she has waited a long time for this book to appear. After that she was looking at some other books. Then she started to look for the book she initially wanted to buy (Inkspell). When she could not find the book she asked a shop assistant whether they had the book in stock or not. The shop assistant looked in
their computer system. Unfortunately the book was sold out. The shop assistant had to order the book. The participant said that she would look further in a different bookstore. After that she went to the cashier to pay for Harry Potter.

*Interview*
The participant was asked why she did not order the book. She answered that it was not that necessary to buy that book as she had Harry Potter now. She would buy that another time.

*Participant P_{n10}*

*Observation*
This participant wanted to buy socks. He wore socks of a particular brand. He knew exactly in which shop he could find the brand he liked. When he entered the shop he looked up the gentlemens section. He used the signpost to find the gentlemens section. Once he found the gentlemens section he looked at the socks of different colors. He first took a brown colored one. Then he put it away and took a black one. After that he also took a blue one. The striking thing was that he took exactly the right size. When he got two pairs of socks he went to the cashier to pay.

*Interview*
We asked the man whether he knew beforehand how many socks he wanted to buy and what color. He stated that he did not know how many socks he wanted to buy nor did he know the color. From the interview it appeared that this man’s favorite colors were dark colors, especially black and blue. That explains why he bought those colors. The participant could not indicate why he bought two pairs.

*Participant P_{n11}*

*Observation*
This participant wanted to buy perfume for herself. She went to a perfume shop where she wanted to buy a perfume of a particular brand. When she entered the perfume shop she did not look up her brand section. She went to a different brand section. One of the shop assistants asked her whether she would like to be helped. The participant said ‘yes’. The shop assistant asked her what kind of odour she was looking for and what kind of odour she liked. She told the shop assistant that she wanted something for
the evening and it should have a sweet odour. The shop assistant showed
her a few perfumes which the participant tried. But she did not like them.
Then, when she was finished, she went to her brand section and tried some
perfumes. Finally, she took a small bottle of perfume and went further to
the powder section. She tried some odours there. She took the powder that
she liked and bought that together with the perfume. Then she left the shop.

Interview
We asked the woman why she bought the powder while initially she intended
to buy perfume only. She answered that she was there anyway and she liked
the powder. So, why not buy it directly instead of waiting for the next visit.

Observations in Dubai

Two participants were observed during a visit to the Golden City, the biggest
shopping mall for gold jewelry, in Dubai. In this section we describe the ob-
servations and interview per participant. The participants are denoted by
$P_{n12}$ and $P_{n13}$.

Participant $P_{n12}$

Observation
This participant was looking for a golden wedding set consisting of a neck-
lace, ring, earring, and a bracelet. The participant did not want a modern
set or an old-fashioned one. The set should be between a modern and a
traditional one. Because of time constraints the participant could not visit
all the shops. She had to make a selection of the shops she wanted to visit.
This selection was mainly based on the jewelry in the window of the shop. If
the shop had jewelry that had appeal for her, she entered the shop and asked
the shop assistant to show her some wedding sets. The wedding sets were
observed carefully on design and on errors. Besides the design, the price
played an important role in making a decision to buy the set. A similar set
with a similar design and weight should be cheaper in Dubai than in the
Netherlands. When the participant had found a set that was appealing to
her, she compared the prices to the prices in the Netherlands and to prices
in other shops in the Golden City. The participant finally bought a set at
the shop with the lowest price offer. The set consisted of a necklace, ring,
and an earring.

Interview
In the interview the participant indicated that the price was more important to her than the number of items in the set. That is why she bought a set with three items instead of four.

Participant \( P_{n13} \)

Observation
The second participant in Dubai was a man who was looking for a photo camera. He had heard from his colleague in the Netherlands that electronic devices were cheap in Dubai. This man visited almost every photo camera shop whenever he had the chance. He wanted a digital photo camera from Nikon which should not be too expensive. He did not want to spend more than 300 euros for a photo camera. This man could not find a digital camera cheaper than 300 euros. The digital cameras he found cost as much as he would pay in the Netherlands. Therefore, he decided to buy the digital camera in the Netherlands.

Observations in Brussels
Two participants were observed in the City Center of Brussels in Belgium. This section describes the observations and interview per participant. The participants are denoted by \( P_{n14} \) and \( P_{n15} \).

Participant \( P_{n14} \)

Observation
This participant was a woman who was interested in lace. The area of the ‘Grote Markt’ has a lot of souvenir shops. Among these souvenir shops there were some shops specialized in lace. At the ‘Grote Markt’ she visited a few of these shops. She went into the a shop where she looked at the handkerchiefs and some blouses. In a second shop she looked again at handkerchiefs and blouses. She also looked at placemats and purses. When the shop assistant asked her whether she wanted to be helped, the participant said that she was only looking at the things. After a while the participant asked the shop assistant whether she could try on a blouse. The shop assistant said ‘yes’. Then she went with a blouse to the fitting room to try it. She liked the blouse but unfortunately the blouse was a little bit small. She asked the shop assistant whether she had a bigger size, but the shop assistant had not. Then the participant left the shop. In a third shop she saw a similar blouse. There she asked the shop assistant to try on the blouse. But this
time she asked for the proper size first. After that she got a blouse to try. This time the blouse fitted well. The participant bought the blouse but did not leave the shop. Instead of leaving she was looking around the shop. She saw a white kitchen apron which she took. She walked to the cashpoint to pay. After that she left the shop.

**Interview**
We asked the participant whether she wanted to buy a particular lace cloth or not. She said that she did not intend to buy anything. She might buy something if she would see something nice. In the interview the participant also said that the blouse was for herself but that the kitchen apron was a present for her daughter.

**Participant** $P_{n15}$

**Observation**
This participant wanted to buy bread and soft drinks in a supermarket. When the participant entered the supermarket she looked around. Then she walked into an aisle with chocolates. There she looked at the chocolates. She took two boxes of chocolates. Then she walked to a different aisle. There, she took two soft drinks and walked back to the front to take a shopping basket. She put the chocolates and the soft drinks into the shopping basket. In a different aisle she took one pack of chips. Then she walked to the bread aisle. There she looked at the different breads. Finally she took brown bread. After that she walked to the cashier to pay.

**Interview**
We asked the participant why she bought the two boxes of chocolates and one pack of chips, when she initially wanted to buy breads and soft drinks. She answered that the two boxes of chocolates were gifts for her friends. She was attracted by the nice looking package of the chocolates. It would be a nice gift. That is why she bought the chocolates. The chips was for herself.

**Search observations in natural setting tabulated**

In Table 3.4 the observed results of the participants in a natural setting are tabulated to get an overview. The participants are called $P_{n1}$ up to and including $P_{n15}$ because of anonymity. The focus here is on the participant’s search behavior. Similar to the task-based observations a distinction is made
between searching without help, searching with direct help, and searching with indirect help for the tabulation of the search observations in a natural setting. In Table 3.4 “searching without help” means that the participant did not need any help from a person, while “searching with direct help” refers to that the participant asked for direct help or information from a person. “Searching with indirect help” refers to that the participant had tried himself first to realize the goal, but when he was not successful he asked a person for assistance in order to pursue his search. In the column “Used information source” all the sources, e.g., signposts, shop assistants, pedestrians, etc, the participant has used in order to reach his goal are summarized. The column “F/S” indicates whether the participants failed or succeeded in their search, i.e., whether the participant found what he was looking for or not. The last column in Table 3.4 shows whether the participant was attracted by other things or not.

Table 3.4: Search observations in natural settings. F=failure, S=success.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Searching without help</th>
<th>Searching with direct help</th>
<th>Searching with indirect help</th>
<th>Used information sources</th>
<th>F/S</th>
<th>Attracted by something/events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pn1</td>
<td></td>
<td>X</td>
<td>X</td>
<td>shop assistant, signpost</td>
<td>F</td>
<td>X</td>
</tr>
<tr>
<td>Pn2</td>
<td></td>
<td></td>
<td>X</td>
<td>passer-by, signpost</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>Pn3</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pn4</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pn5</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pn6</td>
<td>X</td>
<td></td>
<td>shop assistant</td>
<td>S</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Pn7</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pn8</td>
<td>X</td>
<td>X</td>
<td>tram driver, passer-by,</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pn9</td>
<td></td>
<td></td>
<td>street signs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pn10</td>
<td>X</td>
<td></td>
<td>signpost</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pn11</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pn12</td>
<td></td>
<td></td>
<td>shop assistant, shop-window</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pn13</td>
<td></td>
<td></td>
<td>shop assistant, shop-window</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pn14</td>
<td></td>
<td></td>
<td>shop assistant</td>
<td>S</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Pn15</td>
<td></td>
<td></td>
<td>shop window</td>
<td>S</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

between searching without help, searching with direct help, and searching with indirect help for the tabulation of the search observations in a natural setting. In Table 3.4 “searching without help” means that the participant did not need any help from a person, while “searching with direct help” refers to that the participant asked for direct help or information from a person. “Searching with indirect help” refers to that the participant had tried himself first to realize the goal, but when he was not successful he asked a person for assistance in order to pursue his search. In the column “Used information source” all the sources, e.g., signposts, shop assistants, pedestrians, etc, the participant has used in order to reach his goal are summarized. The column “F/S” indicates whether the participants failed or succeeded in their search, i.e., whether the participant found what he was looking for or not. The last column in Table 3.4 shows whether the participant was attracted by other things or not.
3.6 Discussion

3.6.1 Search observation in natural settings (group N)

Table 3.4 shows that 9 of the 15 participants were distracted by other things during their search. This was especially the case when they could make a connection to other things (e.g., comparing prices or because someone did mention about his goal or just curiosity). The same number of participants tried to do a search with help. This includes direct and indirect help. From the “Used information source” column it is obvious that the participants have a preference for verbal communication. This is in accordance with the results found by Nordlie [177]. In that study Nordlie showed that people indeed have a preference for verbal media or verbal communication.

