Trust in Mediated Interactions

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Abstract

Modern technologies are increasingly enabling interactions between people who have never met face-to-face. In some cases, such as e-commerce, user-system interactions even replace human interactions. With the introduction of such systems came a widely publicised *lack of trust* online. In response, many researchers have focused on how to increase users' trust perceptions. Taking a systemic perspective, this thesis posits that long-term acceptance may largely depend on users' ability to make correct trust decisions rather than on high trust in the short term. Further shortcomings of HCI trust research were identified in a critical literature review: current trust research (1) is mostly based on users' self-reports, (2) lacks a coherent conceptual basis, and (3) focuses on cognitive trust, even though it is well established that trust is also based on affective reactions to interpersonal cues.

To overcome these limitations, this thesis makes theoretical, methodological and empirical contributions. It (i) introduces an integrated framework for trust in mediated interactions that unifies existing HCI trust research, (ii) explores novel behavioural trust measures, and (iii) reports a series of experiments on users' ability to make correct trust decisions and on the effect of mediated interpersonal cues on trust and usability.

The experiments on trust in e-commerce found that users could differentiate trustworthy from less trustworthy vendors, but only after a detailed exploration of a site. Judgements based on an inspection of the home page alone were not better than chance. Facial photos of assistants (which are commonly used by online vendors, but rarely researched) were found to affect users' self-reported trust in a vendor only when just the home page was inspected. No lasting negative effect of photos was found on task performance. For user trust in a human advisor interpersonal cues were researched in the form of video, avatar, audio, and photo representations. It was found that video could interfere with users' preference for trustworthy advice. An increase in risk led to an increase in interference. The avatar did not result in an increase in trust relative to other representations; rather there was some evidence for a marginally negative effect of this representation on trust. All representations that contained visual or para-verbal interpersonal cues (including the avatar) were rated as being more friendly and enjoyable than text-only representations.

To my parents,
and my sister.

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A very big thank you goes to John McCarthy, who – as a research fellow on the HIGHERVIEW project – was my colleague and day-to-day advisor throughout my PhD research. He taught me a great deal about experimental designs, statistical analysis, and eye-tracking. I would also like to thank Janet McDonnell, who has been a great source of support since my undergraduate days at UCL. Finally, I wish to thank Maia Garau, who was my mentor and became a friend. I am indebted to everyone in the Human-Centred Systems group, who helped me by discussing ideas, commenting on drafts, and providing good company: Gillian Wilson, Daniel Bruneau, Ivan Flechais, Mischa Weiss-Leijn, Peter Monthienvichienchai, Simone Stumpf, Sacha Brostoff, Dirk Weirich, Michael Tscholl, Philip Bonhard, Hendrik Knoche, Philip Inglesant, and Hina Keval.

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Table of Content

List of Figures

List of Tables

Chapter 1

Introduction

In the past, interactions between individuals who nevver met face-to-face used to be rare. Today, an ever-increasing number of interactions are mediated by or executed with technology: people find business partners in online diliscussion fora and dating partners on *Yahoo! Personals*. In many such encounters, people ddo not expect to ever meet in person: they buy goods from others or from Amazon.com, thaey spend hours playing against each other on Xbox-live or they take online medical advice without ever communicating face-to-face.

These interactions involve different types and levels of risk, and they are only possible if users trust each other, and the systems they use to meet,t, communicate and transact – as well as the organisations that provide them. Yet, in many reccent applications, this essential quality has proved difficult to attain. The widely reported *lackk of trust* in e-commerce (Consumer Web Watch, 2002; Grabner-Kraeuter & Kaluscha, 20003; Egger, 2001) demonstrates that insufficient trust can lead to users "staying away" from a technology altogether.

There is also a less topical – but more far-reachinng – argument to make trust a core concern of human computer interaction (HCI) research. Any technical system can only work efficiently as part of the larger socio-technical system – i i.e. an organisation or society and its human actors (Checkland, 1999). Organisations and soocieties are more productive if they have high levels of trust or *social capital* (Putnam, 20000; Resnick, 2002; Coleman, 1988; Fukuyama, 1999). Some authors claim that reported failulures of systems to yield the expected productivity gains in organisations (Landauer, 1996) partially stem from a reduction in opportunities to build social capital (Resnick, 2002). Truust can be formed as a by-product of informal exchanges, but if new technologies make manny such exchanges obsolete through automation, trust might not be available when it is needeed. Many studies show the economic benefits of high-trust interactions: trust enables exchangess that could otherwise not take place, reduces the need for costly control structures, and mahkes social systems more adaptable (Uslaner, 2002). We find similar considerations in the fifield of sociology and public policy: the drop in indicators of social capital seen in modern societies in recent years has been attributed – amongst other factors – to the transformations of social interactions brought about by advances in communication technologies (Putnam, 22000). Interactions that used to be

based on long-established personal relationships and face-to-face (f-t-f) interaction are now conducted over distance or with automated systems – a process known as *dis-embedding* (Giddens, 1990). According to this view, by conducting more interactions over distance or with computers rather than with humans, we deprive ourselves of opportunities for building trust.

If we are to realize the potential of new technologies for enabling new forms of interactions without these undesirable consequences, trust and the conditions that affect it must become a core concern of HCI. E-Commerce, virtual organisations, online gaming or dating, e-government and ambient services are only possible if users can trust these technologies, the organisations they provide them, and the people they interact with through them.

1.1 Research Problem

Current research on trust in HCI, in particular in the area of e-commerce trust, is often focused on establishing guidelines for increasing the perceived trustworthiness of technology or that of the actors it represents (Feng, Lazar, & Preece, 2004; Egger, 2001; Nielsen et al., 2000; Sapient & Cheskin, 1999). This approach offers important practical guidance for designers, who want to improve the interface of a specific e-commerce vendor. However, Fogg (2003a) in writing about the related concept of credibility remarks:

> *"While most Web designers seek to design sites with maximum levels of credibility, a more admirable goal would be to design sites that convey appropriate levels of credibility (...)."* (Fogg, 2003a,, p. 178)

The view taken in this research is that designing for appropriate levels of credibility or trust is not only admirable, but essential. If guidelines for trustworthy interface design are widely known and used by untrustworthy actors to increase users' trust perceptions, they may lose their validity. If users experience that they cannot rely on their trust perceptions when ordering goods or taking advice online, trust in the technologies and application domains may be lost, or result in a system burdened with costly regulation and control structures. Hence, rather than focussing on increasing the perceived trustworthiness of individual actors, this research investigates users' ability to perceive the trustworthiness of actors they encounter online, i.e. their ability to place trust well.

Another aspect that is under-represented in current HCI trust research is the affective component in decision-making processes. When comparing print and poster adverts from the early days of the consumer society to today's advertising,, it is easy to see that the focus

shifted from explaining product attributes to showing attractive people using the products. The advertising industry has learned to make use of the ability of pictorial representations to directly stimulate affective responses (Nass & Reeves, 2000; Kroeber-Riel, 1996). Practitioners, in particular in the domain of e-commerce, have also started taking this approach. We can see an increasing number of smiling faces on e-commerce vendors' pages; in some cases even animated assistants or video greetings. Yet, relatively little research effort has been devoted into investigating the effect of this practice on user trust. Hence, this research investigates the effect of representations of humans and the effect of human-like synthetic characters in various media representations on trust, and in particular on users' ability to place trust well.

A practical concern with the widely observed use of interpersonal cues in the form of facial photos on websites is that they may reduce a system's usability. Most web design experts argue that non-functional elements should be minimised as they make it harder for users to find the elements they are looking for (e.g. Nielsen, 2000; Krug, 2000). Facial photos may attract visual attention, which could reduce task performance or increase user cost in search processes. Thus, this research used *eye-tracking* to investigate effects of facial photos on homepages of e-commerce vendors on usability and visual attention.

In the course of investigating these empirical research problems, this thesis also addresses conceptual and methodological limitations of current HCI trust research. First, as will be discussed in more detail in section 2.2, the current debate on trust within HCI, but also in the wider social sciences, lacks a common frame of reference. As trust is an everyday term this has lead to a situation where researchers are investigating distinct aspects of trust without explicitly stating the focus of their research. To allow appropriate grounding of this research in existing work, a framework for trust in mediated interactions is established. Second, from a methodological perspective, this thesis takes a critical view of investigating the effect of affective elements on trust with methods that are based on self-reports (e.g. interviews or questionnaires, which are widely used in HCI trust research) because they are subject to individuals' tendency to rationalise decisions post-hoc (Bortz & Döring, 1995). Therefore, this research explores novel behavioural measures to investigate the effect of affective interface elements on users' trust decisions.

1.2 Scope

Trust is a key term in many disciplines and has consequently been investigated from many perspectives and in many application areas within HCI and Computer Science. While trust in agent societies or distributed systems (e.g. Capra, 2004; Abdul-Rahman & Hailes, 2000;

Neville & Pitt, 2003) forms part of this debate, the focus of this research is on human trust in other humans, in organisations, and in technology. Furthermore, while mutual trust in personal relationships (Rempel, Holmes, & Zanna, 1985) or generalised trust in societies (e.g. in public good dilemmas; Kollock, 1998) has also been the topic of HCI trust research (e.g. Resnick, 2002), this work is focused on the investigation of asymmetric situations; that is to say situations, in which one can identify a trusting party and a trusted party.

Within this broad overall scope, the empirical studies conducted for this thesis investigated human trust in e-commerce vendors and human trust in a human advisor that is represented by technology. In both research areas, particular emphasis is given to the effect of interpersonal cues on trust and to users' ability to place trust well. The scope of these empirical investigations will be defined in more detail in section 3.5.3, after the conceptual foundations for this research have been laid. This ensures that findings from the experiments conducted as part of this research can be appropriately positioned within the wider HCI trust debate.

1.3 Research Goals

After sketching out the problem space of trust in mediated interactions above, this section introduces the set of specific problems that were addressed by this thesis in the form of research goals. They are structured into empirical, theoretical, and methodological goals.

Research Goal 1 (Empirical)

Investigating users' ability to correctly identify the trustworthiness of other actors online.

The current debate on user trust in e-commerce and other technology-mediated interactions is largely focussed on identifying ways of increasing user trust. Whether such trust is well-placed, i.e. whether users' trust accurately reflects the trustworthiness of other actors is not frequently considered. This research therefore treats actors' trustworthiness as an independent variable to identify users' ability to perceive the trustworthiness of those they encounter online. This research goal is investigated for trust in e-commerce vendors and for trust in human advisors.

Research Goal 2 (Empirical)

Investigating the effect of interpersonal cues on user trust.

Another aspect that is under-represented in the current HCI trust debate is the role of interpersonal cues in the formation of trust. The advertising industry and also many practitioners in the field of e-commerce build on the effects of affective interpersonal cues when they use *photos* of smiling people in adverts and on website, but relatively little

research attention has been given to these practices iin the HCI trust literature. Hence, the second research goal is to investigate the effect of interpersonal cues on user trust. Addressing common practice in e-commerce interface design, this s thesis investigates the effect of facial photos embedded in web pages on trust in e-commercce vendors. In addition, it explores the effect of richer representations of interpersonal cues s (given in *video*, *audio*, and *avatar* representations) on trust in human advisors.

Research Goal 3 (Empirical)

Investigating the effect of interpersonal cues on visual ggaze, task performance and user cost.

The widely observed use of non-functional affectiive elements such as facial photos contravenes established usability guidelines. Such elements are considered to reduce task performance and to increase the user cost of interactiive systems. As practitioners need to balance designing for trust with optimising usability, Reesearch Goal 3 is to explore the trade-off decisions that may be required for the use of facial pbhotographs on e-commerce sites.

Research Goal 4 (Theoretical)

Creating a framework for trust in mediated interactions.

The current discussion on trust in HCI is fragmented iin terms of approaches, methods, and definitions. It is often unclear which aspect of trust was iinvestigated, and how far findings can be generalised. A high-level framework of trust in mediated interactions can help in overcoming this situation, as specific questions, actors, , technologies, and contextual factors can be positioned on relevant dimensions. Such a frameework should accommodate existing findings and concepts (4.1); it should combine actor annd context variables (4.2); it should show the limits of generalisation for individual findinggs (4.3); and it should provide the theoretical underpinning for the methods used to measuree trust (4.4).

Research Goal 5 (Methodological)

Exploring new methods for measuring trust in mediated iinteractions.

Current HCI trust research, in particular in the domain of e-commerce, is mainly based on methods that rely on users' self-reports such as qualitatitive interviews or questionnaires. As these approaches have known limitations – in particular iin the context of trust research – this thesis explores behavioural trust measures that are based on observing decision-making under financial risk.

1.4 Contributions

This thesis makes empirical, theoretical and methodological contributions to HCI trust research. A brief overview on the contributions is given below.

Theoretical Contributions

1. A framework of trust in mediated interactions. The framework accommodates existing research and it identifies the key dimensions that determine trust and trustworthy behaviour. It is of high relevance to researchers as it supports the planning of studies, appropriate generalisation from results, and well-founded approaches to measuring trust. It is also beneficial to practitioners as it can be used to structure the design space in the search for solutions that support trust in technologies, organisations, and other users.

Empirical Contributions

2. a) **Research findings on users' ability to differentiate trustworthy from less trustworthy e-commerce vendors.** These findings re-set the agenda in e-commerce trust research on supporting well-placed trust, rather than increasing short-term trust. These findings have implications for user education and training, as well as for regulators. They are also relevant for designers who want to ensure appropriate levels of trust in the systems they create.

   b) **Research findings on the effect of facial photos on e-commerce sites on user trust and usability.** These findings are of high relevance for practitioners who are striving to create trustworthy *and* usable interfaces.

   c) **Research findings on users' ability to detect the trustworthiness of a human advisor in different media representations (*video, avatar, audio, photo+text, text-only*).** The findings help clarify contradictory results regarding the effect of mediated interpersonal cues on trust. For practitioners the findings translate into concrete advice on the choice of media representations.

Methodological Contribution

3. **A novel approach to measuring trust by observing decision-making under risk.** Methods for measuring trust introduced in this thesis overcome the limitations of existing approaches such as users' self-reports (interviews or questionnaires), which are bound by participants' limited capability for introspection and post-hoc rationalisation. They also avoid the known weaknesses of widely used Prisoner's Dilemma studies that only model a very specific subset of trust-requiring situations.

1.5 Publications Relating to this Thesis

The research that forms part of this thesis has led to several publications. Table 1.1 matches the contributions of this thesis to individual publications. In addition Riegelsberger (2002) and Riegelsberger (2003), which were presented at doctoral consortia at HCI 2002 and CHI 2003, give brief overviews on the progress of the thesis.

	Contribution	Publication
Chapter 3	A framework for trust in mediated interactions.	J. Riegelsberger, M. A. Sasse & J. D. McCarthy (2005). **The Mechanics of Trust: A Framework for Research and Design.** *International Journal of Human-Computer Studies, 62(3), 381-422*
Chapter 4	A critique of the use of Social Dilemma studies to measure trust and an outline of alternative methods.	J. Riegelsberger, M. A. Sasse & J. D. McCarthy (2003). **The Researcher's Dilemma: Evaluating Trust in Computer Mediated Communications.** *International Journal of Human Computer Studies, 58(6), 759-781*
Chapter 5	Experiment 1 on the effect of photos on visual attention.	J. Riegelsberger, M. A. Sasse & J. D. McCarthy (2002). **Eye-Catcher or Blind Spot? The Effect of Photographs of Faces on E-Commerce Sites.** *2nd IFIP Conference on e-commerce, e-business, e-government (i3e), Oct 7-9, Lisbon, Portugal, pp. 383 - 398.*
Chapter 6	Experiment 2 on user trust in e-commerce.	J. Riegelsberger, M. A. Sasse & J. D. McCarthy (2003). **Shiny Happy People Building Trust? Photos on e-Commerce Websites and Consumer Trust.** *Proceedings of CHI2003, 5-10 April, Ft. Lauderdale, FL, US, pp. 121-128.*
Chapter 7	Experiment 3 on user trust in e-commerce and effects of photos on visual attention.	J. Riegelsberger, M. A. Sasse & J. D. McCarthy (2003). **Trust at First Sight? A Test of Users' Ability to Identify Trustworthy e-Commerce Sites.** *Proceedings of HCI2003, 8-12 Sep 2003, Bath, UK, pp. 243-260.*
Chapter 8	Experiment 4 on the effect of media representations on trust in a human advisor.	J. Riegelsberger, M. A. Sasse & J. D. McCarthy (2005). **Do People Trust Their Eyes More Than Their Ears? Media Bias While Seeking Expert Advice.** *Extended Abstracts of CHI 2005, Portland, OR, US, 2-7 April 2005.* J. Riegelsberger, M. A. Sasse & J. D. McCarthy (2005). **Rich Media, Poor Judgement. A Study of Media Effects on Users' Trust in Expertise.** *To be presented at the British HCI Conference 2005, Edinburgh, UK..*

Table 1.1: Publications relating to this thesis

Prior to commencing the research for this thesis, qualitative studies on trust and interpersonal cues in e-commerce were conducted by the author. The findings from these studies were reported in Riegelsberger & Sasse (2001), Riegelsberger & Sasse (2002a), Riegelsberger & Sasse (2003b) and informed some of the hypotheses that are tested in this thesis.

1.6 Structure of the Thesis

This thesis addresses the two main areas of HCI trust research (Feng et al., 2004): trust in e-commerce vendors and trust in human actors. For both areas Research Goals 1 and 2 are investigated: users' ability to place trust well (Research Goal 1) and the effect of mediated interpersonal cues on user trust (Research Goal 2). In addition, for reasons of practical relevance, the effect of interpersonal cues on the usability of e-commerce sites is researched (Research Goal 3). Chapters 2 to 4 establish the conceptual and methodological background for this research. They are followed by Chapters 5 to 8, which present four experiments undertaken to address the empirical research goals. Each experiment is an independent investigation of one or several issues addressed in this thesis, but approaches and hypotheses of the later experiments are informed by the outcomes of the earlier ones. Each experimental chapter presents hypotheses, methodological details, results, and a discussion of the findings. Chapter 9 then stands outside the linear flow of the earlier chapters. It is included as a part-requirement for the CSEL London Business School scholarship and evaluates the commercial implications of the research presented in this thesis. The thesis closes with Chapter 10, which summarises the contributions and outlines future work. Figure 1.1 gives an overview on the structure of the thesis.

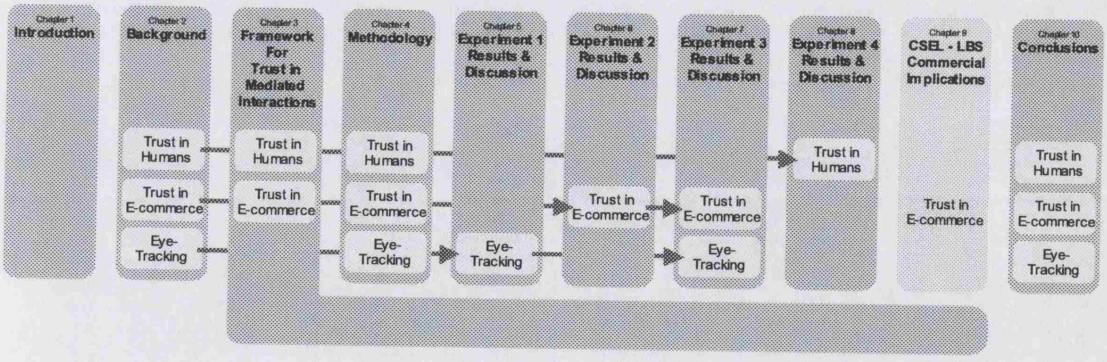


Figure 1.1: Structure of the thesis

Chapter 2 initiates the discussion of trust in mediated interactions by situating the concern for well-placed user trust in the wider field of HCI research. It goes on to argue for the continued relevance of trust, and in particular affective trust, as a design goal. Next, it introduces interpersonal cues, their role in face-to-face trust assessments, and how they are

affected by mediation. A critical literature review of research on trust in human actors (in teams and dyads) and e-commerce vendors forms the central part of Chapter 2. The chapter closes with a review of literature on the effect of interpersonal cues on the usability of interactive systems.

Chapter 3, in response to the fragmented nature of current trust research in HCI, introduces a framework for trust in mediated interactions. This framework incorporates existing research and concepts from HCI, but also from psychology, sociology, and economics. It provides the conceptual and terminological basis for the empirical research presented in this thesis.

Chapter 4 critically reviews the methods employed by current HCI research on trust in human actors and in e-commerce vendors. This review identifies several limitations of existing methods (e.g. limited introspection, post-hoc rationalisation, symmetric games resulting in strategic insecurity, etc.). The remainder of the chapter discusses how these limitations are addressed by the methodological approach taken in this thesis.

Chapter 5 presents Experiment 1. An eye-tracker was used to investigate the effect of a facial photo on visual attraction and task performance. It thus acted as a manipulation check for the experiments undertaken later, to see whether interpersonal cues in the form of facial photos do attract visual attention when users engage in goal-driven tasks with an e-commerce system. It also offered a first test for the effect of photos on task performance in such systems.

Chapter 6 presents Experiment 2, which was the first to focus on user trust as a dependent variable. This experiment included semi-functional copies of 12 existing e-commerce vendors' sites, whose trustworthiness – established from the rating sites *Bizrate*[1] and *Epinions*[2] – was known to the researcher. This allowed investigating users' ability to place trust well. In addition, it tested the effect of embedding 8 different photos – one by one – on the homepage of the e-commerce vendors.

Chapter 7 presents Experiment 3, which combined the approaches of the previous experiments and investigated trust while also taking eye-tracking measures. Based on findings in the earlier studies and on theoretical considerations arising form the framework (Chapter 3), it contrasted a superficial exploration with an in-depth exploration of an e-commerce vendor's site to investigate effects on trust and usability.

Chapter 8 introduces Experiment 4, which investigated trust in a human advisor. Users' ability to place trust well was investigated. In this experiment, the advisor's trustworthiness was manipulated by controlling her level of expertise. Experiment 4 investigated several media representations of interpersonal cues (*video, avatar, audio, photo+text, and text-only*).

[1] www.bizrate.com
[2] www.epinions.com

Chapter 9, included as part-requirement for a CSEL London Business School scholarship, aims to bridge the gap between HCI and marketing practice. It uses the framework introduced in Chapter 3 as a template for an analysis of current marketing and HCI guidelines on trust in e-commerce.

Chapter 10 summarises the substantive empirical and theoretical, as well as the methodological contributions. It gives recommendations for researchers, practitioners, and user advocates.

Trust in e-commerce. The finding that users can differentiate trustworthy from less trustworthy vendors only after an in-depth exploration of the site calls for educating users to explore pages beyond the homepage. An effect of embedding a facial *photo* on users' self-reported trust was only found for superficial explorations of the homepage, suggesting that such photos can help to overcome initial barriers to purchases.

Trust in a human advisor. This research found that advisor expertise could be detected in all media representations, including *text-only*. However, users considered their ability to detect trustworthiness as highest for *video* and *audio* representations. Hence, designers concerned to increase user trust should utilise these representations.

Methodological. This thesis showed that the level of risk present in a specific situation has an impact on user decision-making. It therefore advocates caution for widely generalising from studies that investigated trust in the absence of risk.

Theoretical. The framework for trust in mediated interactions introduced in the thesis proved helpful in structuring the methodological approaches and the empirical research in this thesis. It further was fruitfully employed for an analysis of existing HCI trust design guidelines and marketing practice.

The Appendix contains a glossary of key terms, as well as the material used for the experiments reported in this thesis. This includes screenshots from experimental systems, questionnaires, instruction sheets, and stimulus material, such as photos and web sites. The material in the appendix is referenced from the respective sections in the main part of the thesis.

1.7 Notation

To aid the discussion of experimental approaches and results, a coherent notation scheme was employed throughout the thesis. The names of dependent variables are set in SMALL CAPS (e.g. ADVICE UPTAKE). Independent variables, specific factor levels, and key terms are set in *italics* (e.g. *expert*, *non-expert*).

Chapter 2

Background

This chapter provides the conceptual background for this thesis. It first positions the investigation of user trust in the wider field of HCI research (section 2.1). It then goes on to discuss the relevance of trust and in particular well-placed trust (Research Goal 1, section 2.2). The discussion also shows that there is a need for a more coherent terminological foundation for trust research in HCI (Research Goal 4). This need will be addressed by the framework presented in Chapter 3.

Chapter 2 then goes on to introduce and classify interpersonal cues and their effect on trust in mediated interactions (section 2.3). The main part of this section is formed by a critical discussion of HCI research on trust in human actors (in teams and dyads) and on trust in e-commerce – in particular with a view to the effect of interpersonal cues. This discussion highlights gaps in existing research and results in the formulation of predictions regarding the effect of interpersonal cues on user trust that are tested in the empirical part of the thesis (Research Goal 2). This review also identifies methodological shortcomings of current HCI trust research (Research Goal 5), which will be addressed in more detail in Chapter 4. The final section of this chapter critically reviews studies on visual gaze, task performance and user cost (Research Goal 3, section 2.4).

2.1 Embedding the Thesis in HCI Research

The research presented in this thesis is situated in the field of human computer interaction (HCI). This field draws on the methods and substantive knowledge from several disciplines, such as computer science, psychology, and ergonomics (Nickerson & Landauer, 1997). It formed in the early 1980s when it was realised that many corporate computer systems did not result in the promised productivity gains (e.g. Landauer, 1996). This was partially seen as a result of designing systems without the needs and capabilities of the human user in mind (Nielsen, 1994). In response to this situation, HCI researchers provided methods for evaluating the performance of human-technology systems, as well as design heuristics. One core interest of HCI research is the usability of interactive technologies. A shorthand definition of usability offered by Shackel is *"the capability to be used by humans easily and effectively"* (Shackel, 1991, p. 24). There are a large number of other more detailed

definitions (Keinonen, 1999), but these cover the same aspects and differ mainly in how they divide this space. There is also agreement that usability ought to be measured objectively and subjectively (Shackel, 1991; Park & Lim, 1997; Bevan, 1995; Wilson & Sasse, 2004). This research follows the terminology used by Bouch, Wilson, & Sasse (2001) which divides usability into the core factors *task performance*, *user cost*, and *user satisfaction*. Table 2.1 relates these terms to definitions by Shackel (1991) and ISO 9241 (Bevan, 1995).

Bouch et al. (2001)	Shackel (1991)	ISO 9421(Bevan, 1995)
Task Performance	Effectiveness (above specified level of performance, achieved by some required percentage of target users, within a required proportion of usage environments) Learnability Flexibility	Effectiveness Efficiency (Temporal)
User Cost	Attitude (*"... within acceptable levels of human cost in terms of tiredness, discomfort, frustration, and personal effort."*, p. 25)	Efficiency (Human, mental effort)
User Satisfaction	Attitude (*"... so that satisfaction causes continued and enhanced usage of the system."*, p. 25)	User Satisfaction

Table 2.1: Dimensions of usability

Task performance refers to a system's capability to allow a user to achieve a goal by completing a task effectively (accurately and completely) and efficiently (with minimum use of resources). Efficiency in this context is understood as temporal efficiency (Bevan, 1995). An example of a measure would be the time spent completing a task (Bevan, 1995). User Cost is a measure of the mental or cognitive effort that needs to be expended by the user to complete a task. ISO 9241 (Bevan, 1995) refers to it as human efficiency. Shackel (1991) lists it under the sub-construct *attitudes* and defines it as follows: the system must be *"(...) within acceptable levels of human cost in terms of tiredness, discomfort, frustration, and personal effort"* (p. 25). It is important to note that two systems may not differ in task performance, but in user cost. One system, in other words, may allow the user to complete a task in the same

time, however, at a higher cost in terms of cognitive workload than another system (Wilson & Sasse, 2004). User satisfaction, finally, is the user's subjective assessment of the system.

With the increased spread of *new media* (e.g. online technologies, mobile devices) and prompted by the embedding of computing technology in devices beyond the desktop PC, HCI has broadened its perspective. Rather than just optimising technology for the use in task-oriented environments (e.g. in the workplace), HCI is now also concerned with technologies targeted at consumers, e.g. in a leisure context. This shift has led HCI researchers and practitioners to incorporate new design goals: in a consumer or leisure context traditional usability with a focus on efficiency and task performance may be only one of the factors that differentiate a product. Additional factors that are now increasingly incorporated into HCI research are e.g. *hedonic quality* (Hassenzahl et al., 2000), *fun* (Blythe et al., 2003), or *aesthetics* (Mahlke, 2002). While some authors argue that these factors should form part of usability (e.g. Carroll, 2004), others see them as additional factors next to usability in its classic definition (see Table 2.1; Norman, 2004). In the latter view usability is one of many factors that have to be considered for *User Experience Design* and *Interaction Design* (Preece, Rogers, & Sharp, 2002; Garrett, 2002). This thesis follows this view.

Trust as an important condition for using a system or interacting with another party via technology has also risen to the forefront of the research agenda in this broader understanding of HCI (Corritore, Wiedenbeck, & Kracher, 2001; Corritore, Kracher, & Wiedenbeck, 2003a; Friedman et al., 1999). Egger (2001) situates his work on user trust in e-commerce in the emerging field of user experience research, Fogg (2003a) coined the term *Captology* to frame his work on web credibility and persuasive technologies. He sees Captology as a sub-field of HCI. Norman (2004), finally discusses trust in relation to *Emotional Design*. These developments indicate that the traditional boundaries of HCI need to be widened. Besides building on methodological and substantial HCI knowledge, this research therefore draws also on experimental economics, social psychology and marketing, as these disciplines are traditionally concerned with evaluating decision-making and trust.

While the core interest of this thesis is user trust in mediated interactions, the traditional concern of HCI – a system's usability – is not neglected. A hypothetical system, after all, that is trustworthy but unusable cannot be a design goal. Classic HCI criteria are employed to explore the trade-off decisions that may be required between optimising the trustworthiness and the usability of a system. The importance of optimising trust *and* usability has also been emphasised by Fogg when writing on the related concept of credibility:

> *"Designing for (...) credibility is a balancing act. On the one hand, a site must (ful)fill users' needs for information or services quickly (...) On the other hand, the site must use the homepage to convey (...) credibility"* (Fogg, 2003a, p.169).

In summary, this thesis is grounded in HCI but its focus on user trust – a relatively novel concern in the field – requires a broader approach in terms of methodology and conceptual background. While mainly investigating user trust, this thesis also addresses effects of trust-building efforts on usability, as designers need to be aware of trade-off decisions that may be required between these design goals.

2.2 Trust

2.2.1 Initial Definitions

The term *trust* is used in everyday language, but everyone has a slightly different understanding of what it actually entails. In the scientific community, the situation is unfortunately not very different. Trust has been studied for many years in many disciplines and there is a plethora of trust definitions researchers can choose from (Corritore, Kracher, & Wiedenbeck, 2003b). The definitions contrast on different dimensions and are applicable to different situations. The sociologist Uslaner (2002) concedes that it *"works somewhat mysteriously"* (p. 1). There is no widely accepted theory of trust – rather research is fragmented across several disciplines, divided by conceptual and methodological boundaries (Gambetta, 1988; see 3.1). Trust research in HCI, which often takes definitions and methods from the social sciences, reflects the lack of coherence across these fields. In response to this situation, Chapter 3 presents a framework of trust in mediated interactions (Research Goal 4). It discusses and integrates existing models of trust in HCI. Hence, this short section is only intended to provide initial working definitions.

The actors in situations of trust are referred to as *trustor* (the trusting actor) and *trustee* (the trusted actor). This thesis investigates the trust of human trustors in human and organisational trustees that are represented by technology (see 3.2.5). Trust is only required in situations in which there is some level of *uncertainty* regarding the outcome and where this outcome has some value to the individual (i.e. if there is some *risk*; Mayer, Davis, & Schoorman, 1995; Luhmann, 1979). Uncertainty arises from the dependence of the outcome on the actions of actors in whose reasoning or functioning the trustor has only limited insight (Giddens, 1990). These factors are captured by the following definition of trust:

> *Trust is the willingness to be vulnerable based on positive expectations about the actions of others*[3].

As it is very abstract, this definition can be seen as the lowest common denominator of HCI trust research (Corritore et al., 2003b). It defines *trust* as an *internal state* or *attitude* (Corritore et al., 2003b; Tan & Thoen, 2000; McKnight & Chervany, 2000; Lahno, 2002b), which entails *cognitive* and *affective* aspects (Corritore et al., 2003b; Lewicki & Bunker, 1996; see 3.2). Trust, as an internal state, is different from *trusting action* (e.g. buying online, entering credit card details, relying on advice) or *cooperation* (e.g. in a team setting), which are observable behaviours (Corritore et al., 2003b). Trust is a necessary but not a sufficient condition for trusting action (see 3.2; Tan & Thoen, 2000; Corritore et al., 2003b; McKnight & Chervany, 2000). *Perceived trustworthiness* of an actor contributes (among other factors) to trust in an actor. However, perceived trustworthiness may be different from real trustworthiness, i.e. an actor's actual behaviour might deviate from the behaviour the trusting actor expected (Corritore et al., 2003b). This distinction between real and perceived trustworthiness is the motivation for Research Goal 1, to investigate users' ability to perceive the trustworthiness of others. In the broadest possible terms, trustworthiness depends on *ability* and *motivation* (Deutsch, 1958). Trust may be misplaced because the trustee lacked the expertise, competence, or professionalism (i.e. ability) to act as expected. Alternatively, the trustee might have prioritised other tasks, or wilfully wanted to harm the trustor, i.e. he might have lacked motivation to act as expected. Ability and motivation can often not be observed directly, but need to be inferred from signals (e.g. interpersonal cues, certificates, reputation information). In HCI trust research, signals given in the interface of a system that can form the basis of perceived trustworthiness are referred to as *surface cues* (Einwiller, 2001; Egger, 2001; Fogg, 2003a; Egger, 2001).

2.2.2 Relevance of Trust

> *"Trust is the chicken soup of social life. It brings us all sorts of good things – from a willingness to get involved in our communities to higher rates of economic growth (...), to making daily life more pleasant."* (Uslaner, 2002, p. 1)

Trust permeates most of our actions, because modern life is characterized by a high dependency on others' actions (Giddens, 1990). As an example, making ourselves dependent on others allows us to focus on specialised professional activities, while others ensure the safety of our possessions, the supply of food, or the education of our children. Relinquishing

[3] See Zand (1972), Boss (1978), Mayer et al. (1995), McAllister (1995), Rocco (1998), and Corritore et al. (2001).

direct control of critical activities by externalising them to others frees resources for activities at which we are more productive. Not surprisingly, generalised trust correlates well with macro-economic indicators such as productivity or health (O'Neill, 2002; Uslaner, 2002; Putnam, 2000; Fukuyama, 1999). Trust has also measurable positive effects on the level of micro-economics. Taking the example of two firms collaborating on a research project, a high level of trust of individual employees will allow them to cooperate without the investment in costly legal arrangements that specify each firm's rights and responsibilities in detail. Empirical studies by economists did indeed find a positive effect of trust on productivity in joint ventures and within work teams (Uslaner, 2002; Fukuyama, 1995; Sitkin & Roth, 1993). In research on consumer decision-making, trust in the vendor and the product has been identified as an important factor for purchasing decisions (Aaker, 1996; Kotler, 2002; for a detailed overview on marketing and trust, see Chapter 9). This is reflected in the results of e-commerce trust research, where researchers found that *lack of trust* is a barrier to user acceptance of e-commerce services (e.g. Egger, 2001; Sapient & Cheskin, 1999).

Given the importance of trust, the proverbial *lack of trust* on the Internet has spurred much research in the social sciences (e.g. the ESRC's e-society programme; Waverman, 2005), but also in HCI (Friedman et al., 1999; Corritore et al., 2003a). The notion of a *lack of trust* online is invoked by researchers who publish guidelines for trustworthy interface design (Egger, 2001; Nielsen et al., 2000); by writers on management and business practices (Handy, 1995); and lastly by conference organisers and the travel industry who – in an effort to sell their services – claim that trust breaks down over distance. There is plenty of empirical evidence for this claim. In the area of e-commerce, for instance, surveys found that e-commerce vendors are trusted less than brick-and-mortar organisations (Consumer Web Watch, 2002).

If there is insufficient trust on the Internet, the question is to whether this is a persistent problem or just a short-term consequence of a process of adaptation to new technologies. Online interactions, after all, do not mark the first departure from face-to-face interactions. For example, purchases have previously been conducted via catalogues, telephone, or television. *Lack of trust* is now not considered a major obstacle in these areas. Thus, the reported *lack of trust* on the Internet could be attributed to its relative novelty for most users. One could argue that once conventions have been established and individuals interact online habitually, the *lack of trust* will disappear. Trust would cease to be a research topic of relevance in HCI. The increasing acceptance of online services by consumers (e.g. online booking of flights; Economist, 2004a) in recent years certainly indicates that part of the online trust problem is indeed transitory. However, online technologies also have specific properties

(compared to face-to-face interactions and other media of distant communication), that advocate a persistent concern about trust. These are briefly discussed below.

1. No central control or regulation. Unlike other media (e.g. TV, telephone), the Internet currently has no central authority with a gate-keeping function or regulatory power. This is a direct consequence of the Internet's open architecture and global nature. The lack of central control makes it difficult to know whether one is dealing with a legitimate business. Furthermore, in the case of fraud it is more difficult to track down the individual or organisation that committed the act.

2. More personal information required. Vulnerabilities are increased as mediated transactions are often more information-intensive than face-to-face interactions. While purchases in a shop can be conducted anonymously, online purchases commonly require users to divulge personal information such as email address, payment details, and shipping address. This can raise concerns about data security and privacy (Egger, 2001).

3. Fewer signals available. In traditional retailing consumers perceive a plethora of signals about a vendor as they enter a shop. They know where it is located and under which level of law enforcement it is acting. They instantly get an impression of its size and how well it is kept. They also get information about the expertise and motivation of the sales staff in the form of interpersonal cues. Online shoppers, in contrast, must base their perceptions of trustworthiness on fewer signals. This loss of signals also applies to other forms of mediated interactions (e.g. catalogue shopping, television, telephone). With bandwidth to consumers increasing, richer representations – as they are common in established media – are becoming possible.

In summary, Internet technologies increase the perceived vulnerabilities and uncertainties of trustees compared to face-to-face interactions and other forms of mediation. Some of this increase can be attributed to current a lack of familiarity with these technologies. However, there are also factors that are bound to be more persistent, such as (1) its global and open nature and the associated lack of a central control authority (compared to other media), (2) the increased need to divulge explicit personal information (compared to face-to-face interactions). Initially – compared to other media – Internet technologies also offered relatively (3) impoverished interactions in terms of the signals for trustworthiness available. Increasing bandwidth to consumers may help to overcome this weakness. Taken together

these factors support the continued emphasis on designing Internet technologies in a way which helps users to differentiate trustworthy from less trustworthy actors.

2.2.3 Trust and Well-Placed Trust

As much of the debate on user trust in online interactions – in particular in the domain of e-commerce – is motivated by the desire to overcome the above-mentioned *lack of trust*, most researchers look into how the design of technologies can increase trust (see 9.3 for an overview on studies and results). Researchers in the domain of e-commerce typically ask users about the interface elements that they perceive as indicators of trustworthiness. The elements that are found to have a positive effect on trust are then included in guidelines for trustworthy interface design. These guidelines are of high value for designers, who want to improve the interface of a specific e-commerce vendor. However, from a systemic perspective, they can be criticised for overlooking the fact that high levels of trust are not desirable *per se*. The positive effects of trust can only accrue if trust is well-placed. Technologies that entice users to trust untrustworthy trustees are bound to undermine long-term trust in these technologies and in the whole market place. The majority of e-commerce trust research is focused on *increasing users' trust perceptions*, rather than increasing *users' discriminative ability* which enables them to *place trust well.*

In an earlier qualitative study conducted by the author, some users voiced concerns that anyone could create a trustworthy-looking website (Riegelsberger & Sasse, 2003b). This indicates that the *lack of trust* in the Internet is in fact partially a lack of users' trust in their own discriminative abilities when interacting online. Livingstone & Bober (2004), who found evidence of children's *lack of trust* online, also emphasise the importance of discriminative ability.

> *"A sceptical attitude is of little value unless one is equipped with some means to act upon this scepticism, discriminating between the trustworthy and the problematic."* (Livingstone et al., 2004, p. 28)

These considerations motivated the formulation of Research Goal 1. In addressing this goal, this thesis investigates users' ability to place trust well, i.e. to discriminate between trustworthy and less trustworthy actors. Exploring this question allows investigating whether specific design interventions interact with users' discriminative ability. The answers to these questions are relevant to providers of online services who are interested in maintaining long-term trust in themselves and the market place. Furthermore, if it is found that some design interventions easily manipulate users' trust perceptions, the outcomes are of high relevance for user advocates, regulators and policy makers.

2.2.4 Affective Trust

Lewis & Weigert (1985) define human trust as consisting of *cognitive* and *emotional (affective) trust*:

> *"Trusting behavior may be motivated primarily by strong positive affect for the object of trust (emotional trust) or by 'good rational reasons' why the object of trust merits trust (cognitive trust), or, more usually, some combination of both."* (Lewis & Weigert, 1985, p. 972)

To date, the affective component of trust has been somewhat overlooked in HCI trust research (Feng et al., 2004), in particular in the domain of e-commerce, where research is largely focussed on factors that contribute to cognitive trust, such as trust seals, security mechanisms, or the absence of errors (see 9.3). The effect of interpersonal cues has rarely been the topic of research into user trust in e-commerce. This contrasts with the increasing use of such affective elements (e.g. photos). The focus on cognitive trust does also not reflect the increasing attention that is given to affective processes in the disciplines of sociology, marketing, and psychology. A brief overview on developments in these disciplines is given below.

Sociologists observe that interactions in modern societies are increasingly mediated via complex socio-technical systems (Giddens, 1990; Lahno, 2002a; Zucker, 1986). People write cheques, rather than bartering for goods; they donate to charities, rather than giving directly to the poor; and they order from catalogues and websites, rather than buying from a local shop. Giddens (1990) describes this process of increasing mediation as *dis-embedding*. The classic view in sociology holds that this transformation leads to a shift in how we approportion trust (Shapiro, 1987; Zucker, 1986). In this view, dis-embedded interactions are based on an increased reliance on institutional and cognitive trust (see Lahno, 2002a, for a summary of this argument). More recently, this view is questioned by sociologists who maintain that trust in dis-embedded interactions is supported by cognitive trust in institutions *and* by affective trust in individual human actors that act as representatives of complex socio-technical systems (e.g. call centre employees, corporate spokes people; Giddens, 1990; Lahno, 2002a). According to this second view, trust in human representatives helps to maintain trust in organisations and institutions. Giddens (1990) refers to this process as *re-embedding*.

In psychology, partially prompted by findings in neuroscience (Damasio, 1994), researchers are now also acknowledging that there no purely cognitive or "cold" decision-making (Döring, 1998). Human decisions are increasingly seen to have affective components

(Zajonc, 1980). This marks a departure from the earlier dominant paradigm in this discipline which aimed to explain human decision-making in mainly cognitive terms (Döring, 1998).