When we compare the results of search observations in a natural setting with the task-based observations (the control group), we see similar behavior of the participants. Table 3.3 on page 44 shows that most participants used the help of a person in order to complete the task. The column “Used information source” in Table 3.3 indicates that the participants have a preference for verbal communication.

Observations of participants $P_{n4}$, $P_{n6}$, $P_{n7}$, $P_{n9}$, and $P_{n11}$ show that goals of people may change. Goals change because people change their mind. The participants changed their mind because they saw something new they liked, or something that they needed or because they were reminded of something.

Observations of people in a natural setting show that people do not have always a precise goal. In the observation of participant $P_{n3}$ we saw that the mother ordered the kid’s meal for her child. Her child wanted the kid’s meal because of the toy that is served with the kid’s meal and not because of the delicious fries and drink.

Observations of participant $P_{n12}$ show that people have certain conditions when they are looking for things. All those conditions have a certain value for the person. The observation showed that people may give in a bit to their conditions, which makes them deviate a bit from their initial goal. The participant in this case bought a golden wedding set with three items instead of four. Initially, she wanted to buy a set with four items. But for her the price of the set was more important than the number of items in the set. That made her buy a set with three items.

Observations of people in a natural setting also show that when people take an action to come potentially closer to their goal, for example, to find
a nice dress (see also observation $P_{n5}$ on page 47), the action should work. People will leave if they cannot find what they are looking for. Searches should not take much time, otherwise people will leave. People that have more time or are not looking for something specific will stay longer than people looking for something specific and who have little time.

3.6.2 Observations task-based setting (group T)

Participants mentioned in the interviews that a search should not take much time. When a search takes too much time participants leave empty-handed. A search should be short and simple as reported by the study of Nordlie [177]. That is why participants sometimes choose an “approach of least effort”. It is easier to ask a shop assistant or some ‘expert’ than to find out the answer oneself. The participants have a preference for short and simple queries. We see indeed as Bates mentioned in her article [37] that people use the principle of least effort in their information seeking if it is more readily available.

The search observations based on tasks show that people do not read sentences word by word when doing a search but scan the word they are looking for in the sentences (e.g., in CD-search tasks 1 and 2 on page 35 and 37). This behavior is also mentioned by Bates [37] and Kwasnik [135]. Familiarity speeds up scanning when people are familiar with the situation, e.g., some people know the most likely location to find what they are looking for and thus where they should start scanning.

People need certain foreknowledge in order to search efficiently and quickly. This knowledge makes searching easier and can be obtained during the search or from some other state in the past. The fact that the participant doing the book search task in the library (page 38) knew that the Java programming language is related to computer science made him go to the computer science section in the library. Familiarity with this particular library environment made it easier for the participant to find his way in the library. This is also stated by Kelly and Cool [129] who mention that as one’s familiarity with a topic increases, one’s searching efficacy increases.

In accordance with Bhavani and Bates [44] we observed that there is a learning effect when people do several searches in the same environment. The learning effect speeds up the search. The learning effect depends on how fast the participant can learn and how easy it is to learn the tool or procedure which is being used to do the search. The environment might influence this effect.
People make use of certain patterns when they are aware of it (e.g., the book search task in the study on page 37). The observation of the participant doing the book search in the study showed that the participant expected certain things in certain places (e.g., it is a natural thing that chapters are listed in the table of contents). When this expectation turns out to be false, people get confused. The observation of the participant doing the book search in the study also shows that the participant used standards, traditional rules, i.e., assuming that books are always arranged in alphabetical order by author. In some cases this is just the easiest way to find the answer to a problem (see also Kelly and Cool [129]).

3.7 Assumptions for web design

One of the goals of this pilot study was to find out how people are searching in “non-web” situations and how their goals are influenced. We believe that the results of the “non-web” situations are also valid for web situations although we do not expect to observe the same search behavior on the WWW. This is because the WWW is an engineered environment while “non-web” situations are ‘natural’, e.g., a street market. Keeping this in mind we translated the results from the “non-web” situations to the WWW. This resulted in some assumptions which are summarized in Table 3.5 on page 57. The validity of these assumptions are disputable as this pilot study was a ‘quick and dirty’ ethnography. In Chapter 4 and Chapter 5 we will see how valid these assumptions are.
### Assumption 1
**Expect flexibility (trade-off) of values.**

**Explanation**
Try to establish the value of the user’s conditions and affect that; flexibility pays off.

**Example**
If someone wants to buy a car which should be green, not too expensive, and have a high entry, you might sell him a red car, if the color is not so important in comparison with the other conditions.

### Assumption 2
**Goals may change.**

**Explanation**
New information can lead users to a new direction; variation leads to returning of users.

**Example**
Instead of buying pants a user can buy an evening dress because, e.g., she is reminded by the atmosphere of the evening dress department that she has a party this weekend.

### Assumption 3
**Goals may be vague or unpredictable.**

**Explanation**
Users do not have always a precise goal or the one ‘expected’ by the service provider/web designer. So, make sure you have something more to offer when you want to attract users to your site.

**Example**
In a museum you can look at paintings but some museums also have a restaurant or cafe like the Museum of London. People may also visit the museum at Sundays to have a cup of coffee.

### Assumption 4
**User actions should work.**

**Explanation**
Users have to take certain actions in order to come potentially closer to their goal. So, make sure everything on your site is working.

**Example**
It is very annoying when you click (the user’s action) on a link and nothing happens. Users may leave the site without reaching any goal (and not buying anything).

### Assumption 5
**Keep as much as possible to the standards.**

**Explanation**
Keeping as much as possible to the standards shortens the search time. Standards are familiar for most people and familiarity speeds up the search.

**Example**
In the Western culture people are used to read from left to right and to find the company logo in the upper left corner on a website. When clicked on the logo people are taken to the homepage of the site.

---

**Table 3.5:** First assumptions for web design.
3.8 Conclusion

From the observations of this pilot study we can draw the conclusion that foreknowledge and familiarity are necessary to make connections with the knowledge already present. Once one has made the connection, the thought process gets clearer and this makes it easier for people to perform a successful search.

Besides foreknowledge and familiarity the search is also sped up by the learning effect. The learning effect depends on how fast people can learn and how easy it is to learn the tool or procedure which is being used to do the search. The environment might influence this effect.

In order to search quickly, people do not read sentences word by word but scan the word they are looking for in the sentences. Familiarity speeds up the scanning, i.e., people know where to most likely find the subject they are looking for and thus where they should start scanning.

When people want to realize a goal they have to take certain actions. If they will not take any action the goal will not be realized. [If you are looking, e.g., for a nice ladies dress and you are not taking any actions like finding the ladies department or asking the shop assistant where you can find ladies dresses, you will not come closer to your goal, i.e., the nice ladies dress]. The actions they take are based on the information at the state they find themselves in and their expectations of the actions. Every action taken by a person brings the person into another state. The new state provides the person new information and experience. Combined with the information from the previous state the person may take another action of which he expects that it will bring him potentially closer to his goal. This cycle can go on for a while. It is also possible that people may change their mind when they get new information. This is because they are reminded of something by the new information or that they get influenced by the environment (e.g., atmosphere of a department).

People have certain conditions when they are looking for things. They give these conditions a certain value. [see also participant $P_{n12}$ in Section 3.5.2]. Depending on how high the person values a certain condition he can give in a little bit of some conditions. This makes him deviate a (little bit) from his initial goal. [In the case of the wedding set we saw that the participant initially wanted a set consisting of four items. But she finally ended up with a set consisting of three items because of the very low price. Apparently the price was more important than the number of items in the
set and triggered the participant to buy].

Time is an important factor when people are doing a search. Searches should not take much time and should be therefore short.

Finally, people’s goals are not always clear and predictable.

The results of our pilot approach show that it is very difficult to “randomly” select participants.

Based on the observations of this pilot study we can derive some state triggers and categories which we will use in Chapter 4. The following state triggers can be derived from the observations of this pilot study: shop windows, landmarks, maps, price, colors, displays/boards, location/department, and logo of the shop. The categories which can be derived are: precise goal, no precise goal, new sub goal, new unrelated goal, parallel goals and actions, search for info related to a goal, use of navigation aids to search in order to reach a goal, success, and failure. The observation results show that these state triggers and categories are involved in the participants’ search. In Chapter 4 we go into more details on the state triggers and the categories. We present and discuss also the results of the behavior observations in “non-web” situations in Chapter 4.
Pilot study: Behavior observations in “non-web” situations
Chapter 4

Search behavior observations in “non-web” situations

In this chapter we present and discuss the results of the experiments in which search behavior was observed in “non-web” situations. We observed people in “non-web” situations because this is a “natural” contextual setting. In the future, we aim to identify analogous search needs in a well-designed web context. In Section 4.1 we give an introduction of the study. In Section 4.2 we describe the approach for the study. The results and discussions are described in Section 4.3. In this section we will, for modeling purposes, classify the results into two categories: ‘goal changes’ and ‘no goal changes’. We will use this in Chapter 8 to develop mathematical models for search behavior. In Section 4.4 we summarize the results of the study. The conclusions are given in Section 4.5. Our main observation is that participants deviate from their initial goals because of parallel goals and because of state triggers that influence their interests.

4.1 Introduction

The goal of this chapter is to find out how people search in “non-web” situations and how their goals are influenced. In Chapter 3 we did a pilot study to find out, among other things, what problems may arise in the experimental setup for observing people. The results of our pilot study show that it is very difficult to select participants “randomly” (see Section 3.5 for a discussion). Therefore, we modified the methodology from our pilot study;
we decided not to aim at representativity for a well-defined population of
people that search, but aim at results from a collection of readily available
cases. We do not want to describe a population precisely. Instead, we
want to describe the relevant phenomena on searching in context. This is
only possible when we choose the right context. So we choose to approach
our friends and relatives. Consequently, we were familiar with almost all
of the participants. After the study, we will formulate design patterns for
wild searching (see also Chapter 7) based on the results of this chapter and
Chapter 5. The formulation of design patterns is only possible when we
know how people search and how their goals are influenced.

Our study consists of two kinds of observations: ethnography and task-
based observations. We observed people in a natural setting (group N) and
in a task-based setting (group T). By observing people in these two settings,
we wanted to know what the search behavior of people is. We included the
task-based setting because sometimes people search when they are triggered
by a task. We call the search behavior of people in their natural setting
“natural search behavior”. Similarly, we call the search behavior of people
that are completing a task “triggered search behavior”.

We choose as relevant context for the “non-web” situations shopping
in shopping malls, city centers, book stores, and shopping streets. Here
people have many possibilities in showing search behavior. Moreover, these
locations are natural, relevant, and acceptable for our participants. The
participants indicated that they did not want to be observed in, e.g., a
museum (quote: “Better not in a museum because I will be there with my
family”, “I do not mind observing my shopping behavior as I am doing that
daily”). Observing people in a museum or during leisure is seen as a more
private occasion while shopping is seen as a daily event. Since our goal is
to study how people search in “non-web” situations and how their goals
are influenced, it is not essential to our study to include observations in a
museum.
4.2 Approach

4.2.1 Participants

In our study we have two observers ($O_1$ and $O_2$)\(^1\) who in total observed 40 participants in “non-web” situations of which 12 were relatives and 28 were friends and acquaintances of the observers. All participants were native Dutch speakers. From the 40 participants, 20 participants were randomly selected to participate in the ethnography study (group N: 12 males and 8 females). The other 20 participated in the task-based study (group T: 11 males and 9 females) (see also Section 4.2.3). The observers explained and informed the participants the following:

1. **The goal of this study.** The participants were informed about the goal of this study and that it was a part of a bigger research project.

2. **The procedure.** The observers explained the participants that they would only observe them and that they would not answer any questions during the observation sessions. The participants were informed that an observation session would end after 30 minutes or when they would make a purchase (group N) or when they would finish a task (group T).

3. **The interviews.** The participants were told that they would be interviewed after the observations and that the interview would take 5-10 minutes.

4. **The privacy of the participants.** The observers informed the participants about the procedure to safeguard their privacy. No names were recorded. In the observation results the observers referred to the participants by $N_i$ for the ethnography study (group N) and $T_i$ for the task-based observation study (group T), where $i$ denotes the $i$-th participant in that group. In both notations, $N_i$ and $T_i,i \in \{1, \ldots, 20\}$.

The text (translated to English) to inform the participants can be found in Appendix C.

\(^1\)The two observers ($O_1$ and $O_2$) each observed 10 participants in a natural setting and 10 in a task-based setting.
4.2.2 Ethnography study (group N)

For the ethnography study, one of the observers asked the participants to let them know when they were going out, e.g., to a shopping mall or to the city center. They both agreed upon a location to meet each other. The observations started at that chosen location. Twenty participants took part in group N.

4.2.3 Tasks for the task-based observation study (group T)

In order to formulate tasks that could be successfully performed in regular Dutch shopping malls and shops, we (the observers and the author) identified products that we could ask the participants to search for. We identified 4 products that are listed in Table 4.1.

This table also presents the tasks the participants had to complete and the locations where the observation took place. Every participant had to complete one task and each task was assigned to 5 participants which makes a total of 20 participants \((4 \times 5)\) for group T. The observers agreed with the participants on a convenient time to do the task. The location was determined by the observers themselves.
<table>
<thead>
<tr>
<th>Tasks</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find a Dyson vacuum cleaner. (location: shopping mall)</td>
<td><img src="image1.png" alt="Dyson vacuum cleaner" /></td>
</tr>
<tr>
<td>Find a Black iPod Nano cover. (location: department store)</td>
<td><img src="image2.png" alt="Black iPod Nano cover" /></td>
</tr>
<tr>
<td>Find the the book ‘Ecuador &amp; the Galápagos Islands’ from Lonely Planet. (location: a big book store)</td>
<td><img src="image3.png" alt="Book" /></td>
</tr>
<tr>
<td>Find a home tap for “Hertog-Jan” beer. (location: city center)</td>
<td><img src="image4.png" alt="Home tap" /></td>
</tr>
</tbody>
</table>

Table 4.1: Identified products.
4.2.4 Recording observations for group N and T

To record the observations of the study, we developed an observation form (see Appendix B.1 for the translated form) for both groups N and T. The form consists of five parts.

1. **General part**
   In the general part of the observation form we recorded the
   
   (a) **Participant number.** Instead of recording the name of a participant, the observers gave the participants a number $i$ with $i \in \{1, \ldots, 20\}$. The participants in group N (ethnography) are then identified by $N_i$, and participants of group T (task-based observation study) are identified by $T_i$.
   
   (b) **Gender.**
   
   (c) **Location.** In the location field the observers noted where they observed the participant. This was the name of a mall, city center, or the shopping street name.
   
   (d) **Date and time.** In the date and time field the observers recorded the date and the time when they started to observe the participant.
   
   (e) **Duration.** In this field the observers recorded the duration of the observation in minutes.

2. **What is the participant focused on?**
   From our literature study (see also Chapter 2) we found two search strategies for users searching for a product or information): epistemic and hedonic search strategies (see also Section 2.4.2). To find out whether our participants show one of these search strategies, we included these in the observation form.
   
   (a) **Epistemic.** In epistemic search strategies the participant is focused on his goal. Participants who utilize epistemic search strategies are problem solvers [25]. They are concerned with efficiency and want to complete their shopping trips at the soonest possible time. Therefore, they plan their purchases and move through the store as quickly as they can [96].
   
   (b) **Hedonic.** In hedonic search strategies the participant is unfamiliar with the environment, which is often the case in shopping
environments. They proceed slowly while valuing environmental sensory stimulation. These users have a high tendency to make impulsive purchases [96].

3. **What is the participant drawn to?**

In this part the observers have recorded the *state triggers* at which the participants were looking at when they were shopping. The state triggers below are derived from the observations from our pilot study (see Chapter 3).

(a) **Shop windows.** People often look at shop windows at items that are displayed. Sometimes they are triggered by these items which they did not want to buy initially. The observers recorded whether the participants looked at the shop windows or not.

(b) **Landmarks.** Landmarks are reference points to find a way to reach one’s goal.

(c) **Maps.** The observers recorded this to see whether the participants used maps (in the shop or on street) to reach their goal.

(d) **Price.** Sometimes people are triggered by the price to buy something. When the participants were looking at the price for some reason the observers recorded that.

(e) **Colors.** People are also triggered by colors. This can be the color of items or the color of the environment. In the situations in which the participants were notably triggered by colors, the observers recorded that.

(f) **Displays/boards** on the location. When the participants were triggered by displays or boards, e.g., displays or boards with the word “Sale” or “New”, the observers recorded that.

(g) **Location/department.** People are sometimes triggered by the atmosphere of the location or the department. The observers recorded this when they observed it.

(h) **Logo of the shop.** Many people use the shop’s logo to locate the shop. The observers recorded this in the cases they observed this.

4. **The participant’s behavior.**

In this part of the observation form the observers recorded the participant’s behavior.
5. **Does social navigation take place?**

   As mentioned in Section 2.4.3, social navigation is a navigation type that is based on what others have done or the advice provided by others (e.g., follow people, ask a friend) [216]. From the pilot study we learned that people sometimes choose an “approach of least effort” in order to gain time and to keep the search duration short. Therefore, the observers recorded this navigation behavior.

4.2.5 **Interviews**

   The author and the observers developed interview questions for group N and group T. We did this to cross-validate the search behavior observations of the participants. In addition, we developed some questions (about, e.g., familiarity with the location or goal, participant’s age, etc.) to get extra information to build insight into the participant’s search behavior. The interview questions (translated to English) for group N can be found in Appendix A.1 and for group T in Appendix A.2. As all participants were native Dutch speakers, the interviews were held in Dutch. The observers interviewed the participants after the observations. The answers of the participants were written down.