Marketing and advertising research are possibly the disciplines that have the longest tradition of investigating affective elements in decision-making processes. In these fields it has long been established that a consumer's purchase decision depends on rational argumentation *and* on creating positive affective reactions (Aaker, 1996; Kotler, 2002; see Chapter 9). These strategies closely map the dimensions of cognitive and affective trust.

The shift in the academic reflection on the role of affect in trust and decision-making is mirrored by an increased use of affective elements in advertising and – more recently – in the design of e-commerce interfaces. Photos of staff or customers can now be observed on many web sites that compete for customers, and with increasing network bandwidth we can also expect further representations such as video or audio, which are familiar in classic advertising, to be used more frequently online.

This growing practical and theoretical relevance of affective trust is not yet reflected in HCI trust research which – in particular in the area of e-commerce – has largely focused on cognitive trust (see 9.3). To contribute towards closing this gap, Research Goal 2 was formulated. In addressing this goal, this thesis researches the effects of interpersonal cues, which are of high importance for the formation of affective trust.

2.3 Interpersonal Cues and Trust

This section introduces and classifies types of interpersonal cues (see 2.3.1). It then discusses how these cues are affected by transmission in different media representations (see 2.3.2). The main part of this section reviews studies from HCI trust research and related disciplines that investigated the effect of interpersonal cues (see 2.3.3). This review looks at two streams of research: trust in humans (in teams and dyads; see 2.3.4) and trust in e-commerce vendors (see 2.3.5).

2.3.1 Types of Interpersonal Cues

In every encounter between humans, non-verbal information is given off and perceived. This *"impossibility of non-communication"* (p. 48), as Watzlawick, Beavin, & Jackson (1967) expressed it, stems from the fact that not only our verbal utterances carry information, but also our non- and para-verbal behaviour as well as our appearance. While non-verbal information can serve several functions, such as giving cues for turn-taking, availability, references, feedback, or emphasis (Whittaker & O'Conaill, 1997; Harper, Wiens, & Matarazzo, 1978; Hinton, 1993; Daly-Jones, Monk, & Watts, 1998), the function that is

relevant in the context of this research is that of giving information about individuals' background, emotional stance, affect, and motivations (social information cues in the terminology of Whittaker et al., 1997). The research reported in this thesis refers to such cues as *interpersonal cues*. Interpersonal cues are of relevance in the debate on trust, as they can be interpreted as signals for trustworthiness. A trustor can form an impression of perceived trustworthiness of a trustee from the interpersonal cues she perceives in a face-to-face situation. As discussed in section 2.2.3, this perceived trustworthiness does not necessarily reflect the real trustworthiness of the trustee (see 3.3 for a more detailed discussion of trust signals). The term *cue* emphasises the inherent ambiguity of this communication mode. The vast majority of interpersonal cues do not have a specific, clearly defined meaning; rather cues allow inferences. Some of these inferences may be only possible for the culturally initiated, others may be very imprecise, or just reflect common stereotypes (e.g. physiognomy, Table 2.2). Thus, as cues and meaning are often only loosely coupled non-verbal information is subject to misinterpretation.

Many researchers created classifications of interpersonal cues (Hinton, 1993; Harper et al., 1978). Table 2.2 gives an overview on different types of cues, categorised according to the dimensions that are relevant for this research: *modality*, *control*, *encoding*, and *dynamism*. These have been selected as they are affected by mediation and for their value in assessments of trustworthiness. Modality and dynamism are affected by the media representation used, and control and encoding influence how much information about an individual's trustworthiness can be gained from them.

Modality. Interpersonal cues can be distinguished in terms of the modality by which they are transmitted. *Gestures*, for example, are transmitted visually, whereas *pitch* is an auditory cue. In the context of this research, visual and auditory (para-verbal) cues are considered. While other modalities (e.g. smell, touch) can also carry interpersonal information, they are excluded as they are not easily transmitted with current online technologies.

Dynamism. This dimension (static *vs.* dynamic) is particularly relevant for differentiating visual cues, as all auditory cues are dynamic, i.e. stretch over time. Some visual cues give information about relatively stable personal attributes (e.g. gender, ethnicity) and can easily be captured in e.g. a photo. Other interpersonal cues are dynamic and adapted to what is being said. A photo can capture one facial expression, but the range of expressive capacity over time is lost. Another aspect of dynamism is that once dynamic cues (e.g. a smile) are transferred into a static representation (e.g. a photo), they might give away less information. Real, involuntary smiles, for instance, can be differentiated from artificial, strategic smiles

through a characteristic temporal pattern, which is lost in static representations (Ekman, 2003).

Control. Some cues are easy to control (e.g. dress, haircut), others are nearly impossible to control (e.g. physiognomy), and some can be controlled depending on training or talent (e.g. pitch, posture, facial expressions). The process of controlling the non-verbal cues we are giving of to others is called *impression management* (Hinton, 1993). It has been famously described by Goffman (1959) in theatrical metaphors. Cues that allow little control lead to *information leakage* (Ekman, 2003). These are of particular interest for research into trust, as they can give valuable information about trustee's internal states such as ability and motivation and they can thus form the basis for an assessment of trustworthiness. Interpersonal cues with high leakage, i.e. with potentially high informational content for an assessment of trustworthiness are *body posture*, *movement of extremities*, and *pitch* or *modulation* of voice (Zuckerman, DePaulo, & Rosenthal, 1981; Hinton, 1993; Harper et al., 1978; Ekman, 2003; Zuckerman et al., 1981). *Facial expressions*, on the other hand, can be relatively easily controlled (Zuckerman et al., 1981; Ekman, 2003).

Encoding. Some interpersonal cues require detailed knowledge of specific cultural codes to be decoded (e.g. dress), others are considered to be naturally encoded and universally understood across cultural boundaries (e.g. a smile; Brehm & Kassin, 1996). Some interpersonal cues can even be considered symptomatic[4] for internal states: arousal, for instance, impacts the pitch of a speaker's voice. Interpersonal cues that are naturally encoded can result in immediate inferences. Facial cues (e.g. a smile) in particular have been identified as powerful in evoking immediate affective responses. Using Norman's (2004) classification of levels of experience, these naturally encoded interpersonal cues address the *visceral* level of processing. However, interpersonal cues that rely on knowledge of a cultural code (e.g. dress, hair) can also lead to an instant impression formation (Harper et al., 1978). The inferences drawn from such cues are likely to be about a person's background, socio-economic status, and their self-concept, rather than their affective state at a specific moment. As the decoding of such culturally encoded cues depends on experience and the knowledge of potentially niche-specific cultural codes, their interpretation is likely to vary more among individuals and cultures than that of naturally encoded cues. In addition they are bound to be less reliable, as e.g. a trustee with an interest in deceiving the trustee will find it easier to control culturally encoded cues (see discussion on symbols and symptoms in section 3.3.2). Finally, the granularity of information that can be read from such culturally coded cues is

[4] Symptoms as a specific category of signals are discussed in more detail in section 3.3.2.

coarser, since most of them are static and provide background information, rather than giving insight into ability and motivation for specific utterances.

In summary, interpersonal cues lead to an instant impression formation and thus have an immediate impact on affective trust. The different types of cues differ in their reliability for trust assessments, and in how they are affected by transmission over media. Table 2.2 gives an overview on auditory and visual interpersonal cues that are of relevance for this research.

	Modality	Control	Dynamism	Encoding	Interpretations	Source
Physiognomy	Visual	Low	Static	(Natural)	Physiognomy can be the basis for ascribing personality traits.	Hinton (1993)
Hair, Clothes, Glasses	Visual	High	Static	Cultural	Socio-economic status, social background, group membership	Goffman (1959), Hinton (1993)
Gaze	Visual	High	Dynamic	Natural and Cultural	Interpersonal information: Sincerity, trustworthiness, friendliness, affective attitude to utterances	Whittaker et al. (1997)
Gestures, Body Movements	Visual	Low	Dynamic	Natural and Cultural	Interpersonal Information	Whittaker et al. (1997)
Facial Expression	Visual	Medium	Dynamic	Natural	Affective State: Happiness, interest, surprise, sadness	Whittaker et al. (1997)
Posture	Visual	Medium	Dynamic	Natural	Interpersonal Information	Whittaker et al. (1997)
Para-verbal cues (e.g. pitch, modulation, speed, regional accents.)	Auditory	Low to High	Dynamic	Natural and Cultural	Affective state, emotion, personality traits, honesty, educational background, regional provenience	Zuckerman et al. (1981) Harper et al. (1978)

Table 2.2: Overview on types of interpersonal cues

2.3.2 Mediated Interpersonal Cues

This section introduces the media representations that form part of the empirical part of the research reported in this thesis. The introduction is followed by a discussion of relevant theories from social psychology and communication sciences that leads to the formulation of predictions for the effect of mediated interpersonal cues on trust and users' ability to discriminate between trustworthy and less trustworthy actors.

2.3.2.1 Media Representations

Unlike earlier media that allowed interactions over distance, online technologies allow for various representations (e.g. audio, video, email) to be integrated into one platform. A truly unique way of communication enabled by online technologies is concurrent text communication (text-chat, instant messaging). Another novel representation that can be found online are virtual humans (e.g. in the form of an embodied agent). The media representations that are investigated in this research are described below. Their likely effects on interpersonal cues and trust are discussed in section 2.3.3.

Video. Video is now integrated in personal communication tools such as MSN Instant Messenger[5] and broadcasting companies stream TV programmes over the Internet. At the time of writing, however, video on the Internet is still of considerable lower quality than broadcast television, both in terms of frame rate and resolution. It also often puts severe delays on users (e.g. for buffering a stream). Consequently it is not commonly integrated in most of today's web sites. Pre-recorded video is included in the empirical part of this research largely for its potential once network bandwidth to consumer further increases.

Virtual Humans: Avatars and Embodied Agents. Virtual humans provide synthetic visual interpersonal cues that can either be combined with real voice or synthesized speech (TTS). Avatars visually represent other humans, while embodied agents are the user interface of software agents (Garau, 2003). Virtual humans promise a user experience similar to video, albeit at a lower cost in terms of bandwidth requirements and production cost. Furthermore, as their behaviour can be scripted dynamically at run-time, they offer a higher degree of interactivity than pre-recorded media. Avatars are seen as a promising technology to provide visual cues in e.g. mobile communications, where bandwidth is still severely limited. In such a scenario, synthetic visual interpersonal cues can be created on the side of the receiver from a

[5] messenger.msn.com

small-bandwidth audio stream. Another application area for avatars are immersive virtual environments, where they act as placeholders for other users who are co-present in the same environment. Current examples for embodied agents range from the MS office assistant's very limited conversational capabilities to more advanced research systems such as Bickmore & Cassell's (2001) virtual real estate agent, Rea (see 2.3.5.2). With the current state of the art, avatars and embodied agents, in particular those that are sold to practitioners as off-the-shelf solutions, are easily recognisable as synthetic representations. While there has been a considerable effort in researching virtual humans, they are not commonly seen in mainstream use on e.g. e-commerce sites. Out of the many possibilities for implementing virtual humans, this research focused on an avatar that was created with an off-the-shelf tool (V1 by DA Group[6]) from the audio stream without any manual scripting of non-verbal behaviour. This approach allowed testing how such implementations, often advertised as simple means of enriching the user experience, affect user trust.

Audio. Increasing network bandwidth and advances in compression technology allow for the relatively easy integration of audio into online services. Amazon's[7] preview function for songs, the Apple iTunes[8] online music store, and the rise of voice-enabled online gaming (e.g. Xbox Live[9]) bear witness to this. However, audio is not yet a standard feature of most web sites. The use of direct verbal address, e.g. in the form of a sales advisor, in particular, is rare. Similar to video, this media representation is included to research its future potential.

Photos. Facial photos are not commonly regarded as a separate media representation, as they are static and do not allow communicating explicit information. They only give some insight into the portrayed individual's background and one facial expression (see 2.3.4.5 and 2.3.5.3). They are often used in advertising and increasingly in the interfaces of e-commerce vendors with the aim of building affective trust (see 2.2.4). Photos, compared to text-only representations, increase bandwidth requirements, which is one reason why web interface design guideline advocate to use them sparingly (Nielsen, 2000). However, as they are static they require less network bandwidth than dynamic representations such as video or audio. Consequently, the combination of photo and text is what we now most commonly observe in e-commerce websites. The majority of the empirical research in this thesis is dedicated to the effects of photos on trust and usability.

[6] www.dagroupplc.com
[7] www.amazon.com
[8] www.itunes.com
[9] www.xbox.com/en-us/live/connect/default.htm

Text. Online communications were initially restricted to text-only representations, due to network bandwidth, compression, and processing power constraints. Examples include text-based websites and personal asynchronous communication tools such as email, or synchronous ones such as text chat or instant messaging. In the context of e-commerce, text chat is used to provide help to users on a website (e.g. to find products, to navigate the site) with systems such as LivePerson[10]. Even though higher bandwidth connections are now increasingly available, text-only representations are still frequently used as they offer several advantages over other channels, such as the ease of archiving, searching or reviewing messages. E-Commerce websites, even though they now include other media, mainly consist of text (in contrast to e.g. TV-shopping channels).

2.3.2.2 Effects of Mediation

The process of mediation can lead to the loss or distortion of interpersonal cues. In addition, when interaction is mediated across spatial and temporal distance context is removed, which can make it more difficult to interpret the interpersonal cues perceived. Many theoretical concepts have evolved to classify and explain such media effects. Below, a brief overview is given on the most relevant ones in the context of this work. They are *Social Presence*, *Media Richness*, and *Social Responses to Computer Technology (SRCT)*.

2.3.2.2.1 Social Presence and Media Richness

Social Presence, a term coined by Short, Williams, & Christie (1976), is the oldest widely used concept that distinguishes media in relation to their capacity to convey interpersonal information. Drawing on an early analysis of communicative behaviour by Douglas (1957) and Morley & Stephenson (1969), Short et al. (1976) noted that face-to-face communication commonly has a dual function: *interparty exchange* (i.e. task and content oriented) and *interpersonal exchange* (i.e. presentation of self, socio-emotional relationship). Short et al. hypothesized that different media, based on their differential capacity to transmit interpersonal cues, would influence the balance between interparty and interpersonal exchange. They introduced the term *Social Presence* to capture the degree of interpersonal focus:

> *"We believe (...) that the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships is an important hypothetical construct (...). We shall term this quality Social Presence."* (Short et al., 1976, p. 65 f.)

[10] www.liveperson.com

Short et al. (1976) define Social Presence as a subjective perception of the user that can be measured with semantic differentials (Osgood, Suci, & Tannenbaum, 1957), but they acknowledge that it is dependent on objective media attributes (e.g. the types of cues that are transmitted by a communication channel). Over time, the term Social Presence was appropriated by many researchers in the field. Some proposed new scales for its measurement and some tied it directly to objective media criteria rather than to subjective perceptions of users (Biocca, Harms, & Burgoon, 2003; Lombard & Ditton, 1997). To distinguish this looser understanding of *social presence* from Short et al.'s initial definition, the non-capitalised term will be used (cf. Garau, 2003).

A concept related to social presence is that of *Media Richness*. This term was coined by Daft & Lengel (1986) and captures to what extent users believe that a channel allows handling ambiguity and complexity. Again, these attributes are considered to be linked to the types of interpersonal cues that are transmitted. The term media richness is now widely used (e.g. Hancock, Thom-Santelli, & Ritchie, 2004) simply to distinguish *poor* representations (i.e. those that suppress many interpersonal cues) from *rich* representations (i.e. those that provide many of the cues present in f-t-f interactions). Face-to-face interaction is seen as the richest form of interaction. Interaction involving poorer representations is expected to afford less social presence as the number of interpersonal cues and their fidelity decreases. In this thesis, the terms *rich* and *poor* representation will be used, purely to give an indication of the number of interpersonal cues (see 2.3.1) transmitted by a particular medium. Hence it is intended to describe an independent variable, and not to imply an effect on the interaction.

The concepts of social presence and media richness (in their more general use and linkage to objective media criteria) together with less well-known constructs (e.g. back-channel feedback; Clark & Brennan, 1991) have been labelled as models of *channel reduction* (Döring, 1998). These models see face-to-face inherently as the best channel for interaction, while media, depending on their richness, are seen as resulting in an impoverished form of interaction (Döring, 1998). Support for channel reduction models comes from a large number of laboratory studies (see Lombard et al., 1997; Daly-Jones et al., 1998; Hiltz & Turoff, 1993 for an overview) that did indeed find that poorer media representation resulted in lower personal awareness (Daly-Jones et al., 1998), lower interpersonal preference (Williams, 1975), less emotional exchange (Rice, 1992), and an increased task focus (Rice, 1992; Rutter, Stephenson, & Dewey, 1981).

These effects, however, do not allow equating richness with the quality of a medium, in the sense that rich representations are generally better than poor ones. Firstly, a focus on task-oriented issues might be desirable in certain contexts, e.g. when solving a complex problem. Mediated interaction might even increase task performance over face-to-face interaction as

interpersonal cues that may not be important for the task at hand are not present and can thus not divert attention. Secondly, interpersonal information that may be lost through mediation (e.g. mimics in text chat) can be conveyed in other ways. Affective states, for example, can be conveyed in text-only communications with emoticons, such as ":)" or "8)", or through changes in phrasing or vocabulary. Thirdly, some channels can make interpersonal information explicitly available that is missing in face-to-face encounters. An example is reputation information given in online fora (e.g. Slashdot[11]) or information about an individual trader's past behaviour on the online auction site eBay[12].

In summary, concepts of social presence and media richness describe effects of media representations on interaction and interpersonal perceptions. While the type and fidelity of interpersonal cues available in a given media representation can effect the interaction, they do not fully determine it, as users can adapt to media restrictions.

2.3.2.2.2 Social Responses to Computer Technology (SRCT)

While the concepts introduced above apply to mediated interactions between human actors, studies conducted under the umbrella of Social Responses to Computer Technology (SRCT) looked at the effect of artefacts that emit interpersonal cues (real and synthetic). Reeves & Nass (1996) initiated this field of research and summarised their findings in the well-known book *The Media Equation.* Their approach was to replicate studies from social psychology with computers that give off interpersonal cues (e.g. in the form of a synthetic voice, a photo, or simply by referring to themselves in the first person). They concluded that technical artefacts that exhibit interpersonal cues and human-like behaviour are treated much like real people even with minimal cues given. Criticism of Reeves & Nass' often simple operationalisations, coupled with very wide generalisation of results abound (e.g. Krämer & Bente, 2002). In the context of this thesis, however, the SRCT studies show that even minimal interpersonal cues can have a meaningful impact on users' behaviour.

Much research on virtual humans (avatars and embodied agents) has been conducted outside the umbrella of SRCT. Research on avatars is often tied to the concept of *presence* in immersive virtual environments, where avatars are used to represent humans (e.g. Lombard et al., 1997; Biocca & Levy, 1995). In this area, research is commonly focused on the realism of visual interpersonal cues. Garau (2003), for instance, investigated the effect behavioural realism of eye-gaze in avatars in a moral dilemma negotiation situation. Research into the effects of embodied agents, on the other hand, has been linked to the concept of *para-social*

[11] www.slashdot.com
[12] www.ebay.com

interaction (Horton & Wohl, 1956) from mass media research which describes how TV personas create a pseudo-personal relationship with viewers (Bente & Krämer, 2000).

No overarching theory on the effect of synthetic interpersonal cues as they are given by avatars or embodied agents has emerged from these fields of research. This may stem from the fact that the underlying technology for creating virtual humans is still in rapid development (Fogg, 2003a). Relevant individual studies on avatars and embodied agents in non-immersive situations that investigated effects on trust will be discussed in sections 2.3.4.3 and 2.3.5.2.

2.3.2.3 Effects of Mediation on Interpersonal Cues

After introducing the media that are investigated in this thesis as well as the relevant theoretical concepts, this section maps the media that are studied in this thesis to the types of interpersonal cues they transmit. Table 2.3 summarizes the interpersonal cues discussed in section 2.3.1 into visual and para-verbal cues and links them to the dimension *modality* and *dynamism* for the media representations that form part of the research reported in this thesis (see 2.3.2.1). It is worth noting that video does not transmit all visual interpersonal cues – proxemic information, for instance, is lost.

	Video	Avatar	Audio	Photo	Text
Visual Cues	Real Dynamic	Synthetic Dynamic	-	Real Static	-
Para-verbal Cues	Real Dynamic	Real Dynamic	Real Dynamic	-	-

Table 2.3: Media representations and the types interpersonal cues they convey

As emphasised by critics of the channel reduction models (see 2.3.2.2), in addition to suppressing some interpersonal cues or reducing their fidelity (e.g. from dynamic to static), media representations also differ on other relevant attributes. Clark & Brennan (1991) point out that mediation introduces new properties: *reviewability* and *revisability*. Reviewability refers to the possibility of playing recorded information repeatedly. Revisability captures the ability of the sender to check the cues given off prior to releasing the recorded information. Both aspects are not given in ephemeral face-to-face interactions. Applied to trust in mediated interactions, revisability can be expected to give the trustee additional control over interpersonal cues that are otherwise difficult to control (e.g. pitch, 2.3.1). Mediation can thus support impression management and – by the same token – reduce the reliability of interpersonal cues for an assessment of trustworthiness. Conversely, reviewability can give the trustor additional chances to analyse the non-verbal behaviour of the trustee in detail,

thereby potentially increasing her ability to detect trustworthiness. The next sections review theoretical predictions and studies on the effect of mediated interpersonal cues on user trust in other users and in e-commerce vendors.

2.3.3 Mediated Interpersonal Cues and Trust

The discussion on trust in mediated interactions often takes the arguments of channel reduction models drawing on the terminology of the concepts of social presence and media richness (see 2.3.2.2). It is often implicitly assumed that poor media will result in lower trust, as many of the interpersonal cues that are considered crucial for building affective trust are not present (Giddens, 1990; Handy, 1995). Shneiderman (2000), for instance, argues as follows:

> *"Since users can't make eye contact and judge intonations with an online lawyer or physician, designers must create new social norms for professional services."* (Shneiderman, 2000, p. 57)

Similarly, Giddens' concept of re-embedding (see 2.2.4), as well as Handy's claim that *"trust requires touch"* (Handy, 1995), see the reduction in the number of interpersonal cues when interacting online as one of the reasons for the proverbial *lack of trust* online (see 2.2.2). These claims are well supported by studies conducted in the context of social presence and media richness research (see 2.3.2.2), that found that richer representations result in higher awareness, preference, and interpersonal focus. As such it is plausible to assume that higher social presence will result in higher affective trust. Visual interpersonal cues (e.g. smiles) that are suppressed by text or audio communications have been identified as particularly powerful in evoking immediate affective responses (see 2.2.4 and 2.3.1). Thus, the mere presence of such cues could be expected to result in positive visceral responses that can be the basis for affective trust (see 2.2.4). Hence, while not giving any insight into the trustworthiness of the trustee, interface elements (such as smiling animated synthetic characters, the presence of a synthetic voice, or stock photos of people on websites) may create some level of affective trust compared to interfaces without such additions.

There is, however, also evidence that trust cannot be linked unequivocally to a one-dimensional model of media richness. Firstly, in the presence of cues for untrustworthiness (e.g. nervousness), a rich channel is unlikely to result in a high level of trust compared to one that suppresses such cues. In fact, a poor channel might be trusted more as it can suppress potential cues of untrustworthiness. Walther (1999) found that narrow-bandwidth channels, rather than automatically resulting in an emotionally impoverished form of communication, can lead to an over-reliance on the few cues available, and thus may lead to unwarranted high

attributions of likeability or trust. Walther coined the term *hyperpersonal interaction* to describe this phenomenon. This notion is in line with *Social Identity and Deindividuation Theory (SIDE*; Lea & Spears, 1991), which holds that a lack of individuating information about others (e.g. lack of visual interpersonal cues in text-only chat) can lead to an increased activation of either social or personal identity. If social identity is accentuated, the interaction partner, about whom insufficient information is available, will be perceived as more similar, and thus possibly more trustworthy. Conversely, if individual identity is activated, the interaction partner will be perceived as more distinct, and by extension more untrustworthy. The initial accentuation of collective or individual identity is dependent on contextual factors and expectations.

The second problem with equating a narrow channel with low trust is related to the previously mentioned criticism of channel reduction models (see 2.3.2.2). As some representations suppress some non-verbal information, this information may not be simply lost, but it may be transmitted in another modality (e.g. expressed explicitly verbally). In the process of expressing the same non-verbal information through another signalling system, it might, however, be easier to control the cues given off (see 2.3.1). As a result, narrow channels might make it easier to maintain an appearance of trustworthiness. For example, it can be easier to project an air of expertise in written communications than in face-to-face encounters, since that channel allows for carefully elaborated wording and suppresses naturally encoded (see 2.3.1) para-verbal signifiers of low confidence. Trust arising from communication over narrow channels might therefore not be lower, but it might be harder to place trust correctly, as the modalities that allow relatively little control over the cues given off (e.g. para-verbal cues) are not available.

In summary, there are numerous researchers that take the view that rich media representations result in higher trust in mediated interactions. However, this view is opposed by researchers who hold that richer representations give more accurate insights into an actor's trustworthiness. Below these two positions are expressed in the form of two predictions that will be addressed throughout this thesis.

P1 – Media Bias. Richer representations result in *positive media bias* (i.e. more trust) because they increase social presence.

P2 – Better Discrimination. Richer representations result in *better discrimination* between trustworthy and less trustworthy actors because they convey more information about their real trustworthiness.

P1 reflects the aims of e-commerce vendors who put stock photos of smiling people on their sites. The aim of this practice is not to allow accurate trust assessments, but to positively influence users' trust perceptions. This prediction is investigated in Experiments 2 and 3. Conversely, in the case of trust in a human trustee both predictions can apply (Experiment 4). Following the results from studies on social presence, a richer media representation may result in more trust given to an interaction partner (P1). However, as interpersonal cues provide information about internal states and background of human trustees (see 2.3.1), a richer representation that transmits more such cues may also result in an increase in the trustor's discriminative ability (P2).

The next section critically discusses existing studies in HCI with a view to the predictions P1 and P2. First, studies that investigated the effect of several media representations on trust in human trustees are reviewed (see 2.3.4). This is followed by review of studies that investigated the effect of interpersonal cues on trust in e-commerce vendors (see 2.3.5).

2.3.4 Studies on Interpersonal Cues and Trust in Humans

2.3.4.1 Overview

This section reviews two streams of research: media effects on trust and cooperation in team situations and media effects on trust in dyads. Most studies that systematically varied the media representation of interpersonal cues were conducted as a way of investigating media effects on cooperation and trust in virtual teams. Hence the findings of these studies are not directly applicable to the research problem of this thesis, but their detailed investigation of different media representation allows further elaborating the predictions introduced above (P1 and P2; see 2.3.3). A particular problem with widely generalising from these studies is their reliance on social dilemma games, which will be critically discussed on methodological grounds in section 4.2.3.2. The stream of research that investigated trust in dyads used a more varied experimental approach. Some of these studies were not framed in terms of trust research, but in terms of advice seeking or lie detection. Table 2.4 gives an overview on the studies reviewed in this section. In addition to the studies shown in Table 2.4, the discussion below draws on relevant studies conducted outside the field of HCI and on review papers.

	Research Stream	Media Formats	Method	Results
Brosig, Ockenfels, & Weimann (2002)	Teams	Formats used for pre-game interactions: face-to-face, video, audio, among others	Social Dilemma Game	Video with audio reaches almost same level of cooperation as face-to-face.
Rocco (1998)	Teams	Acquaintance: face-to-face, none	Social Dilemma Game	Higher rates of cooperation in text-only communication after f-t-f acquaintance.
Olson, Zheng, Bos, Olson, & Veinott (2002)	Teams	Acquaintance: Face-to-face, text-chat, photo, personal information sheet	Social Dilemma Game	Getting acquainted via text-chat is nearly as good as meeting f-t-f. Even a photo is better than nothing.
Jensen, Farnham, Drucker &, Kollock (2000)	Teams	Audio, text to speech (TTS), text-chat, no communication.	Social Dilemma Game	Highest cooperation with audio, marginally higher cooperation for TTS compared to text chat.
Davis, Farnham, & Jensen (2002)	Teams	Text chat, text to speech (TTS), text chat + personal profile	Social Dilemma Game	Synthetic speech decreased un-cooperative behaviour relative to text-only.
Bos, Olson, Gergle, Olson, & Wright (2002)	Teams	Face-to-face, video, audio, text-chat	Social Dilemma Game	Highest cooperation for f-t-f and video
Walther, Slovacek, & Tidwell (2001)	Teams	Photos + text communications, text communications	Longitudinal study with problem solving task. Ratings of interaction partners	Better rating of partners without photos in the long run.
Jarvenpaa & Leidner (1998)	Teams	Email	Case study reports of work on globally dispersed teams	Trust is swift but fragile. Users' behaviour can mitigate shortcomings of medium

Table continued on next page

	Research Stream	Media Formats	Method	Results
Horn, Olson, & Karasik, (2002)	Dyads	Video (different frame-rate and visual resolution), audio	Detection of Lies	Best discrimination with high-quality video. Spatially degraded video nearly as good as high-quality video.
Swerts, Kramer, Barkhuysen, van de Laar (2004)	Dyads	Video only, audio only, Video +audio	Detection of Expertise	Best discrimination for video with audio, followed by audio only, followed by video only.
Kiesler, Sproull, & Waters (1996)	Dyads	Face-to-face, Embodied Agent, Synthetic Voice, Text	Social Dilemma Game	Highest cooperation for f-t-f, lowest for embodied agent.
Parise, Kiesler, Sproull, & Waters (1998)	Dyads	Face-to-face, human-like agent, dog-like agent, cartoon	Social Dilemma Game	Highest rate of cooperation for f-t-f and human-like agent, lower rates for others.
van Mulken, Andre, & Müller (1999)	Dyads	Video, embodied agent, voice, text	Uptake of Advice	Marginally higher advice uptake for video and embodied agent

Table 2.4: HCI studies investigating trust in humans

2.3.4.2 Video

Studies on team cooperation found that video resulted in the highest rate of cooperation compared to the other media researched (Bos et al., 2002; Brosig et al., 2002; see Table 2.4). In the study by Brosig et al. (2002), video with audio reached levels of cooperation that were similar to those reached in face-to-face communication. They were, however, reached after a longer time than in face-to-face interaction. Furthermore, cooperation was less stable without face-to-face communication (Bos et al., 2002). These studies thus provide support for P1: face-to-face interactions result in the highest level of trust and cooperation; video – as a very rich media representation – results in marginally lower trust and cooperation. However, in interpreting the findings of these studies, it should be noted that they used symmetric social dilemma games that make it impossible to attribute the increase in cooperation to either an increase in trust or an increase in trustworthy behaviour (see 4.2.3.2).

Among the studies that avoided the problems of symmetric social dilemma games, a study by van Mulken et al. (1999) is particularly relevant as it investigated trust in advice. This study varied the representation of an advisor (video, embodied agent, audio, and text-only) and the quality of the advice. Hence, the effect of media representation could be compared to the effect of advice quality. The study found a preference for high quality advice in all representations, but only a marginal indication of a positive effect for video on the behavioural measures. Unfortunately the study did not vary the interpersonal cues given off in the good *vs.* bad advice conditions (see 4.3.1), which made it impossible to tie findings to effects of interpersonal cues on participants' discriminative ability. Studies that investigated effects of interpersonal cues on discriminative ability were conducted by Swerts et al. (2004) and Horn et al. (2002). Swerts et al. (2004), in a study on the detection of speaker uncertainty, found the best discriminative ability for video with audio (compared to audio-only and video-only). Similarly, Horn et al. (2002) in a study on lie detection in job interviews found a better performance in discriminating lies from truthful statements in high quality video than in audio only. These findings support the prediction, that richer media allow better discrimination and thus make it easier to place trust well (P2). However, Horn et al. (2002) also compared spatially degraded (i.e. low resolution) video and temporally degraded (i.e. low frame-rate) video. They found that spatially degraded video, which suppresses detailed facial cues (e.g. smiles), resulted in as good a performance as high-quality video and in a markedly better performance in lie detection than temporally degraded video. Horn et al. (2002) speculate that this result may be due to a reduced *truth bias* in the absence of clearly recognisable facial

cues. They reason, in other words, that the mere presence of facial cues may lead to overly positive or trusting reaction, thus giving support to P1.

Overall, video is considered to be a rich medium and thus to afford high social presence and trust, as it transmits many visual and audio cues (P1). This view is supported by the results of studies on cooperation in virtual teams. However, there is also evidence from the study by Swerts et al. (2004), that video (with audio) increases users' discriminative ability (P2). Horn et al. (2002) found evidence for P1 and P2 and hypothesized that the visual channel in particular introduces a bias (P1).

2.3.4.3 Avatars and Embodied Agents

Avatars and embodied agents were mostly investigated in dyadic situations, rather than in team settings. While there are many studies on the interpersonal perception of avatars in immersive virtual environments (for a review of those see e.g. Garau, 2003), the focus of this review is on studies that investigated the use of virtual humans in screen interactions. In one of the earliest studies that specifically addressed trust in virtual humans, Kiesler et al. (1996) compared trust in a computer interaction partner (represented as human-like embodied agent, synthetic voice, or text-only) to trust in a human interaction partner in a face-to-face situation. Similar to the virtual team studies, a social dilemma paradigm was employed. The f-t-f situation with a human resulted in the highest rate of cooperation. From the computer partners, the embodied agent elicited the lowest rate of cooperation. In a replication of this study with a higher-quality implementation of the human-like agent, Parise et al. (1998) found cooperation rates for the human-like agent representation to be nearly as high as for f-t-f interaction. On the other hand, the study on advice quality and advisor representation by van Mulken et al. (1999) introduced in section 2.3.4.3, showed only a marginally positive effect on trust for an advisor represented as embodied agent. These contrasting findings suggest that the implementation of an embodied agent or avatar has a substantial effect on its impact on users' trust. This view is also held by Dehn & van Mulken (2000), who – in a review of several studies on embodied agents – found no uniform effect of embodied agents, but concluded that the type of agent, the type of information conveyed by the agent, and the usage domain influence its effect on user perceptions. In another review, Bente et al. (2000) conclude that virtual humans lead to an increase in arousal (called *persona effect*; Lester et al., 1997). This view is supported by Fogg (2003a), who concludes that the use of virtual humans increases the intensity of user reactions – but that it is extremely difficult to predict the valence of these reactions: users may passionately hate an embodied agent or they may cherish it.

With regard to media bias (P1), findings to date do not allow a clear prediction: based on previous research it appears possible that an avatar representation may result in increased or in decreased trust compared to poorer media representations such as audio-only or text-only. At first glance no difference between avatar (including audio) and audio-only representations should be expected for users' discriminative ability (P2), i.e. for their performance at placing trust well, as no additional real interpersonal cues are given. However, findings from lie detection in video Horn et al. (2002) indicate that additional visual cues may decrease discriminative ability, as they may introduce a *truth bias*.

2.3.4.4 Audio

The studies on cooperation in teams confirmed predictions based on media richness models. Audio-only communication resulted in levels of cooperation that were lower than those for video (Bos et al., 2002), but higher than those found for text-only communications (Bos et al., 2002; Jensen et al., 2000; Davis et al., 2002; Olson et al., 2002). Even synthetic speech was found to reduce uncooperative behaviour compared to text chat in the study by Davis et al. (2002). Jensen et al. (2000) found a marginally positive effect of synthetic speech compared to text-only. Both research teams attribute this finding to social proximity, i.e. the illusion of the presence of another human being afforded by synthetic voice. This result suggests that even synthetic interpersonal cues can result in a trust bias (P1). From the studies that investigated trust in dyads, Swerts et al. (2004) found participants' discrimination of cues of certainty was lower for audio-only, compared to video and audio. However, it was higher than for video-only, indicating that cues that are relevant for discriminative ability are mainly conveyed para-verbally (P2). In Horn's et al. (2002) study on lie detection, audio-only resulted in lower performance at detecting lies than high-quality video (incl. audio). No comparisons with other media representation were made. In van Mulken's et al. (1999) study on advice, no effect of audio-only relative to the other representations was found.

In summary, there is evidence that audio introduces a bias (P1) and that audio increases discriminative ability (P2). For both predictions audio was found to result in effects that had a lower strength than those found for video (incl. audio), but a higher one than those found for text-only, thus supporting media richness models.

2.3.4.5 Photos

Out of the studies reported in Table 2.4, only Olson et al. (2002) looked specifically at the effect of exposure to a photo. They found a marginally positive effect on cooperation. Similarly, the economists Bohnet & Frey (1999) found that silent mutual identification prior to making decisions in a social dilemma game with no communications increased cooperation. These effects occurred even though a photo or silent identification did not carry any information that was specific to the task at hand (e.g. intentions and strategies in a social dilemma game). This finding provides further support for the notion that just the presence of interpersonal cues can positively bias trust (P1). It is worth, however, re-emphasising that these studies used symmetric games that make it impossible to attribute the increase in cooperation to either an increase in trust or an increase in trustworthy behaviour (see 4.2.3.2). Finally, this finding has to be seen against those from a longitudinal study by Walther et al. (2001). Investigating the concept of *hyperpersonal interaction* (Walther, 1999), they found that – in the long run – groups that communicated without seeing photos of each other rated their partners more positively than those that had been given photos of each other.

2.3.4.6 Text

Text-only communications (or in the case of Olson et al., 2002, a printed information sheet) were used by many of the studies discussed above for base-line comparisons. Consistently, text-only communication led to lower cooperation than richer channels such as f-t-f or video (Bos et al., 2002; Jensen et al., 2000; Brosig et al., 2002). These findings are corroborated by Frohlich & Oppenheimer (1998), who compared text-only to f-t-f communications and arrived at the same conclusions. In one of the few longitudinal studies in this field, Jarvenpaa et al. (1998) found that collaboration via email only resulted in fragile swift trust (Meyerson, Weick, & Kramer, 1996). However, even text-only communication increased cooperation and trust compared to no communication. This finding is strongly supported by a review of 37 social dilemma studies conducted by Sally (1995).

2.3.4.7 Summary

The review in this section drew on studies in two areas: trust and cooperation in virtual teams and trust in dyads. Studies on the effect of media representations on cooperation in virtual teams form a core part of current HCI trust research (Feng et al., 2004). Findings from these studies provide support for P1: the higher the number of real interpersonal cues transmitted in a media representation the higher the level of cooperation. However, these studies could not investigate effects on users' discriminative ability (P2), as they used symmetric social

dilemma games (see 4.2.3.2 for a critical discussion of this method). Hence, a second stream of research was reviewed: trust in dyads. This discussion covered studies that are not commonly framed in terms of HCI trust research, but that give relevant insight into effects of media representations on users' discriminative ability. Overall, these studies found better discrimination, for richer media (P2). However, in a study by Horn et al. (2002), there was some indication that a bias induced by a rich visual representation could interfere with users' discriminative ability. None of the studies reviewed directly contrasted P1 and P2 and most of them were subject to methodological limitations that will be critically discussed in section 4.2.

2.3.5 Studies on Interpersonal Cues in E-Commerce

2.3.5.1 Overview

While the studies reviewed in the previous section investigated trust in human trustees, this section discusses studies that specifically addressed the effect of interpersonal cues on trust in e-commerce vendors. As the trustee in these instances was an organisation, rather than an individual giving off interpersonal cues, no information leakage (see 2.3.1) could be expected and thus no effects on users' discriminative ability (P2). The focus of the studies reviewed in this section was on investigating effects of media bias (P1).

While there is a wealth of studies on trust in e-commerce vendors (see 9.3 for an overview), there are very few that specifically tested the effect of interpersonal cues. Some of these existing studies investigated the effect of synthetic interpersonal cues given off by embodied agents (see 2.3.5.2), others tested the effect of the widely observed practice of displaying facial photos of human assistants on e-commerce sites (see 2.3.5.3). All of these studies recorded users' trust either in the form of qualitative interviews or with questionnaires. These approaches have limitations that are critically discussed in section 4.2. Most of these studies had a very practical approach, i.e. they looked at whether an e-commerce vendor could increase user trust by adding a facial photo or an embodied agent to an e-commerce site. Hence, these studies commonly created two mock-ups of an e-commerce site, one with and one without a photo or an embodied agent, and compared user reactions. Exceptions are the studies by Bickmore et al. (2001), Urban (1999), and Witkowski, Neville, & Pitt (2003), which investigated the use of interpersonal cues not on websites, but within proto-types of more advanced online shopping environments. Table 2.5 gives a detailed overview on the studies reviewed in this section.

	Description	Method	Results
Urban (1999)	Explored the use of large photos of assistants for the use in a recommender system	Qualitative interviews	Wide range of responses ranging from very favourable to rejection
Fogg et al. (2000)	Investigated how credibility of online articles was influenced by the presence of a photo.	Web survey with rating scales.	Photos increased credibility of articles.
Riegelsberger & Sasse (2002)	Explored the use of photos of customers and assistants in a mock-up of site of the online retailer Amazon.de	Qualitative Interview	Wide range of responses, identified distinct user groups.
Steinbrueck, Schaumburg, Duda, & Krueger (2002)	Compared user trust in a mock-up of an online-bank with and without an employee photo.	E-Commerce trust questionnaire (Kammerer, 2000)	Photo significantly improved trust perception.
Bickmore et al. (2001)	Compared user trust in an embodied conversational real estate agent (REA) to a non-conversational REA	Interpersonal trust questionnaire (Wheeless & Grotz, 1977)	Conversational embodied agent trusted more by extrovert users.
Zachar & Schaumburg (2002)	Researched the effect of an animated assistant on trust in a mock-up of an e-commerce site.	E-Commerce trust questionnaire by Kammerer (2000)	No effect of animated assistant.
Rickenberg & Reeves (2000)	Investigated effect of animated character on users with internal and external locus of control on productivity, anxiety, and trust in e-commerce site	16 item E-commerce vendor attitude questionnaire. Developed for the study.	An animated assistant that monitors users' behaviour had a positive impact on trust in a website. However there was a negative impact on productivity and increased anxiety for some users.
Witkowski et al. (2003)	Investigated user reactions to a full-body animated character in a proto-type for an e-commerce kiosk system	Ranking on characteristics (personal, pleasant, helpful, friendly, engaging)	Overall, positive evaluation but considerable variance in user reactions.

Table 2.5: HCI studies on the effect of interpersonal cues trust in e-commerce vendors

2.3.5.2 Embodied Agents

Only Zachar & Schaumburg (2002) and Rickenberg & Reeves (2000) investigated embodied agents in the context of a conventional e-commerce web site. Zachar & Schaumburg's (2002) research was motivated by earlier work of this author (Riegelsberger & Sasse, 2000). They could not find an effect on user trust measured with an e-commerce trust questionnaire (Kammerer, 2000, see Appendix B.10). On the contrary, they report that several participants expressed extreme dislike for the animated assistant in post-experimental interviews. Rickenberg & Reeves (2000) added an embodied agent to an e-commerce web site that did not directly interact with the user, but that appeared to monitor the user by following movements and exhibiting liveliness. It decreased task performance, but increased arousal (Bente & Krämer, 2001, see 2.3.2.2.2) and trust, which was measured with a post-experimental questionnaire. These effects were not found for a character that just expressed mere liveliness. Beyond these studies that added simple forms of embodied agents to standard e-commerce sites, several studies explored more advanced versions of embodied agents in proto-types of novel e-commerce platforms.