4.2.6 **Raters and categories**

   **Raters**

   All the written observations were scored on *atomic observation units* in categories of goal-related behavior (see further for a scoring example). An atomic observation unit is a relevant observation described in a single sentence. This was done by two raters ($R_1$ and $R_2$). Rater $R_2$ was the same person as observer $O_2$. Rater $R_1$ was the author of this thesis. The atomic observation units were categorized because we wanted to know if, and how often, the participants changed their goals, had parallel goals, succeeded in the search (see ‘Categories for group N’ below for the complete list). The raters categorized the atomic observation units from the observations which were written down.
Categories for group N

The following categories were used for group N to structure the atomic observation units:\(^2\):

1. **Precise goal.** A precise goal is a well-defined goal; the goal is clear and unambiguous. Each participant did have at least one precise goal at the beginning of an observation session. For example, the participant wants to buy a hair dryer.

2. **No precise goal.** The participant did not have any goal at the time. For example, the participant is just walking in the city center.

3. **New sub goal** (triggered by an event such as the perceived state like the price, a sound, an advertisement, etc.). A sub goal is defined as a part of the initial goal (=super goal). For example, a participant is triggered by low prices for a pair of pants, while his initial goal was buying a nice sweater for a party.

4. **New unrelated goal** (triggered by a state or an event). For example, a participant is triggered by nice shoes in a shop window, while his initial goal was buying a nice book.

5. **Parallel goals and actions** (a trade-off between two actions). For example, a participant is reminded by a shop window that he also needs a jacket for the coming party besides the nice shoes he was looking for.

6. **Search for info, related to a goal** (like using a shop map; often based on a well-defined goal). For example, a participant is looking for the ladies department and uses the shop map.

7. **Use of navigation aids to search in order to reach the goal** (like maps, displays, sounds). For example, a participant wants to buy a vacuum cleaner. In the shop he follows the boards to find the section where vacuum cleaners are located.

8. **Hedonic** (=fun/entertainment) (the participant shows a hedonic search strategy). For example, the participant just wants to enjoy shopping. The participant has no particular goal to buy something.

\(^2\)Only the atomic observation units that were found by both raters were counted.
9. **Epistemic** (the participant shows an epistemic search strategy). For example, the participant is moving quickly through the store.

10. **Social navigation.** For example, the participant follows the crowd or asks a friend to realize his goal.

These categories are derived partially from the literature study (see Chapter 2) and partially from the pilot study (see Chapter 3). Categories 3 and 4 were combined into one category, ‘goal changes’. We did this because it was very difficult to distinguish the difference between these two categories. These categories are considered equivalent for modeling purposes.

The following two categories are not an atomic observation unit. We call them *summary observation units* as they are a summary of the total observation.

- **Success** (i.e., the participant realized his goal). For example, the participant found what he was looking for.
- **Failure** (i.e., the participant did not realize his goal). For example, the participant did not find what he was looking for.

**Scoring example**

The example below is part of an observation. In this example the participant is looking for a present for her nephew. She wants to buy something from Playmobil\(^3\). With this example we show how the raters scored the atomic observations units in categories of goal-related behavior.

...The participant walks fast down the streets. She looks at the shop displays. Then she enters the Bart Smit toy shop. She looks quickly around on the ground floor and walks to the stairs. She walks to the first floor and looks at the wall with Lego\(^4\) and Playmobil toys. She walks to that wall. She picks different Playmobil boxes from the wall and looks at the price tickets...

Based on the observation above rater \(R_1\) and \(R_2\) score as follows (see Tables 4.2 and 4.3).

---

\(^3\)Playmobil is a line of toys produced by the Brandstätter Group (geobra Brandstätter GmbH & Co KG), headquartered in Zirndorf, Germany [242].

\(^4\)Lego, officially trademarked LEGO, is a line of construction toys manufactured by the Lego Group, a privately held company based in Billund, Denmark [240].
From these scores we identify the atomic observation units that were found by both raters (see also Section 4.3.1). The other scores we discard.

**Categories for group T**

For group T we can only apply the following categories:

1. **Navigation aids.** For example, the participant follows a shop map to find the ladies department. (This relates to category 7 of group N).
2. **Orientation.** For example, a participant wants to buy a pair of pants. When he enters a shop, he looks around to see what departments the shop has before going to the pants department. (This relates to category 6 of group N).

3. **Goal changes.** For example, a participant is triggered by a nice iPod, and buys the iPod instead a sweater, which was his initial goal. (This relates to categories 3 and 4 of group N).

4. **Expecting.** For example, the participant expects the book ‘Ecuador & the Galápagos Islands’ from Lonely Planet to be located in the section with country books. (This relates to category 9 of group N).

These categories are applicable for group T as this group had to complete a task. The first two are derived from the literature study (see Chapter 2) and the latter two are derived from the assumptions of the pilot study (assumptions 2 and 5, see Chapter 3.7).

### 4.3 Results and discussions

#### 4.3.1 Reliability of raters’ scores

Observations can be scored differently by different persons. This is not invalid if the different observations can be considered to belong to a homogeneous group. Homogeneous in this case means that the observations can be considered to belong to the same category for modeling. (This concerns in essence only the categories ‘goal changes’ and ‘no goal changes’). Therefore, we classify the observations of group N into two categories: ‘goal changes’ and ‘no goal changes’ (see Table 4.4). ‘Goal changes’ consist of the categories 3 and 4. All the other categories are considered to be ‘no goal changes’.

From Table 4.4 we can calculate that 95% of the observations the raters judged belong to the same category. Based on this we conclude that the observation of goal changes is reliable. Therefore, we decide it is sufficient for modeling to use only rater 1 to score for group N and T.

---

5 The iPod is a digital media player from Apple Computer.

6 \((1 - ((2 + 6)/148)) \times 100\% = 95\%\).
Table 4.4: Reliability of scoring atomic observation units in the categories ‘goal’ and ‘no goal’ changes. \( N = 148 \) atomic observation units.

### 4.3.2 Analysis of natural search behavior (group N)

In this section we analyze the natural search behavior of the participants of group N. We want to find out how people search in ‘non-web’ situations in their natural settings. We analyze the behavior to find out how and why the participants deviate from their initial goal. We analyze the interviews to find out whether the observed behavior matches the way the participants experienced their behavior (we call this the *subjective search behavior*).

#### Search behavior

The search behavior of group N (ethnography) is presented in Table 4.5. The number of ‘goal changes’ are given in black and the number of ‘no goal changes’ in gray.

From Table 4.5 we can see that 9 of the 20 participants had a precise goal and 7 had no precise goal. Seventeen of the 20 participants changed their goals during their search. These participants were triggered by events or information at the state they found themselves in. Fourteen of the 20 participants had parallel goals. Eight of the 20 participants searched for information related to their goal. Navigation aids were used by nine of the 20 participants. Seven of the 20 participants showed a hedonic search strategy. The others (13/20)\(^7\) showed a epistemic search strategy. Social navigation was observed at 8 of the 20 participants. Table 4.5 shows that goal changes took place in 31% of the total atomic observed units (\( N = 180 \)).

\(^{7}\)We use the \((x/y)\) notation to indicate \(x\) from \(y\) participants. Consequently (13/20) means 13 from the 20 participants.
Search behavior observations in “non-web” situations

Table 4.5: Search behavior for group N.

State triggers

Table 4.6 shows the observed occurrence of the state triggers. This table shows that the popular state triggers are price (17/20), displays/boards (17/20), landmarks (14/20), and shop windows (9/20). Nobody in group

Table 4.6: Observed occurrence of the state triggers for group N.
N used the logo of a shop in his search. Maps were used by 5 of the 20 participants. Two of the 20 participants were triggered by color. One of the 20 participants was triggered by the location/department.

**Realized goals and search strategy**

We observed that 11 of the 20 participants in group N realized their goal(s). 13 of the participants used an epistemic search strategy and 7 used a hedonic search strategy (see Table 4.5). To find out whether there is a significant relationship with realizing one’s goal and the search strategy we did a chi-square test. The null hypothesis is taken to be $H_0$: there is no significant difference, and the alternative hypothesis is taken to be $H_1$: there is a significant difference. The results are presented in Table 4.7.

<table>
<thead>
<tr>
<th>Observation</th>
<th>Goal reached</th>
<th>Goal not reached</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epistemic strategy</td>
<td>9</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Hedonic strategy</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td><strong>11</strong></td>
<td><strong>9</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

Table 4.7: chi-square test: $\chi^2 = 3.04$, $p = 0.08$, $df = 1$.

From this table we see that we cannot reject the null hypothesis $H_0$. Thus, there is no significant relationship between realizing one’s goal and the search strategy.

**Subjective search behavior**

From the data summarized in Table 4.8 we read that 7 of the 20 participants were very familiar with the location. Three of the 20 participants considered themselves unfamiliar with the location. The other participants classified themselves between unfamiliar and familiar.

Fourteen of the 20 participants mentioned in the interview that they had reached their goal while we observed that 11 of the 20 participants realized their goal. In the interview all the 11 observed participants indicated that they realized their goal. Three additional participants, which we did not observe, indicated that they had realized their goal. We will come back to this in the conclusion section (see Section 4.5).
From Table 4.8 we can see that 7 of the 20 participants mentioned that they deviated from their initial goal. Eight of the 20 participants said that they gained information on their goal somewhere else.

<table>
<thead>
<tr>
<th>Familiar with location</th>
<th>Numbers of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Total unfamiliar)</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>5 (Very familiar)</td>
<td>7</td>
</tr>
</tbody>
</table>

| Did you reach your goal? | Yes | 14 |
| Did you deviate or adapt your goal? | Yes | 7 |
| Did you gain information on your goal somewhere else? | Yes | 8 |

Table 4.8: Scores for familiarity with location and successful goal(s) gathered from interview with participants from group N.

In Section 3.6 we discussed that familiarity with the location speeds up the search. To find out whether there is a significant relationship with being familiar with the location and realizing the goal we did a chi-square test. In order to do so we labeled all the participants who scored on familiar with location 1, 2, and 3 (see Table 4.8) as “not familiar with location”. The participants who scored 4 and 5 were labeled as “familiar with location”. The results are presented in Table 4.9.

<table>
<thead>
<tr>
<th>Interview</th>
<th>Familiar with location</th>
<th>Not familiar with location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal Reached</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Goal not reached</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>7</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 4.9: chi-square test: $\chi^2 = 0.85$, $p = 0.36$, $df = 1$.

From Table 4.9 we see that we cannot reject $H_0$. There is no significant
relationship between being familiar with the location and realizing the goal. We did a chi-square test to find out whether there is a significant relationship with being familiar with the location and the speed of realizing the goal. We calculated the average speed of realizing the goal. The average speed of realizing the goal was 18 minutes. Every participant who scored less than 18 minutes to realize his goal we labeled ‘fast’. The participants who needed 18 minutes or more we labeled ‘slow’. Table 4.10 presents the results.

<table>
<thead>
<tr>
<th>Observation</th>
<th>Familiar with location</th>
<th>Not familiar with location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Realized goal fast (&lt; 18 min.)</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Realized goal slow (≥ 18 min.)</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 4.10: chi-square test: $\chi^2 = 0.04$, $p = 0.85$, $df = 1$.

We see that we cannot reject $H_0$. There is no significant relationship between being familiar with the location and the speed of realizing the goal.

To find out whether there is a significant relationship between the gained information about a goal and having a precise goal we did a chi-square test. The gained information about the goal means that the participant is informed about the object he wants to buy, like the guarantee of the object, where he can buy the object, and the price of the object. The results are presented in Table 4.11.

<table>
<thead>
<tr>
<th>Observation</th>
<th>Gained information</th>
<th>Not gained information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precise goal</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>No precise goal</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 4.11: chi-square test: $\chi^2 = 4.85$, $p = 0.03$, $df = 1$. 
Search behavior observations in “non-web” situations

Table 4.12: chi-square test: $\chi^2 = 1.94, p = 0.16, df = 1$.

From Table 4.11 we see that we can reject $H_0$. There is a significant relationship between the gained information about a goal (i.e., buying an object) and having a precise goal. This means that people who have a precise goal are often informed about the goal.

We did a chi-square test to find out whether there is a significant relationship between the gained information about a goal and realizing the goal. From Table 4.12 we see that we cannot reject $H_0$ which means that there is no significant relationship between the gained information about a goal and realizing the goal. Apparently the gained information about a goal does not guarantee that one would realize the goal.

4.3.3 Analysis of triggered search behavior (group T)

We want to find out how people are searching in ‘non-web’ situations when they have to complete a task. This means we want to find out how people reason, how their reasoning leads to a particular approach in realizing their goal, and how additional information makes them deviate from their goal. Therefore, we analyze the triggered search behavior of the participants of group T in this section.

Search behavior

The search behavior of group T (task-based observations) are given in Table 4.13.

We observed that 18 of the 20 participants used ‘navigation aids’ to complete the given task. This is 35% of the total atomic observations units ($N = 137$). Besides ‘navigation aids’ we observed that the participants were orienting (17/20) and expecting (19/20) things at a certain place often in
the search process. Table 4.13 shows that 12 of the 20 participants changed their goal, which means that they deviated from their initial goal.

Table 4.14 shows state triggers gathered from the observations. The most popular state triggers are displays/boards (18/20) followed by landmarks (15/20).

<table>
<thead>
<tr>
<th>State Triggers</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop windows</td>
<td>6</td>
</tr>
<tr>
<td>Landmarks</td>
<td>15</td>
</tr>
<tr>
<td>Maps</td>
<td>8</td>
</tr>
<tr>
<td>Price</td>
<td>8</td>
</tr>
<tr>
<td>Color</td>
<td>8</td>
</tr>
<tr>
<td>Displays/Boards</td>
<td>18</td>
</tr>
<tr>
<td>Location/dept.</td>
<td>4</td>
</tr>
<tr>
<td>Logo</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 4.14: Scores for state triggers gathered from observations of group T.

The scores of the other state triggers are shop windows (6/20), maps (8/20), price (8/20), color (8/20), location/department (4/20), and logo (9/20).

Subjective search behavior

Table 4.15 shows that many participants (score 1, 2, and 3) were not familiar with the goal. This means that they were not familiar with the objects.
Despite the unfamiliarity with the goal, 14 of the 20 participants said that they realized their goal easily.

Table 4.15: Scores for familiarity with location, familiarity with goal, and successful goal(s) gathered from interview with participants from group T.

<table>
<thead>
<tr>
<th>Familiar with location</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Total unfamiliar)</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>5 (Very familiar)</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 4.16: chi-square test: $\chi^2 = 0.05, p = 0.83, df = 1$.

We initially thought that this was because of the familiarity (score 4 and 5) with the location where they had to complete their task. Because of the familiarity with the location the participants could predict where they could find the items. To find out whether our hypothesis was true we did a chi-square test (see Table 4.16). For the chi-square calculation we labeled all the participants who scored on familiarity with location 1, 2, and 3 (see Table 4.15) as “not familiar with location”. The participants who scored 4 and 5 were labeled as “familiar with location”. From this table we see that we cannot reject the null hypothesis $H_0$. There is no significant relationship
between being familiar with the location and realizing the goal easily.

We did a chi-square test to find out whether there is a significant relationship with being familiar with the location and the speed of realizing the goal for the task-based observation study. We calculated the average speed of realizing the goal. The average speed of realizing the goal was 14 minutes. Every participant who scored less than 14 minutes to realize his goal we labeled ‘fast’. The participants who needed 14 minutes or more we labeled ‘slow’.

<table>
<thead>
<tr>
<th>Observation</th>
<th>Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Familiar with location</td>
</tr>
<tr>
<td>Realized goal fast (≤ 14 min.)</td>
<td>7</td>
</tr>
<tr>
<td>Realized goal slow (≥ 14 min.)</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>14</td>
</tr>
</tbody>
</table>

Table 4.17: chi-square test: $\chi^2 = 0.47$, $p = 0.49$, $df = 1$.

The results are presented in Table 4.17. We see that we cannot reject $H_0$. There is no significant relationship between being familiar with the location and the speed of realizing the goal.

4.4 Summary

In this chapter we presented and discussed the results of the behavior observations in “non-web” situations. The methodology was adapted from our pilot study in Chapter 3. We observed people in their natural settings (group N) and people who had to complete a task (group T). We analyzed the natural search behavior of group N and the triggered search behavior of group T.

In both groups we observed the following:

1. The participants deviate from their goals. We found two different reasons:

   (a) many people have parallel goals or not well-defined goals (no precise goals), and
(b) people’s interest are influenced by state triggers or navigation aids.

2. Navigation aids are used often when people search or when they want to realize their goals. In “non-web” situations the state triggers, price, display/boards, and landmarks are most important. These are especially important when people are not so familiar with the location and when they do not know their goal precisely.

3. We did not find any relationship between being familiar with the location and realizing the goal (easily).

4. We did not find any relationship between being familiar with the location and the speed of realizing the goal.

5. We observed that people expect things at certain locations.

The following two apply only to group N:

1. We found a correlation between the gained information about a goal (the thing you want) and having a precise goal: people who have a precise goal are often informed about the goal.

2. We did not find a correlation between the gained information about a goal and realizing a goal. Apparently the gained information about a goal does not guarantee that one will realize the goal.
4.5 Conclusion

The conclusions regarding people’s search behavior, based on the results of this chapter, can be listed as follows:

Search behavior in “non-web” situations

1. People’s goals may be vague and sometimes unpredictable
   We observed that the participants in our study do not always have well-defined goals. Sometimes they have parallel goals.

2. People are attracted by state triggers
   People’s goals are influenced by state triggers. This makes them deviate from their goal(s).

3. People expect things at certain locations
   People follow the standard. Standards are familiar for most people. They therefore expect things at certain locations.

There is a methodological problem when observing whether people realized their goal or not. Following the participant and watching what he is doing and how he is reacting to the environment gives us objective information about how someone is searching. This observation is not always the same with what the participant is searching for or doing. We therefore cannot model the search behavior completely.

It is clear that the state people find themselves in may change over time. New states provide people with new information and experiences that influence the goal people want to realize. We observed that participants, influenced by state triggers, changed goals. People take actions based on the information at the state they find themselves in and their expectations of certain actions. This search behavior we model mathematically in Chapter 8. Once we have a mathematical model for the search behavior we can apply that to “non-web” and “web” situations (e.g., buying CDs at a record shop or visiting a website) to predict the user’s search behavior.