The best-known example is probably REA, an *embodied conversational agent* (ECA) that has been developed and studied by Cassell & Bickmore (2000) over several years. While REA offers high realism in terms of appearance and non-verbal behaviour, the focus of its development is also on conversational realism; i.e. to create an agent that can engage in (spoken or written) small talk (e.g. use humour, admit own weaknesses, talk about own background) to build trust. REA is an example of a technologically advanced use of interpersonal cues in an e-commerce setting (Cassell & Bickmore, 2000). The REA system processes spoken language and gives output through synthesized speech. It is based on a human-body sized projection and aims to imitate face-to-face interaction very closely. Comparing a task-focused version of REA to a small-talk one, Bickmore et al. (2001) found no main effect of conversational behaviour on trust, but an interaction effect with participants' personality attributes. Extrovert participants trusted the small-talk REA more than the task-only REA. No effect was found for introvert participants. Trust measures in this study were based on self-reports elicited with a questionnaire (Bickmore et al., 2001), a practice that will be critically discussed in section 4.2.2. This finding further supports the conclusion of the reviews by Fogg (2003a), Bente et al. (2000), and Dehn et al. (2000) that reactions to synthetic representations of humans are subject to strong individual differences.

Witkowski et al. (2003) implemented an animated character with TTS voice output, an *electronic personal sales assistant* (ePSA), as part of a novel e-commerce kiosk-system. In a user evaluation, this assistant resulted in mostly positive responses on dimensions such as

pleasantness or helpfulness. Trust, however, was not explicitly evaluated and the system was not compared to one without an ePSA.

2.3.5.3 Photos

Urban (1999) found that screen-sized facial photographs of shopping assistants embedded into a novel shopping interface lead to a wide range of reactions in post-experimental interviews. Some users were extremely fond of this unusual design, whilst others considered it an unnecessary gimmick. In a related study on the credibility of online news articles, Fogg et al. (2001) found that photos of authors increased credibility. However, reactions among participants varied widely. These results are in line with those found by this author (Riegelsberger et al., 2002a), in a study conducted prior to this thesis, in which photos of assistants and customers were embedded in a mock-up of the e-commerce vendor site Amazon.de. In qualitative interviews a wide range of reactions was discovered. Steinbrueck & Schaumburg (2002), based on earlier work by Riegelsberger & Sasse (2000) conducted an experimental study to investigate whether adding a photo of an employee to the homepage of an online-banking site increased user trust in the bank. They did find a positive effect on trust, measured with a questionnaire by Kammerer (2000; see Appendix B.10).

2.3.5.4 Summary

Only few studies looked at the effect of interpersonal cues on user trust in online vendors. From the findings of these studies no clear picture emerges – some photos and some embodied agents appear to increase trust for some users in some settings, but they have also been shown to prompt negative reactions. As these studies commonly compared only one photo or one agent to a baseline condition on one mock-up or one proto-type, it remains unclear what caused the widely differing reactions and how the results transfer to existing e-commerce sites. Furthermore, the studies relied on either qualitative interviews or questionnaires. This practice in the context of trust research will be critically discussed in section 4.2.

2.3.6 Summary: Interpersonal Cues and Trust

In addressing Research Goal 2, investigating of the effect of interpersonal cues on trust in human advisors and e-commerce vendors, this section critically reviewed the literature on interpersonal cues and trust in mediated interactions. Interpersonal cues were introduced as human non-verbal behaviour and appearance that can prompt affective trust and – to varying degree – give insight into the trustworthiness of a human trustee in a specific situation.

This section formulated two predictions regarding the effect of mediated interpersonal cues. The first prediction holds that additional cues given in richer representations will increase user trust, because they increase social presence (P1). The second prediction holds that additional cues given in richer representations improve users' ability to discriminate between trustworthy and less trustworthy actors, because they provide additional information (P2). For an investigation into trust in a human advisor P1 and P2 apply, but none of the studies reviewed directly contrasted P1 and P2. For trust in e-commerce vendors, only P1 applies, as interpersonal cues used by vendors (e.g. in the form of stock photos) do not give any additional insight into the trustworthiness of a vendor (see 3.3.2). There is a paucity of studies that investigated the effect of interpersonal cues in this area and the results of the existing studies are contradictory. No study investigated the effect of photos or embodied agents on existing e-commerce sites. This situation is addressed by Research Goal 2 – to investigate the effect of mediated interpersonal cues on trust in e-commerce vendors and human advisors.

In addition, the discussion identified several methodological limitations of existing studies in HCI trust research (e.g. the use of symmetric social dilemma games or reliance on questionnaires). This situation motivated Research Goal 5 – to explore novel ways of measuring trust. Chapter 4 will first critically discuss the methods used by current HCI trust research and then introduce the approach taken in this thesis.

2.4 Interpersonal Cues and Usability

Most researchers investigating trust in HCI mention good usability as one of the building blocks of user trust (see 9.3). However, to date few have researched how elements that are added to the interface to build user trust may affect usability. Integrating additional elements, such as interpersonal cues in a user interfaces may increase the duration of search processes and thereby reduce usability. To explore the potential trade-offs between trustworthiness and usability, this thesis investigated Research Goal 3. Beyond analysing the effects of interpersonal cues on users' trust, this thesis investigated their effect under the classic framework of HCI to identify effects on usability.

A study conducted by the author prior to this thesis (Riegelsberger et al., 2002a) used qualitative interviews to elicit users' reaction to an e-commerce interface, in which facial photos had been embedded. This study found very negative responses from some users, indicating that photos can reduce user satisfaction. Asked for a reason for these negative reactions many participants stated that they felt that photos unnecessarily cluttered the pages and made searches more difficult. These responses suggest that photos may negatively affect

task performance and user cost for search tasks on web sites. In this thesis, these dimensions are thus the central concern of the investigation into the effect of interpersonal cues on usability (Research Goal 3). This section critically reviews existing literature in the light of this research goal.

2.4.1 Effects on Attraction, Task Performance, and User Cost

It is well established in print advertising research that photos attract visual attention, in particular if they contain faces (Kroeber-Riel, 1996). Motion, as it is present in dynamic visual representations such as video or avatars, is another well-documented attractor for visual attention (Hillstom & Yantis, 1994). While such effects of facial cues and motion are desirable in advertising, where adverts compete with other stimuli for a recipient's attention, they could be detrimental to usability in a task-oriented environment, such as a transactional website. Consequently, many web usability experts recommend minimising the use of non-functional elements (Nielsen, 2000; Krug, 2000), in particular images and animations.

The Stanford Poynter Project (Lewenstein et al., 2002), however, conducted eye-tracking studies on online news sites and their results do not confirm findings from off-line media research. On the contrary, they found that users first focus on text, headlines in particular, and tend to ignore graphics and photographs. The notion of *banner blindness* (Benway & Lane, 1998) further advocates caution when applying findings from off-line reading to an online context. Benway (1998) found that users of web sites largely ignore banner ads that are designed to attract visual attention. Extrapolating from these studies, facial photos or dynamic representations on a page should not attract visual attention and therefore not lower task performance.

This inference, however, is not supported by other eye-tracking studies. Witkowski et al. (2003) integrated an embodied sales assistant in a novel e-commerce application (see 2.3.5.2). In an evaluation they found that the character attracted significant visual attention: participants spent nearly 20% of total gaze time looking at it even though they were engaged in a product search task. This value does not include the time spent looking at the character's text output, which was displayed in a separate speech bubble. They also found that users looked at a full-bodied agent's face for 76% of the time they looked at the agent, further underlining the attraction of – even synthetic – facial cues.

Similarly, in a recent eye-tracking study Burke et al. (2004) found that animated banner ads, like animated assistants, attracted visual attention and increased search time (i.e. lowered task performance). Ironically, even though they were fixated, most banner ads were not

recalled in a post-experimental questionnaire. Burke et al. (2004) concluded that *"Banner ads hinder visual search and are forgotten"* (p. 1139).

In summary, there is evidence that interpersonal cues in the form of facial or motion stimuli may attract visual attention and can therefore impede task performance. However, there are also studies, which found that users largely ignore such stimuli. None of the studies reported specifically investigated the effect of facial photos on visual attraction and task performance in an e-commerce environment.

Evidence for negative effects on user cost is provided in the form of some users' negative self-reports in Riegelsberger et al. (2002a). In addition, Burke & Hornof (2000), in an earlier study on animated banner ads, found that subjective workload (user cost), measured with the NASA Task Load Index (TLX; Hart & Staveland, 2003), was increased in the presence of animated banners. They did not find a negative effect on task performance in that study. This indicates that visually distracting elements may not have a measurable effect on task performance in the short time spans that can be examined in a laboratory setting. However, they may increase user cost. In the long run this could also impact task performance (e.g. by inducing fatigue) and decrease user satisfaction.

2.4.2 Effects of Task Type

An intervening factor that might help to explain contradicting evidence with regard to the effect of pictorial information on visual attraction is the type of task the user is involved in. Pagendarm & Schaumburg (2001) compared recall and recognition of banner ads in a *goal-directed search task* to *aimless browsing*, where participants were asked to just have a look at the page to get a general impression. They predicted that goal-directed search would rely on schemata that involve top-down (schema-driven) information processing. Top-down information processing modes were expected to result in less attention given to non task-related elements, as visual attention was expected to be mainly guided by users' search target (e.g. the navigation pane). Aimless browsing, on the other hand, was assumed to be governed by bottom-up information processing, where visual attention is not guided by schemata but by environmental cues such as human faces or motion. Pagendarm & Schaumburg (2001) found that recall and recognition were significantly higher for participants who engaged in aimless browsing. They conclude that task-type has an impact on the dominant processing mode (top down *vs.* bottom up), which in turn impacts how peripheral information is processed. Unfortunately, they did not use an eye-tracker and could thus not directly investigate effects on visual search. Given the disparity between recall and visual attention found by Burke et al. 2004 (see 2.4.1), a lack of recall does not imply that an element did not distract the user in her

search processes. Hence, it is not clear whether task type has an effect only on the level of memory (recall), or whether it influences where visual attention is directed in the first place.

2.4.3 Summary: Interpersonal Cues and Usability

Adding interpersonal cues to an interface with the aim of building trust is of little use if these cues are either not perceived, or worse, if they reduce the usability of the system. Earlier findings by the author, based on qualitative interviews, suggested that such cues might have negative effects on task performance and user cost because they attract visual attention. A review of research in traditional media revealed that static facial cues (photos) and motion (e.g. exhibited by embodied agents or video) are indeed strong attractors of visual attention. Initial findings from studies conducted on websites question whether these results can be directly transferred to an online context, as they found mixed results for visual attraction and task performance. Differences in task type (goal-oriented *vs.* aimless browsing) may explain some of this variation. In addition, visual attraction may not have an effect on task performance, but on user cost. Measures such as recall and recognition are insufficient to investigate effects of visual attention, as lack of recall does not allow inferring that an object has not been viewed.

2.5 Chapter Summary

This chapter reviewed the existing literature pertaining to the research goals of this thesis. It was structured into four main sections. First, the topics of this research, trust and usability, were situated in the field of HCI (see 2.1), then the widely stated *lack of trust* in mediated interactions was analysed (see 2.2). Next, interpersonal cues and their transmission in different media representations were introduced (see 2.3). This section also reviewed existing studies on interpersonal cues and trust in HCI. The final section of this chapter discussed potential effects of interpersonal cues on the usability of online systems (see 2.4).

Section 2.2 introduced trust as a condition of existence for a functionally diversified society. The discussion showed that mediating human interactions or replacing them with technology increases vulnerabilities and uncertainties and hence the need for trust. This effect can only be partially attributed to transient factors such as current novelty and lack of familiarity, indicating that trust as a design goal for such technologies is of long-term relevance. The discussion also revealed that current trust research in HCI, and in particular in the area of e-commerce, is focused on increasing user trust rather than on enabling well-placed trust. It became clear, that a focus on users' discriminative ability, i.e. on their ability to place trust well, is crucial, because trust in the whole market and technology may be lost, if

users learn that they cannot rely on their trust perceptions. This thesis addresses this issue by including an actor's trustworthiness as an independent variable to investigate users' ability to place trust well (Research Goal 1). Affective trust was identified as another gap in current online trust research, which – in particular in the area of e-commerce – is largely concerned with cognitive trust; i.e. trust based on explicit reasons why the trustee merits trust (e.g. privacy policies, security technologies). Affective trust, on the other hand, is partially based on first impressions formed on the basis of interpersonal cues. Many practitioners try to win users' affective trust by including e.g. photos of smiling people into their e-commerce systems. HCI research, however, has scantily investigated the effects of this common practice. Research Goal 2 addresses this gap by investigating the effect of interpersonal cues on trust in mediated interactions.

Section 2.3 introduced different types of interpersonal cues and classified them on the relevant dimensions: modality, dynamism, control, and encoding. Next, the media representations that are investigated in the empirical part of this thesis were introduced: video, avatar, audio, photo, text. A review of theories and concepts of mediation allowed the formulation of two predictions regarding the effect of mediated interpersonal cues in an interface: interpersonal cues may increase trust by increasing social presence (P1) or interpersonal cues, in the case of a human trustee, may increase information leakage, i.e. give additional insight into a trustee's trustworthiness and may thereby increase users' ability to discriminate between trustworthy and less trustworthy actors (P2).

With a view to finding evidence for P1 and P2, HCI studies on interpersonal cues and trust in humans (see 2.3.4) as well as in e-commerce vendors were reviewed (see 2.3.5). In most studies that investigated trust in humans a higher number or a higher quality of real cues led to more trust and cooperation (P1). Media representations that contained synthetic visual cues (avatars, embodied agents) resulted in mixed responses. Of the studies reviewed, only few investigated users' discriminative ability (P2). These were mostly framed as lie detection studies and they found the best discrimination for the richest representation. An exception, however, was a study by Horn et al. (2002), which found evidence for a bias (P1) in high quality video relative to spatially degraded video. This indicated that a media bias (P1) effect might outweigh a positive effect on discrimination (P2). None of these studies, however, directly opposed P1 and P2, thus leaving a gap in current research. Studies that specifically addressed trust in e-commerce only investigated media bias (P1) for photos and embodied agents. For both media representations the results were mixed, with some reporting positive effects, and others reporting negative ones. None of these studies investigated the effect of interpersonal cues on existing e-commerce sites. In summary, none of the studies reviewed

provided clear evidence for either P1 or P2 and many studies were subject to methodological limitations (see Chapter 4).

Section 2.4 discussed potentially adverse effects of interpersonal cues on the usability of a user interface. This discussion had been motivated by earlier findings in a qualitative study (Riegelsberger et al., 2002a), where some users expressed low satisfaction with photos embedded in an e-commerce interface. In response to these comments, studies from traditional media research and from HCI were reviewed to identify likely effects of interpersonal elements on visual attention, task performance, and user cost in visual search tasks. While it became clear that visual interpersonal cues are strong attractors of visual attention in traditional media, it remained open as to whether this attraction has an effect on task performance and user cost when users are engaging in a goal-oriented search task with an interactive system. To close this research gap, the empirical part of this thesis employed eye-tracking to investigate effects of photos on e-commerce sites on task performance and user cost (Research Goal 3).

Before introducing the experiments conducted to answer the empirical research goals of this thesis, the following two chapters address some of the limitations of existing HCI trust research that became apparent in the discussion in this chapter. One of these limitations is the fragmentation of HCI trust research into different areas such as trust in e-commerce or trust in teams. In response, Chapter 3 introduces a framework for trust in mediated interactions (Research Goal 4). This framework will then be used to position the questions that are empirically addressed by the research reported in this thesis (section 3.5.3). Another limitation of current HCI trust research that became apparent in the critical discussion in Chapter 2 is its focus on methods such as qualitative interviews, questionnaires, or social dilemma games that are subject to several limitations. These methods will be critically discussed in Chapter 4. Based on an analysis of the shortcomings of existing methods, novel approaches are proposed (see section 4.3.1).

Chapter 3

The Framework for Trust in Mediated Interactions

3.1 Introduction

The critical literature review in Chapter 2 revealed several methodological and conceptual shortcomings of current HCI trust research. The most fundamental one was a lack of coherence in terms of approach, definition, and measures (see 2.2). One reason for this lack of coherence can be seen in the term *trust* being used in everyday language with imprecise meaning. Another reason is that the disciplines on which HCI researchers draw, such as psychology, economics, or sociology, also lack a coherent approach to trust. This has led to a situation where many researchers, who claim to investigate trust in HCI, may in fact be studying distinct aspects of trust. Unsurprisingly, in such a situation many apparently contradictory findings arise which are difficult to reconcile as common terminology and a common frame of reference are lacking.

Before addressing the empirical research questions of this thesis, a framework for trust in mediated interaction is presented, which allows the positioning of the empirical questions in the wider context of HCI trust research. The framework is founded on conceptual and empirical work in HCI, but also integrates theories and findings from disciplines such as sociology, economics, and psychology. As such, the framework goes beyond the scope of the empirical questions addressed in this thesis. It constitutes an independent contribution (Research Goal 4), but it also helps in building a conceptual foundation for the empirical research. Consequently, using the terms and concepts introduced in the framework, the scope of the empirical section of this thesis will be more specifically defined (see 3.5.3).

Several researchers have recognized the need for such underlying models of trust and credibility in mediated interactions (see Table 3.1). These models categorise the underlying dimensions of perceived trustworthiness. However, out of these models only the one by McKnight & Chervany (2000) is truly applicable to all areas of HCI trust research. The other models are either limited to one domain (e.g. e-commerce; Tan & Thoen, 2000), or to one type of trustee – an organisation and its' websites (Fogg, 2003a; Corritore et al., 2003b).

HCI Trust Models	
Tan & Thoen (2000)	Generic model of trust in e-commerce.
McKnight & Chervany (2000)	Domain-free model of trust in technically mediated interactions.
Corritore et al. (2003b)	High-level model of trust perceptions of informational and transactional websites.
Fogg (2003a)	Model of computer credibility.

Table 3.1: Models of trust in HCI research

The aim of the framework presented in this chapter is to be applicable to trust in other users (e.g. in computer-mediated-communication settings), in organisations, and in the technologies they employ. It goes beyond the model by McKnight & Chervany (2000) in that it includes contextual factors, i.e. factors that influence trust but are not an attribute of the trustee or trustor. Interpersonal cues (Research Goal 2, also see 2.3), as one important signal for trustworthiness in face-to-face interactions are incorporated into the framework. The specific goals for the framework are:

Accommodating existing findings and concepts. To help in iteratively building knowledge about trust in HCI, the framework incorporates existing concepts and accommodates existing findings (Research Goal 4.1).

Actors and context. Rather than focusing only on trustor and trustee variables, the framework accommodates key contextual factors that determine the formation of trust. The importance of contextual factors for HCI research has been well-established (e.g. Beyer & Holtzblatt, 1998) and also applies to HCI trust research (Research Goal 4.2).

Boundaries for generalisation. Being able to place a specific situation in the space defined by the main actor and context variables will help to appropriately generalise from experimental findings. This helps researchers to avoid inadvertently referring to different aspects of trust. In this way the framework can help build a coherent body of knowledge on trust in mediated interactions (Research Goal 4.3)

Foundation for trust measurement. Some current approaches to measuring trust are not clearly tied to the real-world situations that they aim to model (e.g. social dilemma studies in virtual team experiments, see 2.3.4). This makes appropriate generalisations from

experimental findings to real-world problems of trust difficult. A framework that allows locating a specific trust-requiring situation on the relevant dimensions can allow for better founded trust measures (Research Goal 4.4).

The perspective of the framework is a descriptive one since it categorises the factors that make up trustworthiness. Consequently it can be used to deduce under which circumstances it would be wise to place trust and thus to evaluate individuals' trusting decisions. Over the next sections, the framework is built up step by step from an abstract trust-requiring situation. In elaborating this abstract situation, the terminological foundation for the framework and this thesis is laid. Next, the factors that make up actual (as opposed to perceived) trustworthiness are introduced. Finally, existing definitions and types of trust are incorporated into the framework (see 3.5.1). The chapter closes by scoping the empirical part of the research in more detail, using the structure provided by the framework (see 3.5.3).

3.2 The Foundations of the Framework

3.2.1 Trust-Requiring Situations

Many researchers state that trust is only required in situations that are characterized by risk (Deutsch, 1958; Mayer et al., 1995; Corritore et al., 2003b). Unfortunately, risk itself is a concept that has widely differing definitions and connotations in fields such as economics, sociology, risk management theory and in everyday use (Adams, 1995). At times risk is understood to express the probability of an adverse outcome. In this understanding it is sometimes used synonymously with uncertainty (e.g. Grabner-Kraeuter & Kaluscha, 2003). In other contexts risk is applied to describe the compound of probability and the magnitude of the adverse outcomes (Adams, 1995). The latter interpretation applies to trust: trust will only be required if there are things at stake *and* if there is the possibility of adverse outcomes. In many everyday or habitual interactions, even though there is a hypothetical possibility of adverse outcomes, they will not be considered and trust will be replaced by an *expectation of continuity* – it ceases to be a topic of concern (Luhmann, 1979). The terms *uncertainty* and *risk* also require further delineation. Adams (1995), following Knight (1921), uses the term risk to describe adverse events with a known probability. Uncertainty, on the other hand, describes situations in which adverse events are possible, but for which no probabilities are known. Luhmann (1979) sees trust as particularly relevant in situations that are characterized by uncertainty. He points out that individuals will often not have the time or ability to work out probability expectations due to the complexity and interdependencies of social systems

that determine future outcomes (Luhmann, 1979). In situations of uncertainty, trust allows short-cutting probability calculations and thus reduces complexity (Luhmann, 1979). Uncertainty, and thus the need for trust, stems from a lack of detailed knowledge about others' *abilities* and *motivation* to act as promised (Deutsch, 1958). If the trustor had accurate insight into the trustee's reasoning or functioning and that of the actors he relies on, trust would not be an issue (Giddens, 1990).

3.2.2 The Abstract Situation

The abstract situation on which the framework is built is based upon an analysis of the Trust Game (Berg, Dickhaut, & McKabe, 2003; Bacharach & Gambetta, 2003). The framework is developed from the sequential interaction between two actors, the *trustor* and the *trustee*. Figure 3.1 shows a model of a prototypical trust-requiring situation.

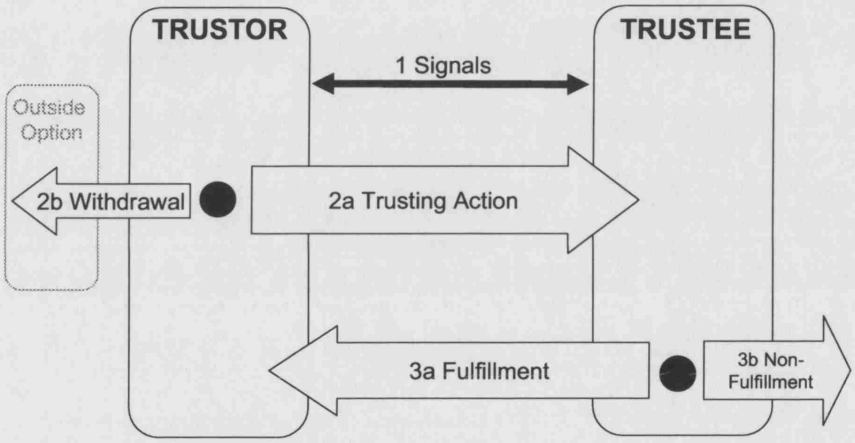


Figure 3.1: The basic interaction between trustor and trustee

There are two actors (trustor and trustee) about to engage in an exchange. For now they can be assumed to be human, in section 3.2.5 non-human actors will be discussed. Both actors can realize some gain by conducting the exchange. The exchange may depict a first encounter, or a 'snapshot' of an established relationship consisting of many subsequent exchanges. Prior to the exchange, trustor and trustee perceive signals (1) from each other and the context. The trustor's level of trust will be influenced by the signals perceived – among other factors such as her disposition to trust (McKnight & Chervany, 2000; Corritore et al., 2003b; Egger, 2001). Trust in the terms of this framework is understood as an internal state of the trustor regarding the expected behaviour of the trustee in the given situation. This understanding reflects the commonly used definition of *trust* as *an attitude of positive expectation that one's vulnerabilities will not be exploited* (see 2.2.1). It emphasizes that trust is an internal state of

the trustor with cognitive and affective components rather than an observable behaviour (McKnight & Chervany, 2000; Corritore et al., 2003b).

Depending on her level of trust and other factors (e.g. the availability of outside options) the trustor will either engage in trusting action (2a) or withdraw from the situation (2b). *Trusting action* is defined as a *behaviour that increases the vulnerability of the trustor.* Trusting action puts goods of value to the trustor in the hands of the trustee. The reason for a trustor to engage in a trusting action, is that she can realize a gain if the trustee fulfils his part of the exchange (3a). However, the trustee may also lack the motivation to fulfil and decide to exploit the trustor's vulnerability, or he might simply not have the ability. Both possibilities result in non-fulfillment (3b).

3.2.3 Separation in Time and Space

The signals (1) exchanged prior to trusting action are of key interest for trust research, as they form the basis of the trustor's trust. In the case of repeated encounters the signals perceived may identify the trustee and thus allow the trustor to relate the present situation to previous encounters with the same trustee. The signals perceived from the trustee and the context also allow inferences about the trustee's ability and motivation. However, these inferences are bound to be imprecise for two reasons. Firstly, they depend on the trustor's ability to interpret the signals. Secondly, untrustworthy trustees will also try to emit signals to appear trustworthy (3.3.1).

If trustor and trustee are separated in space, their interactions will be mediated (e.g. by mail, email, telephone) and some of the signals that are present in face-to-face encounters may not be available or become distorted (see 2.3.2.3). This loss of information is often considered to increase uncertainty, and to result in lower trust (see 2.3.3).

In many situations, mediation may also increase the delay between trusting action (2a) and fulfillment (3a), for example if an exchange relies on the postal system. This separation in time prolongs the period of uncertainty for the trustor. Thus, temporal as well as spatial separation of trusting action and fulfillment can increase uncertainty and thus the need for trust (Giddens, 1990; Brynjolfsson & Smith, 2000; see Figure 3.2).

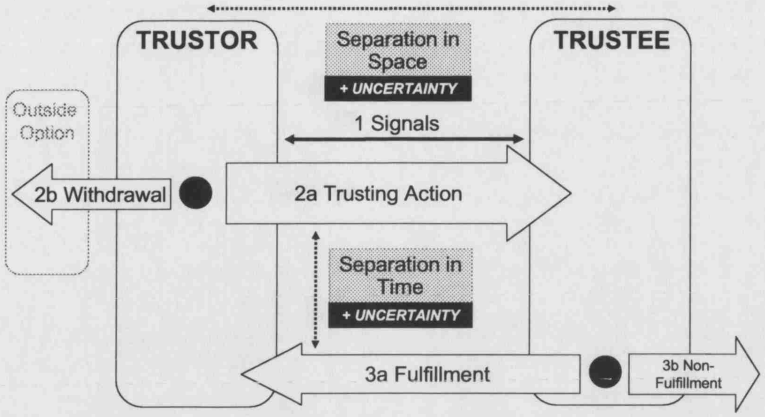


Figure 3.2: Effects of separation in time and space

3.2.4 Trust-Warranting Properties

The trustor's trusting action (2a) gives the trustee an incentive not to fulfil (3b, e.g. keeping a customer's money, but not delivering the goods). In the absence of any other motivating factors being trusted and then refusing to fulfil (3b) is the best outcome for the trustee. Hence, in the absence of other such factors, the trustor should not engage in trusting action. However, in most real-world situations, trusting actions and fulfillment in spite of situational incentives to the contrary can be observed: vendors deliver goods after receiving payment, banks return money, individuals do not sell their friends' phone numbers to direct marketers. The reason for this behaviour is that in many cases, trustees' actions will be motivated by *contextual* and *intrinsic properties* whose effects outweigh the immediate gain from non-fulfillment. An example of a *contextual property* is the existence of law enforcement agencies and the associated fear of being punished for non-fulfillment (see 3.4.1.3). An example of an *intrinsic property* are the pangs of conscience a trustee may have to deal with if he would not fulfil (see 3.4.2.2). Expressed in the terms of the framework, a trustee will only fulfil if he has the ability *and* if the motivation provided by the contextual and intrinsic properties outweighs the motivation to realize the gain from non-fulfillment (Bacharach & Gambetta, 2001). Ability is defined as an intrinsic property, but most of the discussion is focused on properties that relate to motivation. Bacharach & Gambetta (2001) refer to properties that cause fulfillment as *trust-warranting properties*. This is because trust in the trustee is only warranted if these properties are present and if they motivate the trustee sufficiently. Identifying and reliably signalling trust-warranting properties is the key concern for developing systems that foster well-placed trust.

3.2.5 Actors

Initially, the framework was used to describe interactions between human actors; now the scope is widened to other types of actors. The wide range of literature on institutional trust (Lahno, 2002a; Shapiro, 1987; Zuckerman et al., 1981) and trust between firms in sociology (e.g. Raub & Weesie, 2000a) and organisational behaviour research (e.g. Ring & Van de Ven, 1994; Macauley, 1963; Rousseau et al., 1998) advocates also applying the framework to organisations and institutions in the role of the trustee.

The question of human trust in technology is also widely researched. Ratnasingam & Pavlou (2004), for instance, use the term *technology trust* in B2B e-commerce transactions, to differentiate it from trust in the trading partner. Similarly, Lee & Turban (2001) address trust in technology by integrating *trustworthiness of the Internet shopping medium* as one dimension in their model of trust in e-commerce. Trust in technology is of particular importance for delegating to or relying on decision aids or software agents (Milewski & Lewis, 1997; Dzindolet et al., 2003; Muir, 1987). In many cases trust in technology will be linked to trust in the socio-technical systems which this technology is part of. Furthermore, human trustors are known to treat technological artefacts in similar ways as they treat human ones (Reeves et al., 1996; Fogg, 2003a). Researchers and designers should reflect this in their approach (Corritore et al., 2003b).

Finally, there is also a body of literature on technology in the role of the trustor. Automated trust management systems or software agents often hold *trust scores* about trustees (e.g. Jensen, Poslad, & Dimitrakos, 2004). The discussion of such agent systems is outside the scope of this work, but the framework presented here may be helpful to the development of agent systems by highlighting existing approaches to maintaining trust in socio-technical systems.

3.2.6 Types of Vulnerability and Fulfillment

Vulnerability, trusting action, and fulfillment do not only apply to financial goods, but to anything of value to the actors: money, time, personal information, or psychological gratification, e.g. realized in the form of entertainment or sociability. A single trusting action can result in several vulnerabilities. Ordering a product online may lead to a loss of privacy, illicit access to credit card information, or problems with the delivery of the product (Egger, 2001). For each of these vulnerabilities, several forms of non-fulfillment are possible: a product may not arrive at all, or it may arrive late or damaged. Different instances of the framework can be used to analyse the multiple vulnerabilities or levels of non-fulfillment that

may be possible in any given situation. Each instance can then be used to analyse one particular configuration of trust-warranting properties that are relevant for this instance.

3.2.7 Scope

In many cases, the outcome of an exchange depends on factors over which the trustee has only limited control. An ordered product, for instance, may be lost due to the failure of the postal service, not because the vendor failed to fulfil. Raub & Weesie (2000a) introduce the term *parametric risk* to capture such occasions of non-fulfillment. In the context of e-commerce, Grabner-Kraeuter & Kaluscha (2003) use the term *system-dependent uncertainty*, which was first coined by Hirshleifer & Riley (1979). An analysis of parametric risk or system-dependent uncertainty can be performed with the framework by making the sources of parametric risk the focal point, i.e. the trustee, in a new instance of the framework. In the above example, a new instance of the framework would be created with the postal service in the role of the trustee. Any real-world situation that requires trust is likely to contain several such embedded trust relationships. It is also likely to be embedded in several layers of higher-level relationships with actors that guard trust in the present situation. These guardians of trust are themselves trustees that need to be trusted (Shapiro, 1987): contractual arrangements are guarded by a legal system, but the legal system itself requires trust.

The use of the framework to analyse embedded situations can be exemplified with a bank clerk interaction. The framework can be used to analyse the exchange with the bank clerk in the role of the trustee. By 'zooming out', it can be used to analyse the interaction of the trustor with the organisation as the trustee. Alternatively, by 'zooming in', if the bank's online banking system mediates the exchange, it can be analysed in the role of the trustor and underlying Internet technology can be seen in the role of the mediating channel. As the focal point of the framework is changed, different trust-warranting properties come into play which will be signalled in different ways. However, for practical reasons, it will often be sufficient to limit the considerations to the most salient trustees.

3.2.8 Structure

The framework is a template for *asynchronous* and *asymmetric* exchange – trustor and trustee act sequentially and under different situational incentives. This models many real-life trust situations: a sale, delegating a critical task, lending money to someone, etc. It also applies to relationships in which one speaks of *mutual trust*, such as work teams or life partners. In such relationships, one can identify specific exchanges, often overlapping or succeeding quickly, in which one actor is the trustor and the other actor is the trustee. The framework also applies to

problems of trust in advice (Zimmerman & Kurapati, 2002) or when delegating important tasks to others (Milewski et al., 1997). A trustor, when delegating, needs to rely on cues from the trustee and the context (1) to assess his ability and motivation. She makes herself vulnerable by not executing the task herself, but by relying on the trustee (2a). The trustee has a situational incentive not to do the delegated task (3b; e.g. saving time or effort), but is likely to be motivated by contextual and intrinsic properties to perform within the limits of his ability (3a). In the case of acting on advice, the advice itself can be interpreted as a signal (1), following advice equals trusting action (2a) and the realization whether advice was good or bad is captured by fulfillment (3a) and non-fulfillment (3b), respectively (see 3.5.3.2 for a detailed discussion).

3.2.9 Re-Stating the Trust Problem

After explaining its higher-level components, the framework will now be linked to the terminology of existing trust models.

A trustee who lacks trust-warranting properties, i.e. the motivation (based on contextual or intrinsic properties) or ability to fulfil in a specific situation, is *untrustworthy* in that situation. Uncertainty and hence the need for trust arises from the fact that trust-warranting properties are only indirectly observable via signals, which may be unreliable (3.3). As an example, the existence of a law enforcement agency may lead the trustor to believe that the trustee's actions will be guided by fear of being punished for non-fulfillment, but she cannot be sure. Similarly, after chatting to the trustee for a while, the trustor might think that the trustee is the type of person who would feel uncomfortable about not fulfilling, but again she cannot be certain. Hence, the trustor's trust has to be based on *perceived trustworthiness* (Corritore et al., 2003b), rather than on the trustee's real trustworthiness. Note that in this use the term *trustworthiness* is not understood as a stable attribute of a trustee, but as a configuration of trust-warranting properties in a specific situation. The use of the terms trust and trustworthiness in the framework is intentionally kept very broad at this stage to accommodate a wide range of trust-warranting properties and types of trust. Many researchers define trust with only a subset of the trust-warranting properties introduced in the framework. Section 3.5.1 links these definitions to the framework components.

3.3 Signalling Trustworthiness

Analysing technology as the channel for exchanges (rather than as the trustee, see 3.2.5), one can identify several functions. It can (1) transmit signals prior to trusting action (e.g. on an e-commerce vendor's site), (2) be the channel for trusting action (e.g. when entering personal

information in a web form), and (3) be used for fulfillment (e.g. emailing ordered software). The discussion in this thesis is focussed on the signalling function of technology (1). Signals from the trustee and the context allow the trustor to form expectations of behaviour. As many mediated transactions are relatively novel, the observed *lack of trust* can often partially be explained by a lack of experience and inappropriate assumptions about baseline probabilities (Riegelsberger & Sasse, 2001). In first-time or one-time interactions, the signalling of trust-warranting intrinsic and contextual properties is particularly important because no previous experience with a trustee is available. In repeated exchanges, it becomes important to signal identity, as this allows the trustor to extrapolate from knowledge about the trustor that was accumulated in previous encounters. To act on cues of trust-warranting properties or identity, users need to trust the channel and the channel provider to transmit them reliably and without bias.

3.3.1 Mimicry

A key problem of trust is that of mimicry (Bacharach & Gambetta, 2003). Untrustworthy actors may aim to *appear trustworthy* in order to obtain the benefits. Trustees who do not act under the influence of trust-warranting properties will aim to emit signals of the presence of these properties in order to persuade trustors to engage in trusting action to then refuse fulfillment. Burglars may wear couriers' uniforms, people may look you in the eyes when they lie to you, and an 'online bank' may be hosted from a teenager's bedroom. Mimicry has a cost for untrustworthy actors (Luhmann, 1979; Goffman, 1959). To stay within the above example: fake uniforms have to be bought, steady gaze while lying requires practice, and fake websites have to be designed. However, successful mimicry can have substantial benefits for untrustworthy trustees, as they will be treated like trustworthy ones. Bacharach & Gambetta (2003) give a detailed account of the conditions of mimicry in situations that are covered by a Trust Game structure. In the view of many consumers who abstain from e-commerce, moving transactions online reduces the cost for mimicry (Riegelsberger & Sasse, 2001). The presence of mimicry implies that the knowledge of trust-warranting properties and their signals is not sufficient for designing a system that results in high levels of trust and trustworthy behaviour. Rather, designers need also take into account the reliability of such signals and their cost structure. Good trust signals are cheap and easy to emit for trustworthy actors, and costly or difficult for untrustworthy ones.

3.3.2 Symbols and Symptoms

Drawing on a distinction from semiotics, two types of signals can be distinguished: symbols and symptoms (see Figure 3.3).

Symbols of trustworthiness: Symbols are not intrinsically linked to trust-warranting properties, but often have an arbitrarily assigned meaning. They are often specifically created to signify the presence of trust-warranting properties. Examples of symbols are e-commerce trust seals (see 9.4.4) or uniforms. One way of protecting symbols is to make them very costly to emit. Another way is to threaten sanctions in the case of misuse. An example for this practice are the penalties levied on the misuse of professional titles or certifications. Symbols are a common way of signalling trustworthiness, but their usability is limited. Because they are created for specific settings, the trustor has to know about their existence and how to decode them. A professional certification, for instance, from a little-known institution will be of low value. At the same time, trustees need to invest in emitting symbols and in getting them known (Bacharach & Gambetta, 2003). Anecdotal evidence for this practice comes in the form of the high profile online advertising campaigns that were conducted by trust seal providers such as TRUSTe[13] (Riegelsberger & Sasse, 2000). In the case of interpersonal cues being used with the sole aim of biasing trust perceptions, i.e. when they give no insight into a trustee's trust-warranting properties, this research refers to them as symbols. Embedding stock photos of smiling people on an e-commerce site is an example of using interpersonal cues symbolically. Other examples of interpersonal cues with a predominantly symbolic function are culturally encoded cues, such as dress or hairstyle. They can be easily used strategically for deliberate impression management (see 2.3.1).

Symptoms of trustworthiness: Symptoms are not specifically created to signal trust-warranting properties; rather, they are given off as a by-product of trustworthy actions. For example, the existence of a large number of customer reviews for a product sold on an e-commerce site can be seen as a symptom for a large customer base. Professionalism in site design and concern for usability may also be seen as symptoms for a professionally run and hence trustworthy company. Symptoms, because they are a by-product of trustworthy behaviour, come at no cost to trustworthy actors, but need to be mimicked at a cost by untrustworthy ones. Some interpersonal cues (e.g. pitch of voice) can be considered to be symptomatic. Such interpersonal cues result in information leakage and give insight into emotional states (Baron & Byrne, 2004). They may thus allow inferences about people's

[13] www.truste.com

trustworthiness in specific situations. However, as discussed in section 2.3.1, interpersonal cues differ in the degree to which they can be controlled, i.e. to which degree they are symptomatic.

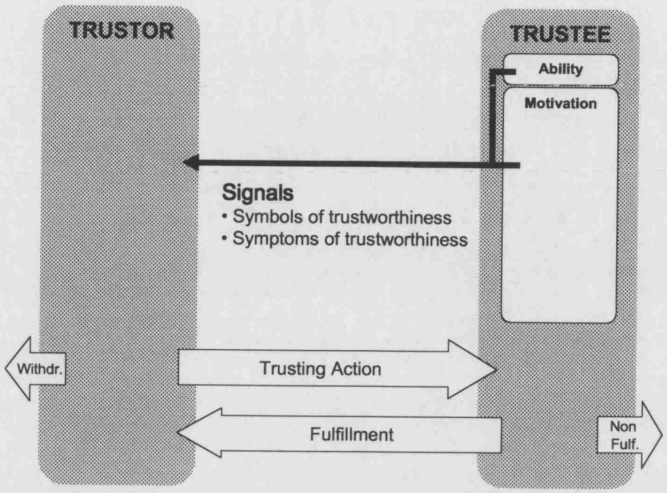


Figure 3.3: Ability, motivation, and signal types added to the framework

3.4 Trust-Warranting Properties

The framework distinguishes between contextual and intrinsic properties. Intrinsic properties can preliminarily be defined as relatively stable attributes of a trustee that make up his trustworthiness. Most established models of trust focus on intrinsic properties. Contextual properties, on the other hand, are attributes of the situation that provide motivation for trustworthy behaviour. While introducing the properties, evidence for their effect taken from empirical studies, as well as sociological and economic theories is discussed.

3.4.1 Contextual Properties

A rational self-interested actor, faced with the basic trust-requiring situation described in section 3.2.2, would maximize his benefit and decide to not fulfil. However, there are several factors that can induce such an actor to behave in a trustworthy manner (Diekmann & Lindenberg, 2001). The framework refers to such factors as contextual properties. Their effect allows trustors to make themselves vulnerable, even if they know very little about the personal attributes of the trustee. Consequently, contextual properties do not fully capture human trust and many researchers contest the use of the term "trustworthy" to describe actors who only fulfil because they are coerced by contextual properties. Hence, in the framework they are complemented by a discussion of intrinsic properties which will be introduced in

section 3.4.2. This distinction is closely matched by Tan & Thoen's (2000) dichotomy of *control trust* and *party trust*, where control trust captures trust in enforcement systems, and party trust is based on attributes of the trustee. In many cases such control system will be of socio-technical nature, relying on security technologies (Ratnasingam & Pavlou, 2004). These can be analysed individually with a new instance of the framework that puts them into the role of the trustee (see 3.2.7).

Raub & Weesie (2000b) identified three categories of factors that can support trustworthy behaviour and thus signal trustworthiness. They are incorporated as contextual trust-warranting properties into the framework. They are *temporal*, *social* and *institutional embeddedness* (Figure 3.4).