This chapter was about people’s search behavior in “non-web” situations. The WWW is a relatively new context for people to search in. We do not know whether the search behavior will be the same as the search behavior in “non-web” situations. In Chapter 5 we therefore observe the search behavior of people on the World Wide Web.
Search behavior observations in “non-web” situations
In this chapter we setup a study to observe the search behavior of people on the WWW. In Section 5.1 we give an introduction of the study. In Section 5.2 we describe the approach for the study. The results and discussions are described in Section 5.3. Section 5.4 gives an overview of the observations and interview results of this chapter. In Section 5.5 we summarize the results of the study. The conclusions are given in Section 5.6.

Our main observations are that

- the participants are irritated by 404 page-not-found errors,

- the participants deviate from their initial goals because of parallel goals and because of state triggers that influence their interests, and

- the participants find unrelated content behind the page links or menu items.

We conclude that the observations can be distinguished into web design problems and issues related to search behavior of website visitors. We have listed both in Section 5.6.
5.1 Introduction

5.1.1 Natural versus engineered

In Chapter 4 we saw that people in our study often deviate from their goals during their search process. Sometimes they have parallel goals and sometimes they are triggered by the state they find themselves in, the so-called “state triggers”. Moreover, we saw that people in our study did not always have a precise goal, and also expect things (information, objects, etc.) at certain locations. It is not clear that search behavior of people on the WWW has the same features, or is the same as search behavior in “non-web” situations, because the WWW is an engineered environment and a relatively new medium, while “non-web” situations are ‘natural’ like, e.g., a street market. In fact, a street market is also an engineered environment, but its development over time has resulted in a natural environment for people. In Figure 5.1 one can see the street market Albert Cuyp in Amsterdam. Features like the visiting hours, the market booths, and the market supervisors are “engineered” over the course of time based on the development of social structures of behavior of buyers and sellers, and on the evolution of market culture.
The way the things are arranged at the market booths, like, e.g., the fruits and flowers in Figure 5.1, are “redesigned” over the course of time and people experience this as ‘natural’. It is ‘natural’ that the Albert Cuyp street market is closed on Sundays and that the flower booth is the first booth on the right side of the market.

### 5.1.2 The origin of the WWW

The WWW was originally conceived as a way for physicists to share their research data [113]. In 1989, Tim Berners-Lee led a team at Switzerland’s European Particle Physics Laboratory (CERN) (Figure 5.2) in developing the initial World Wide Web standards.

Key among these was the use of hypertext or “hot” portions of an online document that, when selected, took the user to a related, or “linked”, document. The next great innovation for the WWW came in 1992, when programmers from the National Center for Supercomputing Applications (NCSA) (Figure 5.3) at the University of Illinois developed the Mosaic browser, a software application that displayed not only the text of a Web document (or page), but embedded graphic elements as well.

By bringing multimedia to the Web, Mosaic vested it with enormous potential. The WWW is relatively young and still in development. It is a relatively new context for people to search in. People need to get used to the WWW. So to speak, they have access to the whole world from their computer screen. They do not need to leave their room to get, e.g., a book from the library. It is all there on their computer screen.
The goal of this chapter is to find out whether, and in what appearance, we can observe the ‘natural’ search behavior in “non-web” situations also on the WWW.

5.1.3 Methodology

The methodology that we use to gather observations in a WWW setting is identical to the methodology used in “non-web” situations in Chapter 4. This study consists of two kinds of observations: ethnography and task-based observations. Each participant was observed twice: once in their natural setting (situation N) and once in a task-based setting (situation T)\(^1\). First, we observed the participants in their natural setting. After that, we observed the participants in a task-based setting. Both the natural search behavior (natural setting) and the triggered search behavior (task-based setting) observations were done at the participant’s house. By doing so, the participants could work on their own computer in a familiar context. While the participants were searching on the WWW, they could, e.g., sit down as they wish, take a coffee, take care of their children, etc. We wanted the

\(^1\)Each participant had a double role: once as a participant in situation N, and once as a participant in situation T.
participants’ behavior to be as natural as possible.

5.2 Approach

5.2.1 Participants

Twenty participants (15 males and 5 females) were observed by observer $O_1$ and $O_2$. All participants were native Dutch speakers. Six of the participants were relatives, the others were friends and acquaintances of the observers. Seventeen observations were done at the participant’s house. Three participants were observed at the author’s university because it was not possible to observe them at their house. The observers made an appointment with the participants to observe them at home or at the author’s university. We asked the participants beforehand to collect their searches on the WWW for that appointment.

5.2.2 Explanation and information

The observers explained and informed the participants about the following:

1. **The goal of this study.** The participants were informed about the goal of this study. They were informed that this study was a part of a bigger research project.

2. **The observation procedure.** The observers explained to the participants that they would only observe them and that they would not answer any questions during the observation sessions. The participants were informed that an observation session would end after 30 minutes or when they would realize their goal (situation N) or when they would finish a task (situation T).

3. **The interviews.** The participants were told that they would be interviewed at the start and after each of the two observations, and that the interviews would take 5-10 minutes.

4. **The privacy of the participants.** The observers informed the participants about the procedure to safeguard their privacy. No names were recorded. In the observation results the observers referred to the

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2The two observers ($O_1$ and $O_2$) observed 10 participants each.
participants by $N_i$ for the ethnography study (group N) and $T_i$ for the task-based observation study (group T), where $i$ denotes the $i$-th participant in that group. In both notations, $N_i$ and $T_i, i \in \{1, \ldots, 20\}$.

The text (translated to English) to inform the participants can be found in Appendix C.

5.2.3 Tasks for the task-based observation (situation T)

For the task-based observation we (the observers and the author) formulated three questions. Question 1 and 2 consisted of two subquestions. We assumed that finding the answers to the three questions would take approximately 30 minutes. The participants were supposed to find the answers to those questions using the WWW.

Below is the list of questions ³ (translated to English).

1. (a) Who was Bilderdijk?
   (b) What is the address of the Bilderdijk Museum in the Netherlands?

2. (a) In which year did Ajax win the European Cup 2?
   (b) Who scored a goal during that match?

3. Find a notebook stand for a 15 inch screen notebook on the Dynabyte website.

We formulated questions that were not that easy to search for on the WWW: typing a keyword in a search engine would not result in the first link to be a correct pointer. The link to the answer could be, e.g., on the next 50 hits of the search results or deeper in the website relevant to the particular question. We used the Google⁴ search engine to test the questions.

³Answers to the questions:
1. (a) Willem Bilderdijk (1756-1831) was a Dutch historian, poet, and lawyer.
   (b) Vrije Universiteit Amsterdam, Rm 1B-21 (bilderdijkmuseum.vu.nl).
2. (a) 1987 or season ’86/’87.
   (b) Marco van Basten.

5.2.4 Recording observations for situations N and T

To record the observations we developed an observation form (see Appendix B.2 for the form translated to English) for the situations N and T. This form is identical to the form we used in Chapter 4 (see Appendix B.1) with one exception: we adapted the ‘What is the participant drawn to?’ part in the form used in this chapter. We choose state triggers which were suitable for the WWW. For example, shop windows are not suitable for the WWW. Therefore, we replaced shop windows with advertisements. The state triggers “Display/Boards” and “Department” were omitted. The other state triggers were left unchanged. We use the same categories of atomic observation units for both studies (search behavior observations in “non-web” situations and on the WWW) in order to be able to compare the results of both studies.

The participant’s search behavior was observed by one observer who sat next to the participant. To record the observations he wrote everything that he observed on the form. In order to collect precise observations, he followed the cursor on the computer screen\(^5\) and listened to what the participant was saying during the observation session. He also observed the expressions on the participant’s face. All these observations were written down (see example below).

The next example is a part of an observation. This example shows how we recorded the observations.

...The participant clicks with her mouse on the Internet Explorer shortcut on her desktop. She moves her mouse to the address bar in Internet Explorer and types the following address: www.lego.nl. The browser redirects her to www.lego.com. She looks at the website. In the beginning she looks only at the top of the page. Then she scrolls down by using the scroll bar of Internet Explorer. She says: “I am looking for a Dutch button. It’s weird that the Lego site is only in English, French, and German”. She clicks on the shop button at the top of the page...

5.2.5 Interviews

The author and the observers developed interview questions for situations N and T. Appendices A.3 (interview before observation) and A.4 (interview

\(^5\)Following the cursor on the computer screen is a substitute for eye-gaze. The observations were done with the means we had, because of the limited budget.
after observation) show the interview questions (translated to English) for situation N. The interview questions for situation T are described in appendix A.5 (translated to English). As the participants in situation N were the same as in situation T and the interview questions before the observations were the same for both situations, it was not necessary to repeat the questions before the observation. The order of the observations and interviews was as follows:

1. Interview before observations in situation N (see Appendix A.3)
2. Observations in situation N
3. Interview after observations in situation N (see Appendix A.4)
4. Observations in situation T
5. Interview after observations in situation T (see Appendix A.5)

All the answers of the participants were written down.