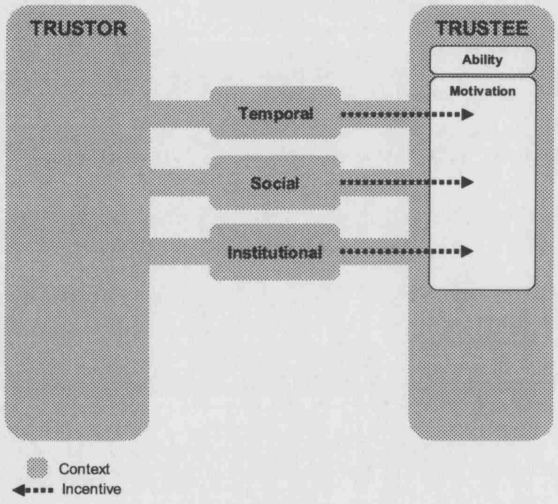


Figure 3.4: Contextual trust-warranting properties

An important condition for the effect of these contextual properties is that the outcome of a situation can be traced to the action (or inaction) of trustees, i.e. that parametric risk (3.2.7) is low and that identities are stable.

3.4.1.1 Temporal Embeddedness

Axelrod (1980) called the prospect of further interactions the "shadow of the future", as it encourages trustworthy behaviour in the present. This effect has been shown empirically in several studies with iterated Prisoner's Dilemmas (Axelrod, 1980; Sally, 1995; Kollock, 1998; see 4.2.3.1) and Trust Games (e.g. Bohnet, Frey, & Huck, 2001; Berg et al., 2003). While a trustee could realize an immediate gain from non-fulfillment, he also knows that in the case of non-fulfillment, the trustor would not place trust in future encounters. Non-

fulfillment in the present encounter thus leads to the loss of the gains that could be realized in future exchanges (Friedman, 1977)[14]. Additionally, if future encounters with reversed roles can be expected, a defrauded trustor could retaliate. Hence, a trustor can interpret temporal embeddedness as a signal for the likelihood of trustworthy behaviour in the present situation. While individuals may not explicitly consider this function of temporal embeddedness in everyday interactions, it helps explaining several known signals of trustworthiness. Temporal embeddedness through repeated interactions also allows the trustor to accumulate knowledge about the trustee, and thus to make better predictions about his future behaviour. Hence, assuming stability of attributes, repeated interactions can decrease uncertainty. By extrapolating from past behaviour, trust in future encounters can be won (Luhmann, 1979).

3.4.1.2 Social Embeddedness

Social embeddedness allows for the exchange of information about a trustee's performance among trustors. This information is known as *reputation* and it is included in many models of trust, such as the ones by Corritore et al. (2003b) and Fogg (2003a). From the perspective of these models reputation is historic information about trustors' attributes such as *honesty*, *reliability*, or *dependability* (McKnight & Chervany, 2000; Sapient & Cheskin, 1999; Corritore et al., 2003b; see 3.4.2). On the assumption of the stability of such attributes across time and context, they can form the basis of trust in present encounters. However, reputation also has a second function, as it provides an incentive to fulfil, even if a trustee does not expect a future interaction with a specific trustor. If the trustor is socially embedded, the trustee's interest in future interactions with any trustor who might gain access to reputation information creates an incentive for fulfillment in the present encounter (Raub & Weesie, 2000a). Reputation can thus act as a "hostage" in the hands of socially well-embedded trustors (Raub & Weesie, 2000a; Einwiller, 2001). Glaeser et al. (2000) demonstrated the incentive-setting effect of *social embeddedness* in an experimental study. They found that individuals with a higher degree of *social embeddedness* (measured in this study by the number of friends, involvement in volunteer activities, family connections, and having a sexual partner) elicited more trustworthy behaviour from trustees.

Trust based on reputation alone, however, is vulnerable to strategic misuse. Inherently untrustworthy actors can build up a good reputation to 'cash in' by not fulfilling in the final transaction. Anecdotal evidence of such behaviour exists for online-auction sites (Lee, 2002); it also commonly emerges in game-theoretic laboratory experiments, where rates of non-

[14] In the known last round of an experimental Trust Game and a Prisoner Dilemma, the *shadow of the future* is diminished and non-fulfillment is commonly observed. By way of backward induction one could then also expect non-fulfillment in the penultimate round, and so on up to the first round. However, empirically such complete backward induction is not observed and cooperation commonly only erodes in the few last rounds (Poundstone, 1993).

fulfillment considerably increase towards the end of the experimental sessions, when the reputations gained within the game cease to be of further value (Bos et al., 2002; Sally, 1995; Bohnet, Huck, & Tyran, 2003)

The incentive-setting aspect of reputation has been studied extensively from the perspective of game theory (e.g. Dellarocas & Resnick, 2003; Baurmann & Leist, 2004; Huberman & Fang, 2004; Bohnet et al., 2003; Keser, 2002; Ely, Fudenberg, & Levine, 2004; Bolton, Katok, & Ockenfels, 2004). This research relied on simulations with agents and on empirical lab studies with human participants. Factors that influence the effect of reputation are identifiability and traceability, the social connectedness of the trustor (Glaeser at al., 2000), the topology of the social network (Granovetter, 1973), and the degree to which such information itself can be trusted to be truthful (Bacharach & Gambetta, 2003).

The Internet allows for the cheap dissemination of reputation information across a large but loosely knit network. Hence, reputation systems are increasingly receiving attention in the HCI community (e.g. at the MIT Reputation Systems Symposium: Dellarocas & Resnick, 2003; at the Symposium on 'Trust and Community on the Internet': Baurmann et al., 2004; or at the iTrust Trust Management Conference: Jensen et al., 2004). Eliciting reputation information from trustors, however, poses a social dilemma in itself: trustors may have no personal benefit from sharing this information, but usually incur a cost (e.g. time spent entering feedback) from making it public. Approaches to solving this problem include showing the personal efficacy of feedback and collecting implicit feedback, by recording actors' behaviour (for a detailed discussion see McCarthy & Riegelsberger, 2004). In summary, reputation mechanisms require stable identities and the traceability of actions. Additionally, reputation information needs to be accurate, easy to disseminate, and easy to elicit.

3.4.1.3 Institutional Embeddedness

Raub & Weesie (2000a) define institutions as *"... constraints for human action that result from human action itself and structure the incentives for transactions"* (p. 22). Institutions often take the form of organisations that influence the behaviour of individuals or other organisations. Examples of institutions are law enforcement agencies, judicial systems, trade organisations, or companies amongst others. Trusted Third Parties (TTP) or escrow services are examples of institutional approaches that have been very popular in online environments. Institutions are often embedded in wider networks of trust in which one institution acts as guardian of trust for another one (Shapiro, 1987). As an example, appropriate behaviour of a company might be safeguarded by trade organisations. Trade organisations, in turn, are answerable to governmental consumer protection agencies. As indicated in section 3.2.7 the

framework can be used to focus on the trust relationships at various levels of these embedded networks. The institution that acts as a contextual trust-warranting property at one level can be analysed in the place of the trustee at the next level.

As most everyday interactions are conducted within a web of institutional embeddedness (Rousseau et al., 1998; McKnight & Chervany, 2000), the effect of institutions often does not come to mind as long as a situation conforms a template of standard interactions. McKnight & Chervany (2000) in their model refer to this as the trustor's perception of situational normality. When new technologies transform the way in which people interact, their templates of situational normality may not apply any more. This can lead to a perception of increased vulnerability until a sufficient number of successful transactions establish a new perception of situational normality (see 2.2.2). Additionally, if technology increases the spatial distance between the actors, the trustee may be based in a different society or culture, and consequently the trustor may be less familiar with the institutions that govern his behaviour (Jarvenpaa & Tractinsky, 1999; Brynjolfsson & Smith, 2000).

Organisations as a special case of institutions should be discussed in more depth: they structure the behaviour of employees through job roles, salary, career opportunities, disciplinary actions, etc. Trust in an organisation and its processes and control structures, allows the trustor to make herself vulnerable towards a representative of a company even if she knows very little about the personal attributes of that particular representative (Raub & Weesie, 2000a). Many sociologists state that cooperation in everyday interactions is increasingly based on trust in institutions such as companies, or their brands, rather than on trust in individuals and their personal attributes (Putnam, 2000; Zuckerman et al., 1981; Giddens, 1990). As discussed in section 2.2, this process of replacing personal trust with institutional trust vastly increases the efficiency of everyday life, as we do not have to rely on observing an individual's behaviour over time, but can aggregate trust in a corporation or a brand. However, many researchers also maintain that institutional trust is almost always complemented by at least rudimentary forms of trust based on intrinsic properties of the trustee (Giddens, 1990; Lahno, 2002a).

For institutional embeddedness to have an effect, sanctions in the case of non-fulfillment need to pose a credible threat. Hence, beyond stable identities and low parametric risk, clear definitions of non-fulfillment and fulfillment are needed, and the cost of investigation has to be in balance with the cost of non-fulfillment (Macauley, 1963; Diekmann et al., 2001). Due to these constraints, some researchers state that institutional trust can only support trustworthy action if there is some level of mutual understanding, shared norms, and goodwill between the actors (Macauley, 1963; Fukuyama, 1999). Finally, institutions can also signal personal

attributes such as ability or honesty, because many institutions select their members carefully and give thus valuable information about the members' intrinsic properties (3.4.2).

To summarize, institutions support trustworthy action by providing incentives and sanctions for behaviour. Most everyday actions are embedded in a web of institutions. For institutions to have an effect actions must be traceable and the cost of investigation and sanctioning must be low compared to the cost of non-fulfillment. Companies are a special form of institutions and they or their brands can bundle institutional trust and thus replace – to some extent – the need for trust in personal attributes of employees.

3.4.1.4 Signals and Incentives

This section introduced contextual properties. They provide incentives for trustworthy behaviour of the trustee. Because incentives can increase the likelihood of trustworthy behaviour they can be interpreted as signals for trustworthiness. In addition, contextual properties can signal intrinsic properties of the trustee. Repeated interactions (*temporal embeddedness*), for instance, allow gaining knowledge about a trustee's personality traits; reputation information (*social embeddedness*) can be understood as giving information about stable attributes; membership in an organisation (*institutional embeddedness*) can signal specific professional qualifications. Figure 3.5 summarizes both functions of contextual properties.

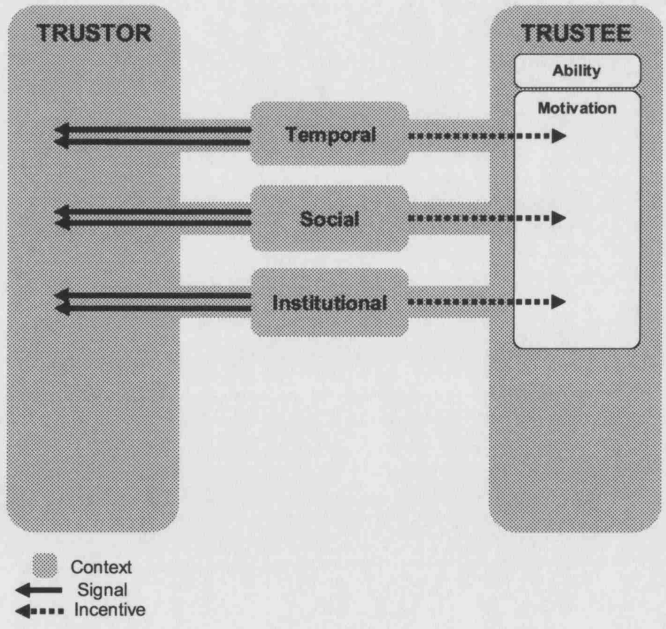


Figure 3.5: Contextual trust-warranting properties signal incentives and attributes

3.4.2 Intrinsic Properties

Contextual properties do not fully explain how actors behave empirically (Fukuyama, 1999). In everyday terms, one would not describe someone who is cooperating only because he is induced by contextual properties as trustworthy. In an excellent review article, Fehr & Fischbacher (2003) discuss experimental evidence for human altruism and intrinsic trustworthiness in the absence of contextual properties. A common way of accounting for such behaviour within models of rational self-interested actors is to assign seemingly altruistic acts non-monetary utility (Bacharach & Gambetta, 2001; Lahno, 2002a). A trustee may not maximize his monetary gain by fulfilling, but he may experience intrinsic gratification from acting in accordance with his ethical beliefs, which he might value more than other types of gain.

Intrinsic properties are defined as relatively stable attributes of a trustee. They include factors that provide intrinsic motivation for fulfillment (Deci, 1992) as well as ability to fulfil. Most established models of trust focus on the trustor's perceptions of these attributes. However, many of the attributes listed in existing models are behavioural (e.g. responsiveness or reliability in the model by McKnight & Chervany, 2000), which makes them difficult to separate from the behavioural consequences of contextual properties. The approach taken here is to provide a framework for many of the finer-grained sets of attributes that are listed by existing models. This approach results in a parsimonious framework with only three types of intrinsic properties: *ability* (see 3.4.2.1), *internalised norms* (see 3.4.2.2), and *benevolence* (see 3.4.2.3; Figure 3.6). These properties reflect the components of trustworthiness defined by Mayer et al. (1995): *ability*, *integrity*, and *benevolence*. They are also easily mapped to Tan & Thoen's (2000) concept of *party trust*, which covers attributes of a trustee (as opposed to control trust, which refers to the context). Corritore et al. (2003b) define the perception of trustworthiness as being dependent on the attributes *honesty*, *expertise*, *predictability*, and *reputation*. Honesty is captured by the intrinsic property *internalised norms,* and *expertise* can be linked to the property *ability*. *Predictability*, on the other hand, is a behavioural outcome that may be deduced to several properties (e.g. *ability* and *institutional embeddedness*). Reputation has been discussed in terms of *social embeddedness*; it can give information about other attributes and it can also act as a hostage in the hands of the trustor. Fogg (2003a) introduces *expertise* and *trustworthiness* as key dimensions of computer credibility. Again, expertise is captured by the property *ability*. Trustworthiness, defined by Fogg (2003a) as an actor being *unbiased, fair*, and *honest*, is captured by the property *internalised norms*.

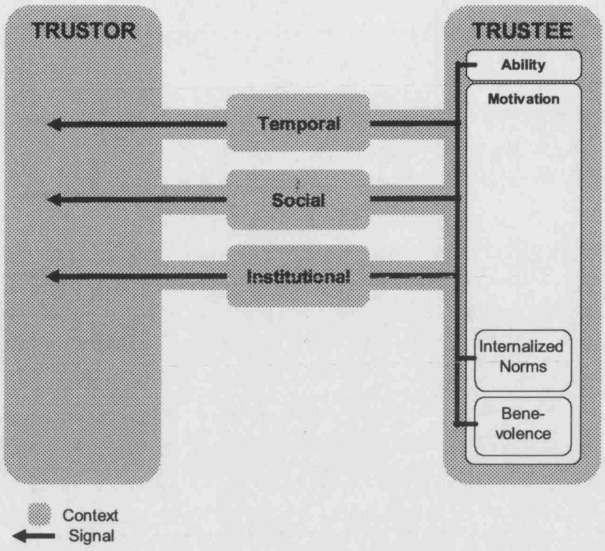


Figure 3.6: Intrinsic trust-warranting properties

3.4.2.1 Ability

Ability as the counterpart to *motivation* in Deutsch's (1958) classic definition of trustworthiness is commonly under-represented in the game-theory inspired work on trust in mediated interactions (Bos et al., 2002; Rocco, 1998; Jensen et al., 2000; Olson et al., 2002; Davis et al., 2002). However, the more salient concern in everyday trust decisions will often be whether an actor is *able* to fulfil. Mayer et al. (1995) define ability for human and institutional actors as a *"... group of skills, competencies, and characteristics that enable a party to have influence within some specific domain"* (p. 717). McKnight & Chervany (2000) use the sub-constructs *competence*, *expertise*, and *dynamism* to capture *ability* in their model. Fogg (2003a) and Corritore et al. (2003b) introduce *expertise*, which can be seen as a specific case of the framework property *ability*. *Ability* has domain-specific (e.g. technical knowledge) and general components (e.g. intelligence). Signals for a trustee's *ability* are given through contextual properties (previous encounters, reputation, or institutional certification), but also directly through interpersonal cues (3.4.2.4) and by observing behaviour.

3.4.2.2 Internalised Norms

Granovetter's (1985) classic example of the economist, who – against all economic rationality – leaves a tip in a roadside restaurant far from home[15] illustrates the effect of internalised norms. In many cases, norm compliance will be internalised to such an extent that it becomes habitual (Fukuyama, 1999). However, while behaviour will be influenced by internalised

[15] This situation is not embedded temporally (he will not visit the restaurant again), socially (the waiter cannot tell relevant others about his behaviour), or institutionally (there is no formal way of enforcing tipping).

norms, it will not be completely governed by them. The prospect of realizing a very large gain by non-fulfillment may, for instance, outweigh the effect of internalised norms (Granovetter, 1985).

Inducing trustees to internalize social norms is a difficult and lengthy process. The foundation is laid in individuals' socialization, in which we are "culturally embossed" with basic social norms (Brosig et al., 2002). However, social norms differ across groups and cultures, they have to evolve over time, and triggering them may depend on the trustor's signalling of group membership (Bohnet et al., 2001; Fukuyama, 1999). Not all norms are desirable per se, as strong in-group reciprocity may come at the cost of hostility or aggression towards non-members (Fukuyama, 1999).

Mayer et al. capture the effect of internalised norms in their construct of integrity: *"... the trustee adheres to a set of principles that the trustor finds acceptable."* (Mayer et al., 1995, p. 719). Sitkin & Roth (1993) capture a similar notion when they note value congruence as a condition for trust among employees within an organisation. Most models of trust focus on the content of these principles, values, or norms and on their behavioural consequences. McKnight & Chervany (2000) use the term integrity to capture a trustee's *honesty*, *credibility*, *reliability*, and *dependability*. They also include further attributes that can be traced back to internalised norms. These include *good morals*, *good will*, *benevolent caring*, *responsiveness*, and *openness*.

3.4.2.3 Benevolence

The intrinsic property *benevolence* captures the gratification that the actors gain from each-other's company and well-being. The capacity for benevolence is an attribute of the trustee, but the specific level of benevolence in a specific situation is an attribute of the relationship between trustor and trustee. A trustee may act benevolently towards one trustor, but not towards another one.

Granovetter (1985), in discussing the effect of social ties on trustworthiness notes that *"(...) continuing economic relations often become overlaid with social content that carries strong expectations of trust and abstention from opportunism"* (p. 490). This indicates that benevolence is typically an attribute of long-established relationships. Strong feelings of benevolence only evolve over repeated episodes of trusting and fulfilling (McAllister, 1995). In benevolent relationships, actors do not expect immediate or equal returns. Exchanges that are based on benevolence are also said to be characterized by *knowledge-based* or *identification-based* trust (Koehn, 2003; Rousseau et al., 1998). It should be noted that benevolence defined in this way is different from McKnight & Chervany's (2000) use of the

term to summarize trustee attributes such as good morals or good will. These were covered in the discussion of internalised norms (see 3.4.2.2).

3.4.2.4 The Role of Interpersonal Cues

Interpersonal cues play a special role in signalling and triggering intrinsic trust-warranting properties in interactions between humans. Intrinsic trust-warranting properties are widely believed to manifest themselves through interpersonal cues (Bacharach and Gambetta, 2003; Goffman, 1959). This function is the basis of prediction P2 (see 2.3.3): that the inclusion of interpersonal cues in an interface increases trustor's discriminative abilities.

The symptomatic nature (see 3.3.2) of interpersonal cues was then supported by several studies reviewed in section 2.3.4. Swerts et al. (2004), for instance, showed that speakers emit para- and non-verbal cues of certainty that can be decoded by trustors to make inferences about a speaker's ability. Information about a trustee's socio-demographic background and thus about the set of norms that are likely to guide his behaviour can be inferred from interpersonal cues such as dress, hairstyle, or para-verbal cues (see 2.3.1). Non-verbal cues, such as pitch or posture, have been shown to be good signals for internal states and affect and may thus be interpreted as signals for *benevolence* (Hinton, 1993; Harper et al., 1978).

While interpersonal cues can give information about intrinsic properties, they are also subject to individuals' impression management (see 2.3.1). This is particularly relevant because some interpersonal cues are considered to trigger involuntary visceral reactions (Norman, 2004; O'Doherty et al., 2003). Hence, interpersonal cues may create some level of affective trust, even if there is no rational basis for such trust attributions. For instance, even a synthetic animated character that exhibited only very simplistic interpersonal cues was found to increase users' self-reported trust (Rickenberg & Reeves, 2000; see 2.3.5.2).

Finally, interpersonal cues may also trigger immediate responses from the trustee. Several studies showed that social presence afforded by interpersonal cues can call into action culturally embossed norms. By reducing perceived social distance, interpersonal cues can induce human trustees to fulfil. Visual identification (Bohnet & Frey, 1999), a photo of the interaction partner (Olson et al., 2002), and even a synthetic voice (Davis et al., 2002) have been shown to increase cooperation in social dilemma studies.

3.5 Discussion

This section discusses the implications of the framework (Figure 3.7) in view of the goals that were presented in section 3.1. Section 3.5.1 shows how the framework can accommodate existing classification of trust (Research Goal 4.1); section 3.5.2 shows the relevance of

distinguishing actor and context variables (Research Goal 4.2) by delineating *trust* and *reliance*. Section 3.5.3, uses the framework to position the studies conducted as part of this thesis in the wider problem space of trust in mediated interactions (Research Goal 4.3). This section also lays the foundation for the approaches used to measure trust in this thesis (Research Goal 4.4).

3.5.1 Accommodating Existing Types of Trust

Researchers in HCI and other disciplines have created many classifications of trust and introduced many terms to describe the various forms they found. This section discusses how the different types of trust can be accommodated by the framework (Research Goal 4.1). Each type of trust relates to a belief about a specific configuration of trust-warranting properties. Subsequently, types of trust differ in the way trustworthiness is signalled and perceived, in their stability over time, how wide their scope is, and what types of vulnerabilities are covered by them (Corritore et al, 2003). The fundamental distinction between contextual and intrinsic properties is reflected in the discussion of other researchers. Trust based on contextual properties is also called *reliance* or *assurance-based trust* (Lahno, 2002a; Yamagishi & Yamagishi, 1994, see 3.5.2). Describing a similar concept, Rousseau et al. (1998), and Koehn (2003) use the terms *calculus-based trust* or *calculative trust*, respectively. Other terms that have been coined are *guarded trust* (Brenkert, 1998; Corritore et al., 2003b), *deterrence-based trust* (Lewicki et al., 1996; Lewis & Weigert, 1985), and *control trust* (Tan & Thoen, 2000).

Institutional trust (Lahno, 2002a; Zuckerman et al., 1981) specifically captures the effect of the contextual property *institutional embeddedness*. Rousseau et al. (1998) see it as a backdrop that envelopes and safeguards our everyday interactions, thus closely matching McKnight & Chervany's (2000) concept of *situational normality*. *Technology trust* (Ratnasingam & Pavlou, 2004) and *Internet trust* (Lee & Turban, 2001) are largely based on the *ability* of technological systems used to carry out interactions. However, as they are embedded in socio-technical systems, technology trust commonly also entails other types of trust in non-technical actors that safeguard technology (e.g. regulators).

Types of trust that are mainly based on intrinsic properties are *relational* (Rousseau et al., 1998), *party* (Tan & Thoen, 2000), *partner* (Ratnasingam & Pavlou, 2004), *knowledge-based* (Koehn, 2003), or *respect-based trust* (Koehn, 2003). Relational trust develops over time and is founded on a history of successful exchanges. It has a higher *bandwidth*, i.e. ensures risk-taking across a wider range of situations (Rousseau et al., 1998; Corritore et al., 2003b). Some of the authors describing different types of trust link them to different stages in a relationship

(Table 3.2). However, it is important to note that the relevance of individual trust-warranting properties is also determined by other factors than just the level of acquaintance. Tan & Thoen (2000), for instance, hold that most trust relationships are founded on party trust (i.e. intrinsic properties) *and* control trust (i.e. contextual properties). Time may shift this balance, but it does not fully explain the configuration of trust-warranting properties in a given situation.

Level			Source
Early	Medium	Mature	
Deterrence-based	Knowledge-based	Identification-based	Lewicki & Bunker (1996)
Calculus-based		Relational	Rousseau et al. (1998)
Basic/Guarded		Extended	Corritore et al. (2003)
Swift			Meyerson et al. (1996)
Calculative		Knowledge-Based, Respect-Based	Koehn (2003)
Mainly based on Contextual Properties		Mainly based on Intrinsic Properties	

Table 3.2: Different types of trust linked to levels of acquaintance

It is important to emphasize that identification-based or relational trust is not the optimal form of trust in all situations (Rousseau et al., 1998). While these forms may be the most stable ones and while they may be preferable from a moral or ethical perspective (Koehn, 2003), they come at a high cost in terms of time requirements and lower flexibility. Aiming for relational levels of trust in most exchanges would be very costly, and would tie the trust to an individual rather than to a role. It would be very time-consuming to aim for close relationships with sales assistants, bank clerks, or airline pilots. Indeed, as indicated in section 2.2, trust in organisations, brands, and institutions allows for much of the flexibility and complexity of today's life (Giddens, 1990). Most exchanges are conducted on the level of calculus- or knowledge-based trust – often assured by *institutional embeddedness* (Rousseau et al., 1998).

A classification that was introduced early in this thesis (section 2.2.4) was the distinction between *affective* and *cognitive trust*. Many researchers share this classification (Corritore, Kracher, & Wiedenbeck, 2001; Lewis & Weigert, 1985; McAllister, 1995; Rocco et al., 2000). As stated in section 2.2.4, cognitive trust is based on *"(...) good rational reasons why the object of trust merits trust"* (Lewis & Weigert, 1985, p. 972)[16]. It is thus based on evaluating trustee's incentive structures and ability. It reflects the economic understanding of

[16] While the distinction between affective and cognitive trust is widely used, it should be noted that cognition and affect are not distinct systems of decision-making. Findings in neuroscience indicate that a clear distinction between rational reasoning and affect cannot be upheld (Damasio, 1994; see also Norman, 2004; O'Doherty et al., 2001; Zajonc, 1980).

trust as a rational choice. Affective trust, on the other hand, is based on immediate affective reactions, on attractiveness, aesthetics, and signals of *benevolence*. Often trusting action will result from a mix of affective and cognitive trust (Corritore et al., 2003b; Zajonc, 1980; Lewis & Weigert, 1985).

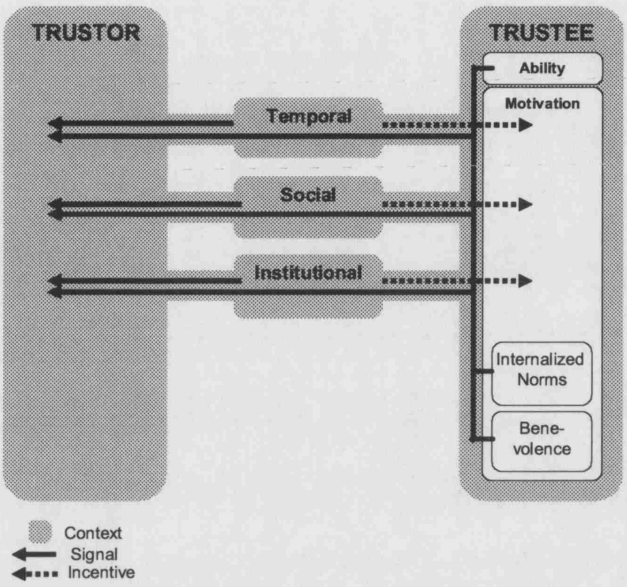


Figure 3.7: The complete framework

3.5.2 Including Actors and Context

By identifying *contextual* and actors' *intrinsic properties*, the framework pinpointed a terminological ambiguity that has not been discussed widely in HCI research: the distinction between reliance and trust. It is often claimed in the security literature (Schunter, Waidner, & Whinett, 1999), but also in HCI research (e.g. Sapient & Cheskin, 1999), that security, control, and enforcement structures, as well as institutional embedding, increase trust. Expressed in the terms of the framework, assurance mechanisms can increase observable trusting action by increasing one component of trust – *reliance* (Lahno, 2002). However, reliance is largely independent of the intrinsic properties of the trustee, and cooperation based on it is likely to cease when contextual properties are not in place. The philosopher Onora O'Neill (2002) even argues that we might be losing chances to build trust by increasingly relying on assurance mechanisms. Drawing on empirical studies, Sitkin & Roth (1993) drew similar conclusions for "legalistic" approaches (i.e. those based on *institutional embeddedness*) in the field of organisational behaviour:

> *"(...) adopting legalistic mechanisms may not only fail to restore trust, but may lead to an escalating spiral of formality and distance that increases distrust."* (Sitkin & Roth, 1993, p. 385)

This insight suggests that HCI researchers also need to focus on intrinsic properties for trustworthy behaviour. In the context of interactions that are mediated by technology, this is particularly important, because contextual properties lend themselves more easily to automation and technical solutions than intrinsic ones, and thus may seem more appropriate. Email enables users to easily trace and record past statements and behaviours of others (*temporal embeddedness*), the power of reputation information can be amplified through electronic networks (*social embeddedness*), and software applications can check a multitude of certificates in seconds (*institutional embeddedness*). However, intrinsic properties are at least as important, even if they do not scale as well as approaches based on contextual properties.

In many everyday situations, trust and fulfillment rely – with varying degree – on contextual *and* intrinsic trust-warranting properties. Thus, research needs to address how the design of online environments can support the evolution and internalization of norms and the growth of benevolent relationships. If researchers disregard intrinsic properties, and try to ensure cooperation through external incentive mechanisms only, they run danger of replacing trust with reliance on assurance mechanisms (Yamagishi et al., 1994; Lahno, 2002a; O'Neill, 2002).

3.5.3 Positioning the Studies in the Framework

The framework introduced above is applicable to a wide range of areas in HCI trust research, such as trust in technology, trust in human interaction partners, and trust in organisations that are represented by technology (e.g. e-commerce vendors). In creating such a general framework, it was aimed to provide a terminological foundation for HCI trust research and a frame of reference in which to position specific studies to ensure appropriate generalisation of findings (Research Goal 4.3) and appropriate measurement of key variables (Research Goal 4.4). The empirical research conducted as part of this thesis cannot cover the whole space sketched out by the framework. Rather, the framework is used to position and scope the studies conducted as part of this thesis more precisely[17]. The studies conducted as part of this thesis research human trust in e-commerce vendors (see 3.5.3.1) and in a human advisor (see 3.5.3.2, see Table 3.3).

[17] An initial scope for the whole thesis had been defined in section 1.2.

	Experiment 2	Experiment 3	Experiment 4
Chapter	Chapter 6	Chapter 7	Chapter 8
Research Goal Addressed (see section 1.3)	1,2,4	1,2,3,4	1,2,4
Trustee	E-Commerce Vendor	E-Commerce Vendor	Human Advisor
Prediction addressed	P1	P1	P1 and P2
Time of Experimental Sessions	Sep 2002	Jan – Feb 2003	Jul 2004
Results Published in	Riegelsberger et al. (2003a)	Riegelsberger et al. (2003c)	Riegelsberger et al. (2005a) Riegelsberger et al. (2005c)

Table 3.3: Overview on the trust-related studies conducted for this thesis

3.5.3.1 Trust in E-commerce Vendors

Experiments 2 and 3 investigate trust in e-commerce. In applying the framework to this area one can differentiate between vulnerabilities that are related to the transmission technology as trustee (e.g. reliability of data transmission, interception), and those that are related to the vendor's actions (e.g. fulfillment, privacy protection). This research focuses on user trust in the vendor. Figure 3.8 adapts the basic trust-requiring situation as defined by the framework (see 3.2.2) and shows the specific types of signals (1), trusting actions (2a), withdrawal (2b), fulfillment (3a), and non-fulfillment (3b) for this situation.

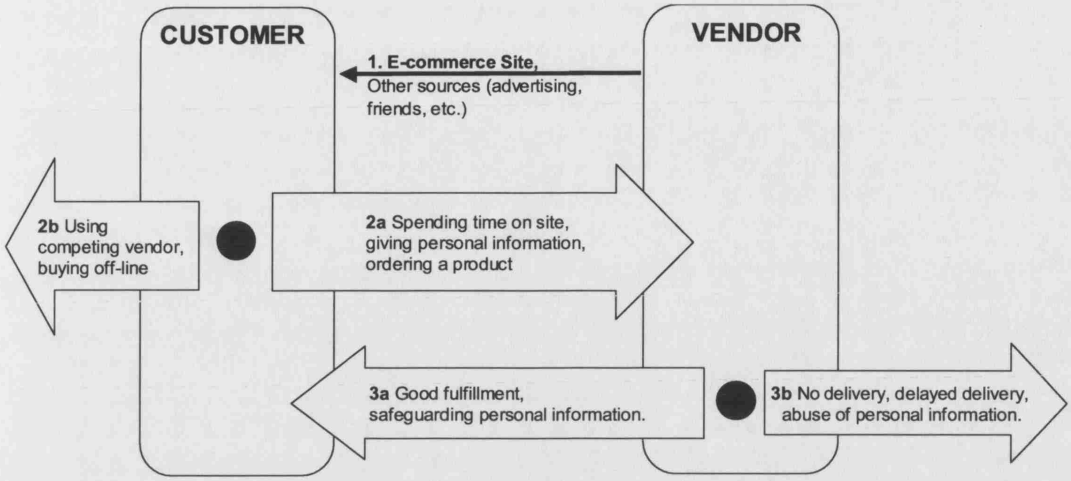


Figure 3.8: Trust in an e-commerce vendor expressed with the framework

A further aspect incorporated into the framework is the distinction between ability and motivation: non-fulfillment or insufficient fulfillment may result from a lack of ability or from lack of motivation. In many initial encounters with e-commerce vendors (e.g. after following a search engine link) users wonder about the professionalism of the vendor they are dealing with (see 9.4.1), i.e. whether he is capable of delivering goods or services as promised. Professionalism is captured by the intrinsic property ability (see 3.4.2.1). It should be noted that a vendor may also lack motivation to fulfil, e.g. in the case of a *phishing site*[18] that is aimed at eliciting personal information, rather than at providing a service. Investigating users' ability to identify such sites is outside the scope of this thesis. However, it is an important area for future research (see 10.4), as knowledge about the presence of such sites will also influence users' trust in the whole market place.

The discussion of the framework in section 3.5.1 showed that the level of acquaintance between trustor and trustee affects how trust is formed. On this dimension, the focus of the empirical research conducted for this thesis is on first encounters. In the terminology of Fogg (2003a), this research is thus concerned with *surface credibility*. Users need to extrapolate from the surface cues they perceive in the e-commerce system's interface on the professionalism of the e-commerce vendor. In addressing Research Goal 1, Experiments 2 and 3 evaluate users' ability to make such inferences.

In addressing Research Goal 2, Experiments 2 and 3 investigate the effect of the commonly observed practice to use photos of people to build affective trust. As discussed in section 3.4.2.4, interpersonal cues given in a photo, such as smiles, may lead to immediate visceral reactions that may build some level of affective trust (see 2.2.4). The distinction between symbolic and symptomatic cues, introduced as part of the framework (see 3.3.2),

[18] See e.g. www.antiphishing.org

helps in clarifying the function of interpersonal cues in the context of this research. While interpersonal cues have some symptomatic function in face-to-face encounters (it requires, for instance, some effort to sustain the appearance of *benevolence*), they become purely symbolic once they are mediated, e.g. in the form of photographs. That is to say, they carry no information about the trustworthiness of the trustee (as they are often taken from generic photo libraries), but they may still haven an effect on users' affective trust, as humans are prone to instant affective reactions to such cues (see 3.4.2.4). Hence, symbolic interpersonal cues may have an effect on users' trust assessment of the vendors without giving insight into trust-warranting properties. As a result they may bias users' trust assessment (P1, see 2.3.3).

3.5.3.2 Trust in Human Advisors

Experiment 4 investigates trust in online advice. In this domain, trust between a human trustor and a human trustee (the advisor) is researched. The technology performs the role of the channel that conveys signals, i.e. interpersonal cues, from the trustee. Figure 3.9 expresses advice seeking in the terms of trust-requiring situations as defined by the framework (see 3.2.2). It illustrates the question whether to ask someone for advice. The effort to ask (2a in Figure 3.9) will only be expended if there are sufficient signals (1 in Figure 3.9), that good or confident advice will be given (3a in Figure 3.9).

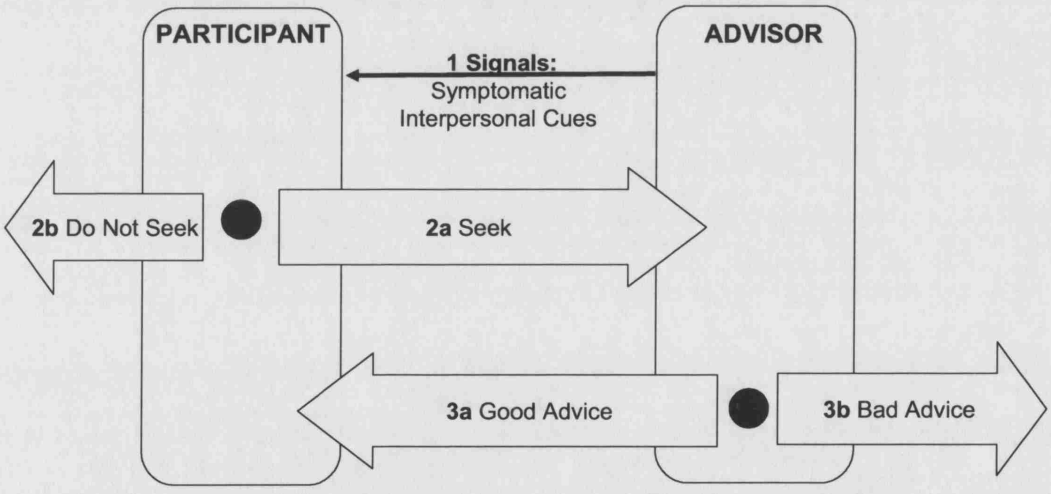


Figure 3.9: Advice seeking expressed in the terms of the trust framework

For technically mediated interactions between humans there is a particular shortage of research that addresses effects of ability. Most research focuses on the property motivation, either in the form of willingness to cooperate in team settings or in the form of lie detection studies (see 2.3.4). Hence, as for the research into trust in e-commerce vendors (see 3.5.3.1) the focus for Experiment 4 is set on the intrinsic property ability (see 3.4.2.1). Again, the investigation is focused on first-time encounters. Contextual properties were held constant and thus did not have any signalling function, but participants needed to infer ability (Research Goal 1) from the interpersonal cues given. The number and cues available are varied with the different media representations that were investigated (Research Goal 2).

An important difference between the two strands of empirical research that form part of this thesis is the function of interpersonal cues. In the context of trust in a human advisor (Experiment 4), interpersonal cues may have a symptomatic function (see 3.3.2), as they can leak information about the advisor's expertise or ability. Mediating the interpersonal cues in different representations may influence the degree of insight they give. This aspect was discussed in more detail in section 2.3.2.3. Hence, for Experiment 4, the inclusion of interpersonal cues may either lead to a trust bias (P1), as the social presence of the advisor may be increased, but it may also lead to an increase in participants' ability to place trust well, i.e. in discriminative ability (P2).

3.6 Summary

This chapter introduced a framework for trust in mediated interactions for HCI research. The motivation for creating such a framework was the fragmentation of current HCI trust research in terms of terminology and approaches. This state could be partially seen as a consequence of a similar situation in the social sciences, on which HCI researchers based their approaches. Several models of trust (Corritore et al., 2003b; Tan & Thoen, 2000; Fogg, 2003a; McKnight & Chervany, 2000) had been proposed to remedy this situation. However, most of these models are still related to a specific technology or application domain. Furthermore, most do not integrate contextual factors, which can have an impact on the way in which trust is formed.

The framework presented in this chapter was built from an abstract asymmetric situation, in which one can identify a trustor and a trustee. The trustor can make inferences about the trustee's trustworthiness based on the signals she perceives from the trustee and the context. However, these signals are subject to mimicry, because non-trustworthy trustees will aim to be perceived as trustworthy. Two types of signals were identified: symbols and symptoms.

Symptoms are signals of trustworthiness that are given as by-product of behaviour. They are preferable to symbols, which can be costly to emit, are less reliable, and subject to mimicry. Interpersonal cues can have symptomatic qualities (i.e. give insight into trust-warranting properties, P2), but they may also be used symbolically (i.e. without being firmly linked to underlying properties, P1). Different instances of the framework can be used to analyse the different vulnerabilities and trustees that might be relevant in a specific situation. The framework allows analysing trust in first-time, one-time, and continued interactions. Contextual properties (*temporal*, *social*, and *institutional embeddedness*) and intrinsic properties of the trustee (*ability*, *internalised norms*, and *benevolence*) were identified as the basis of trustworthy behaviour.

The discussion showed that the framework is capable of accommodating existing classifications of trust (section 3.5.1). In addition, the distinction between intrinsic and contextual properties allowed pinpointing an ambiguity regarding trust and reliance, which to date had not been widely discussed in HCI (section 3.5.2). Finally, it was demonstrated that the framework is useful in positioning specific research problems within the wider problem space of trust in mediated interactions by anchoring them on relevant dimensions: section 3.5.3, used the framework to delineate the empirical studies conducted as part of this thesis. A key distinction that became apparent was the function of interpersonal cues. For Experiments 2 and 3, which focus on trust in e-commerce vendors, interpersonal cues have only a symbolic function (i.e. they give no insight into the trustee's intrinsic properties) – they can only be expected to bias users' trust perceptions (P1). Experiment 4, on the other hand, researches the effect of interpersonal cues that emanate from a human trustee. Including them in an interface can be expected to give additional insight for assessments of trustworthiness and may thus increase users' ability to place trust well (P2), because they can act as symptoms of trust-warranting properties. On the other hand, it can also result in a bias – due to increased social presence (P1).

Chapter 4

Methodology

This section discusses the methods used to measure effects on user trust (Research Goal 1 and 2) on the one hand, and on usability on the other (Research Goal 3). Section 4.1 gives a brief review of the dimensions on which empirical research methods can be categorised together with a discussion of the limitations and trade-off decisions that are associated with different approaches. This review provides the basis for a critical discussion of the methods used in the HCI trust research that was reviewed in Chapter 2 (see 4.2). Section 4.3 then introduces the methods employed for this thesis and shows how they address the limitations of methods previously used. The final section (see 4.4) of this chapter discusses the methods used for investigating the effect of interpersonal cues on visual search and usability.

This chapter introduces the experimental paradigm that is common to all studies reported in Chapters 5 to 8. Specific details of individual experiments are discussed in the respective chapters (section 5.2 for Experiment 1; section 6.2 for Experiment 2; section 7.2 for Experiment 3; and section 8.2 for Experiment 4).

4.1 Classification of Empirical Methods

The methods used for empirical research can be contrasted on several dimensions. The commonly used dimensions are briefly introduced below. Section 4.2 then builds on this foundation to critically discuss the methods currently used in HCI trust research.

4.1.1 Qualitative and Quantitative Approaches

The discussion about the value and applicability of qualitative methods versus quantitative methods in the social sciences is longstanding (Bortz et al., 1995). While it may be impossible to reconcile the philosophical positions underlying this discussion, more recently a pragmatic consensus has emerged. This consensus sees both types of methods as having strengths and weaknesses and emphasises that they can be used in a complementary fashion (Bortz et al., 1995).