5.2.6 Raters and categories

Raters

All written observations were scored on atomic observation units in categories of goal-related behavior (see also Section 4.2.6 for a scoring example). This was done by rater 1 \(R_1\) who also scored the atomic observation units in categories of goal-related behavior for the search behavior observations in the “non-web” situations in Chapter 4. The atomic observation units were categorized because we wanted to know if, and how often, the participants changed their goal, had parallel goals, succeeded in the search, used search engines, and used bookmarks (see ‘Categories for situations N and T’ and ‘Search units for situations N and T’ for the complete list).

Categories for situation N

To compare the results of this study with the results of the study from Chapter 4 we kept the labels to categorize the atomic observation units the same as in Section 4.2.6 (Categories 1 to 10 for group N). We added the categories ‘orienting’ (11) and ‘expecting’ (12) to the list of categories. We added these categories for two reasons:
1. We expect this behavior on the WWW as many web sites have different, or even unique, look and feel, and navigation support. Many first time, or incidental, web visitors (may) have to orient first in order to know how to proceed.

2. From the study from Chapter 4 we learned that people expect things at certain locations. We predict to see expectation-based behavior on the WWW because many unwritten “rules” on the Internet are followed by the masses [82]. Masses of visitors, e.g., expect blue underlined text or words to be a hyperlink. They expect that a logo is always clickable. Masses of websites follow the rules (design patterns), e.g., that clicking on the label “Home” or the logo should bring the web visitor to the homepage [231, 225] or that the login link or login form should be at the right top corner [225].

Categories for situation T

In order to allow comparison with the results from Chapter 4, the labels to categorize the atomic observation units for situation T are the same as in Section 4.2.6 (Categories for group T).

Search units for situations N and T

We detailed the observation of category 6 into ‘search units’ (A to F) for situations N and T. Search units are specific unambiguous categories to search which can only occur on the WWW or in browsers. So, search units are also atomic observation units. The search units, derived from the literature study (see Chapter 2), are listed below.

Search units for situations N and T:

A. URL (the participant typed the URL of a particular site in the browser’s location bar).

B. Bookmarks (the participant used his bookmarks).

C. Search option on the sites (the participant used the search option on the site).

D. Browser find option (the participant used the find option in the browser, e.g., CTRL+F in Mozilla FireFox\(^6\)).

E. Browser back button (the participant used the browser’s back button).

F. Search engine (the participant used a search engine, e.g., Google\(^7\)).

This category was added to the categories of situation T.

### 5.3 Results and discussions

#### 5.3.1 Analysis of natural search behavior on the WWW (situation N)

In this section we analyze the natural search behavior of the participants in situation N. We want to find out how people search on the WWW in their natural setting. We analyze the observed behavior to find out how and why the participants deviate from their initial goal.

**Search behaviors**

The scores of the participants’ search behavior in situation N (ethnography) are given in Table 5.1. All participants had precise goals, since we asked the participants beforehand to collect their searches on the WWW for this observation study. Nine of the 20 participants deviated from their initial goal(s). None of the participants had parallel goals. We observed that all the participants searched to realize their goal. From Table 5.1 we can see that 19 of the 20 participants used navigation aids to reach their goal(s). This category seems to be important to the participants. None of the participants used a hedonic search strategy. They all used an epistemic search strategy. This was not surprising since we asked the participants beforehand to collect their searches on the WWW for this observation study. Social navigation did not take place at all\(^8\). The categories orienting (17/20), and expecting (14/20) also seem to be important to the participants.

We itemized the category ‘Searches’ into search units.

Table 5.2 shows the behavior scores for the searches, itemized into search units for situation N.

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\(^7\)http://www.google.com.

\(^8\)Social navigation could take place on the WWW, e.g., by means of e-mail, by calling with Skype (http://www.skype.com), or a chat application like MSN (http://www.msn.com/).
Many participants (16/20) typed the URL of the site. We observed this in 43% of the total search units ($N = 119$). The URL was not always the one the participants expected. For example, the website ‘Flight Centre’ did not have the logical URL http://www.flightcentre.com but
had http://www.flightcentre.com.au instead. Bookmarks and search options on the site were used by one (the same) participant. Nobody used the browser find option. The browser back button was used frequently by the participants (31% of the total search units). Fourteen of the 20 participants used the browser back button. Search engines were used by 14 of the 20 participants.

State triggers

Table 5.3 shows the observed occurrence of the state triggers for group N. Thirteen participants clicked on advertisements (banners and textual advertisements). Some of these participants indicated in the interview that they initially did not know that they clicked on textual advertisements (e.g., Google ads). Eight participants clicked on landmarks (e.g., home, faq, about button). We have not been able to observe anyone who was triggered by maps, prices, or colors. Two participants clicked on the logo to go to the homepage of the visiting website.

Realized goals

We observed that 15 of the 20 participants realized their goal(s).

Subjective search behaviors

In Table 5.4 we have summarized the interview results. On the question ‘How would you classify yourself as computer user?’, 3 participants considered themselves as novice and 5 as expert. The other 12 classified themselves
Table 5.4: Scores on interview questions before and after the observations gathered from interview with participants in situation N.

<table>
<thead>
<tr>
<th>Computer experience</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Novice)</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>5 (Expert)</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Internet experience</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Novice)</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5 (Expert)</td>
<td>7</td>
</tr>
</tbody>
</table>

* Interview questions before the ethnography

---

between novice and expert. For calculation purposes we considered all the participants who scored on computer experience 1, 2, and 3 (see Table 5.4) as “non-experts”. The participants who scored 4 and 5 were considered as “experts”. This means that we had 9 computer non-experts and 11 computer experts. We did the same for internet experience; all the participants who scored on internet experience 1, 2, and 3 were considered as “non-experts”. The participants who scored 4 and 5 were considered as “experts”, which means that we have 8 internet non-experts and 12 internet experts.

All the participants used search engines. In the interview all the participants indicated that they in particular use the Google search engine\(^9\). One participant indicated that he clicks on banners. Although 16 of the 20 participants indicated in the interview that they realized their goal(s), only 14 participants said that they were satisfied with the results. This was mainly because of unexpected content behind the links or menu items. Another reason was that the participants could not always find the information they were looking for easily on the websites. Six of the 20 participants deviated from their goal(s). Seven of the 20 participants experienced problems

in their search. Five participants said that they like websites with a dark background color and a light font color. In general the participants did not like an animated introduction on a website. Just one person answered that he does not mind an animation as introduction on websites. Seven of the 20 participants prefer many images (> 3) on websites. The participants indicated that many images or animations on a website slow down the website. According to the participants, 2 or 3 images on a webpage is acceptable.

We did chi-square tests to find out whether there is a significant relationship between computer experience and realizing one’s goal, and between internet experience and realizing one’s goal. The null hypothesis is taken to be \( H_0 \): there is no significant difference, and the alternative hypothesis is taken to be \( H_1 \): there is a significant difference.

From Tables 5.5 and 5.6 we can see that we cannot reject \( H_0 \) for computer experience and for internet experience. There is no significant relationship between computer experience and realizing one’s goal, and between internet experience and realizing one’s goal.

We did chi-square tests to find out whether there is a significant relationship between the speed of realizing one’s goal and computer experience, and between the speed of realizing one’s goal and internet experience. We calculated the average speed of realizing the goal. The average speed of realizing the goal was 20 minutes. Every participant who scored less than 20 minutes to realize his goal we labeled ‘fast’. The participants who needed

### Table 5.5: chi-square test: \( \chi^2 = 1.82, p = 0.17, df = 1 \).

<table>
<thead>
<tr>
<th>Interview (computer experience)</th>
<th>Experts</th>
<th>Non-experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal reached</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Goal not reached</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>9</td>
</tr>
</tbody>
</table>

### Table 5.6: chi-square test: \( \chi^2 = 0.47, p = 0.49, df = 1 \).

<table>
<thead>
<tr>
<th>Interview (internet experience)</th>
<th>Experts</th>
<th>Non-experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal reached</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Goal not reached</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>
Results and discussions

Table 5.7: chi-square test: $\chi^2 = 0.09, p = 0.77, df = 1$.

Table 5.8: chi-square test: $\chi^2 = 0.16, p = 0.69, df = 1$.

20 minutes or more we labeled ‘slow’. The results are presented in Table 5.7 and 5.8.

The chi-square tests show that there is no significant relationship between the speed of realizing one’s goal and the computer experience, and between the speed of realizing one’s goal and the internet experience.

5.3.2 Analysis of triggered search behavior (situation T)

We want to find out how people search on the WWW when they have to complete a task. This means that we want to find out how people reason, how their reasoning leads to a particular approach in realizing their goal, and how additional information makes them deviate from their goal. In this section we therefore analyze the triggered search behavior of the participants in situation T.

Search behaviors

The participants’ search behavior observations in situation T (task-based observations) are given in Table 5.9.

This table shows that 19 of the 20 participants used navigation aids. This behavior concerns 38% of the total atom observation units ($N = 325$).
Seventeen of the 20 participants oriented on the visited websites. Two participants changed their goal. Nineteen of the 20 participants had expectations on the visited websites. All participants searched to realize their goal. We itemized the category ‘Searches’ into ‘Search units’ in Table 5.10 for situation T.