Qualitative techniques offer several benefits. For instance, they result in rich and contextualised data (Beyer & Holtzblatt, 1998). This allows building an understanding of

novel and complex phenomena, such as trust in mediated interactions. Their necessarily open, participant-driven approach helps researchers avoid focusing on the wrong issues or taking too narrow a view when they set out to investigate a phenomenon. As such, qualitative methods are commonly used as a first step in approaching a research problem. They help researchers in formulating appropriate questions and hypotheses (Beyer & Holtzblatt, 1998).

Conversely, a disadvantage of qualitative methods is that they cannot be used to falsify hypotheses (Popper, 1959; Bortz et al., 1995). Falsifiability is at the core of the quantitative scientific method (Popper, 1959). However, the logical strength of the quantitative method comes at a cost, as effects need to be reliably measured, procedures need to be standardised, and intervening factors controlled. Hence, quantitative approaches lend themselves most easily to experimental laboratory settings (see 4.1.3), which have been criticised for being reductionist and lacking in ecological validity (Bortz et al., 1995). Qualitative findings, on the other hand, have been criticised for lacking reliability – as they can be extremely dependent on the interviewer's agenda or the analyst's interpretations. This is particularly the case if no formal method for analysing qualitative data is employed. Examples of methods that ensure a controlled and reliable analysis of qualitative data are *Qualitative Content Analysis* (Mayring, 2000) or *Grounded Theory* (Strauss & Corbin, 1998).

4.1.2 Surveys and Experiments

The distinction between surveys and experiments is related to the distinction between qualitative and quantitative methods, as experiments typically follow a quantitative paradigm, whereas surveys may be conducted quantitatively (e.g. with questionnaires such as the one by Kammerer, 2000; see Appendix B.10) or qualitatively (e.g. through interviews, see 4.1.4). Experiments typically involve researchers manipulating one or more *independent variables* of interest (e.g. *media representation* or *vendor trustworthiness*) to find effects on one or more *dependent variables* (e.g. trust). To ensure that effects can be unequivocally attributed to the independent variable, experimenters aim to keep potentially intervening variables constant or to control them. It is for this reason that experimental approaches lend themselves most easily to laboratory settings, where such control can be relatively easily achieved. As indicated above, this may severely compromise the ecological validity of the results gained, because experimental controls may create relatively artificial situations that are substantially different from the real-world situations to which one wishes to generalise.

Surveys do not suffer from these problems, as they do not systematically manipulate variables of interest. Surveys often elicit participants' own inferences, by asking them about their real life experiences. A related, non-experimental approach are ethnographic studies

(Kujala, 2003). This approach, rather than eliciting self-reports from users, relies on researchers engaging with the user in the situation of interest and questioning them about events as they occur. Ethnographic studies typically span a substantial period of time. Both approaches, surveys and ethnographic studies, are descriptive in nature and do not allow to test hypotheses (see 4.1.1). An exception may be seen in surveys that elicit quantitative data and use naturally occurring variations on independent variables to make inferences about their effect (e.g. comparing user trust under two different regulatory regimes; see *institutional embeddedness* 3.4.1.3). This approach is sometimes referred to as quasi-experimental (Bortz et al., 1995). However, it carries the problem that naturally occurring groups may differ on more than the variables of interest, which may make it difficult to draw appropriate inferences.

4.1.3 Laboratory and Field Studies

The distinction between laboratory and field studies is again closely aligned with the distinction between quantitative and qualitative approaches. Experiments that elicit quantitative measures are typically conducted in the laboratory and ethnographic studies are conducted in the field, i.e. in the situations where the phenomena of interest normally occur. There is some cross-over, e.g. in focus groups or in focused interviews with users, where participants are invited to the laboratory – sometimes to observe and record their engagement with an artefact. Experimental studies may also be conducted in the field. However, this commonly requires substantial resources, as the field setting increases the effort required in controlling for potentially intervening variables. Laboratory studies are typically conducted as one-off events, rarely lasting more than a couple of hours. Qualitative field studies or ethnographic studies, on the other hand, may last several years (e.g. studies of early online neighbourhoods, Hampton, 2001).

4.1.4 Data Acquisition Techniques

Any empirical study needs to acquire data for analysis. Common ways of data elicitation in trust research are users' self-reports, either through qualitative interviews or through structured questionnaires, and behavioural measures that observe users' behaviour.

Interviews. Interviews in the context of trust research can either be used to get insight into users' trust or to elicit their own inferences about their decision-making on trust. The latter approach elicits aggregate experience together with conclusions drawn by the respondent. The advantage of this approach is that researchers gain rich and contextualised insights. The

disadvantage is that these insights are bounded by respondent's own limited capacity for introspection (Bortz et al., 1995). This problem becomes particularly virulent in the case of trust research. As discussed in section 2.2, trust is partially based on pre-rational, visceral reactions (see 2.2.4), which are not fully accessible to individuals' own introspection. The problem is aggravated by the fact that individuals are known to give a post-hoc rationalised account of their decision-making (Bortz et al., 1995) and are thus likely to understate the effect of affective or pre-rational components in their decision-making process.

Questionnaires. Unlike qualitative interviews, questionnaires can be used in an experimental paradigm, as they allow the elicitation of quantified trust measures (e.g. Steinbrueck & Schaumburg, 2002). Questionnaires share the above-mentioned limitations of qualitative interviews in that they elicit cognitively mediated information, are subject to post-hoc rationalisation, and are bounded by individuals' limited capabilities to introspect their decision-making process. In addition, trust questionnaires – unlike open-ended qualitative interviews – can guide participants' attention to specific risks that they might otherwise not consider and thereby skew results.

Behavioural Measures. Observing actions that require trust avoids the problem of limited introspection and post-hoc rationalisation. Rather than asking individuals for their own inferences regarding their behaviour, the researcher directly observes it. This approach can be seen as particularly beneficial to research into trust, due to the shortcomings of self-report measures discussed above.

Behavioural measures, however, also carry the disadvantage that they do not give any additional insight into participants' decision-making processes. As an example, it may be difficult to judge from observed behaviour, whether a user acted in a specific way because she lacked trust in a trustee or due to some other motivational impulse. For this reason behavioural measures commonly require carefully controlled experimental settings to ensure that observed behaviour can be attributed to the constructs under research. In many cases researchers combine behavioural and self-report measures.

4.2 Trust Measures in Current HCI Research

After the previous section introduced the main dimensions on which empirical methods can be differentiated, this section critically discusses the methods used in current HCI trust research. They are categorised into qualitative approaches (see 4.2.1), experiments with trust questionnaires (see 4.2.2), and social dilemma games (see 4.2.3). Social dilemma games are

discussed in more depth for a number of reasons. First they are more complex than standard experimental approaches and thus merit a more detailed description. Second, they have become very popular in HCI research on trust in virtual teams, which formed a substantial part of the discussion in section 2.3.4. Finally, and most importantly, their use has been relatively controversial.

4.2.1 Qualitative Approaches

Initial studies on trust in e-commerce used qualitative, semi-structured interviews to gain an understanding of how users evaluate an e-commerce vendor's trustworthiness from the surface cues they perceived on its web site (e.g. Sapient & Cheskin, 1999; Egger, 2001; Nielsen et al., 2000; Riegelsberger & Sasse, 2000, see 9.3). These studies asked users for aggregate reports about their own decision-making. Other studies used qualitative interviews in conjunction with user evaluation sessions, in which users' immediate reactions to interface prototypes were elicited (e.g. Riegelsberger et al., 2002a; Witkowski et al., 2003).

These approaches are very well suited to begin exploring complex phenomena such as trust in e-commerce or to learn about users' reactions to novel designs. They enable researchers to focus on relevant aspects of the problem space and to begin formulating relevant hypotheses. However, as indicated in section 4.1.4, they are limited by users' ability to analyse their own decision-making processes, in particular with regard to a complex phenomenon such as trust. A further shortcoming of much current research on trust, which is particularly apparent in commercial e-commerce trust research (Dayal, Landesberg, & Zeisser, 2001; IBM, 2003; Sapient & Cheskin, 1999, see 9.3), is that no formal method for analysing qualitative data has been employed. This makes it difficult to judge the validity and reliability of the conclusions made. In some cases, e.g. when analysing long-term effects of media on trust in the field (as done by Jarvenpaa & Leidner, 1998), a qualitative survey approach can be the only feasible mode of enquiry. In many other cases, however, initial qualitative findings and the hypotheses they generated can and should be subjected to experimental tests.

4.2.2 Experiments with Trust Questionnaires

Initial qualitative research on trust in mediated interactions has been followed up in some experimental tests. Many of these studies, in particular in the area of trust in virtual teams, used social dilemma games. These will be discussed separately in section 4.2.3. The remainder of the experimental studies, mostly on the effect of interpersonal cues on trust in e-commerce, varied the presence of interpersonal cues in the interface (e.g. a photo or an

animated assistant) and measured differences in user trust with questionnaires. However, the lack of a coherent conceptual basis for trust research (see 3.1) is reflected in a lack of standardisation of questionnaire tools. Many researchers created trust questionnaires ad-hoc. They included items that pertain to trust or trustworthiness in a particular situation (e.g. Jarvenpaa & Tractinsky, 1999; Rickenberg & Reeves, 2000). In these studies, trust is often elicited with one or a few items that are rated with Likert scales (e.g. Rickenberg & Reeves, 2000). Out of the studies that investigated the effect of interpersonal cues on trust in e-commerce vendors (section 2.3.5) only a few studies used questionnaire instruments that were constructed and tested more thoroughly. One questionnaire was developed by Kammerer (2000) and one by Egger (2001). The questionnaire by Kammerer was used in the studies by Steinbrueck & Schaumburg (2002) on photos and Zachar & Schaumburg (2002) on embodied agents. A translated version of the questionnaire by Kammerer is given in Appendix B.10.

While experimental questionnaire studies allow hypothesis testing, they still share the shortcoming of qualitative studies in that they rely on users' self-reports. A further limitation of these laboratory experiments is that they do not induce risk. In qualitative interviews users are asked to report their everyday decision-making in situations where they were subject to real risk. In questionnaire studies on e-commerce trust, however, no risk is present. As risk is an integral attribute of trust-requiring situations (see 3.2.1), this shortcoming is particularly grave. While experiments on trust without the induction of risk are relatively commonplace in HCI trust research (with the exception of trust in virtual teams, see 2.3.4), this practice is widely criticised in experimental economics (e.g. by Glaeser et al., 2000). Results gained by simply questioning participants are deemed to be of low validity in this field (see e.g. Fehr et al., 2003). In an attempt to overcome the limitations of rating measures that do not induce risk, several HCI researchers have begun using social dilemma games with financial risk as a means of investigating trust.

4.2.3 Behaviour in Social Dilemma Games

Most studies reviewed in section 2.3.4 that investigate the effect of media on trust in other humans (in teams and dyads) employ social dilemma games based upon the Prisoner's Dilemma. This approach is taken from experimental economics and draws on game theory. These studies measure players' rate of cooperation and defection (non-fulfillment) to infer media effects on trust and trustworthy behaviour. The interpretation of cooperation as trust in a social dilemma situation is based on the definition of trust *as willingness to be vulnerable based on positive expectations about the actions of others* (see section 3.2.4). Indeed, the

decision to cooperate carries more risk: a player will regret having chosen to cooperate if the other player chooses to not-fulfil.

4.2.3.1 Introduction to Social Dilemma Games

Situations in which individual rational outcome contravenes collective rational outcome are known as *social dilemmas*. In these situations, individuals' efforts to maximise their own outcome will result in a reduced outcome for everyone (including themselves). An example of such a situation is trading: each trader is better off receiving the other's good without giving his own. However, both traders acting in this way will result in no exchange of goods, which is less desirable for both than a completed exchange. Social dilemmas are often seen as prototypical situations that require trust: actors have to forego maximised situational benefit and they have to trust others to do the same in order to achieve a maximal collective outcome. The *Prisoner's Dilemma* (Tucker, 1950; Flood, 1952) is the most prominent social dilemma, but not the only one. Other examples are *Assurance Games*, *Stag Hunt,* and the *Trust Game* (Kollock, 1998), which forms the basis of the framework introduced in Chapter 3. Most experimental research based on social dilemmas in HCI uses an incentive structure that is based on the Prisoner's Dilemma. In games with a social dilemma structure, two players' decisions are associated with monetary rewards. The outcome with the highest pay-off for one particular player is to defect while the other player cooperates (DC), next is cooperation by both players (CC), followed by joint defection (DD). The outcome with the smallest pay-off results from cooperating while the other player defects (CD). Table 4.1 exemplifies the pay-off in a Prisoner's Dilemma game.

As can be seen from Table 4.1, the individually rational decision to defect will lead to suboptimal outcome for both players: both will be left with an outcome of 1 rather than 2. If both players were fully rational and would only decide based on the pay-offs defined by the game, they would always choose to defect in a one-off game as this is the *Nash-Equilibrium* of the game (Nash, 1950). The latter will always be the best decision in retrospect (Poundstone 1993), independent of the other player's decision. However, it results in a socially suboptimal outcome (Table 4.1; figures in the upper right corner denote the column player's pay-off; figures in the lower left corner indicate the row player's pay-off). This research refers to such social dilemma games with a Prisoner's Dilemma pay-off structure as PD-based games.

	Cooperate	Defect
Cooperate	2 (CC) 2 (CC)	3 (DC) 0 (CD)
Defect	0 (CD) 3 (DC)	1 (DD) 1 (DD)

Table 4.1: Illustration of pay-off distribution in a Prisoner's Dilemma (PD) game. Figures in the upper right corner give column player's pay-off. Figures in the lower left corner indicate the row player's pay off.

However, in experimental PD games and in real-world situations that have a PD structure, actors do not just act on situational pay-off, but on their *utilities.* Utilities are a reflection of the players' real preferences. These will be influenced by many factors other than just the rewards given in a one-off PD game (see trust-warranting properties in the framework, 3.2.4). Experimental rewards as shown in Table 4.1 are also called *endogenous pay-off,* as they are defined within the game rules. These endogenous pay-offs will influence each player's utility, but the final utility associated with each outcome will also be shaped by *exogenous pay-offs.* Using this terminology, the trust-warranting properties (e.g. *internalised norms*, *temporal embeddedness*, etc.) introduced in the framework can be seen as exogenous pay-offs. Table 4.2 illustrates how the hierarchy of preferences might change when exogenous pay-offs are factored in. In the example given, the row-player attaches value to cooperation (e.g. motivated by *internalised norms*) irrespective of the move made by the other player.

	Cooperate	Defect
Cooperate	2 2+*2*	3 0+*2*
Defect	0 3+*0*	1 1+*0*

Table 4.2: Hypothetical utilities of the row-player

Thus, experimental PD games are games of *incomplete information,* as a participant does not know the other participant's true utility for each outcome. The missing information about *exogenous pay-offs* must be estimated from other cues available. This conflict between endogenous and exogenous pay-off reflects the conflict between situational temptation and trust-warranting properties that are central to trust (see 3.2.4). This conflict makes PD games interesting models for trust research.

4.2.3.2 Critique of Social Dilemma Games

Investigating trust in mediated transactions by means of social dilemma games with financial incentives can be seen as beneficial for several reasons. First, social dilemma studies are part of an experimental approach and thus allow testing hypotheses (section 4.1.1). Second, this approach avoids the problems of introspection and post-hoc rationalisation that limit self-report measures such as qualitative interviews or trust questionnaires (section 4.2.1 and 4.1.2). Finally, by inducing financial risk the validity of the decision-making processes observed is increased compared to rating scales that do not carry any risk (section 4.2.3).

However, PD-based social dilemma games can also be too limited when assessing a technology's trust-building potential for the following four reasons that are discussed below: *structure* (see 4.2.3.2.1), *ability* (see 4.2.3.2.2), *risk modelling* (4.2.3.2.3), and *time* (4.2.3.2.4).

4.2.3.2.1 Structure

PD-based social dilemma games are symmetric and synchronous. Hence, defection might take place due to any of the following reasons:

Lack of trustworthiness. The player is not trustworthy (has no intrinsic trust-warranting properties) and just acts on the situational pay-off.

Lack of trust. Defection takes place due to defensive motives, as the other player is expected to defect. The player might want to withdraw rather than defect, but the PD game forces her to act as a defector if she lacks trust.

Expectation of not being trusted. The fear that the other player will act based on motive 2, i.e. defect pre-emptively, could trigger defection.

These considerations could be extended infinitely with each player trying to second-guess the other's intention. It results in a further risk that is specific to synchronous symmetric situations, in which all actors are trustor and trustee at the same time. This additional risk is called *strategic insecurity* (Lahno, 2002a). It cannot be overcome by complete information about the other player's motives and preferences, but depends solely on the specific synchronous and symmetric structure of the game. Synchronous and symmetric games are used in experimental economics to investigate *public good problems*. Due to the size of the group, an actor in a public good problem cannot base his or her decision on knowledge about

all the other actors' decisions. A PD game's synchronous structure is thus a good model of such situations. Furthermore, public good dilemmas are *symmetric* dilemmas as all individuals are confronted with the same situational pay-offs. In many everyday trust-requiring situation, however, even when we speak about *mutual trust*, we rarely refer to situations in which two individuals have to reach a trust-decision at exactly the same time without knowing the other's decision (Lahno, 2002a). Trust is more likely to manifest itself and grow through sequential asynchronous trust-requiring situations, where on any given instance one individual is the trustor and the other individual the trustee (Luhmann, 1979; Bacharach & Gambetta, 2003). The framework introduced in Chapter 3 takes the asynchronous Trust Game as its basis. The Trust Game has been widely used as a paradigm in experimental economics (e.g. Bohnet et al., 2003; Keser, 2002; Berg et al., 2003) to research trust. In the context of this research a particular benefit is that it allows for a separate analysis of effects on trust and trustworthy behaviour.

In summary, using asynchronous Trust Games, rather than synchronous PD-based games, allows for the analysis of trusting action and trustworthy behaviour separately. Additionally, it removes the need to opt for non-fulfillment for defensive reasons, and it models many real-world situations more accurately.

4.2.3.2.2 Ability and Motivation

Social dilemma games focus on whether trustees are willing to fulfil or not – they investigate motivation which is one factor of trustworthiness. However, following Deutsch's, (1958) classic definition (see 3.2), trustworthiness also consists of the ability to perform as expected. Motivation of the trustee ensures that he will not choose to exploit the trustor's vulnerability, and ability ensures that he will not involuntarily harm the trustor.

In many everyday situations, however, questions of trust do not arise from the risk of wilful deception, but because one is uncertain about the other's ability to perform as expected. An individual might mean well, but lack the expertise to be truly helpful. If, in a virtual team, a critical task is assigned to a team member, the concerns would not only include that he might lack *motivation* to perform, but also that he might not be *able* to perform, or that he misinterprets the instructions. Risks that are based on lack of competence or misunderstandings are often more salient than wilful defection. While motivation and ability are factors contributing to trustworthiness, social dilemma games only investigate motivation.

4.2.3.2.3 Risk Modelling

Social dilemma studies with financial incentives constitute an improvement over studies that do not induce any risk for the study of trust. However, this approach can still be criticised for

falling short of studying trust under real complex risk as it is present in real-world situations. Trust has been described as a device to reduce complexity, a shortcut to avoid complex decision-making processes when facing decisions that carry risk (Luhmann, 1979). Trust is of particular importance when an individual knows little about the type, quantity and gravity of outcomes associated with a particular decision. Users of online technologies face more – and often less understood – risks than actors in face-to-face situations (see section 2.2.2). In a social dilemma game, by contrast, participants are very well aware of the gravity and nature of risks associated with their decisions. Trust is needed precisely when individuals cannot calculate a utility for every possible outcome, or where this calculation would be too costly (Kee & Knox, 1970).

Secondly, for ethical reasons, all experiments lack the ability to create serious risks for the participants. In experimental studies participants do not lose money in the course of the experiment – rather, their decisions determine the size of their *gain*. From a mathematical point of view, there may be no difference between a loss, and missing a gain that was expected. However, Kahneman, Slovic, & Tversky (1982) showed that individuals' decisions depend on whether the outcomes are framed as loss or gain: generally, people are keener to avoid loss than to achieve gain. Furthermore, real-world risks are usually multi-dimensional and include non-monetary cost (such as embarrassment, loss of privacy, or cognitive effort), in a social dilemma experiment, risks are generally monetary.

Finally, in the real world it is often impossible for trustors to find out whether they have been cheated, or whether they are victims of unlucky circumstances (see 3.2.7 on parametric risk). A colleague who does not deliver an important milestone on a project might just have had to prioritise another task (non-fulfillment due to parametric risk) or she might have wilfully sabotaged the project (non-fulfillment due to lack of motivation).

4.2.3.2.4 Time

A disadvantage that social dilemma studies share with other approaches that rely on laboratory experiments is the difficulty of assessing the impact of time. Most social dilemma studies consist of one-off laboratory sessions, normally lasting only a couple of hours. Most studies ensure that participants do not know each other prior to the study to minimise the effects of prior acquaintance. This practice shows that the factor time, e.g. in the form of length of acquaintance, is expected to have a strong effect on behaviour in social dilemma games. The discussion of the framework for trust in mediated interactions (see 3.4.1.1 and 3.5.1) also emphasised that time is an important factor that influences how trust is formed and how contextual and intrinsic trust-warranting properties are balanced. For practical reasons, however, this is prominent role of time is not reflected in studies investigating trust in the

laboratory. Only qualitative surveys and ethnographic studies (e.g. Rocco et al., 2000) looked at longer-term effects.

4.2.4 Summary

This section reviewed various methods used in current HCI trust research. They were categorised into qualitative methods (see 4.2.1), experimental questionnaire studies (see 4.2.2), and experimental social dilemma studies (see 4.2.3). The review showed that much work on trust within HCI is based on qualitative methods alone. Whilst this approach is vital when beginning to investigate a new phenomenon or when exploring long-term effects, it is also necessary to follow up on such hypothesis-generating research with hypothesis-testing quantitative studies. This was seen as particularly relevant for trust research, where qualitative methods that rely on self-reports are severely compromised by individual's limited capacity for introspection or their tendency for post-hoc rationalisation. The body of work that used laboratory experiments and questionnaires to compare user trust in different conditions addressed the first issue (hypothesis-testing), but still falls short on the second as it is based on users' self-reports.

Special attention was given to the review of experimental social dilemma studies, since these overcame the limitations of users' self-reports, by allowing researchers to observe trusting action and trustworthy behaviour directly. These studies used financial incentives to enable observing participants' decisions under risk. This approach is a common practice in experimental economics but has been rarely used in HCI trust research outside the area of trust in virtual teams. A critical discussion identified several limitations – some of which are easy to overcome within the paradigm, whereas others are not. A fundamental problem identified with their wide-spread use was the synchronous and symmetric structure of the particular games that were used (mostly games with a Prisoner's Dilemma structure). These are an appropriate model for public good problems, but are inappropriate for asymmetric and asynchronous situations in which one can identify one trustor and one trustee who are not acting at precisely the same moment. Consequently, other disciplines, such as economics, are using another social dilemma game, the Trust Game, to investigate trust-requiring situations with behavioural measures. HCI researchers should explicitly state the type of situation they are modelling (see 3.5.3 for such a scoping for this research) and use the appropriate social dilemma game. A further problem that is shared by all social dilemma studies is that they focus on motivation to act on a trustworthy manner. As was shown in the framework (see 3.4.2.1) trustworthiness is also determined by the trustee's ability to act as expected. Finally, two points of criticism were made that are shared by all approaches that rely on laboratory

experiments. First, it is not possible to model the complexity and potential gravity of real-world risk. Second, laboratory experiments commonly do not investigate long-term effects, as they rely on experimental sessions only lasting a few hours. Section 4.3 introduces the methods used in the research that was conducted for this thesis. The discussion highlights which methodological limitations of earlier work were overcome and which ones had to be accepted.

4.3 Trust Measures in this Thesis

This section first discusses how the research presented in this thesis builds upon methods used in previous studies and how it overcomes some of their limitations (see 4.3.1). Next, the approach and methods used in this research are described in detail (see 4.3.2). A focus is given to the methodological aspects that are shared by all experiments; specific details about the methods used in each experiment are given in the respective method sections (section 5.2 for Experiment 1; section 6.2 for Experiment 2; section 7.2 for Experiment 3; and section 8.2 for Experiment 4).

4.3.1 Addressing the Limitations of Current Research

This thesis takes the view that quantitative and qualitative approaches should complement each other (see 4.1.1). The effect of interpersonal cues on trust in e-commerce is a relatively novel research area, which has been investigated with qualitative methods in earlier research by the author (Riegelsberger & Sasse, 2000; Riegelsberger et al., 2002a) and by other researchers (e.g. Urban, 1999). The investigation of effects of interpersonal cues on interpersonal perception of other users has a longer research tradition, including qualitative and quantitative studies (see 2.3.4). Hence, building on a rich basis of qualitative work in both research areas (trust in e-commerce and trust in a communication partner), this thesis took a hypothesis-testing quantitative approach.

This approach requires experimental control of independent variables, which can be either achieved in a laboratory or in a quasi-experimental field study. As discussed in section 4.1, both approaches have advantages and disadvantages that have to be traded off against each other. For this research it was decided to use laboratory studies, as they allow a high level of experimental control while keeping resource requirements relatively low. As this decision carries a cost in terms of reduced ecological validity (laboratory situations may differ significantly from the real world situation about which one wishes to make predictions), considerable emphasis was given to maximising ecological validity within the constraints of a laboratory situation.

Previous research into trust had been criticised (see 4.2.1 and 4.2.2) for relying exclusively on users' self-reports, either elicited in qualitative interviews or with trust questionnaires. In addition, previous laboratory research (with the exception of studies into trust in virtual teams, see 2.3.4) measured trust without inducing any form of risk. To overcome these limitations, the studies reported in this thesis induced financial risk and observed participants' trusting behaviour. This approach ensured that measures were not impeded by participants' post-hoc rationalisation or by their limited capacity for introspection. It is acknowledged that financial risk in a laboratory situation does not fully model real-world complex risk (see 4.2.3.2.3). However, it allows combining the strength of a laboratory setting (control of variables) with some element of real-world risk and thus constitutes an improvement over laboratory studies that do not induce risk at all.

Studies in virtual teams used a similar approach, but they were criticised for using a synchronous and symmetric social dilemma task which induced strategic insecurity. Strategic insecurity was identified as a property of public good problems, but it is not normally present in everyday situations in which one can identify a trustor and a trustee (see 3.2.8). Symmetric and synchronous tasks further do not allow investigating trust and trustworthy behaviour separately. Hence, the research reported in this thesis used experimental tasks that were modelled on the first move in a Trust Game, which has been widely used in economics and which also forms the foundation of the framework introduced in section 3.2. In contrast to other Trust Game studies, this research controlled the trustworthiness of the trustee as an independent variable. This allowed investigating users' ability to identify trustworthy from less trustworthy vendors (Research Goal 1).

In a further step towards addressing the limitations imposed by conducting laboratory studies, the stimulus material used in this research was carefully chosen. Whereas previous studies in the area of e-commerce trust created mock-ups of e-commerce sites to test the effect of interpersonal cues (e.g. Riegelsberger et al., 2002a; Steinbrueck & Schaumburg, 2002; Zachar & Schaumburg, 2002; Urban, 1999), the experiments conducted for this thesis used semi-functional copies of existing vendors' sites (Experiment 1 to 3). Similarly, in the area of online advice, this research used an untrained *vs.* a trained advisor to control the factor expertise, whereas some previous research only varied the ratio of correct to incorrect advice (van Mulken et al., 1999).

While the studies conducted as part of this thesis were carefully constructed to overcome several limitations of earlier studies (conducted by the author and by other researchers), there are still some limitations that had to be accepted. Some of these result from a limitation of resources, others are the consequence of unavoidable trade-off decisions. One of the limitations of the latter type was incurred by the decision to conduct controlled experimental

studies, which made it impossible to observe decisions made under higher or complex risk as it would be present in the field. A further limitation of previous research that was not overcome is the focus on the short term. While some of the experiments conducted as part of this thesis looked at repeated interaction with a stimulus during one experimental session (Experiment 3 and 4), none explored long-term effects of several days or weeks (Table 4.3).

Limitations Addressed	
Limitation of Earlier Studies	Improvements Introduced in this Thesis
Reliance on self-reports	Observation of trusting behaviour
Absence of risk	Financial risk induced
Symmetric Prisoner's Dilemma Games	Asymmetric tasks modelled on Trust Game
Focus on increasing trust	Focus on well-placed trust
Experimental mock-ups used	Copies of existing sites used
Limitations Accepted	
Focus on financial risk rather than complex real-world risk	
Focus on short time spans (1-2 hours) rather than long-term trust development	

Table 4.3: Overview on the limitations of earlier studies an how they were addressed

This section discussed the methodological approach of this thesis in relation to the methods and limitations of earlier research. The next section describes the approach and specific methods used in more detail.

4.3.2 Methodological Approach

As discussed in section 4.3.1, experimental laboratory studies were chosen as the main methodological approach of this research. While the individual experiments of this thesis use different experimental tasks and scenarios, they share the main variables of interest. Hence, this section on methodology is structured according to the main independent (see 4.3.2.1) and dependent variables (see 4.3.2.2) under research. Details and auxiliary variables that are specific to individual experiments are discussed in the respective method sections (section 5.2 for Experiment 1; section 6.2 for Experiment 2; section 7.2 for Experiment 3; and section 8.2 for Experiment 4). Table 4.4 gives an overview on the Experiments and classifies them on key dimensions.

	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Chapter	Chapter 5	Chapter 6	Chapter 7	Chapter 8
Research Goal	3	1,2,4	1,2,3,4	1,2,4
Trustee	Online Vendor	Online Vendor	Online Vendor	Human Advisor
Prediction	n/a	P1	P1	P1 / P2
Interpersonal Cues (see 3.3.2)	Symbolic	Symbolic	Symbolic	Symptomatic
Key Topic	Usability	Trust	Trust & Usability	Trust
Experimental Sessions	Jan - Feb 2002	Sep 2002	Jan – Feb 2003	Jul 2004
Published	Riegelsberger, Sasse, & McCarthy (2002b)	Riegelsberger et al. (2003a)	Riegelsberger et al. (2003c)	Riegelsberger et al. (2005a), Riegelsberger et al. (2005c)

Table 4.4: Overview on the experiments conducted as part of this thesis

4.3.2.1 Independent Variables

This section introduces the independent variables, i.e. the factors that were experimentally manipulated. The main independent variables of this research are an actor's *trustworthiness* (Research Goal 1) and the *presence of interpersonal cues* and – determined by the media representation – *type of interpersonal cues* (Research Goal 2). *Trustworthiness* is either operationalised as an e-commerce vendor's expected post-order performance (*vendor trustworthiness*, Experiment 2 and 3) or as an advisor's *expertise* (Experiment 4). Interpersonal cues are investigated in the form *facial photos* (Experiments 1 to 3) and in the form of *video*, *avatar*, *audio*, and *photo+text* representations (Experiment 4, see Table 4.4).

4.3.2.1.1 Trustworthiness

The independent variable *trustworthiness* is instrumental in addressing Research Goal 1, i.e. to broaden HCI trust research beyond a focus on increasing user trust to investigating users' ability to discriminate between trustworthy and less trustworthy actors. Hence, the experimental designs in Experiments 2 to 4 manipulate the *trustworthiness* of the trustee.

Table 4.5 describes how this approach allowed assessing users' discriminative ability (the table shows a binary treatment of *trustworthiness*; in Experiments 2 and 3 *vendor*

trustworthiness was also determined on a scale from 1-10 – see 6.2.2.2 and 7.2.2.1). From the signals they perceived participants had to evaluate the trustworthiness of the trustee. Trusting a trustworthy trustee resulted in well-placed trust. Trusting an untrustworthy trustee constituted a gullibility error (Fogg, 2003a). Vice-versa, not trusting an untrustworthy trustee was a correct decision, while not trusting a trustworthy trustee constituted an incredulity error (Fogg, 2003a).

	Trustworthy Actor	Untrustworthy Actor
Trusting	Well-placed Trust	Misplaced Trust (Gullibility Error)
Not Trusting	No Trust (Incredulity Error)	No Trust (Justified)

Table 4.5: Error types in trust decisions (Fogg, 2003a)

One indicator for discriminative ability in such a binary setting is the level of trust given to trustworthy actors *vs.* that given to untrustworthy actors. This treatment of trust allows framing the problem of placing trust well as a signal detection problem. This approach was explored in the analysis of Experiment 4 (see 8.2.6.3), where participants' SENSITIVITY to correct advice was investigated. In addition to this binary treatment of trustworthiness, Experiment 2 and 3 also used continuous measures for participants' level of trust.

4.3.2.1.2 Media Representation

The second key interest of the studies conducted as part of this thesis was to identify an effect of interpersonal cues on user trust (Research Goal 2). Consequently, the experiments varied the presence and type of media representations of interpersonal cues. Experiments 1 to 3, which focused on trust in e-commerce varied the *presence of a facial photo* of a sales assistant. As was argued in section 2.2.4, researching effects of the presence of a photo is of high practical value, as it is an easily implemented and thus commonly used way of trying to build affective trust. In addition, Experiments 2 and 3 also varied the content of the photo, i.e. the interpersonal cues given off. These experiments investigated whether interpersonal cues have an impact on affective trust in a situation where they clearly give no additional insight into the trustee's (i.e. the vendor's) trustworthiness (symbolic use of interpersonal cues, see 3.3.2). In this setting interpersonal cues could only be expected to bias users' trust perceptions (P1, see 2.3.3).

Experiment 4 took a different approach. Here, the trustee was a human advisor and the interpersonal cues given off could be expected to give real insight into her expertise,

confidence, or background (symptomatic function of interpersonal cues, see 3.4.2.4). Additional interpersonal cues transmitted in richer representations could be expected to give additional insight into the trustee's trustworthiness (P2, see 2.3.3), but also to bias trust by increasing social presence (P1, see 2.3.3). Experiment 4 was designed to contrast these two predictions. It investigated the effect of adding a facial *photo*, but it also included the richer media representations *video*, *avatar*, and *audio*.

4.3.2.2 Dependent Variable: Trust

The key dependent variable of this thesis is user trust. As this research is committed to a hypothesis-testing experimental approach, it requires a way of quantifying participants' trust. In aiming to overcome the limitations of previous elicitation techniques (see 4.2), this research measured trust by observing decisions made under financial risk. The approach taken in all experiments in this research was to make participants' pay dependent on their ability to identify trustworthy actors. As in real life, trusting untrustworthy actors resulted in a loss (reduced final pay), whereas trusting trustworthy ones yielded a gain (increased final pay). While this approach constitutes an improvement over measures that do not induce any risk, it is acknowledged that this approach still falls short of inducing real complex risk (see 4.2.3.2.3 and 4.3.1).

The research conducted for this thesis presented asymmetric situations of risk: the experimenter controlled the trustworthiness of the trustee (see 3.2.8) and the participants were in the role of the trustor, having to make trust decisions based on the surface cues they perceived. In the terms of the framework presented in Chapter 3, this approach observes trusting action (e.g. investment of parts of participation pay) to make inferences about the participant's internal non-observable level of trust. In a laboratory setting, where other factors (e.g. availability of outside options) that could impact the relationship between trust and trusting action are controlled, such inferences can be made. The range within which trust decisions impacted final pay varied across the experiments. The smallest range was £6 (Experiment 3), the highest was £12 (Experiment 2). As the majority of participants in all experiments were students, these sums can be expected to have posed considerable risk compared to studies without such financial incentives.

The method sections in the chapters describing the experiments will introduce the methods for observing and quantifying trust decisions in the respective experiments in detail. In all experiments the trust measures that created financial incentives were complimented with standard rating measures that did not induce financial risk.

4.4 Usability Measures in this Thesis

A further goal of the research presented in this thesis was to investigate potentially adverse effects of facial photos on the usability of e-commerce systems (Research Goal 3). Previous qualitative research (Riegelsberger et al., 2002a) suggested that such non task-related elements reduce task performance and increase user cost. A review of the existing literature was inconclusive regarding the effect of facial photos on e-commerce sites on visual attention and usability (see 2.4). Hence, experimental methods are used in this research to answer these questions. This section introduces the quantitative methods that are commonly used to investigate task performance and user cost. It then goes on to argue for the use of eye-tracking measures to investigate these issues. Task performance and user cost are core dimensions of usability and several measures have been introduced to quantify them (see 2.1). Table 4.6 (adapted from Park et al., 1997) gives an overview on those that are commonly used.

Task Performance	User Cost
• Percentage of users successfully completing task • Number of user errors • Ratio of error to task completion • Number of tasks completed in a given time • Average accuracy of completed tasks • Time to complete a task • Number of references to help • Tasks completed per unit time • Time spent using help or documentation • Learning time	• Task Load Index (TLX; Hart & Staveland, 2003) • Physiological Measures (e.g. Electro-dermal activity; Wilson & Sasse, 2004) • Eye-Tracking (McCarthy, 2003; Roetting, 2001)

Table 4.6: Task performance and user cost with associated measures

While task performance is relatively easily measured objectively (e.g. timing, counting), objective measures of user cost are more difficult to elicit, as the concept relates to an internal state that is not directly observable. Forays have been made to use physiological measures (e.g. electro-dermal activity; Wilson & Sasse, 2004). However, there is still uncertainty as to how to interpret physiological arousal in relation to user cost (Wilson & Sasse, 2004). A method for investigating user cost that has been proposed in particular in relation to visual search tasks is eye-tracking (Roetting, 2001). Eye-tracking systems are becoming more affordable and less intrusive, which makes it easier to employ them for an investigation of usability issues on a fine-grained level. Out of the studies discussed in section 2.4, Lewenstein et al. (2002), Burke et al. (2004), and Witkowski et al. (2003) used this method. The other studies used post-experimental recall and recognition of individual interface elements to infer,

whether these elements had received visual attention (e.g. Pagendarm & Schaumburg, 2001). However, findings by Burke et al. (2004) indicate that these measures do not allow unequivocal inferences about whether specific interface elements had attracted visual attention or not (Burke et al., 2004; see 2.4). Eye-tracking, on the other hand, gives fine-grained insight into the users' pattern of search and how it may be affected by additional interface elements. The following section will briefly introduce the background to this method and describe the measures and the apparatus used in this research.

4.4.1 Introduction to Eye-Tracking

This section gives a brief overview on eye-movement and eye-tracking. A detailed review is outside the scope of this research but good introductions in the context of usability research are given by Roetting (2001), Jacob & Karn (2003), Schiessl et al. (2003), and McCarthy (2003). There are several methods for tracking the position of a user's gaze on a screen. These can be divided into remote tracking systems and head-mounted systems. The latter allow free head movements, but they create a very artificial situation as the tracking system is attached to the participant's head. An additional problem is linking the eye-movement data to positions on a screen, as eye movements are recorded relative to the head, rather than relative to a fixed point on the screen.

Remote tracking systems do not require anything to be attached to the participant, as they measure eye movements via the relative location of a reflection of a light source on the user's eye. However, older remote tracking systems required the head of the participant to be fixed in a stable position. Newer systems can account for participants' head movements and thus do not need such restrictions. This increases the ecological validity of eye-tracking studies, as users are less constrained. However, this gain in naturalness comes at the cost of lost data points if users move too rapidly or move their head out of the tracking field of the system (Jacob & Karn, 2003).

Eye-trackers provide a continuous stream of x-y-coordinates, identifying the user's position of gaze at a specific point in time. This data stream needs to be processed for a meaningful interpretation. The eye-movement model most commonly used is the *fixation-saccade* model. It divides eye movements into rapid movements (*saccades*) between points of spatially relatively stable gaze (*fixations*; McCarthy, 2003; Jacob & Karn, 2003). During a saccade the sensitivity to signals is reduced (Roetting, 2001). Objects that are looked at are projected on the *fovea* – the area at the back of the eye with the highest visual resolution. Visual resolution of the eye rapidly declines around the fovea allowing only for a vague perception.

4.4.2 Eye-Tracking Measures

Due to its relatively recent widespread application in usability research, there is still a controversial discussion on how to best create meaningful measures from eye gaze data. Jacob & Karn (2003) as well as Roetting (2001) give a detailed overview on the commonly used measures and on their interpretation. They found that the most frequently used measure in usability eye-tracking research is the TOTAL NUMBER OF FIXATIONS as an indicator of task performance (Jacob & Karn, 2003). However, this measure is highly correlated with TASK TIME, which can be easily measured without an eye tracker. It does not give much additional insight into the effect of specific interface elements on search processes. Thus, measures that capture the spatial distribution of visual attention are also commonly employed. These measures are based on defining areas of the interface as *regions of interest (ROI).* The eye-tracking data is then analysed for the ABSOLUTE or RELATIVE TIME SPENT FIXATING ROIS, where relative time is defined as time in a ROI divided by the total time spent on completing a task. The time spent in a ROI is seen as an indicator of difficulty in extracting information (Jacob & Karn, 2003) and can thus be understood as a measure of user cost for the specific information presented in that ROI. However, it is known that pictorial information (e.g. photos, graphical elements) is processed more rapidly than e.g. text (Kroeber-Riel, 1996). It has thus been argued that, in order to identify the visual impact of a ROI, measures that are independent from fixation length should be used (Jacob & Karn, 2003). One such measure is VISUAL ATTRACTION (McCarthy, 2003). VISUAL ATTRACTION is a binary measure that captures whether a region had been looked at by a participant all. Motivated by the finding that involuntary eye-movements result in periods of fixation that are shorter than standard, voluntary fixations (Graf & Krueger, 1989), this thesis uses two variants of this measure. One measure, VISUAL ATTRACTION (LOOKED), records whether any eye gaze was recorded in the ROI. It is more sensitive than VISUAL ATTRACTION (FIXATED) which records whether a ROI had received any fixation by a particular participant. If a ROI that is not relevant for task completion (e.g. a photo of an assistant) scores high on these measures, this can be seen as an indicator of a usability problem. Even if there is no effect on TASK TIME (task performance), such an increase in attraction can indicate that users are struggling to concentrate on the relevant information in the face of distracting elements. In the context of online advertising research, attraction of a ROI is used to identify whether an interface element (e.g. banner ad) had been perceived or not (Stern, 2002; Schiessl et al., 2003).

ATTRACTION OF ROI has two functions in the context of the research presented in this thesis. Firstly, it is used as a manipulation check to identify whether the added facial photo had received any visual attention at all. Secondly, it allows inferences on user cost. Additional

elements, such as photos, may not increase the overall length of a visual search task, but an increased number of fixated, but non-task-related elements, might increase user cost – independent of task completion time (Burke & Hornof, 2000). Measures of user cost that are more specific to the problem of searches on web sites are SCANPATH-LENGTH (the total length of all saccades) and BACKTRACKING (subsequent saccades with an angle < 90°; Goldberg & Kumar, 1998). These measures indicate problems with finding target elements and can thus, similar to attraction of non-task related ROIs, be used to infer whether additional interface elements really act as distracters. Table 4.7 gives an overview on the eye-tracking measures that are employed for this research and on their interpretation.

	Explanation	Reference
VISUAL ATTRACTION		
(LOOKED)	Participants whose eye-gaze was sampled in the ROI	McCarthy
(FIXATED)	Participants who who fixated the ROI	(2003)
SCANPATH-LENGTH	Total length of saccadic movements (indicator for user cost)	Goldberg & Kumar (1998)
BACKTRACKING	Number of times the angle between two subsequent saccades is <90° (indicator for user cost)	Goldberg & Kumar (1998)

Table 4.7: Eye-tracking measures used in this thesis

4.4.3 Apparatus

The research reported in this thesis used the EyeGaze system from LC Technologies. It has a tracking frequency of 50Hz and a spatial resolution of 0.5 degree, which translates to 5 mm on the screen at a standard viewing distance of 60 cm. It does not require the use of a chinrest or impose other restrictions on participants. Prior to conducting measurements, the system needs to be calibrated for each individual participant. The calibration process requires the participant to look at a sequence of fixation points on the screen. With the LC system a compromise between financial cost and ecological validity had been reached. As a result, several weaknesses of the system had to be accepted. First, it does not allow for testing fully functional web sites, as the tracking software cannot account for scroll movements and page links[19]. The analysis is thus restricted to single static pages. Secondly, its spatial resolution with 5 mm is relatively low. Newer systems or those that restrict participants' head movements reach higher levels of accuracy.

[19] The LC EyeGaze system gives only an output of continuous x-y-coordinates of eye-gaze. The research reported in this thesis used the experimental software that was developed by John McCarthy and Cameron Angus as part of the HIGHERVIEW project.

4.5 Chapter Summary

This chapter discussed the methodological approach of the studies that form the empirical part of this thesis. First, relevant dimensions on which empirical research can be classified were introduced (see 4.1). This section highlighted the advantages and limitations of several approaches. It also made clear how they are linked by trade-off relationships. This classification was then used to discuss existing work on trust in HCI.

This discussion revealed that a large part of existing work is based on qualitative, hypothesis-generating work. It was argued that, while qualitative work is an ideal way of exploring novel phenomena, it should be followed up by hypothesis-testing experimental research. Experimental studies can be conducted most efficiently in a laboratory setting, as it allows relatively easy control of intervening variables. Ecological validity, however, is compromised as the situation in the laboratory may deviate substantially from the real-world setting to which the researcher wants to generalise. Due to resource constraints and to achieve a high level of experimental control, this research employed laboratory experiments. The problem of ecological validity was addressed by using real-world stimulus materials (copies of existing websites in Experiments 1 to 3; real variations in expertise in Experiment 4 that investigated trust in a human advisor) and by inducing financial risk. These steps constitute methodological improvements over much existing research, which used less realistic stimulus material (e.g. mock-ups) and did not induce risk. Furthermore, reliance on self-reports (either in qualitative interviews or in experimental studies with trust rating scales) is a particular concern when researching trust. As trust is partially based on affective, visceral reactions (see 2.2.4), self-reports are problematic as they are subject to post-hoc rationalisation and individual's limited capability for introspection. To overcome this limitation, this research observed participants' trusting actions in the presence of financial risk. This approach had also been used by HCI studies on trust in virtual team. However, those studies had been criticised for creating rather artificial Prisoner's Dilemma situations that do not allow distinguishing trustor and trustee. Hence, the empirical studies in this research were modelled on the first move in a Trust Game in which the trustworthiness of the trustee (Research Goal 1) and the presence and representation of interpersonal cues (Research Goal 2) were experimentally varied (see 4.3). The section concluded that the research conducted as part of this thesis overcame many of the limitations of earlier work (e.g. reliance on introspection, lack of risk-modelling, strategic insecurity), but that some limitations had to be accepted as part of trade-off decisions and resource constraints. Laboratory studies, while inducing financial risk, can not completely model complex real world risk and they also make it difficult to investigate effects over an extended period of time.

The discussion of methods used for an investigation of effects of photos on visual attention and on the usability of online systems (section 4.4) showed that research in this area was mostly based on qualitative interviews (e.g. Riegelsberger et al., 2002a) and self-report measures such as recall and recognition. To test the predictions that were derived from earlier qualitative studies (Research Goal 3), an experimental approach was chosen. Eye tracking was identified as a particularly promising method, as it allows fine-grained insight into visual search tasks without being subject to users' cognitive mediation or memory effects. Firstly, eye-tracking was employed as a manipulation check to identify whether non-task related peripheral facial photos were attended at all (e.g. VISUAL ATTRACTION). Secondly, eye-tracking measures gave insight into effects on patterns of visual search and thus on user cost (e.g. SCAN PATH LENGTH, BACKTRACKING).

The following chapters report – in chronological order – the four experiments that were conducted for this thesis. In each chapter, the research questions addressed by the experiment in reference to the overarching research goals are introduced. Then the specific methods used in the experiment are discussed and the results are presented. Each chapter closes with a discussion of the finding in relation to the research goals and to previous research. Table 4.8 gives an overview on all the experiments conducted as part of this research.

	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Chapter	Chapter 5	Chapter 6	Chapter 7	Chapter 8
Research Goal	3	1,2,4	1,2,3,4	1,2,4
Trustee	Online Vendor	Online Vendor	Online Vendor	Human Advisor
Prediction	n/a	P1	P1	P1 / P2
Interpersonal Cues	Symbolic	Symbolic	Symbolic	Symptomatic
Key Topic	Eye-tracking	Trust	Trust & Eye-tracking	Trust
Key Independent Variables	*Presence of a photo* *Task type* *Time* (*Exposure order*)	*Vendor Trustworthiness* *Presence of a photo* *Trustworthiness of a photo*	*Vendor trustworthiness, Presence of a photo, Trustworthiness of a photo, Time* (*Exploration depth* and *Exposure order*)	*Trustworthiness* (*Expertise*) *Media representation* (*video, avatar, audio, photo+text, text-only*) *Time* (*Repeated encounters*)
Key Dependent Variables	TASK TIME, VISUAL ATTRACTION (LOOKED / FIXATED)	INVESTMENT , ASSESSMENT	INVESTMENT, ASSESSMENT, TASK TIME, VISUAL ATTRACTION (LOOKED/ FIXATED) BACKTRACKING, SCANPATH-LENGTH	ADVICE SEEKING INTERPERSONAL ASSESSMENTS
Location	CS Multimedia Lab	ELSE Centre	CS Multimedia Lab	ELSE Centre
Conducted	Jan - Feb 2002	Sep 2002	Jan – Feb 2003	Jul 2004
Number of Participants	40	115	39	160
Results Published in	Riegelsberger et al. (2002b)	Riegelsberger et al. (2003a)	Riegelsberger et al. (2003c)	Riegelsberger et al. (2005a), Riegelsberger et al. (2005c)

Table 4.8: Overview on the experiments conducted as part of this research

Chapter 5

Experiment 1: Preliminary Eye-Tracking Study

5.1 Research Goals and Hypotheses

The overarching interest of the empirical sections of this thesis is the effect of interpersonal cues on users' trust and on their ability to identify the trustworthiness of online actors. Within this area, a large part of this research is devoted to investigating the effect of facial photos on e-commerce sites. The rationale for this research interest is the widespread use of such photos, reflecting e-commerce vendors' attempts to build affective trust (see 2.2.4). This widespread use, however, contrasts with reservations of usability experts, who advocate minimising the use of non-functional elements such as photos (see 2.4). In an earlier qualitative study (Riegelsberger et al., 2002a), users had also stated that such photos cluttered pages and slowed them down whilst using e-commerce sites. In response to these concerns, this thesis incorporated Research Goal 3 – to investigate effects of facial photos embedded in the pages of e-commerce vendors on users' task performance and on user cost. Experiment 1 constitutes the first step towards addressing this research goal. It focused on task performance – user cost is investigated in more depth in Experiment 3 (see 7.2.3.2). As visual search had been identified as a main activity conducted on web-sites (see 2.4), Experiment 1 investigated task performance effects for visual *search tasks*. The first hypothesis addressed by Experiment 1 was thus as follows:

H1: Task performance in a visual search task on an e-commerce site will be reduced by the presence of a facial photo.

A page with a photo was compared to a page with a non-task related text box of the same size to ensure that any effects found could unequivocally be attributed to the presence of a facial photo as opposed to the presence of an additional element on the page. An additional interest at this stage of this research was whether facial photos do attract visual attention at all. Experiment 1 thus also served as a manipulation check for the experiments that investigated trust effects of facial photos. While one might intuitively expect a facial photo to be a strong

attractor of visual attention, the discussion of related literature on the topic (section 2.4) revealed a contradictory picture. There is strong evidence that representations of faces attract visual attention in print media, but some studies showed that users ignore pictorial information online. However, facial photos had not been specifically investigated by these studies. Hence, the next hypothesis tested in Experiment 1 was:

H2: A facial photo will attract users' visual attention when they are engaged in a visual *search task.*

In the discussion of existing eye-tracking studies (see 2.4) *task type* had been identified as a potential intervening variable that could determine whether facial photos are attended to or not. The reasoning was that a strong top-down (see 2.4) information processing focus, which can be the consequence of a goal directed *search task*, could overshadow any bottom-up attraction exerted by facial photos. Consequently, Experiment 1 varied participants' task and included a non-goal directed *"aimless browsing"* task (Pagendarm & Schaumburg, 2001) alongside several *search tasks*. A further variable investigated in this experiment was the effect of *exposure order*. The reasoning was that, if a photo acts as a distractor on first time exposure to a page, but not on repeated use of pages with the same visual structure within a site, this might be considered an acceptable trade-off between efforts to optimise task performance and to build trust.

In summary, Experiment 1 investigated whether a facial photo embedded in the interface of an e-commerce system decreases users' task performance (TASK TIME, H1) and whether it attracts VISUAL ATTENTION (H2). Further factors that were explored were *task type* and *exposure order.*

5.2 Method

5.2.1 Participants

Experiment 1 was conducted with 40 students at the Department of Computer Science at University College London. Participants were paid £5 for taking part in the study. The mean age of the participants was 22 years and 13 participants were female. The participants were experienced Internet users, as 38 of them stated that they used the Internet for at least one hour per day. Data from 2 participants had to be excluded from the analysis and for 7 participants data was only captured for some of the experimental tasks.

5.2.2 Materials

To maximise ecological validity within a laboratory experiment (see discussion on methodology in section 4.3.1), existing web pages from Sainsbury's, the online grocer, were used for Experiment 1. Technical limitations of the eye-tracking system (see 4.4.3) required the use of static copies of the pages. The pages chosen were *aisle-pages* containing product listings from three food categories (fruit, deli, and juices). The pages only differed in products listed, whilst their structure was identical. For each aisle-page, a version with a photo and one with a non-task related text box of the same size was created (Figure 5.1).

Figure 5.1: Examples of aisle-pages

5.2.3 Independent Variables

Presence of a Photo. Pages with a *photo* (Figure 5.2) were compared to pages with a *text box* of the same size (Figure 5.2) at the same position. It was decided to include the *text box* on the *no-photo* pages to keep the total number of individual items on the page constant. This ensured that any effect found could be attributed to the presence of the photo rather than to a difference in the total number of elements present on a page. In the next step, Experiment 3 (Chapter 7) compared pages with a photo to pages with no extra element added. The photo was taken from a business-themed stock photography collection. It was cropped in a way to maximise the area covered by the face. The text box was taken from another page on the Sainsbury's web site and its content had no relation to any of the *search tasks*. *Photo* and *text box* had the same size (160 x 135 pixels; Figure 5.2). Following conventions in eye-tracking studies this area is subsequently referred to as *region of interest* (ROI; McCarthy, 2003).

Figure 5.2: The regions of interest (ROI) – photo and text box

Task Type. The main task type employed in Experiment 1 was a visual *search task*, as it had been identified as users' main activity on web sites (Krug, 2000). In total 5 variants of a *search task* were included. They were selected to model a range of typical user activities on e-commerce sites, such as finding a product, or looking for specific functions offered by the site (Table 5.1). To test whether the goal-orientation of a task influenced the effect of a photo (see 2.4.2), one non-goal directed task modelled on Pagendarm & Schaumburg's (2001)'s *aimless browsing task* was included (Task 6, Table 5.1). The *aimless browsing* task was conducted on the same pages as the other tasks, but a filler task on another page was included between the *search tasks* (Tasks 1-5) and the non-goal directed Task 6. To complete a *search task*, participants had to move their mouse to the search target and click it. Thus, the total TASK TIME included visual search plus the time needed for homing on the target and clicking it.

	Task	Type	Products on Page
Task 1	Select favourite product (conducted twice with different product pages)	Search Task	Deli / Fruit
Task 2	Find change delivery time function	Search Task	Juice
Task 3	Find product search function	Search Task	Juice
Task 4	Find help section	Search Task	Juice
Task 5	Find customer service telephone number	Search Task	Juice
	Filler Task		
Task 6	Just look at the page and get an impression	Aimless Browsing Task	Juice

Table 5.1: Experimental tasks in Experiment 1

Task 1 was more complex than the other *search tasks*, because it required the participants to scan the product list on the page to then decide on their favourite product. This task was conducted twice (on pages with different products but with the same structure), to investigate

effects of *exposure order* (see below). This approach was considered to offer a high level of realism, as scanning product lists to decide on what to buy is likely to be a more frequent task on an online shopping site, than e.g. finding the delivery time button.

Exposure Order. Task 1 was conducted repeatedly on two pages with an identical structure to identify whether *exposure order* had an effect on visual search. Holding the task constant across *first* and *second exposure* to pages with an identical structure allowed unequivocally contributing effects to *exposure order* rather than to differences in *task type*. The products displayed on the page (deli, fruit) were changed between *first* and *second exposure* whilst the structure of the pages was held constant, to ensure that the products had to be scanned on each occasion. To avoid any bias due to product type, the order of the products displayed was counter-balanced between participants (see Table 5.2).

5.2.4 Dependent Variables

Experiment 1 foremost investigated the effect of a photo on task performance (H1). Hence, search time was taken as key dependent variable. In addition, eye-tracking was used to investigate whether the photo attracted visual attention (H2).

TASK TIME. This measure was defined as the time from when the page was displayed on screen to the participant's click on the search target.

VISUAL ATTRACTION (LOOKED / FIXATED). This binary measure captured whether a ROI (photo or text-box) had received any visual attention or not. Consequently it had a value of 1 if a participant had looked at or fixated the ROI at all, and 0 otherwise (see 4.4.2).

5.2.5 Design

The primary aim of Experiment 1 was to find effects of the *presence of a photo* on task performance (TASK TIME) and VISUAL ATTRACTION. In addition it aimed to investigate effects of the potentially intervening variables *task type* and *exposure order*. These aims are reflected in the experimental design. Conceptually, the experiment can be divided into two sections. The first section consisted of Task 1, which was repeated ("Select favourite product", Task 1 in Table 5.1). It investigated whether *exposure order* (i.e. 1st *vs.* 2nd exposure to a page with the same structure) influenced the effect of a photo on task performance (TASK TIME) and gaze (VISUAL ATTRACTION). This section thus had a 2 (photo – text box *vs.* text box – photo, between) x 2 (1st *vs.* 2nd exposure, within) design. To ensure that participants had to scan the

page again on 2nd exposure, the products listed on the page were changed between 1st and 2nd exposure. As product order (fruit, deli *vs.* deli, fruit) was counterbalanced across participants, this resulted in a design with 4 between subject conditions (see Table 5.2). The second section of Experiment 1 consisted of four *search tasks* (Task 2 – Task 5) and one non-goal directed task (Task 6). It thus had a 2 (*presence of a photo*, between) x 5 (*task type*, within) design.

Exposure Order	Condition A	Condition B	Condition C	Condition D
1	TEXT ♦ Task 1	PHOTO ♦ Task 1	TEXT □ Task 1	PHOTO □ Task 1
2	PHOTO □ Task 1	TEXT □ Task 1	PHOTO ♦ Task 1	TEXT ♦ Task 1
3	TEXT ■ Task 2	PHOTO ■ Task 2	TEXT ■ Task 3	PHOTO ■ Task 3
4	PHOTO ■ Task 3	TEXT ■ Task 3	PHOTO ■ Task 2	TEXT ■ Task 2
5	TEXT ■ Task 4	PHOTO ■ Task 4	TEXT ■ Task 4	PHOTO ■ Task 4
6	PHOTO ■ Task 5	TEXT ■ Task 5	PHOTO ■ Task 5	TEXT ■ Task 5
	Filler Task (search on a page with a different structure)			
7	PHOTO ■ Task 6	TEXT ■ Task 6	PHOTO ■ Task 6	TEXT ■ Task 6

Legend: All pages had the same structure but differed in the products listed:

♦ page contained fruit, □ page contained deli products, ■ page contained juices

Table 5.2: Experimental conditions for Experiment 1

5.2.6 Procedure and Apparatus

On arrival, a participant completed a questionnaire eliciting socio-demographic data. Then the eye-tracker was calibrated with several test-screens. Before starting the experimental tasks, participants completed a practice search task on pages of a different site. Search instructions were presented on the screen, centred vertically and horizontally. Once they had read and understood the instructions, participants said "ready". The stimulus web page was then displayed and the eye-tracker and task-timer started. To complete their task participants clicked on the search target. This brought up the next instruction screen and this sequence continued up to the end of the experiment.

The LC Eye Gaze system, as described in section 4.4.3, was used for Experiment 1. The pages were displayed on a TFT 17" screen set to a resolution of 800x600 pixels. Participants sat on a standard height-adjustable office chair in front of the screen at an approximate distance of 60 cm. Their movement was not restricted, but they were asked to move as little as possible, once the eye-tracking system had been calibrated.

5.3 Results

5.3.1 Task Performance (H1)

H1 predicted that participants would spend more time searching for targets on a page with a photo than on a page with a text box. Figure 5.3 shows TASK TIME for Task 1 for *first* and *second exposure* by content of ROI (photo *vs.* text box). Outliers (*z-scores* < -3 or >3) were excluded. On first time exposure to a page, participants who saw the page with a photo spent more time on the search task (t (35) = 2.380, p = .024, two-sided) than those who saw the page without a photo. On second exposure to a page with the same structure but different products and completing the same task, there was no difference in TASK TIME between pages with a photo and pages with a text box (t (35) = 0.693, *ns.*). The effect of *exposure order* is also supported by a repeated measures ANOVA. This analysis yielded a main effect of 1st vs. 2nd exposure (F (1, 35) = 18.42, p < .001) and an interaction effect between *exposure* and the between-subject factor *ROI content* (photo – text box *vs.* text box – photo; F (1, 35) = 4.67, p = .039). There is also some indication for a main effect of *ROI content* (F (1, 35) = 3.37, p = .075).

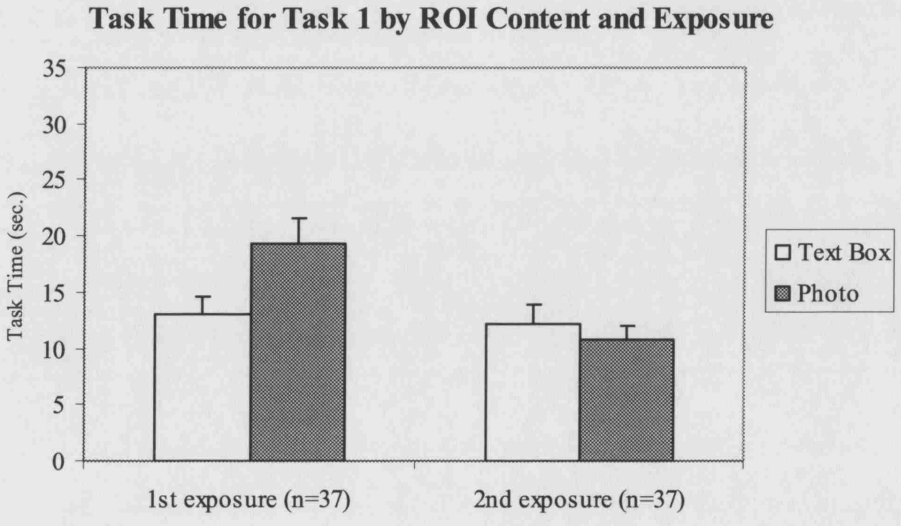


Figure 5.3: TASK TIME for Task 1 by *exposure order* and *presence of a photo*

For the subsequent tasks, no difference in TASK TIME were found between text box and photo pages. Figure 5.4 shows TASK TIMES for Task 2 – 6 (excluding outliers on a per task basis). Hence, H1 is confirmed for *first exposure*, but not for *subsequent exposures*. *Task type* was not found to influence the effect of a photo: for all tasks, including aimless browsing (Task 6), there was no difference in the TASK TIME between pages with a photo and pages with a text box.

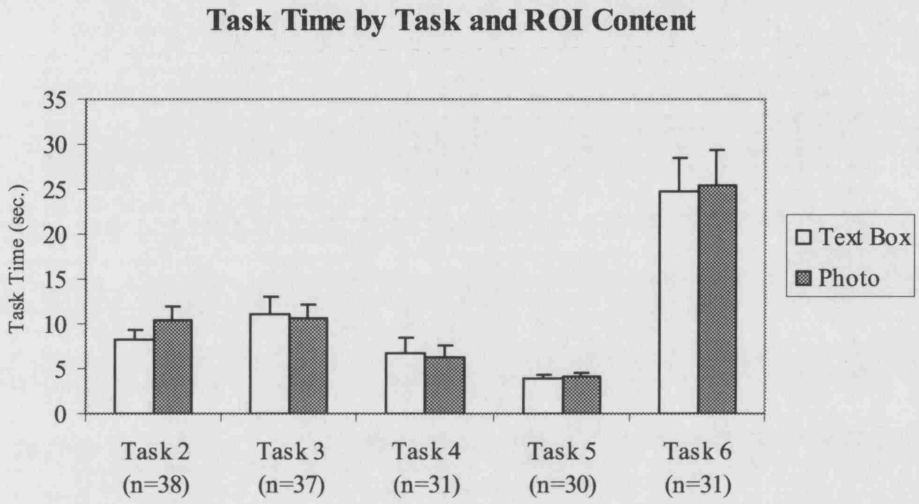


Figure 5.4: TASK TIME by *task* and *presence of a photo*

5.3.2 Visual Attraction of Photo (H2)

H2 predicted that a photo would attract more visual attention than a non task-related text box. The analysis revealed that on the *first exposure* to a page, the *presence of a photo* had a significant effect on the VISUAL ATTRACTION (LOOKED) of the region of interest (ROI). If for a participant at least one eye-gaze sample in the ROI, VISUAL ATTRACTION (LOOKED) was recorded as 1, otherwise it as 0 for that participant (see 4.4.2 and 5.2.4). The analysis revealed that on first exposure more participants looked at least once at the ROI when the photo was present compared to when the text box was present (χ^2 (1, N = 38) = 5.109, p = .024; Figure 5.5). For the similar but less sensitive measure VISUAL ATTRACTION (FIXATED), the number of participants who had at least one fixation in the ROI, the same trend (photo: 8 out of 18 participants, text box: 4 out of 20 participants) was found, but the differences were not significant (χ^2 (1, N = 38) = 2.620, *ns.*). On the second exposure to the pages (with a different list of products), the photo did not result in a higher VISUAL ATTRACTION (LOOKED) than the text box (χ^2 (1, N = 38) = 0.317, *ns.*; see Figure 5.6). There was also no effect on the measure VISUAL ATTRACTION (FIXATED): (χ^2 (1, N = 38) = 0.246, *ns.*

An analysis for the subsequent tasks yielded no effect for the measure VISUAL ATTRACTION (LOOKED) on any task. For the measure VISUAL ATTRACTION (FIXATED) a higher attraction was found for the text box than for the photo on Task 3 ('Find product search', see Table 5.1; χ^2 (1, N = 38) = 4.08, p = *.043*) and Task 6 (aimless browsing; see Table 5.1; χ^2 (1, N = 31) = 4.76, p = *.029*).

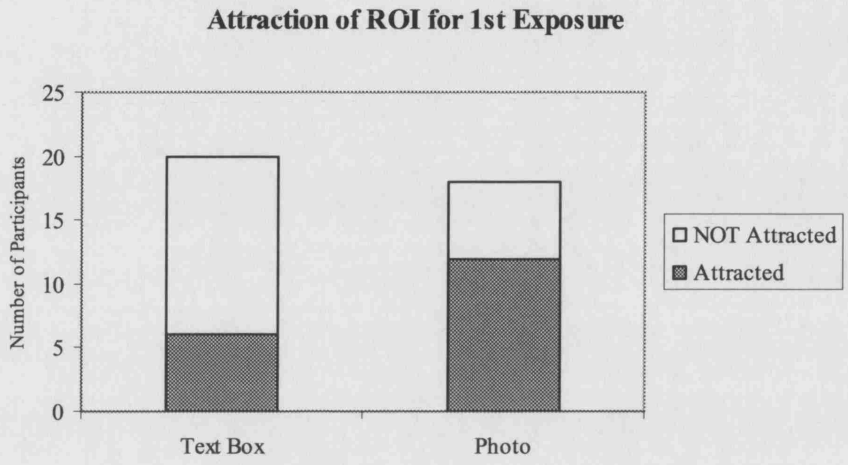


Figure 5.5: VISUAL ATTRACTION (LOOKED) of ROI on *first exposure* to a page

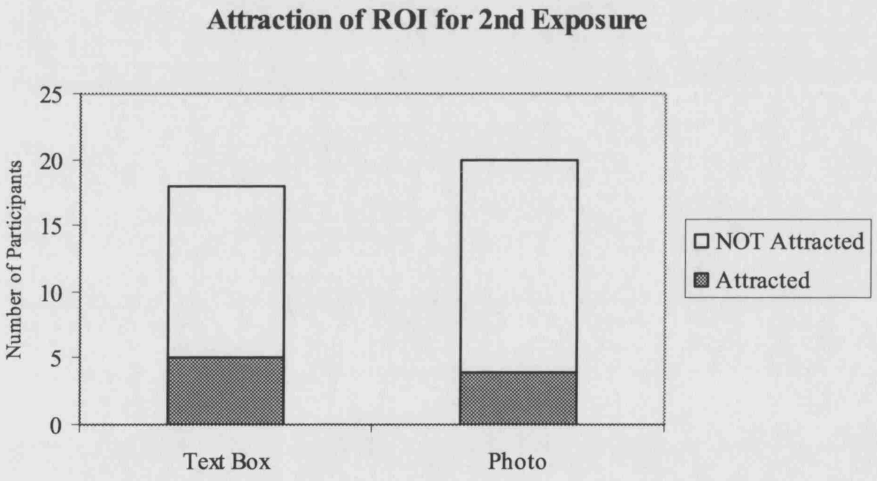


Figure 5.6: VISUAL ATTRACTION (LOOKED) of ROI on *second exposure* to a page

5.4 Discussion

Within this thesis, Experiment 1 was the first step towards addressing whether facial photos on e-commerce sites inhibit users in conducting their tasks (Research Goal 3, H1). An additional concern was to identify whether such photos attract visual attention (H2). Consequently, the key independent variable researched in Experiment 1 was the presence of a facial photo. Comparisons were made between pages with a photo and with a non task-related

text box of the same size. The text box was included to keep the total number of items constant between the two versions of the pages that were used. This allowed unequivocally attributing any effects to the presence of mediated interpersonal cues rather than to a difference in the total number of elements present on a page.

Usability experts advocate minimising non-functional and non task-related elements. The reasoning is that a facial photo may attract visual attention, distract users in their *search tasks* and thereby reduce task performance (see 2.4). User feedback in earlier studies by the author (Riegelsberger et al., 2002a) supported this prediction. A review of traditional media research confirmed that reproductions of faces act as strong attractors of visual attention in off-line media (see 2.4). However, online media studies reported contradictory evidence with some researchers finding that users mainly focus on text and largely ignore pictorial representations on news websites (Lewenstein et al., 2002). Experiment 1 was conducted to answer the questions that were left unanswered by these previous studies. Findings by Pagendarm & Schaumburg (2001) indicated that the differences in effect between offline and online media could be due to differences in *task type* (see 2.4.2). Hence, like Pagendarm & Schaumburg (2001), Experiment 1 included goal-driven *search tasks*, as well as a non-goal directed *aimless browsing task*. A further variable investigated was *exposure order*, i.e. whether effects of the *presence of a photo* differed depending on whether a page was viewed the first or subsequent times. This variable allowed investigating as to whether any effects found were likely to persist.

Experiment 1 was conducted in the laboratory to allow for eye-tracking measures to be taken and for independent variables to be experimentally controlled. Consequently it is subject to the limitations of this approach (section 4.1.3), such as reduced ecological validity and a focus on short time spans. Additional constraints induced by the version of the eye-tracking system used (see 4.4.3) included a confinement to the use of static copies of pages and the unavailability of eye-tracking measures of user cost (SCANPATH-LENGTH, BACKTRACKING). The updated eye-tracking system used in Experiment 3, overcame the latter limitation. Accepting these constraints allowed using eye-gaze data to research fine-grained effects on users' gaze behaviour – an approach that had been identified as crucial to overcome the weaknesses of other methods such as recall and recognition (see 4.4). Within the boundaries of a laboratory setting Experiment 1 aimed to maximise ecological validity by using copies of existing web sites (rather than experimental mock-ups). It further employed a remote eye-tracking system that did not inhibit participants' movements (see 4.4.3) and it investigated effects of time in the form of *exposure order*.

5.4.1 Task Performance

A prolonged TASK TIME on a page with a facial photo, compared to a page with a text-box of the same size, was only found for *first exposure* to a page. On second exposure to a page with the same structure, there was no effect for the presence of a photo. This lack of persistent effect of the photo held true for all *search tasks* and the *aimless browsing task* subsequently conducted. This finding tallies well with results by McCarthy et al. (2003), who – in a later study – found that web sites with an unusual arrangement of elements only led to lower task performance on first-time exposure. Thereafter users adapted to this new layout and no effect on task performance was found. Hence, the results from Experiment 1 could be interpreted as there being no lasting negative effects on usability from including a facial photo in an e-commerce site. Based on this finding alone, it appears that existing usability guidelines (see 2.4) that advocate restriction in the use of pictorial non-task related elements over-estimate the negative effects such elements could have. However, based on findings by Burke & Hornof (2000) it appears possible that task completion time remains relatively unaffected by the presence of facial photos, while user cost is permanently increased. Burke & Hornof (2000), found that animated banners did not decrease task performance, but increased users' subjective workload measured via the NASA Task Load Index (TLX; Hart & Staveland, 2003). They concluded that in the presence of distracting elements, task performance is held constant by users, albeit at the cost of increased mental effort. If such an effect existed for facial photos, it would help to explain the comments made by participants in an earlier qualitative study by the author (Riegelsberger et al., 2002a). There, participants claimed that photos unnecessarily cluttered pages and slowed them down.

An additional concern with widely generalising from this finding is that is based upon comparisons made between pages with a photo and pages with a non-task related text box. This approach allowed attributing an effect to the photo, rather than to the total number of elements on the page. It could be argued, however, that this approach does not model real-world design problems, where practitioners have to decide on adding a photo, rather then deciding between a photo and a text box. Hence, Experiment 3 (Chapter 7) compared a page with a photo added to one without any additional element. In addition, Experiment 3 explicitly investigated effects of task performance *and* user cost.

5.4.2 Visual Attraction of Photo

The measure VISUAL ATTRACTION recorded whether a participant had looked at a region of interest (ROI) at least once during task completion (see 4.4.2). Across all participants, it gives the number of individuals who could potentially have perceived the photo. As for task

performance, there was an effect of *exposure order* on the more sensitivie variant of this measure (VISUAL ATTRACTION (LOOKED)). Experiment 1 found that a photo was looked at by more people than a text box on *first exposure* to a particular page. In subsequent views of pages with the same structure the photo, as well as the text box, were ignored by most participants. Thus, for *first exposure*, results from off-line magazine reading (see 2.4.1) apply to online shopping: photos of faces do attract visual attention. They are looked at by the majority of users, even though they are non-task related. The lack of VISUAL ATTRACTION of the photo on subsequent page views (for Task 3 and Task 6 the text box resulted even in a higher VISUAL ATTRACTION (FIXATED) suggests that users quickly adapt their search patterns to the visual structure of the pages. Visual attraction resulting in involuntary visual attention given to a non-task related photo thus appears to be only a short-term effect. As such, the effect of *exposure order* also helps to explain the partially contradicting results of previous studies. The results support the notion that search processes on web pages are governed by top-down processes to such an extent that non-task related pictorial stimuli – which otherwise act as strong attractors – are ignored on repeated exposure to a page. In that respect predictions based on the Poynter study (Lewenstein et al., 2002; see 2.4) are supported. On the other hand, bottom-up processes in the form of an instant attraction to viscerally salient cues (i.e. faces), were shown to be at work during the first time view of a page, when users were gaining an overview on the structure of the page. In that respect predictions from traditional advertising research are supported (see 2.4).

This finding from Experiment 1 indicates that photos on e-commerce sites may affect user trust, as they attract visual attention – at least on first time exposure to a page – even when users are engaged in a search-task with a top-down focus. Experiments 2 (Chapter 6) and Experiment 3 (Chapter 7) investigated whether an effect user trust (Research Goal 2) did really result from such minimal exposure.

5.5 Chapter Summary

The key interest of this thesis is the effect of interpersonal cues on user trust. However, trust building efforts, such as the use of photos of people in the interface, may also have negative effects on usability and thus may require trade-off decisions[20] (see 2.1 and 2.4). Hence, before investigating effects of interpersonal cues on trust, Experiment 1 tested for potentially negative effects on usability (Research Goal 3). The aim of this experiment was to identify whether a facial photo embedded in an e-commerce page really reduced task performance (H1), as was predicted by usability experts and stated by users in initial qualitative interviews

[20] As usability has been identified as a contributor to perceived trustworthiness (e.g. Corritore et al., 2003), it appears questionable whether high trust with low usability could be achieved at all.

(Riegelsberger et al., 2002a). In addition, Experiment 1 aimed to identify whether facial photos did attract visual attention at all (H2), as then could they be expected to influence user trust (Research Goal 2). In that respect, Experiment 1 acted as a manipulation check for Experiments 2 and 3. A literature review found ample evidence for the role of reproductions of faces as attractors of visual attention in traditional media. However, findings from eye-tracking studies on web pages found contradicting evidence. *Task type* was identified as a variable that could potentially explain the different effects found in these two contexts. Hence, Experiment 1 included goal-directed *search tasks* and an *aimless browsing task.*

Experiment 1 found an effect of *exposure order.* When participants saw a page with a photo for the first time, TASK TIME was higher than when they saw a page with a text box for the first time. However, this effect vanished with repeated exposure to pages with the same layout. Similarly, a photo acted as attractor of visual attention only on *first exposure* to a page. On *subsequent exposure* the same page the photo attracted less visual attention.

Overall, these findings suggest that photos could have an effect users' trust perceptions, because they are looked at even when participants are engaged in a competing *search task.* Furthermore, they have only a minimal negative short-term effect on task performance. An e-commerce vendor aiming to improve the trustworthiness of his site through the use of affective interpersonal cues might consider this negative one-time effect an acceptable trade-off. However, at this stage, such a practical conclusion is limited by two factors. First, earlier research found that distracting elements can have negative effects on user cost without affecting task performance measured in TASK TIME. Experiment 3 (Chapter 7) thus further investigated Research Goal 3 and researched effects on user cost. Second, for methodological reasons (see 5.1), Experiment 1 compared pages with a photo to pages with a text box of the same size. In many situations where practical design decisions have to be made, however, the question whether to add a photo as an additional element will be more prevalent. Consequently, Experiment 3 (Chapter 7) compared pages with a photo added to pages without an additional element added.

Chapter 6

Experiment 2: Trust in E-Commerce Vendors

6.1 Research Goals and Hypotheses

Experiment 2 was the first conducted for this thesis to address user trust. It investigated users' ability to discriminate between trustworthy and less trustworthy actors (Research Goal 1) and effects of interpersonal cues on users' trust (Research Goal 2). Experiment 2 investigated these questions for e-commerce vendors in the role of the trustee and for interpersonal cues in the form of facial photos. Expressed in the terms provided by the framework presented in Chapter 3, this experiment investigated interpersonal cues that are used symbolically. Stock photos embedded in the interface of an e-commerce vendor cannot give any insight into the trust-warranting properties of the vendor (P2, see 2.3.3), but they are commonly used by vendor with the aim to increase users' trust (P1, see 2.3.3).

Research Goal 1, investigating users' ability to identify trustworthy e-commerce vendors (and how this ability is affected by the use of interpersonal cues), has not been previously addressed by HCI trust research, which is primarily concerned with creating guidelines for increasing the perceived trustworthiness of e-commerce vendors. For reasons set out in section 2.2.3, focusing only on increasing perceived trustworthiness is a dangerous approach. While researchers such as Fogg (2003a) recognised the need for investigating users' discriminative ability, this experiment was the first to empirically investigate this important aspect.

The second aim of Experiment 2 was to clarify the effect of a facial photo on users' trust in e-commerce vendors. Experiment 1 (Chapter 5) showed that facial photos embedded in the pages of e-commerce vendors can attract visual attention, even when users are engaged in goal-oriented *search tasks*. Hence, an effect on trust based on immediate visceral reactions (see 3.4.2.4) appears possible. The widespread use of such photos on existing e-commerce sites also indicates that many e-commerce vendors hope to influence users' trust with such measures. To date, however, HCI trust research in this area is relatively scarce. A review of existing studies and design guidelines (see 2.3.5) resulted in no clear picture: some found positive effects on trust (Fogg, 2003a; Steinbrueck & Schaumburg, 2002) and others found a

variety of responses including very negative ones (Riegelsberger et al., 2002a; Urban, 1999). These existing studies were limited by their use of trust measures that relied on participants' self-reports (see 4.2) and by investigating the effect of only one photo on one mock-up of a site. Following a critical discussion of these methods in Chapter 4, Experiment 2 aimed to overcome some of the limitations of this earlier work.

In addressing Research Goal 5, Experiment 2 explored new ways of measuring trust by observing participants' trusting behaviour under financial risk. To increase ecological validity, semi-functional copies of 12 existing e-commerce sites were used in Experiment 2, rather than testing for the effects of one photo on one mock-up of a site. The independent variable *vendor trustworthiness* was operationalised by establishing the trustworthiness of the vendors whose sites were used in the study via the rating services *Bizrate*[21] and *Epinions*[22] (see 6.2.2.2). The hypotheses that were investigated in Experiment 2 and additional variables of interest are introduced below.

H1: Sites of trustworthy vendors are trusted more than sites of untrustworthy ones.

This hypothesis addresses Research Goal 1, to investigate users' ability to correctly identify trustworthy actors. The claim of some users that it is impossible to infer a vendors' trustworthiness from the cues that are present in the interface (Riegelsberger & Sasse, 2000; see 2.2.3) is thus put to a test. The other main interest of this research is the effect of the presence of mediated interpersonal cues (Research Goal 2) – in the case of Experiment 2 in the form of a facial photo.

H2: The presence of a facial photo on the homepage of an e-commerce vendor increases users' trust in that vendor.

To investigate whether the contradictory results of previous studies might have been due to differences in photos, 4 photos that had been rated as very trustworthy, and 4 photos that had been rated as less trustworthy in a pre-experiment (see 6.2.2.1) were included (*photo trustworthiness*).

H3: Photos rated *a priori* as more trustworthy will increase trust in the vendor on whose homepage they are shown.

[21] www.bizrate.com
[22] www.epinions.com

In addition, based on comments by Jakob Nielsen[23] and advertising research (Stern, 2002), the following photo variables were *gender*, professional quality of the photo (*professionalism*), and *realness* (i.e. whether the person depicted appeared to be a model or a real employee).

6.2 Method

6.2.1 Participants

115 participants (61 female, 54 male, average age 25) took part in this study and all had shopped online-shopping before. 110 participants were undergraduate or postgraduate students, 5 participants were members of administration staff.

6.2.2 Independent Variables

6.2.2.1 Photo Trustworthiness

To address H3, the perceived trustworthiness of the photos used in Experiment 2 needed to be established in a pre-experiment. The pre-experiment also served to establish how professional the photo was perceived to be (*professionalism*) and how likely it was that the photo depicted a real person (i.e. an employee of an e-commerce vendor) rather than a model (*realness*). 29 stock photos of people (15 male, 14 female) were presented to 69 participants, who did not take part in the main part of Experiment 2. The photos were embedded, one by one, in the homepage of an e-commerce vendor and participants of the pre-experiment rated *photo trustworthiness* and *professionalism*, and *realness* of the photos on 7-point Likert scales (Appendix B.1). To ensure a gender balance among the photos, the 2 female photos that had been rated as most trustworthy, and the 2 male photos rated as most trustworthy were selected for inclusion in the study as the group of trustworthy photos. The group of 4 untrustworthy photos was similarly created by picking the 2 least trusted female and the 2 least trusted male photos. The group of trustworthy photos differed from the other group on *photo trustworthiness* (Mann-Whitney U (N = 8) = 0.00, p = .021) and *realness* (Mann-Whitney U Test U (N = 8) = 0.00, p = .021) but not on *professionalism* (Mann-Whitney U Test U (N = 8) = 2.00, *ns.*; Table 6.1).

[23] Personal communication at the presentation of an earlier paper (Riegelsberger et al., 2002a) at CHI 2002, April 23, 2002.

	photo trust-worthiness	*Gender*	*Trustw.*	*Realness*	*Profession.*
			1 low 7 high	1 model 7 real	1 prof. 7 unprof.
Photo 1	*Trustworthy*	Female	5.31	3.80	3.54
Photo 2	*Trustworthy*	Female	5.38	3.42	2.12
Photo 3	*Trustworthy*	Male	5.12	6.26	4.77
Photo 4	*Trustworthy*	Male	4.48	4.86	3.67
Mean *Trustworthy Photos* (O)			**5.07**	**4.86**	**3.51**
Photo 5	*Less Trustworthy*	Female	3.48	1.46	1.65
Photo 6	*Less Trustworthy*	Female	3.83	1.57	1.66
Photo 7	*Less Trustworthy*	Male	3.03	1.75	2.23
Photo 8	*Less Trustworthy*	Male	3.07	2.60	2.32
Mean *Less Trustworthy Photos* (∇)			**3.35**	**1.85**	**1.97**

Table 6.1: Results from the photo pre-study

6.2.2.2 Vendor Trustworthiness

US e-commerce vendors from 3 different product domains were chosen for inclusion in the study (Table 6.2). US vendors for UK participants were used, as this constituted a realistic scenario with relatively high risk, due to the vendor and user being located in two different countries (see 3.4.1.3). Digital cameras and computer hardware were chosen, as these are popular items to be ordered online, which carry a considerably higher financial risk than e.g. books. Internet flower services carry less financial risk, but poor service could result in high non-monetary cost, such as embarrassment. Hence, trust is of high relevance in all three domains.