We observed that 15 of the 20 participants typed the URL of the websites in their browser. Nobody used bookmarks. This was not so surprising as the chances were low that the websites we choose for the tasks would be in the participants’ bookmarks. A search possibility on websites seems important to realize goals. Five of the 20 participants used the search option on the visited websites. Seven of the 20 participants used the browser search option.
Results and discussions

Table 5.11: Observed occurrence of the state triggers for group T on the WWW.

<table>
<thead>
<tr>
<th>State triggers</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advertisements</td>
<td>9</td>
</tr>
<tr>
<td>Landmarks</td>
<td>12</td>
</tr>
<tr>
<td>Maps</td>
<td>0</td>
</tr>
<tr>
<td>Price</td>
<td>0</td>
</tr>
<tr>
<td>Color</td>
<td>0</td>
</tr>
<tr>
<td>Logo</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 5.11: Observed occurrence of the state triggers for group T on the WWW.

(e.g., CTRL+F in Mozilla Firefox\(^\text{10}\),) especially when the websites did not have search possibilities or when the search option the websites provided did not give keyword-related results. We observed that 14 of the 20 participants used the browser back button. Eighteen of the 20 participants used search engines to complete their tasks.

State triggers

Table 5.11 shows the observed occurrence of state triggers for group T. Nine participants clicked on advertisements (banners and textual advertisements). 5 of these 9 participants indicated in the interview that they did not know that they clicked on textual advertisements (e.g., Google ads). Twelve participants clicked on landmarks (e.g., home, faq, about button). We have not been able to observe anyone who was triggered by maps, prices, or colors. Three participants clicked on the logo to go to the homepage of the visiting website.

Subjective search behaviors

Table 5.12 shows that none (score 1, 2, and 3) of the participants considered themselves familiar with the goals. Four of the participants expected the navigation (i.e., the main menu) at the top of the webpage, fifteen expected the navigation on the left side of the webpage, and one participant expected it on the right side of the webpage. None of the participants expected the navigation at the bottom of the webpage.

\(^{10}\text{http://www.mozilla.org/}.\)
Table 5.12: Scores on interview questions after the observations gathered from interview with participants in situation T.

<table>
<thead>
<tr>
<th>Familiar with goal</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Total unfamiliar)</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>5 (Very familiar)</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Navigation position on the web</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top</td>
<td>4</td>
</tr>
<tr>
<td>Left</td>
<td>15</td>
</tr>
<tr>
<td>Right</td>
<td>1</td>
</tr>
<tr>
<td>Bottom</td>
<td>0</td>
</tr>
</tbody>
</table>

| Did you reach your goal? | 15 |
| Did you search differently? | 1 |
| Did you experience any problems in your search? | 11 |

Even though none of the participants considered themselves familiar with the goal, 15 of the 20 participants indicated that they realized their goals. Only one participant indicated that he searched differently for this study. Eleven of the 20 participants said that they experienced problems in realizing their goals. In the interview the participants said that the Dynabyte website was not user friendly. The participants said that the button names in the menu where not chosen properly. Some of the participants said that the content behind the links or menu items were not the expected ones. This led them into a different direction/location. Sometimes this was irritating for the participants. A few participants mentioned that they did not know on what page they were in the Dynabyte site. This caused irritation as they had to start from the homepage again or they had to click many times on the browser back button to find a page in the website from where they could go on. Another thing that irritated the participants were the 404 error pages (the page not found errors).
5.4 Overview of results

In this chapter we presented and discussed the results of the behavior observations on the WWW. We used the same methodology as we used in Chapter 4. We observed and analyzed people’s natural search behavior (situation N) and their triggered search behavior (situation T) on the WWW. Each participant in our study had a double role: once as a participant in situation N, and once as a participant in situation T.

In both situations we observed the following:

O-1 Most participants (19/20 in both situations) in our study used navigation aids on the visited websites to search or to realize their goal(s).

O-2 In both situations in our study the participants tried to predict the content behind a link or menu item. The interviews showed that this was because the participants expected certain content behind certain links or on some location in the website (14/20 in situation N and 19/20 in situation T).

O-3 We observed that participants in our study took a few seconds before they started to navigate on the website. We interpreted this as orienting to get familiar with the visited webpage (17/20 in both situations).

O-4 Search engines are used often in our study (14/20 in situation N and 18/20 in situation T). The Google search engine is very popular with the participants. All the participants said in the interview that they use the Google search engine.

O-5 Many participants (16/20 in situation N and 15/20 in situation T) first tried to guess the URLs of the websites mentioned in the tasks before they used a search engine.

O-6 Many participants clicked on advertisements (13/20 in situation N and 9/20 in situation T). Some of these participants, who clicked on advertisements, indicated in the interview that they initially did not know that they clicked on textual advertisements.

The browser back button was used by 14 of the 20 participants in both situations.

The participants in our study used the browser search option when the visited websites did not have any search options or when the provided search option did not give keyword-related results.

The observed participants in our study were irritated when they encountered the 404 error pages and when they found unexpected content behind menu items or links.

Participants in our study deviated in both situations from their goal.

State triggers make participants deviate from their goal.

We did not find any significant relationship in our study between computer experience and realizing one’s goal.

We did not find any significant relationship in our study between internet experience and realizing one’s goal.

We did not find any significant relationship in our study between the speed of realizing one’s goal and internet experience.

We did not find any significant relationship in our study between the speed of realizing one’s goal and computer experience.

From the interviews we found the following:

Many participants (15/20) in our study expect the navigation main menu on the left side of the webpage. Some of the participants (4/20) expect the navigation main menu on the top of the webpage.

Most participants (19/20) in our study do not like an animated introduction on websites.

About one third (7/20) of the participants in our study prefer more than three images on websites.
5.5 Summary

Below we give a summary of the observation and interview results. The results are related to the following aspects:

- Navigation behavior: O-1, O-4, O-6, O-7, and O-8
- Expecting: O-2, O-3, O-5, and I-1
- Goals: O-10 and O-11
- Emotions: O-9, I-2, and I-3
- Experience: O-12, O-13, O-14, and O-15

These aspects will be used for modeling the visitor’s search behavior and to formulate design patterns to optimize websites.

5.6 Conclusion

In this chapter we observed that problems in web design can cause website visitors to adapt their search behavior. Therefore, the observations of this chapter can be distinguished into web design problems and problems in search behavior of website visitors. Below we give a list of website problems and issues in search behavior.

5.6.1 Website problems

1. **Web visitors do not get the expected information behind links or menu items.**
   We observed that the participants in our study got irritated when they found other information behind the link or menu item than the expected one.

2. **Web visitors face 404 error pages.**
   Web visitors get this error code when the page is not found or does not exist. This causes irritation.

3. **The navigation support is not at the expected location of the website.**
   The navigation support of the website is not located at the expected
part of the web page. Most participants in our study expected the main menu on the left side of the web page.

4. **Web visitors cannot find a search option on the visited website.**
As websites are growing and becoming more complex, a search option on websites is essential. A website without a search option makes it difficult for the web visitor to find the information he is looking for.

5. **Web visitors get lost in the structure of the website, because they do not know where they are in the website.**
Web visitors are off-track when they do not know where they are in the website. We observed this behavior on the Dynabyte\textsuperscript{12} website in our study. The participants in our study got irritated when they got off-track and lost in the structure of the website.

6. **Web visitors cannot guess the URL of the visited websites, because the URL is not chosen logically.**
Many participants in our study tried to guess the URLs of websites. We observed that most of the time the guessed URLs were not correct.

7. **There are too many images or animations on the visited website which makes the website slow.**
Too many images on a website makes a website slow (i.e., it takes a while before the web visitor sees something on his screen). In the interviews, the participants in our study said that they do not like waiting too long for the webpage to see something on their screen.

### 5.6.2 Search behavior on the WWW

1. **Web visitors may change their goal(s).**
New information can lead web visitors in a new direction. Web visitors can be triggered by state triggers (e.g., advertisements), which means that they may deviate from their initial goal(s).

2. **Web visitors predict the content behind a link or menu item.**
We observed that the participants in our study expect certain content behind a link or menu item. When the prediction is not true, they

\textsuperscript{12}http://www.dynabyte.nl/.
get disappointed and irritated. This behavior is related to website problem 1.

3. **Web visitors use navigation aids on the visited websites.**
   Good navigation seems important. Our participants used the navigation aids on the visited websites frequently. We observed that the participants in our study wanted to realize their goal easily. This means that they should not need a manual to navigate through a website. They depend on good navigation aids and a good search system on the website to realize their goal. This behavior is related to website problem 3.

4. **Web visitors orient on the website first before they proceed.**
   Web visitors want an overview of the website at a single glance. We observed that the participants in our study orient on the website first before they proceed. This behavior is related to website problem 5.

5. **Web visitors try to guess the URL of websites.**
   Many participants in our study tried to guess the URL of websites they wanted to visit. This behavior is related to website problem 6.

6. **Web visitors use search engines to realize their goals.**
   Search engines seem important to find a website especially when website visitors cannot guess the URL of a website. We observed that all our participants used search engines. This behavior is related to website problem 6.

7. **Web visitors use the browser search option when the visited websites do not offer a search option.**
   A search option on websites makes it easier for website visitors to realize their goals. When a website lacks this search option, web visitors use the browser search option. This behavior is related to website problem 4.

In Chapter 6 we develop an approach to reduce the website problems to a minimum and to accommodate to the website visitors’ search behavior. We work this out in Chapter 8 and further.