For each domain, two vendors of high trustworthiness (*good vendors*), and two of low trustworthiness (*bad vendors*) were chosen. *Vendor trustworthiness* was established from reputation ratings by *Bizrate* and *Epinions*. These services aggregate feedback from customers of e-commerce vendors based on post-order service and handling of privacy and security. Thus, these ratings are not based on the quality or appearance of the web site (i.e. not on the surface cues given off), but on actual post-order performance (i.e. fulfillment). This operationalisation of trustworthiness – expressed in the terms of the trust framework (Chapter

3) – captured the intrinsic trust-warranting property ability. It is worth noting that this operationalisation of *vendor trustworthiness* captures only one aspect of trustworthiness. Another approach would be to focus on the intrinsic property motivation (see 3.2.4), and to investigate users' ability to identify deceptive or *phishing* sites that are not aiming to provide a service but simply to defraud the user. These sites are outside the scope of the empirical part of this thesis (see 3.5.3.1), but they are discussed in the section on future work (see 10.4).

Bizrate aggregates customer feedback to ratings ranging from 1 (*bad vendor*) to 10 (*good vendor*). *Epinions* gives ratings in terms of the percentage of customers who state they are willing to buy again (0% bad to 100% good). This percentage range was mapped onto a scale from 1-10. The vendors chosen were among the best and poorest performers in their respective domains (Table 6.2).

	Name	Rating	Vendor Type
	Digital Cameras		
Vendor 1	Best Stop Camera	8	Good
Vendor 2	Click for Digital	8	Good
Vendor 3	Broadway Photo	3	Bad
Vendor 4	A & M Photo World	2	Bad
	Computer Hardware		
Vendor 5	A Jump	9	Good
Vendor 6	Computer Geeks	9	Good
Vendor 7	EMS Computing	2	Bad
Vendor 8	Compuvest	3	Bad
	Flower Services		
Vendor 9	Proflowers	9	Good
Vendor 10	Iflorist	10	Good
Vendor 11	Florist.com	4	Bad
Vendor 12	Hand-Flowers.com	4	Bad

Table 6.2: Overview on *vendor trustworthiness* (1 bad – 10 good)

Semi-functional copies of the sites including the homepage and one or two subsequent layers (depending on the number of links available in each layer) were mirrored on the server that

hosted the experimental system. This allowed varying the home pages according to the experimental conditions, whilst preserving some of the sites' functionality. Any certification or reputation seals that were present on some pages were removed. The mirroring led to some functions (such as *shopping cart* or *search*) not being available in the experimental version. However, on all sites, participants were able browse detailed product descriptions and to access general information on the company (such as privacy and security policies). Figure 6.1 shows an example of a homepage with and without a photo embedded. All homepages are included in Appendix B.4.

Figure 6.1: Examples of pages with and without photo added

6.2.3 Dependent Variables

To overcome the problems of post-hoc rationalisation and limited introspection, which burden self-report measures such as trust questionnaires (see 4.2.2), this research primarily used behavioural measures to gain insight into participants' levels of trust. Framed within the terms of the framework introduced in Chapter 3, Experiment 2 observed trusting action under financial risk to infer on user trust. This approach constitutes a novelty in e-commerce trust research in HCI, which previously relied upon users' self-reports. The key measure of Experiment 2 was INVESTMENT (see 6.2.3.1). Further measures included ASSESSMENT (see 6.2.3.2), which also carried financial incentives, and a PREFERENCE ranking (see 6.2.3.3) without incentives.

6.2.3.1 Investment Measure

Expressed in the terms of the framework (see Chapter 3), the INVESTMENT measure put the participant in the place of the trustor. They had to infer from the surface cues on the vendor's non-observable trust-warranting properties. Based on the level of trust that resulted from these inferences, they had to decide whether and to what extent to make themselves vulnerable, i.e. engage in trusting action. In everyday life, such a decision to engage in trusting action could

for instance take the form of ordering a product, giving access to personal information, or spending time in registering with a service. After this risky first move, the customer would typically wait for the vendor's fulfillment. In Experiment 2, trusting action was framed as an investment in a vendor. Participants could invest nothing or up to 100 pence (in discrete 10 pence increments) in each vendor. Investments in good vendors resulted in a gain of the size of the amount risked. Investing £1 in a good vendor resulted in the gain of £1 in additional pay. Investments in bad vendors resulted in a loss of the investment. As they could invest in 12 vendors, participants' decisions for this measure potentially impacted their final pay in a range of +/-£12, as they did not know the ratio of good and bad vendors in the experiment. As the majority of participants were students with a limited income, this range could be expected to pose considerable financial risk. Figure 6.2 illustrates the measure in the terms of the framework introduced in section 3.2.

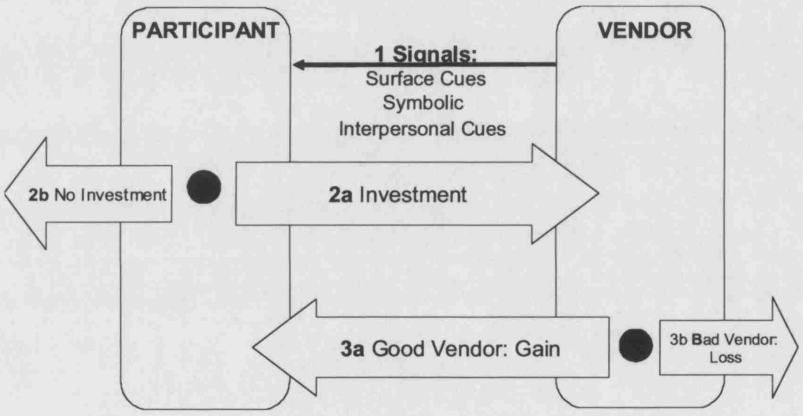


Figure 6.2: INVESTMENT measure expressed in the terms of the trust framework

The amount risked on a particular vendor was taken as a measure of the level of trust a participant had in this vendor. As the INVESTMENT measure is expected to be confounded with a participant's general propensity for taking risks, each participant's willingness to invest in a chance event was measured (see 6.2.4). Appendix B.5 and B.9 show how the measures were introduced to the participants.

6.2.3.2 Assessment Measure

Another new measure, not previously used in e-commerce trust research, is the quadratic incentive scheme. It is used in experimental economics to motivate participants to give their best possible guess on an outcome (Huck & Weizsaecker, 2002). For this measure, participants were asked to rate vendors' trustworthiness on a scale from 1 to 10. Participants' pay for this measure decreased with the squared distance of their guess from the

trustworthiness of the vendor under research, which had been established through reputation ratings from Epinions and Bizrate (see 6.2.2.2). Thus, this measure did not require participants to invest or risk an amount of money, but remuneration was based on the accuracy of their estimates. It was decided to frame inaccurate guesses as losses, rather than to present correct ones as gains, to emphasize the presence of risk. Tversky & Kahneman (1988) established that risk perception can depend on such differences in framing. An additional £6 was paid on top of a participant's base pay, and up to 50 pence per vendor were deducted from that according to the squared error of the participant's assessment from the actual rating. Appendix B.5 shows how the measure was introduced in the instruction sheet. This measure is conceptually closer to established trust rating measures (e.g. Kammerer, 2000). However, rather than just asking for an assessment it also induces financial risk.

6.2.3.3 Preference Ranking

Finally, participants were asked to rank the 4 vendors in each product domain according to their preference. The question was phrased as follows: "*For this question we want you to consider which site you would be most comfortable buying from. Assuming that all sites offer the product you are looking for at the same price with the same condition.*" (Appendix B.5 and B.9). This measure did not carry any financial risk, but in contrast to the other measures it forced the participants to bring the vendors into a hierarchical order.

6.2.4 Auxiliary Variables

Several user variables were elicited alongside the key measures. First and foremost, participants' tendency to invest in chance events was measured. Similar to the INVESTMENT measures (see 6.2.3.1), participants were given the opportunity to invest (0-100 pence; in 10 pence increments) in a 50% chance event (CHANCE INVESTMENT). As for the INVESTMENT measure, participants could double their chance investment or lose it. The amount invested was used as an indication of a participant's tendency to seek or avoid risk (Egger, 2001; Corritore et al., 2003b). To establish prior familiarity with the vendors, participants were shown the logos and names of all e-commerce vendors included in the study and they were asked whether they had seen the vendors' sites or shopped from them. Additional participant variables are *Internet usage experience, Internet shopping experience, Internet attitude, Internet risk perception, and functionality-orientation* (see Appendix B.6).

6.2.5 Design

Each participant saw the sites of all 12 vendors and all 8 photos that formed part of the study. This was realised in a within-subjects design that was balanced for the factors *vendor trustworthiness* (*good vendor, bad vendor*) and *photo trustworthiness / presence of a photo* (*trustworthy photo, less trustworthy photo, no photo*). Each participant saw 2 *good vendors* with a *trustworthy photo*, 2 *good vendors* with a *less trustworthy photo*, and 2 *good vendors* with *no photo*. In addition, each participant saw 2 *bad vendors* with a *trustworthy photo*, 2 *bad vendors* with *a less trustworthy photo*, and 2 *bad vendors* with *no photo*. Table 6.3 gives an overview on the design.

	Digital Cameras				Computer Hardware				Flowers			
	Good		Bad		Good		Bad		Good		Bad	
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12
C1	⭘		⭘		⭘	∇	⭘	∇	∇		∇	
C2		⭘		⭘	∇	⭘	∇	⭘		∇		∇
C3	∇		∇		⭘		⭘		⭘	∇	⭘	∇
C4		∇		∇		⭘		⭘	∇	⭘	∇	⭘
C5	⭘	∇	⭘	∇	∇		∇		⭘		⭘	
C6	∇	⭘	∇	⭘		∇		∇		⭘		⭘

Legend

Rows represent experimental conditions (C1-C6).

Columns represent individual vendors (V1-V12).

Photo trustworthiness / Presence of a photo: ⭘: *trustworthy*, ∇: *less trustworthy*, empty cell: *no photo*

Table 6.3: Experimental conditions for Experiment 2

For each condition in Table 6.3, 4 variants were created by replacing the placeholders for *trustworthy* and *less trustworthy photos* (⭘ and ∇, respectively) with the 4 different photos. This resulted in a total of 24 (6x4) between-subject conditions. Across these conditions trust was measured for 96 (12x8) photo-site combinations (8 photos, 4⭘ and 4∇, across 12 sites) and for the 12 sites without a photo added for baseline comparisons. Each participant saw a particular photo only once. Presentation order of the sites within the shopping domains (*camera, computer, flowers*) was randomised.

6.2.6 Tasks and Procedure

Participants first conducted a practice task (on flight booking sites) to familiarise themselves with the measures and the experimental system. They then completed a questionnaire eliciting socio-demographic data and the auxiliary variables (see 6.2.4). The 12 sites were presented in 3 sets of 4 sites, reflecting the product domains (cameras, computer, flowers). Each site was presented in a separate browser window. A menu at the bottom of the screen allowed participants to switch between the different sites as they wished. For all 3 product domains, participants were first asked to explore the sites (complete instructions and the experimental system are reproduced in Appendix B.5 and B.9):

> *"When looking at the sites, imagine that you are about to buy a digital camera, a colour printer or send a bouquet of flowers. Imagine that the 4 sites offer the same products at the same price with the same conditions. For each set of sites you have to decide, which site you would feel most comfortable buying from."* (Appendix B.9)

After exploring the 4 sites in a product domain for a maximum of 10 minutes, participants were asked to make their investment decisions (see 6.2.3.1), to assess the sites (see 6.2.3.2), and to rank the sites according to their preferences (see 6.2.3.3). It was stressed that it was at their own discretion whether they wanted to invest part of their base pay or not. To facilitate recall of the sites when completing the questionnaires, thumbnails of the homepages, as seen by each participant were displayed. After completing all 3 shopping domains, participants were paid. Subsequently, a short informal interview was conducted with each participant about how they reached their investment decisions.

6.3 Results

None of the participants had previously bought anything from any of the sites in the study. For each site between 0 and 10 participants stated that they had seen the site previously. Over all sites and participants only 3.3 % of sites had been previously seen. In post-experimental interviews, no participant mentioned the photo-manipulation, which indicates that the photos had been added to the sites in an unobtrusive manner. As expected, a correlation between the participants' INVESTMENT IN A CHANCE EVENT and their average INVESTMENT in vendors (r = .48, $p < .01$, n = 115) was found.

6.3.1 Identifying Vendor Trustworthiness (H1)

The analysis for H1 was conducted with Wilcoxon Signed Rank Tests. This non-parametric within-subjects test was used as it could not be assumed that the dependent variables (INVESTMENT, ASSESSMENT, PREFERENCE) were interval scaled and normally distributed. Such a non-parametric test is more conservative than the parametric equivalent (t-test; Bortz, 1993). A within-subject analysis also eliminates the effect of covariates that are tied to individuals, such as CHANCE INVESTMENT.

The analysis yielded that without photos added, participants invested marginally more in *good vendors* than in *bad vendors* (Z (N = 115) = 1.93, p = .054, two-sided). They also assessed *good vendors* better than *bad vendors* (Z (N = 115) = 2.859, p = .004, two-sided) and they gave them a higher preference ranking (Z (N = 115) = 2.125, p = .034, two-sided). H1 is thus confirmed for all three key measures (see Figure 6.3, Figure 6.4, and Figure 6.5).

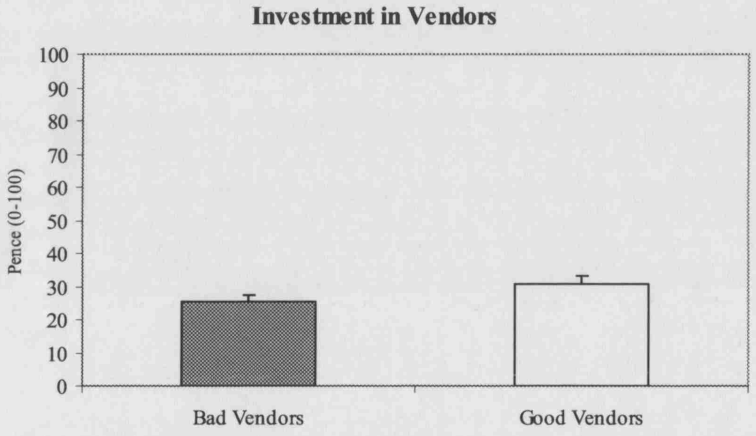


Figure 6.3: INVESTMENT in *bad vendors* and *good vendors*

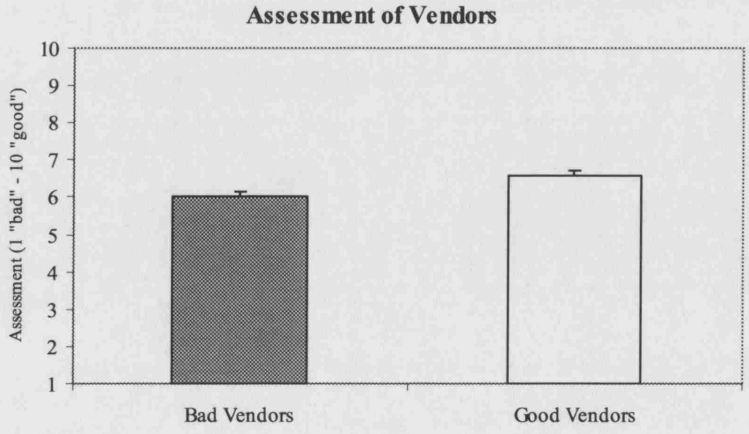


Figure 6.4: ASSESSMENT of *bad vendors* and *good vendors*

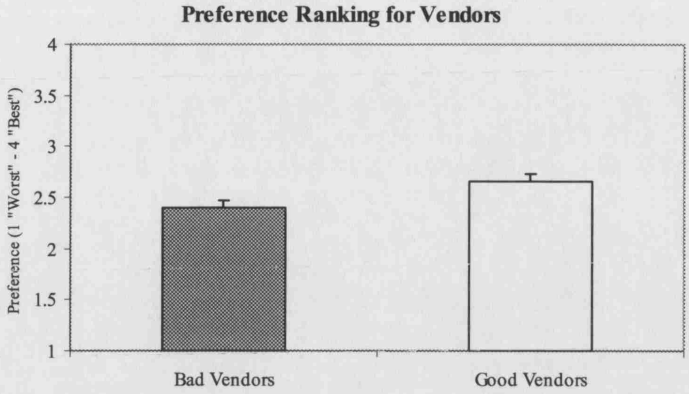


Figure 6.5: PREFERENCE for of *bad vendors* and *good vendors*

6.3.2 Photo Effects (H2, H3)

The data was then analysed for an effect of the *presence of a photo* across all sites irrespective of which of the 8 photos had been displayed. Again, the analysis was performed as a non-parametric within-subjects test. H2 could not be confirmed for any of the measures. There was no significant difference in the INVESTMENT (Z (N = 115) = 0.076, *ns.*), ASSESSMENT (Z (N = 115) = 0.705, *ns.*), and in the preference ranking (Z (N = 115) = 0.527, *ns.*) for sites with a photo compared to sites without one.

This finding also holds true if one only tests for an effect of the 4 photos that *a priori* had been rated as very trustworthy (see 6.2.2.1, H3). Sites with these trustworthy photos embedded did not result in a higher INVESTMENT (Z (N = 115) = 0.09, *ns.*), ASSESSMENT (Z (N = 115) = 0.54, *ns*), or PREFERENCE ranking (Z (N = 115) = 0.428, *ns.*) than those with no photo embedded.

6.4 Discussion

Experiment 2 investigated trust in e-commerce vendors. It researched users' ability to identify the trustworthiness of e-commerce vendors based on the surface cues they perceived in the interface (Research Goal 1). It further investigated the effect of adding a facial photo to the homepage of an e-commerce vendor on users' trust in that vendor (Research Goal 2). On a methodological level, it aimed to overcome part of the limitations of conventionally used trust measures such as qualitative interviews or trust questionnaires by introducing behavioural measures of trust that were elicited under financial risk (Research Goal 5).

6.4.1 Identifying Vendor Trustworthiness

The first question addressed by Experiment 2 was whether users can correctly identify the trustworthiness of e-commerce vendors from the surface cues they perceive in the vendor's user interface (H1). Experiment 2 – in contrast to previous studies on user trust in e-commerce (see 2.3.5) – used copies of existing e-commerce vendors' sites whose trustworthiness was known to the researcher. This methodological innovation allowed an analysis of the quality of users' trust assessments. Vendor trustworthiness was incorporated in the form of customer ratings, which had been aggregated by *Epinions* and *Bizrate*. Based on these ratings, the vendors in the study were divided into *good* (trustworthy) *vendors* and *bad* (less trustworthy) *vendors*. The analysis found that participants could differentiate *good* vendors from *bad* ones. Thus, Experiment 2 demonstrated that users can perceive the trustworthiness of a vendor from the surface cues that are present in the user interface. Claims that the interface of an e-commerce vendor does not provide reliable cues for an assessment of trustworthiness, which were raised by participants in an earlier qualitative study (Riegelsberger & Sasse, 2000), were thus challenged in Experiment 2.

From the perspective of an e-commerce vendor who has to decide on how to allocate his resources between trust-building strategies such as advertising, third party assurance mechanisms (see Chapter 9), or an impeccable interface, the findings of Experiment 2 underline the importance of the interface as a communicator of trustworthiness. Experiment 2 showed that the interfaces of existing e-commerce vendors have a symptomatic function (see 3.3.2) and allow inferences about trust-warranting properties. Taking the perspective of a consumer advocate, the inferences to be drawn from the findings of Experiment 2 are less clear. Whilst, overall the trustworthy vendors were trusted more than the less trustworthy ones, these differences were relatively small. The average investment in a *good vendor* differed only by approximately 5 pence from the average investment in a bad vendor, while the range of possible investments was 0 to 100 pence. Similarly, the average responses given by participants on the ASSESSMENT measure which had a range from 1 (bad) to 10 (good) were 6.0 for the *bad vendors* and 6.6 for the *good vendors*. This suggests that many gullibility errors (i.e. trusting untrustworthy vendors, see 4.3.2.1.1) and incredulity errors (not trusting trustworthy vendors, see 4.3.2.1.1) were made. Whether the ability to discriminate can be seen as sufficient or alarmingly small depends on the consequences that are associated with gullibility and incredulity errors. In some instances such as e-health services, relying on a poor quality provider (gullibility error) could potentially have very grave outcomes and a single misjudgement may profoundly undermine a users' trust in the whole domain. In the context of choosing a provider of online gaming services, on the other hand, the

professionalism of the provider might be less important and users might be willing to accept relatively high rates of gullibility errors if this helps them in reducing their search time. Furthermore, it should be kept in mind that the investigation of users' ability to identify vendors' trustworthiness was focussed on discriminating between vendors of different service quality levels (intrinsic property ability, see 3.4.2.1) – rather than discriminating between legitimate and fraudulent vendors (intrinsic property motivation, 3.4.2). Thus, while Experiment 2 showed that reliable cues for trust-warranting properties are present in the interface, it did not show whether they are sufficient to build users' trust in the market place in the long run. In further investigating this issue Experiment 3 explored where in the interface the cues that allow discrimination between trustworthy and less trustworthy vendors emanate from. Answering this question can help in educating users on how to assess the sites they encounter online and which areas to focus on.

6.4.2 Photo Effects

In contrast to earlier studies on the effect of photos on e-commerce sites (see 2.3.5), Experiment 2 investigated the effect of 8 photos (4 trustworthy and 4 less trustworthy ones) across 12 different e-commerce vendors' sites. As earlier studies had shown that users' trust perceptions (based on their self-reports, see 4.2) can be swayed by adding one photo to one homepage (Steinbrueck & Schaumburg, 2002; see 2.3.5.3), the aim of Experiment 2 had been to identify whether the strategy of adding a photo holds when tested across several vendors' sites and photos – and when trust is measured under financial risk (see 4.3.1). Experiment 2 did – across all 8 photos and all 12 sites – not find an effect for the *presence of a photo* on the trust measures INVESTMENT, ASSESSMENT, and PREFERENCE (H2). Thus, the results should discourage the notion that photos are a straightforward way of building trust. Also, when focusing only on photos that individually had been rated as trustworthy in a pre-test, no effect on trust in a vendor was found (H3). Thus, even if a photo is regarded as authentic or trustworthy individually, this is no guarantee that it will benefit the vendor when embedded on the home page. Based on the results from Experiment 2, there appears to be no simple heuristic as to which photos to put on an e-commerce site to increase trust.

6.4.3 Novel Trust Measures

While previous studies on trust in e-commerce measured trust via users' self-reports (either elicited with qualitative interviews or questionnaires), this research measured trust by observing decisions made under risk. The reasoning was that through the creation of financial risk under laboratory conditions and consequently through an observation of users'

willingness to make themselves vulnerable, one could gain insight into their levels of trust. Such an approach avoids the problems associated with cognitively mediated self-reports (e.g. participants' desire to be perceived as a rational decision-maker), which were discussed in section 4.2.

Two novel measures that induced financial risk were introduced in Experiment 2: an INVESTMENT measure and an ASSESSMENT measure. INVESTMENT is the closest match to a real-world trust-requiring situation. Investing in a good vendor yields a gain, investing in a vendor that turns out to be bad results in a loss. The ASSESSMENT measure, on the other hand, was conceptually closer to a standard rating measure, as it elicited participants' assessment on a scale from 1 (bad) to 10 (good). However, in contrast to standard questionnaire measures, inaccurate assessments resulted in losses proportional to the squared assessment error. Thus, at the very least, these measures can be understood to motivate participants to assess the vendors accurately, as an inaccurate assessment will lead to a loss – just as it would in a trust-requiring situation outside the lab.

The novel measures introduced in Experiment 2 are clearly focused on the behavioural aspect of trust. Behavioural outcomes are of higher relevance for practitioners who are ultimately interested in users' behaviour in the form of purchase decisions; but they are also of highest relevance for user advocates who are concerned with protecting users from making themselves vulnerable to untrustworthy actors.

An additional source of variance that is introduced by the INVESTMENT measure are individual differences in willingness to invest money. This effect had been expected and it is easily accounted for by eliciting chance investments and using these as control variables for between subject analyses involving the INVESTMENT measure.

6.5 Chapter Summary

Experiment 2 addressed the two main research goals of this thesis. First, it investigated users' ability to correctly identify the trustworthiness of e-commerce vendors based on surface cues (Research Goal 1). This question, despite its importance for the development of trust in e-commerce in the long-term (see 2.2.3), had not been addressed in previous research. Secondly, Experiment 2 tested the effect of adding a facial photo to an e-commerce vendor's homepage on user trust (Research Goal 2). It thus focused on the symbolic use of interpersonal cues (P1, see 2.3.3 and 3.3.2). This question is of high relevance, because this strategy is widely used by e-commerce vendors in an attempt to increase trust and attract customers (see 2.2.4). It had been addressed by previous studies, but these studies tested the

effects of adding one photo to a mock-up of one e-commerce site. In addition, these earlier studies investigated trust exclusively through participants' self-reports (questionnaires, interviews, see 2.3.5.3). Experiment 2 aimed to overcome many of these limitations by testing several photos on several semi-functional copies of existing vendors' sites. In addition, Experiment 2 introduced novel methods for measuring trust that required participants to make decisions under financial risk (Research Goal 5).

Experiment 2 found – contrary to earlier claims (see 2.2.3) – that users are indeed able to infer a vendor's trustworthiness based on the surface cues they perceive in the interface (Research Goal 1). This statement is, however, only true in the sense that participants trusted the good (i.e. high quality of service) vendors *on average* more than the bad (i.e. low quality of service) ones. A question that is raised by this finding is where the reliable surface cues are located in an e-commerce interface. Experiment 3 approached this question by investigating the quality of users' trust assessments at different stages of the exploration process. No clear picture emerged regarding the effect of photos (Research Goal 2). Neither the *presence of a photo* nor pre-rated *photo trustworthiness* had an effect across all the sites in the study. The practical implication of this finding is that, whilst some photos may have a positive effect on some sites (see 2.3.5.3), it is impossible to predict this effect from the variables that were investigated here. It seems advisable instead to pre-test photos individually.

Chapter 7

Experiment 3:

Trust and Usability in E-Commerce

7.1 Research Goals and Questions

Experiment 3 completed the series of experiments investigating trust in e-commerce within this thesis. It combined the research interests of Experiment 1 (effects of photos on usability and visual gaze) with those of Experiment 2 (effects on user trust). Its aim was to answer some of the questions that were left open by the previous experiments.

Experiment 1 (Chapter 5), in addressing Research Goal 3, compared pages with a facial photo embedded to pages with a non task-related text box of the same size. It found that – when users conducted a *search task* – a facial photo was looked at on *first exposure* to a page, but largely not attended to in subsequent exposures to page with the same structure. Similarly, the negative effect on task performance on a first time view was short-lived, and disappeared with subsequent exposure to pages with the same structure. Experiment 3 aimed to replicate these findings under varied experimental conditions. Whilst the comparison between a page with a photo and one with a text-box in Experiment 1 ensured that effects could be attributed to the presence of a photo rather than to the presence of an additional interface element, Experiment 3 took a more pragmatic approach. Here, a page with a photo added was compared to one with no additional element added. The reasoning was that designers do not commonly face a choice between a photo and a text box, but one between adding a photo and not changing the page. As an additional variation relative to Experiment 1, Experiment 3 included an *exploration task* and a *search task*. Finally, Experiment 3 recorded eye-tracking measures of user cost (SCANPATH-LENGTH, BACKTRACKING), which were not available in the earlier version of the eye-tracking system used in Experiment 1.

Experiment 2 found that users could differentiate trustworthy from less trustworthy vendors based on the surface cues perceived in the interface (Research Goal 1). It found no effect of a facial photo on the homepage on user trust in an e-commerce vendor (Research Goal 2).

A new variable, introduced in Experiment 3, is the depth of a users' exploration of a site (*exploration depth*). The introduction of this independent variable was motivated by four factors. First, the finding from Experiment 1 that *exposure order* (1st *vs.* subsequent views) had a strong influence on the effect of photos suggested an examination of this factor in further studies. Second, the finding from Experiment 2 that users can differentiate trustworthy from less trustworthy vendors raises the question as to which interface elements allow for this differentiation. Investigating exploration-depth was expected to give insight into the location (homepage *vs.* pages deeper in the site) of reliable cues for trustworthiness. Third, *exploration depth* was expected to clarify contradictory findings regarding the effect of photos on user trust. Experiment 2 had found no effect of adding a photo to the homepage on users' trust, whereas previous studies found effects on trust (albeit measured with self-reports, see 4.2). Fourth, most models of trust (see section 3.5.1) include time as an important factor influencing trust. Trust in first encounters is bound to be based on other factors than trust from a long-standing relationship. Applying this consideration to the short time-scale that can be realised in a laboratory experiment (see 4.1.3), it can be expected that the level of trust after an initial glance of the homepage will be based upon other factors than trust after a detailed exploration of the site. A photo might have a strong effect based on an initial glance, but lose its importance once more information (e.g. from a site's privacy policy) is available. Alternatively, one could also predict that the first impression (e.g. influenced by a photo) colours further information processing and thus has a lasting effect (Baron & Byrne, 2004). From the point of view of an e-commerce vendor this question has practical implications, as Internet users who arrive at the homepage may choose to stay or quickly discard it based upon first impressions. Good first impressions can be seen as a necessary, but not a sufficient condition for winning customers. The detailed goals of Experiment 3 were as follows:

Trust (Research Goals 1, 2, 5)

1. To test for effects of *exploration depth* on users' ability to discriminate between trustworthy and less trustworthy vendors.
2. To test whether *exploration depth* influences the effect of photos on user trust.

Task Performance and User Cost (Research Goal 3)

3. To replicate the effect of *exposure order* on VISUAL ATTRACTION of a photo in a varied experimental setting (different tasks and sites).
4. To replicate the effect of *exposure order* on the effect of a photo on task performance (TASK TIME) in a varied experimental setting (different tasks and sites).
5. To investigate effects of photos on measures of user cost derived from an analysis of eye gaze (SCANPATH-LENGTH, BACKTRACKING).

7.2 Method

7.2.1 Participants

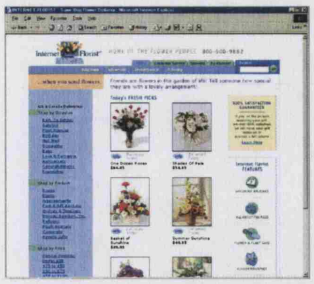
Experiment 3 had 39 participants, who had not seen the sites that formed part of the experiment prior to the study. Out of these 22 were male, 17 female, and their average age 23 years. Most participants were students. 31 out of 39 spent two hours or more per day on the Internet and 30 of them had shopped online before.

7.2.2 Independent Variables

7.2.2.1 Sites

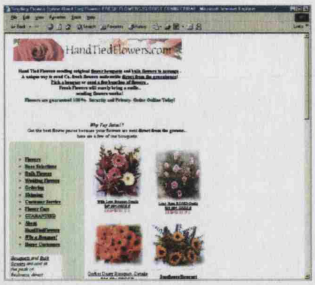
While Experiment 2 evaluated 12 different sites, Experiment 3 only included 3 sites as stimulus material. This restriction was necessary as the procedure for Experiment 3 was more complex than for Experiment 2. First, the combination of eye-tracking with trust measurements made each experimental session longer as the eye-tracker needed to be calibrated. Second, whilst Experiment 2 was conducted with a computer-based experimental system that allowed conducting experimental sessions with up to 20 participants at a time (section 6.2.6), Experiment 3 had to be conducted on a person-by-person basis and the eye-tracking and trust measures had to be coordinated manually, thus further increasing the length of each individual experimental session. Finally, the inclusion of two levels of *exploration depth* for each site increased the time spent with each site as well as the time needed to elicit the trust measures.

The vendors chosen for inclusion in Experiment 3 were three of the flower delivery services sites that had been used in Experiment 2. Flower delivery poses a high non-monetary risk, such as embarrassment, if the service is not on time or the products are of lower than expected quality. Furthermore, quality cannot be assured by branded goods from trusted manufacturers, as is the case for buying electronics or computer hardware online. One trustworthy (good, V1 in Figure 7.1) vendor and two less trustworthy (bad; V2 and V3 in Figure 7.1) vendors were chosen from the material used for Experiment 2 (see 6.2.2). As discussed in section 6.2.2.2, the vendors' trustworthiness had been established from ratings of post-order performance by *Bizrate* and *Epinions*. The values for trustworthiness ranged from 1 (bad) to 10 (good). The stimulus material thus consisted again of semi-functional copies of the top layers of these sites that were hosted on an experimental server.



Good Vendor (V1)
Rating 10 (out of 10)

Bad Vendor (V2)
Rating 4 (out of 10)



Bad Vendor (V3)
Rating 4 (out of 10)

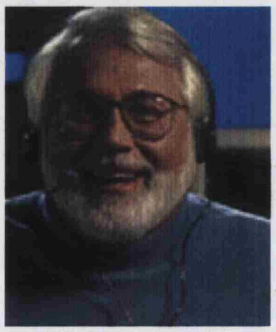
Figure 7.1: Vendors and their performance ratings (10 good / 1 bad)

7.2.2.2 Photos

The two photos used in Experiment 3 were a subset from those in Experiment 2. The photos were selected based upon their performance in Experiment 2. The photo that resulted in the highest (*trustworthy photo*) and lowest ratings (*less trustworthy photo*) across all measures and across those sites that were selected for Experiment 3 were included (Figure 7.2). It is worth noting that the photo which came out as the less trustworthy photo when embedded on the pages in Experiment 2, had been initially categorised as one of the trustworthy photos in the pre-test to Experiment 2 (see 6.2.2.1). This further underlines the finding (see 6.4.2), that effects of photos on a page cannot be easily predicted independent from the context in which they are deployed.

In Experiment 1, which investigated effects on visual attention, a text box was introduced to keep the overall number of page elements constant. As Experiment 1 had already shown effects that were specifically due to the photo, Experiment 3 varied this approach. It compared a page with a photo to the same page without the photo added. This approach has a high relevance to designers, who must decide whether a photo should be added.

Trustworthy Photo



Less Trustworthy Photo

Figure 7.2: Photos used in Experiment 3

7.2.2.3 Time: Exploration Depth and Exposure Order

The factor time is incorporated as an independent variable in Experiment 3 in two ways. First, the component of Experiment 3 concerned with investigating trust as a dependent variable included the factor *exploration depth* by comparing a *superficial exploration* of the homepage (T1) to a subsequent *in-depth exploration* of a vendor's site beyond the homepage (T2). The aim was to investigate how *exploration depth* affected users' ability to differentiate between trustworthy and less trustworthy vendors, and how it affected a photo's ability to bias user trust in a vendor. Time was incorporated into the eye-tracking component of Experiment 3 as the factor *exposure order* by comparing *first exposure* (T1) to *subsequent exposure* of the same page (T3). Here, it served to test results from Experiment 1, which found an effect of *exposure order* on a photo's VISUAL ATTRACTION (LOOKED) and its impact on TASK TIME (task performance).

7.2.3 Dependent Variables

7.2.3.1 Trust Measures

The measures introduced in Experiment 2, INVESTMENT (see 6.2.3.1), ASSESSMENT (see 6.2.3.2), and PREFERENCE (see 6.2.3.3) were also used in this experiment. Again participants could invest between 0 and 100 pence on a vendor being a good vendor, resulting in a potential impact of +/- £3 on final pay for this measure. As in Experiment 2, CHANCE INVESTMENT was elicited (see 6.2.4). For the ASSESSMENT measure, inaccurate assessments incurred a penalty with losses of up to £1 per vendor. This measure added a further £3 to the range of trust-dependent pay.

An additional measure used in Experiment 3 is EVALUATION. This measure, like the assessment measure, asked participants to rate the vendor on a scale from 1 (*bad*) to 10 (*good*) on putative post-order service. However, the correctness of participants' EVALUATION was not linked to their pay for this measure. Including the identical measure, once with financial incentives (ASSESSMENT) and once without (EVALUATION) allowed further investigating the effect of financial risk when measuring trust in a laboratory setting.

7.2.3.2 Eye-Tracking Measures

To identify potential effects of the photos on users' gaze pattern and on user cost, the LC EyeGaze eye-tracking system was used (see 4.4.3 for a detailed description). In line with Experiment 1, this experiment analysed eye-tracking data for the VISUAL ATTRACTION (LOOKED / FIXATED) of the photo (see 5.2.4) and for effects on TASK TIME (task performance,

5.2.4). In addition, SCANPATH-LENGTH and BACKTRACKING were in this experiment. In the eye-tracking literature (see 4.4.2) they are interpreted as indicators of user cost. Their inclusion was possible due to an updated version of the eye-tracking software used for this study.

7.2.4 Design

Experiment 3 consisted of two components: one that investigated user trust and one that investigated visual gaze and task performance. The sites and photos used were a subset of those used in Experiment 2 (see 6.2.2). Again *vendor trustworthiness* (1 *good vendor*, 2 *bad vendors*) and *photo trustworthiness / presence of a photo* (*trustworthy photo, less trustworthy photo, no photo*) were experimentally manipulated. The design of the component that focused on user trust mirrored that in Experiment 2 (see 6.2.1): each participant saw every site and every photo. The resulting 9 photo-site combinations (see Table 7.1) were integrated in 3 between-subject conditions. For each of these conditions, 6 permutations of presentation order were created. *Exploration depth* (see 7.2.2.3) was included as an additional within-subject variable. Hence, each participant saw each vendor twice: first only the homepage (*superficial exploration*), then the homepage and additional pages that were linked from it (*in-depth exploration*). Participants gave their PREFERENCE and EVALUATION responses after *superficial exploration* (homepage only, T1 in Table 7.2) and after *in-depth exploration* (T2 in Table 7.2). The measures INVESTMENT and ASSESSMENT, which carried financial risk, were only taken after the *in-depth exploration* (T2). This decision was made to ensure that the EVALUATION and PREFERENCE measures could be taken before and after *in-depth exploration* without introducing the relatively complex INVESTMENT and ASSESSMENT measures in the meantime. However, this design decision made it impossible to investigate the effect of *exploration depth* with the measures that induced financial risk.

	Vendor 1 (V1) *Good Vendor*	Vendor 2 (V2) *Bad Vendor*	Vendor 3 (V3) *Bad Vendor*
Condition 1	∇	⭘	
Condition 2		∇	⭘
Condition 3	⭘		∇

Photo trustworthiness / Presence of a photo:

⭘ *trustworthy photo*, ∇ *less trustworthy photo*, empty cell: *no photo*

Table 7.1: Experimental conditions of Experiment 3

The eye-tracking component of Experiment 3 used the same conditions as the trust component (Table 7.1), but the analysis did not differentiate between trustworthy and less trustworthy photo. It only investigated the effect of *presence of a photo*. The second independent variable for the eye-tracking component was *exposure order*. Consequently eye-tracking measures were taken twice for each participant for each vendor's homepage (T1 and T3 in Table 7.2). The eye-tracking component of Experiment 3 differed from Experiment 1 in several aspects. Whilst Experiment 1 kept the task (goal-directed search) for 1st and 2nd exposure constant, Experiment 3 used a non-goal directed task on *first exposure* and then a *search task* for *subsequent exposure*. Furthermore, while Experiment 1 investigated effects of *exposure order* in very close temporal proximity, Experiment 3 created a gap of several minutes between *first* and *subsequent exposure*. These variations allowed for a test of the findings from Experiment 1 under different contextual conditions. It would be desirable to systematically investigate the effect of these variations in future studies through manipulating them as independent variables (see 10.4 for a discussion of future work).

7.2.5 Procedure

Participants were first shown static copies of the homepages in the study to form an impression of the vendors (T1; Table 7.2). Their task was given as follows (for the complete materials used, see Appendix C.2):

> *"For this question we want you to consider which vendor you would be most comfortable buying from. Assuming that all vendors offer the product you are looking for at the same price with the same conditions; Which vendor would you feel most comfortable buying from?"* (Appendix C.2)

Participants' eye-gaze was tracked during this exploration task (T1) to find effects of *first exposure*. As the eye-tracking system only allowed the display of static pages, gaze data could not be recorded during the *in-depth exploration* that spanned several pages (T2). Hence, participants conducted a separate *search task* (T3) for which eye-tracking measures were taken to investigate effects of *exposure order* (see 7.2.2.3). Table 7.2 gives an overview on the different tasks and measures.

	Material	Task	Measures		
Task T1	Screenshot of homepages	*Superficial Exploration (First Exposure)*	No Risk	PREFERENCE EVALUATION	Eye Tracking
Task T2	Functional copies of vendors' sites	*In-depth Exploration*	No Risk	PREFERENCE EVALUATION	
			Risk	INVESTMENT ASSESSMENT	
	(search tasks on other sites)				
Task T3	Screenshot of homepages	*Search Task (Subsequent Exposure)*			Eye Tracking

Table 7.2: Overview on experimental tasks and procedure in Experiment 3

7.3 Results

7.3.1 Trust Measures

As in Experiment 2, participants' CHANCE INVESTMENT was analysed for a correlation with their average INVESTMENT in vendors. However, in Experiment 3 no significant correlation was found (r = .262, *ns.*, n= 39).

7.3.1.1 Identifying Vendor Trustworthiness

The first question addressed in Experiment 3 was whether users can differentiate trustworthy from less trustworthy vendors from the surface cues they perceive in the interface. Experiment 2 found that users were able to do so after a detailed exploration of vendors' sites. Experiment 3 investigated, whether users are also able to do so by only exploring the homepage of a vendor. In response to this question participants' PREFERENCE and EVALUATION responses were analysed for the sites without any photos added. The analyses were conducted as non-parametric between-subjects comparisons (Mann-Whitney *U*). Non-parametric tests were chosen as interval scale level of the novel measures could not be assumed. In contrast to Experiment 2, comparisons had to be made between subjects, because the low number of sites in the study resulted in only one measurement of a site without a photo added per participant. The analysis yielded that, based on an exploration of the homepage alone, participants did not differentiate bad from good vendors on the PREFERENCE

(T1: Z (N = 39) = 0.458, *ns.*; Figure 7.3) and EVALUATION (T1: Z (N = 39) = 0.220, *ns.*; Figure 7.4) measures. After a detailed exploration (T2), participants ranked the *good vendors* higher than the *bad vendor* (T2; Z (N = 39) = 3.71, p = .001, two-sided; Figure 7.3) on the PREFERENCE measures and they gave them higher ratings on the EVALUATION measure (T2; Z (N = 39) = 3.21, p = .002, two-sided; Figure 7.4). For the ASSESSMENT measure that induced financial risk, the trend was the same, but no significant effect was found (T2: Z (N = 39) = 1.822, p = .076, two-sided, Figure 7.5). INVESTMENTS in the *good vendor* were also higher than INVESTMENTS in *bad vendors,* but the effect was marginal (T2: Z (N = 39) = 2.00, p = .052, two-sided, Figure 7.6).

The effect of *exploration depth* suggested by the non-parametric tests above is also supported by a repeated measures ANOVA. For the PREFERENCE measure this analysis yielded a main effect for the within-subject factor *exploration depth* (F (1, 37) = 20.36, p < .001) and an interaction effect between *exploration depth* and the between-subject factor *vendor trustworthiness* (F (1, 37) = 23.45, p < .001). There is also a main effect of *vendor trustworthiness* (F (1, 37) = 4.35, p = .044). Similarly, for the EVALUATION measure this analysis yielded a main effect for *exploration depth* (F (1, 37) =9.45, p = .004) and an interaction effect between *exploration depth* and *vendor trustworthiness* (F (1, 37) = 6.52, p = .015). There is also some indication for a main effect of *vendor trustworthiness,* but it is not significant (F (1, 37) = 3.38, p = .074).

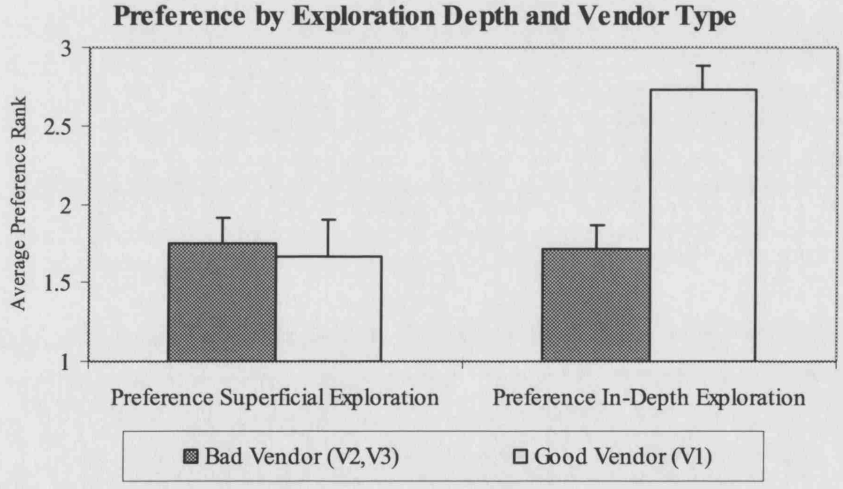


Figure 7.3: PREFERENCE measure (3 best, 1 worst)

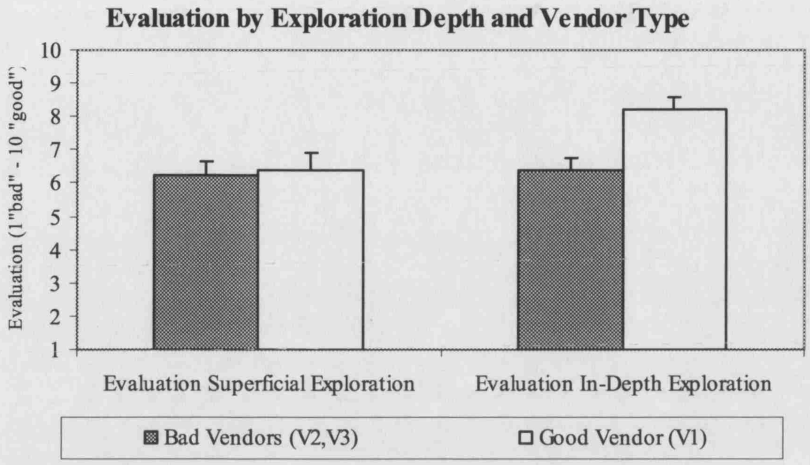


Figure 7.4: EVALUATION measure (10 good, 1 bad)

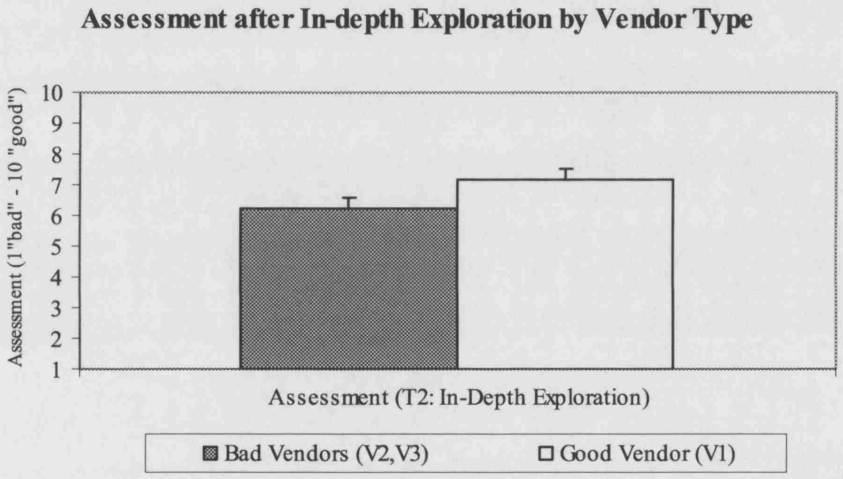


Figure 7.5: ASSESSMENT measure (10 good, 1 bad)

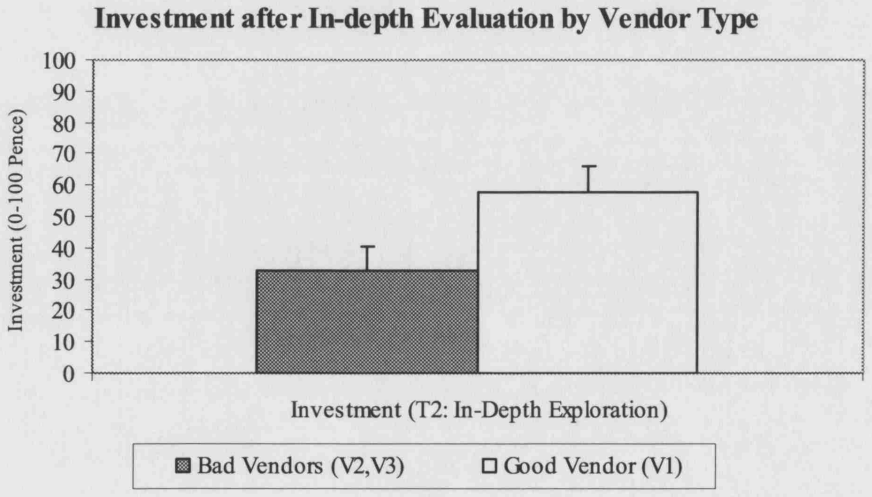


Figure 7.6: INVESTMENT measure (10 good, 1 bad)

The difference between *superficial* and *in-depth exploration* is also illuminated by looking at the number of participants who ranked the *good vendor* highest on the PREFERENCE measure (see Table 7.3). Based on *superficial exploration* of the homepage (T1), only 5 out of the 16 participants (a ratio of .31) who saw it without a photo added ranked the *good vendor* highest. As there were 3 vendors in the study, this is no better than random guesses, where each participant's probability for placing the good vendor highest would be $p = .33$. After a detailed exploration, the number of correct ratings rose to 13, a result significantly better than chance (see Table 7.3). This result also holds for the INVESTMENT measure, which induced financial risk: 13 out of 16 participants risked parts of their participation pay with the *good vendor.*

	Incorrect	Correct	N	p	Binomial Test
Superficial exploration (T1)	11	5	16	.33	P (X >= 5) = .650, *ns.*
In-depth exploration (T2)	3	13	16	.33	P (X >= 13) < .001

Table 7.3: Rankings for Vendor 1 (*good vendor*)

7.3.1.2 Photo Effects on Trust

The second question related to trust in Experiment 3, was whether *exploration depth* influenced the effect of a photo on user trust. In Experiment 2, which only investigated *in-depth explorations*, no such effect was found. In Experiment 3 non-parametric Kruskal-Wallis tests were used for this analysis to conduct between-subject comparisons (no photo, trustworthy photo, less trustworthy photo) for each vendor. As in Experiment 2, no effect of the *presence of a photo* emerged after an *in-depth exploration* (T2) of the site on any of the measures taken (PREFERENCE, EVALUATION, ASSESSMENT, and INVESTMENT).

Focussing on the *superficial exploration* (T1) of the homepage only, type and presence of a photo was found to have an effect on the PREFERENCE (χ^2 (2, N = 39) = 6.466, p = .039) for the *good vendor* (V1) and on its EVALUATION (χ^2 (2, N = 39) = 8.884, p = .012). Figure 7.7 illustrates this effect for the EVALUATION measure. For the *bad vendors'* sites (V2 and V3) no effects were found on the PREFERENCE and EVALUATION measure after *superficial exploration* (T1).

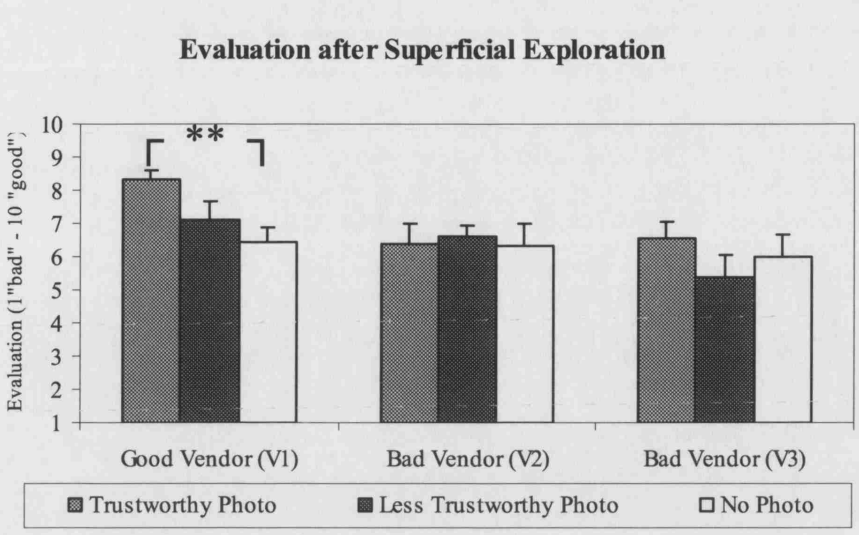


Figure 7.7: Effects of photos on EVALUATION measure after *superficial exploration* (T1)

7.3.2 Eye-tracking and Task Performance Measures

7.3.2.1 Visual Attraction

The first aim of the eye-tracking component of Experiment 3 was to replicate findings on the effect of a photo on VISUAL ATTRACTION (LOOKED / FIXATED) in a varied experimental setup. In contrast to Experiment 1, Experiment 3 compared a page with a photo to a page with no additional element added. It compared an exploration task on *first exposure* to a *search task* on *subsequent exposure* with a time gap of several minutes between *first* and *subsequent exposure*.

Due to a loss of eye-tracking data on re-calibration (see 4.4.3), eye-tracking measurements for the *first* and *subsequent exposure* were only available for 25 participants. For this repeated exposure design, McNemar Tests (Berenson & Koppel, 2005) were chosen to compare the ratio of participants who were attracted by the photo on *first exposure* (T1) to the ratio attracted on the *subsequent exposure* (T3). The tests yielded that the photo had a higher VISUAL ATTRACTION (LOOKED) on a *first exposure* than in a *subsequent exposure* (trustworthy photo: $P\ (M <= 0, p = .5, n = 12) < .001$, untrustworthy photo: $P\ (M <= 1, p = .5, n = 12) = .003$). An analysis for the less sensitive measure VISUAL ATTRACTION (FIXATED) yields the same result: more participants fixated the photo at least once on *first exposure* than on *subsequent exposure* (trustworthy photo: $P\ (M <= 3, p = .5, n = 19) = 004$, untrustworthy photo: $P\ (M <= 2, p = .5, n = 17) = .002$). Hence, Experiment 3 corroborates the findings from Experiment 1. Figure 7.8 illustrates this finding for the trustworthy photo and the measure VISUAL ATTRACTION (LOOKED).

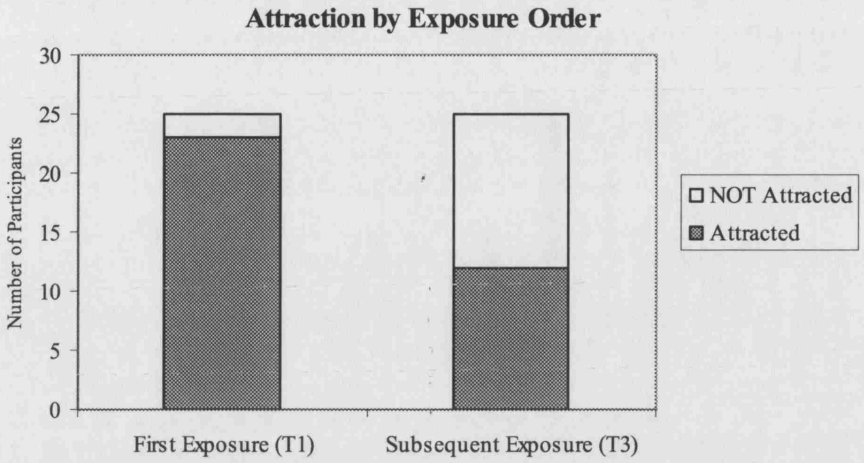


Figure 7.8: VISUAL ATTRACTION (LOOKED) for trustworthy photo by *exposure order*

7.3.2.2 Task Performance

Experiment 1 found that TASK TIME (as a measure of task performance in *search tasks*) was increased by the *presence of a photo* on *first exposure* only. Experiment 3 aimed to replicate this finding in a varied experimental setup. Before analysing TASK TIME data, outliers were removed. On *first exposure* (T1) the *presence of a photo* had no effect on TASK TIME on any of the vendors' homepages (V1: t (32) = 1.641, *ns.*; V2: t (30) = 0.449, *ns.*; V3:t (32) = 0.853, *ns.*; Figure 7.9). There was also no effect on task performance for the subsequent view (T3), on which a *search task* was performed (V1: t (24) = 0.427, *ns*; V2: t (25) = 0.190, *ns.*; V3: t (25) = 0.225, *ns*; Figure 7.10).

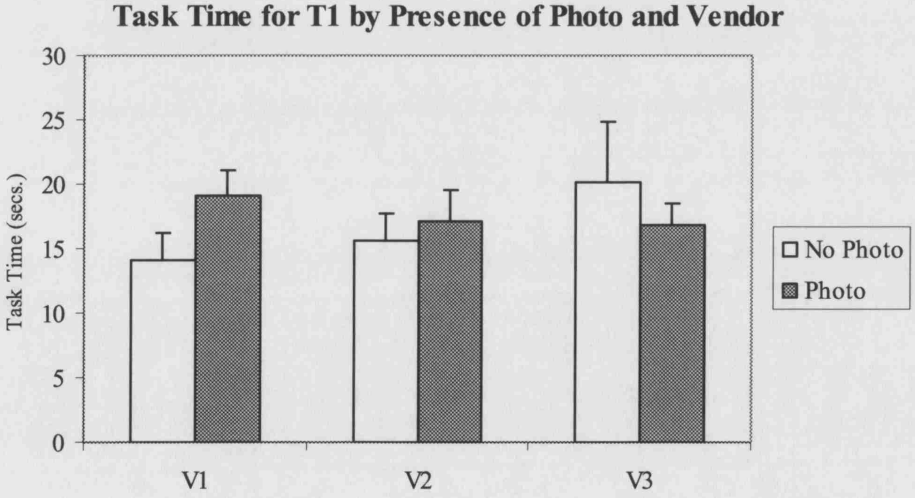


Figure 7.9: TASK TIME on *first exposure* (T1)

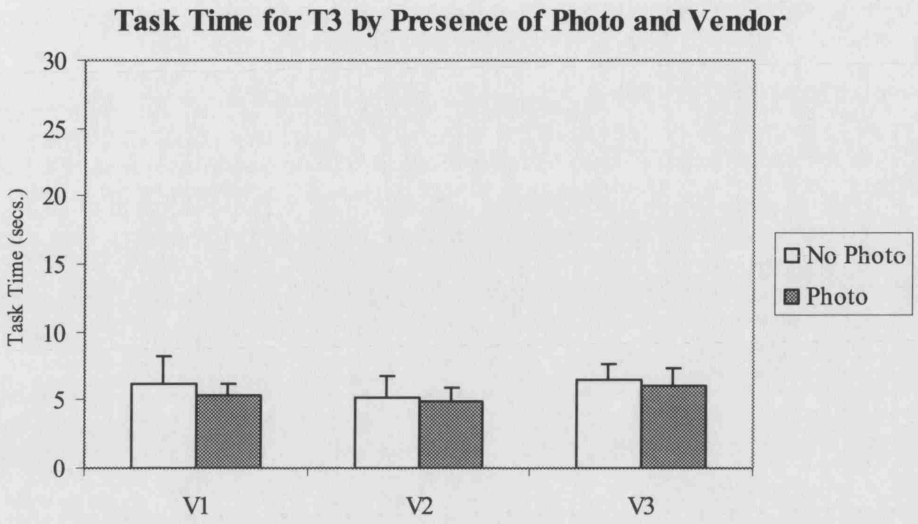


Figure 7.10: TASK TIME on subsequent view (T3)

7.3.2.3 User Cost

The eye-gaze measures SCANPATH-LENGTH and BACKTRACKING were calculated as they were expected to give insight into user cost in visual search processes (section 4.4.2). As for the analysis of TASK TIME, outliers (*z-scores* > 3 or < -3) were excluded on a per-task and per-measure basis. A comparison between pages with a photo added and those without for the first task (T1) did not find a significant result for SCANPATH-LENGTH (V1: t (32) = 0.729, *ns*; V2: t (30) = 1.007, *ns.*; V3: t (32) = 1.115, *ns.*) and not for BACKTRACKING (V1: t (32) = 1.429, ns; V2: t (20.26) = 0.039, *ns.*; V3: t (31) = 0.010, *ns.*). The same analysis conducted for the subsequent *search task* (T3) did also not find an effect for SCANPATH-LENGTH (V1: t (24) = 0.460, *ns*; V2: t (26) = 0.688, *ns.*; V3: t (26) = 0.542, *ns.*) and BACKTRACKING (V1: t (24) = 0.731, *ns*; V2: t (26) = 0.463, *ns.*; V3: t (25) = 0.596, *ns.*). Hence, no effects of adding a photo were found on the eye-gaze user cost measures SCANPATH-LENGTH and BACKTRACKING.

7.4 Discussion

Experiment 3, the final experiment on trust in e-commerce conducted within this thesis, combined an investigation of the topics that had been researched separately in Experiments 1 and 2. It investigated users' ability to detect the trustworthiness of e-commerce vendors (section 7.3.1.1) and the effect of photos on trust (section 7.3.1.2). It also investigated photo effects on VISUAL ATTRACTION (LOOKED / FIXATED; section 7.3.2.1), TASK TIME (task performance; section 7.3.2.2), as well as BACKTRACKING and SCANPATH-LENGTH with an eye-tracker (user cost; section 7.3.2.3).

7.4.1 Trust

In the area of user trust the two main research goals of this thesis were addressed by Experiment 3. Experiment 3 used the same experimental approach to address these questions as Experiment 2. Copies of sites of existing vendors whose trustworthiness was known to the researcher were used as experimental material. Trust was measured by observing decisions made under financial risk. A variation to Experiment 2 was the inclusion of the factor *exploration depth* (*superficial exploration* of the homepage only *vs. in-depth exploration* of additional pages of the site). This factor was included for several reasons. First, it was hoped to find out where in the interface the reliable cues for a correct assessment of a vendor's trustworthiness are located. Second, the factor *exploration depth* promised to help clarify earlier contradicting results regarding the effect of photos on users' trust in e-commerce vendors. Third, the framework presented in Chapter 3 showed that trust is dynamic and may depend upon different types of signals at different stages of acquaintance. Whilst the effect of longer time-spans could not be investigated within the experimental paradigm employed in this research (see 4.3.1 for a critical discussion of this aspect), investigating time in terms of two stages of *exploration depth* could be accomplished. From a practitioner's point of view, first impressions are highly relevant, as they will determine whether a user is willing to spend more time on a site or discard it for a competitor's site.

7.4.1.1 Identifying Vendor Trustworthiness

Experiment 3 corroborated findings from Experiment 2, as it was found that users could tell the *good vendor* from the *bad vendors* based upon an inspection of surface cues. After an *in-depth exploration* (i.e. after inspecting the sites beyond the homepage) participants showed more trusting responses to the *good vendor* on the EVALUATION and PREFERENCE measures. They were also willing to invest more in the *good vendor* than in the *bad* ones. As participants risked part of their participation pay with this measure, it can be seen as a particularly strong indicator of trust compared to measures that do not carry financial risk (see 4.2). Based upon results from Experiments 2 and 3, there is clear evidence that users can differentiate trustworthy (*good*) from less trustworthy (*bad*) vendors from the surface cues they perceive in the interface. This finding disproves the notion that it is impossible to make inferences about a vendor's trust-warranting properties from its interface. It thus contrasts with the belief of some users, who thought it impossible to make inferences from an interface (Riegelsberger & Sasse, 2000).

This contrast may be explained by differences in Internet literacy between the participants of Experiments 2 and 3 and those that took part in the study reported in Riegelsberger &

Sasse (2000). Participants in experiments conducted for this thesis were university students with a high level of Internet experience. The participants in the earlier study, in contrast, had been recruited to reflect the composition of the wider Internet user population in terms of age and educational level. This inference is supported by Fogg's (2003b) *prominence-interpretation theory,* which predicts that the effect of surface cues depends, amongst other factors, on users' interpretative abilities. These may vary between the different participant pools investigated in these studies. Furthermore, the contrasting results may reflect a collective increase in interpretative ability of the user population from the year 1999 in which the empirical work for Riegelsberger & Sasse (2000) was conducted to the years 2002 and 2003, in which Experiments 2 and 3 were conducted (see 2.2.2).

Beyond interpretative ability of the user, the impact of a surface cue also depends on its prominence (Fogg, 2003b). This factor, which refers to the likelihood of a surface cue being noticed, is of high relevance to this discussion as it captures the factor *exploration depth* (*superficial vs. in-depth*). Experiment 3 showed that – based upon an exploration of the homepage alone – participants did not do better than chance when trying to tell *good* from *bad vendors*. The cues that are given on the homepage of a vendor thus seem insufficient to assess its trustworthiness. A clear discrimination between trustworthy and less trustworthy vendors was only achieved after an exploration beyond the homepage. Expressed in terms of the framework (Chapter 3), the interface elements that reliably signal vendors' trust-warranting properties have little prominence, i.e. they are not part of the homepage, but require an *in-depth exploration* of a site. The cues that are firmly linked to trust-warranting properties appear to lie in the interaction experience across the whole site; i.e. the size of the site, how the information is structured, and how easy it is to find relevant policies.

This interpretation of the findings suggests that a reliable assessment of a vendor's trustworthiness requires an exploration beyond the homepage. It advocates educating users to avoid committing to a vendor based on first impressions of the homepage. For researchers, the findings from this study encourage a continued investigation of surface cues, as they allow users to reach correct trust-decisions. The first goal is to more precisely identify the cues that allow for a correct trust assessment. These are not necessarily those listed in designer's guidelines, as many of those cues might also be used by untrustworthy vendors who want to appear trustworthy.

Concluding from these findings that trustworthiness can be assessed with sufficient reliability for long-term trust in e-commerce to grow would, however, be premature. Whilst users – after an *in-depth exploration* – trusted the trustworthy vendors more, this does not mean that users can easily avoid having their vulnerabilities exploited. As indicated in section 6.4.1, there are two main reasons for this. First, whilst it is encouraging that trust aggregated

over all participants was mostly well-placed, many individual participants committed incredulity and gullibility errors (Fogg, 2003a). Outside the laboratory even a single such error could potentially have severe effects and thus undermine an individual's long-term trust in the whole market place. Second, this investigation of trustworthiness was limited to vendors' professionalism and post-order quality of service in fulfillment. In everyday e-commerce interactions, further vulnerabilities arise; e.g. whether the vendor is a legitimate business or a 'spoof' site aimed at extracting personal information. A similar experimental paradigm as was pioneered in Experiments 2 and 3 could be used for an investigation of these issues (see discussion on future work 10.4).

7.4.1.2 Photo Effects

Experiment 3, in contrast to Experiment 2, found that users' trust in a vendor could be biased through the addition of a photo to its homepage. It thus corroborated earlier research by Steinbrueck & Schaumburg (2002) and Fogg et al. (2001), and provided support for prediction P1: the symbolic use of interpersonal cues can sway users' trust, simply by signalling the presence of a human. However, this effect was only found for a *superficial exploration*, i.e. only if participants just explored the homepage of a vendor and not other parts of the site. Furthermore, it is only based on measures that were taken without inducing financial risk (EVALUATION, PREFERENCE). The interesting outcome of Experiment 3 is that this effect disappeared once users had expected vendors' sites in more depth, i.e. once they had looked at pages beyond the homepage. *Exploration depth* thus helps in explaining some of the contradictory evidence in the literature on the effect of facial photos on trust in e-commerce vendors (Steinbrueck & Schaumburg, 2002; Fogg et al., 2001; Urban, 1999; Riegelsberger et al., 2002a). Experiment 2, which found no effect for the *presence of a photo*, was based on *in-depth explorations*.

This finding corresponds with the effect of *exploration depth* on participants' ability to identify the trustworthiness of vendors (see 7.4.1.1). Based on a *superficial exploration* of the homepage, participants were not able to correctly identify the trustworthiness of a vendor and their judgement could be swayed by the simple addition of a photo. In a detailed exploration, the cues that carried reliable information about a vendors' trustworthiness were perceived, and photos could not easily influence this judgement. Hence, with reference to the predictions that were given in section 2.3.3, a photo did not have a lasting effect on user trust and it did not colour the perception of additional site elements (Baron & Byrne, 2004). Rather, the additional information perceived on additional pages reduced the relative impact of the photo. For an e-commerce vendor, this effect of a photo on first impressions is important. Users arriving at a site homepage will decide, based upon such first impressions, whether to explore

the site in more depth or whether to discard it for a competitor's site. Positively influencing such first impressions with a photo can thus help e-commerce vendors to overcome the first hurdle in the process of converting a visitor to a customer. Conversely, from the perspective of a user advocate, photos are unlikely to make users shop from untrustworthy vendors, as committing to a transaction commonly requires an interaction with a site beyond its homepage, which would bring the user in contact with more reliable cues of trustworthiness. Good first impressions are thus not a sufficient condition, but a necessary one for e-commerce vendors to be perceived as trustworthy and to win customers. An interesting future avenue for researching the effect of photos on e-commerce sites would be to vary the function or role of the depicted person: e.g. in the form of a testimonial (see section 10.4).

7.4.1.3 Novel Approaches to Measuring Trust

Experiments 2 and 3 introduced several methodological innovations. First, they used existing vendors' sites, whose trustworthiness – based on reputation ratings – was known to the researcher. This approach required that the photos had to be added to existing designs by the researcher. However, no participant mentioned this manipulation in the post-experimental interviews, suggesting that they had been added in a professional and unobtrusive manner. Besides increasing the ecological validity of the stimulus material, this approach allowed comparing participants' trust to the real trustworthiness (as defined by the reputation ratings) of the vendors. In this way Research Goal 1, investigating users' ability to infer vendors' trustworthiness, could be addressed. A second advantage of this approach is that well-placed trust could be rewarded. In this way financial risk could be induced into participants' decision-making, which further increased the ecological validity (see 4.3.1) of the study and lends further credibility to the results.

Experiments 2 and 3 allowed the comparison of the novel INVESTMENT and ASSESSMENT measures to a simple PREFERENCE ranking and (in Experiment 3) to an EVALUATION measure that did not carry financial risk. In both experiments, the results on the PREFERENCE and EVALUATION measure were very similar to those found for the measures that carried financial risk. This could be interpreted as evidence that the financial risk imposed in the experiments did not have an impact on participants' decisions and that this approach did not add much beyond what could be achieved with simple rating measures. This interpretation can be questioned for three reasons.

1. The similarity in outcome may be partially explained by a *consistency bias* (Chaudhuri & Buck, 1995), due to these measures being elicited at the same time. Consistency bias occurs when respondents – in an attempt to appear coherent –

respond similarly to different, but related questions that are posed in close temporal succession. A systematic comparison between standard rating measures and the novel risk-inducing measures would have to elicit these measures at different points in time or from different participants (see 10.4).

2. The presence of financial risk can be expected to motivate participants who might otherwise choose carelessly in a laboratory situation. The lack of effect for financial risk observed in Experiments 2 and 3 could thus also be explained by participants' high degree of involvement in the study, independent of whether an individual measure carried risk or not. Inducing risk on one measure may have motivated participants sufficiently for the whole experiment.
3. The level of financial risk created in Experiments 2 and 3 (up to 100 pence per vendor) might have been too low to significantly increase participants' involvement in their decision-making compared to ratings that did not induce risk. Experiment 4 in continuing to explore novel risk-inducing measures of trust (Research Goal 5), varied the levels of risk to find effects on participants' behaviour.

7.4.2 Eye-Tracking

Experiment 3 broke new ground by combining an investigation into the effects of photos on trust with a check for the potentially negative impact of these additional elements on usability, the traditional core interest of HCI. While this multi-dimensional approach surely can be further refined (see below), it can be seen as a step into the right direction, as HCI research increasingly has to combine an evaluation of classic usability criteria such as task performance with relatively novel elements of user experience such as trust (see 2.1).

The eye-tracking component of Experiment 3 tested some of the findings of Experiment 1 for their robustness in a varied experimental setup. It also aimed to find effects on eye-gaze related measures of user cost that had been unavailable in Experiment 1. There it was found that a photo attracted visual attention while users were engaged in a visual *search task* only on *first exposure* to a page. A negative effect of a photo on task performance (measured as TASK TIME in a *search task*) was only found for *first exposure*. No effects of *task type* (*search vs. aimless browsing*) were found. Experiment 3 tested these findings by comparing a page with a photo to a page with no additional element added (Experiment 1, 5.1). The main reason for this variation was that designers must often decide between adding a photo and not changing an existing page, rather than between a text box and a photo. An additional variation resulted from the combination of an investigation of user trust with an analysis of eye-gaze in Experiment 3. This approach required some trade-off decisions regarding the experimental

design. One of these was that *task type* and *exposure order* could not be disambiguated for the eye-tracking section of the experiment: all participants first conducted an exploration, i.e. a non-search task on the homepage followed by a visual *search task.* As a result, Experiment 3 did not allow testing for interaction effects between *exposure order* and *task type.* Nonetheless, it was possible to test whether effects of *exposure order,* found in Experiment 1, held under varied conditions. The findings for the VISUAL ATTRACTION of a photo from Experiment 1 are corroborated by the data in Experiment 3. Even with different stimulus material, different task types, and several minutes of user activity on other pages between *first* and *subsequent exposure*, the finding that a photo attracts visual attention only on a first time view holds. In Experiment 3 this finding was confirmed not only for the measure VISUAL ATTRACTION (LOOKED) but also for the less sensitive measure VISUAL ATTRACTION (FIXATED). Given the influence of *exposure order*, further studies would be necessary to identify an impact of *task type*, as suggested by Pagendarm & Schaumburg (2001). Such studies would use a non-goal directed task (e.g. evaluation of a site) for *first* and *subsequent exposure.*

No effect of the *presence of a photo* on TASK TIME was found. This holds true for the *evaluation task* conducted on *first exposure* and for the *search task* conducted *subsequently.* The lack of effect on *subsequent exposure* is in line with findings from Experiment 1. However, the lack of effect on TASK TIME for the *first exposure* stands in contrast to the findings made in Experiment 1. A likely cause for this outcome is the difference in tasks between Experiments 1 and 3. The *evaluation task* used in Experiment 3 had no specific search goal, no clear task completion state. The task used for *first exposure* in Experiment 1, on the other hand, required participants to find one clearly defined target and click on it. Following Pagendarm & Schaumburg's (2001) argument the differences in findings reflect the difference in information processing between these tasks. In this view, the *search task* in Experiment 1 induced a strong top-down information processing focus that could be negatively affected by distracting elements, such as facial photos. The *evaluation task*, on the other hand, had a high variability in time and was guided by bottom-up information processing. Clearly attributing effects to differences in task type, however, requires further studies that manipulate *task type* and *exposure order* as two independent variables.

The measures SCANPATH-LENGTH and BACKTRACKING had not been available in the earlier Experiment 1. They were included in Experiment 3 with the aim of identifying effects on user cost (see 4.4.2). The reasoning was that, while photos may have no lasting effect (see Experiment 1) on task performance, they may still increase user cost, as individuals might struggle more to keep task performance high when additional distracting page elements such as photos are present. This prediction was formed based upon a study by Burke & Hornof

(2000) that found no effect of distracting elements on task performance, but on subjective user cost. The data from Experiment 3, however, gave no indication for an increase in user cost based on these measures. The absence of an effect on these eye gaze measures of user cost together with the absence of a lasting effect on task performance stands in contrast with subjective feedback from participants in an earlier study (Riegelsberger et al., 2002a). There, participants had stated that additional non-functional elements such as photos slowed them down in their use of an e-commerce system and that they made it more difficult to use. There are several factors that can help in reconciling these findings. First, effects on user cost may only accrue after engaging with an e-commerce site for a longer time than was the case in Experiments 1 and 3. Future studies would have to investigate this issue by recording users' eye-gaze over a prolonged period of use. Second, the user cost measures employed for Experiment 3 may not capture the aspect of user cost that is affected by additional page elements such as photos. To answer the question for effects on user cost conclusively further studies with a longer duration using additional objective (e.g. physiological measures such as skin conductance; Wilson & Sasse, 2004) and subjective (e.g. Task Load Index; Hart & Staveland, 2003) need to be conducted.

7.5 Chapter Summary

Experiment 3, combined the research goals of Experiment 1 and 2. It investigated users' ability to correctly identify the trustworthiness of e-commerce vendors, the effect of photos on user trust, and the effect of photos on usability. Largely, the same experimental approaches as in Experiments 1 and 2 were used – a key variation was the inclusion of the factor *time* in the form of *exploration depth* and *exposure order.*

Experiment 3 found that users trusted *good vendors* more than *bad* ones, once they had explored their sites beyond the homepage. Trust assessments based on an exploration of the homepage alone were not better than chance. A practical conclusion to be drawn from this finding is that users should be educated to investigate sites in detail before engaging in a transaction. Further research is needed to identify the specific interface elements that act as reliable signals for a vendors' trustworthiness. Combining the evidence form Experiments 2 and 3, this research clearly showed that surface cues give information about a vendors' trustworthiness (see 7.4.1.1). Whilst this finding is encouraging for the prospect of long-term development of trust on the web, the discussion also emphasised that it has to be seen in the context of acceptable error rates (gullibility and incredulity errors), as well as types and levels of vulnerabilities. Furthermore, this research did not investigate users' ability do recognise illegitimate *phishing* sites (see 10.4 on future work).

Experiment 3 found a positive effect of a photo only after a *superficial exploration* of a vendors' homepage. Hence, it provided evidence for prediction P1: the mere presence of interpersonal cues can result in some level of trust, even if they clearly give no insight into the trust-warranting properties of the trustee. These visceral reactions, however, do not appear to colour the subsequent processing of signals, as their effect vanished with the perception of additional signals from an *in-depth exploration*. Given the effect of a photo on users' self-reported trust following a superficial evaluation of a vendor's homepage, a photo – if pre-tested on its target page – may be used to build initial trust. If, however, this initial trust is not corroborated by the cues perceived in the subsequent interaction with pages beyond the homepage (e.g. when searching for a product) this initial trust – according to the results of Experiment 3 – may be lost quickly. A long-term manipulation of user trust through the use of photos appears thus unlikely. They can, however, sway first impressions and lead users to engage with a site in more depth, thereby overcoming an important first hurdle in highly competitive online markets.

The eye-tracking component of Experiment 3 confirmed Experiment 1. A photo acted as an attractor on *first exposure* to a page, but not on *subsequent exposures* to pages with the same structure. No effects of the presence of photos on the measures of user cost that were taken from the eye-tracking data were found. Further research is needed to clarify the difference in findings between these objective measures and users' subjective claims found in earlier studies by using additional measures of user cost, such as structured self-reports (e.g. TLX; Hart & Staveland, 2003) or physiological measures in a prolonged investigation to find potential effects of *perceptual strain* (Wilson & Sasse, 2004).

From a methodological point of view, Experiment 3 further demonstrated that financial risk can be used in a laboratory experiment to increase the ecological validity of trust research. This approach, by observing users' behaviour, gives results that are of higher relevance to e-commerce vendors who are ultimately interested in users' behaviour in terms of purchase decisions or – taking the perspective of a user advocate – in behaviour that might increase users' vulnerabilities. To investigate the use of financial risk in a laboratory setting further, Experiment 4 varied the level of risk in the course of the study.

Chapter 8

Experiment 4:
Trust in a Human Advisor

8.1 Research Goals and Approach

The previous experiments tested users' ability to differentiate between trustworthy and less trustworthy e-commerce vendors (Research Goal 1) and they investigated effects of interpersonal cues in the form of photos (Research Goal 2). Experiment 4 explored the same research goals, but it investigated them for a human advisor in the role of the trustee (i.e. a human rather than an organisational trustee). As discussed in section 3.5.3, such a change in the type of trustee has important consequences for the function of interpersonal cues. Stock photos do not give any information about the trust-warranting properties of a vendor. In the case of a human trustee, however, interpersonal cues can also have a symptomatic function (see 3.4.2.4), i.e. they can give insight into his trust-warranting properties. This function is known as *information leakage* (see 2.3.1). The discussion in section 2.3.3 resulted in two predictions. Prediction P1 held that richer representations result in positive media bias (i.e. more trust) because they increase social presence. P2 held that richer representations result in better discrimination between trustworthy and less trustworthy actors as they convey more information about their trustworthiness.

Experiment 3 found evidence for P1 in the form of a positive effect of a photo displayed on the site of an e-commerce vendor (i.e. an organisational trustee) on users' self-reported trust (see 7.4.1.2). P2 did not apply to this research area, as a photo could not be expected to give additional insight into the trustworthiness of an organisational trustee. For trust in human trustees there is evidence for P1 and for P2 from related studies (see 2.3.4.7), but no study directly contrasted these two predictions. Hence, Experiment 4 was designed to contrast trustworthiness with media richness. It controlled the trustee's trustworthiness as an independent variable to investigate users' ability to place trust well. In this experiment, like in those previously conducted for this thesis, the focus was on the trust-warranting property ability (see 3.4.2.1), rather than motivation. This addresses a gap in existing HCI research on

trust in human trustees (section 2.3.4) which focuses on the detection of deception or lying (which are behaviours related to the trust-warranting property motivation). Unknown to the participants, Experiment 4 included a confident *expert* advisor (who had been trained) and a less confident *non-expert* advisor (who had not been trained).

Experiments 1 to 3 focused on interpersonal cues in the form of photographs, because these are widely used by e-commerce vendors but only few studies exist that investigated their effect (see 2.3.5). For trust in human trustees – the focus of Experiment 4 – there is a relatively rich set of literature on several media representations (see 2.3.4). However, as discussed above, the existing studies did not contrast P1 and P2, and most of them did not investigate the trust-warranting property ability. Hence, to allow an integration with existing literature and to reflect the growing importance of richer media representations as part of online systems (see 2.3.2.1), Experiment 4 investigated several rich media representations: *video*, *avatar*, *audio*, and *photo+text*. For baseline comparisons a *text-only* representation was included.

In addition to the factors *expertise* and *media representation*, Experiment 4 investigated how trust developed over *time*. The previously conducted Experiment 3 had shown that time, by determining the type of signals that are perceived and how deeply they are processed, impacts the way in which trust is formed. Hence, Experiment 4 continued to investigate how the factor *time* affects trust: users' trust was elicited over 30 instances of receiving advice from a human advisor. Thus, within the limits of a laboratory setting (see 4.1.3 for a critical discussion of this approach), Experiment 4 allowed an investigation of how the factor *time* affected trust in a human trustee. Finally, Experiment 4 investigated other means of measuring trust avoiding the limitations of users' self-reports (see section 4.2 for a critical discussion). The focus again was given to creating risk and observing participants' decisions. In addition, to clarify an issue that emerged in the previous experiments (see 7.4.1.3), Experiment 4 varied the level of *risk*. The aim of this variation in *risk* was to demonstrate that the level of financial risk present in a situation impacts participants' decision-making and their trusting behaviour. The reasoning was that if such an effect could be found, it would demonstrate the benefit of eliciting trust measures in the presence of risk.

In summary, Experiment 4 addressed the same research questions as the previous experiments in this thesis. A key variation was that trust in a human trustee (advisor) rather than in an organisation (e-commerce vendor) was researched. This allowed an experimental design that directly contrasted prediction P1 and P2 (see 2.3.3 for a detailed description of P1 and P2):

P1 (Media Bias). Richer representations increase trust.

P2 (Discrimination). Richer representations increase users' ability to place trust well.

In addition, Experiment 4 investigated how trust changes over *time* (i.e. over 30 interactions with a trustee) and how the level of *risk* influences participants' decision-making.

8.2 Method

8.2.1 Participants

A total of 160 participants took part in Experiment 4. Participants were recruited from subject databases at the Centre of Economic Learning and Social Evolution (ELSE) and from the Departments of Psychology and of Computer Science at UCL. These consisted largely of students. The mean age was 23.75 years (SD = 3.30) and the sample was balanced for gender (49 % female). The median time participants spent with a computer per day was 4 hours and the median time spent on the Internet was 2 hours per day. The median number of purchases conducted over the Internet per month was 1.

8.2.2 Overview

The study was framed as a quiz, similar to the well-known TV show 'Who Wants to Be a Millionaire' (see Figure 8.1). Participants' pay depended on their performance in answering the extremely difficult questions (see 8.2.4) in the quiz. For each question, four answer options (labelled A-D) were given. Participants had access to two advisors in different *media representations* (*text-only vs. video, avatar, audio, photo+text*; see Figure 8.2) and – unknown to them – with different levels of *expertise* (*expert vs. non-expert*). Advice was free, but only one advisor could be asked per question. ADVICE SEEKING (see 8.2.6.1) and the degree to which participants followed advice they had received (ADVICE UPTAKE, see 8.2.6.2) were taken as measures of participants' trust in the advisors. A post-experimental questionnaire elicited participants' subjective assessment of the advisors. Participants answered 30 questions prior to receiving feedback on their performance at the end of the study.

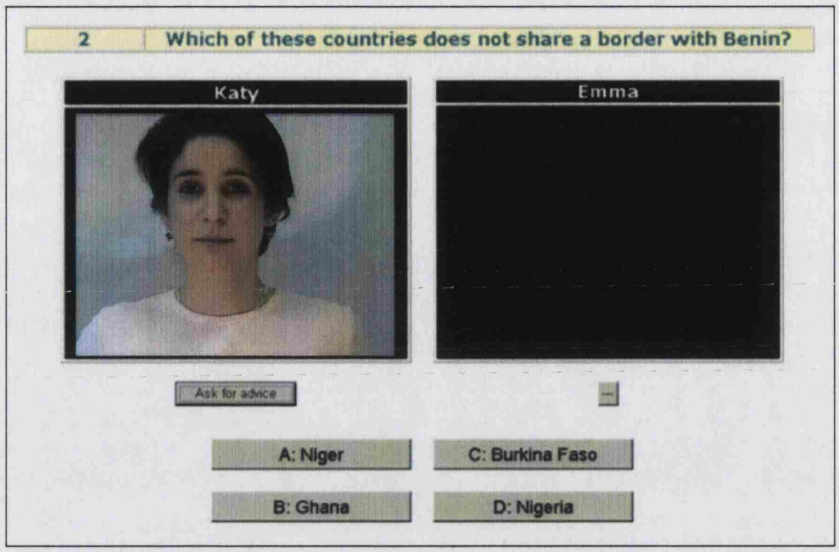


Figure 8.1: Experimental system (*video* advisor selected)

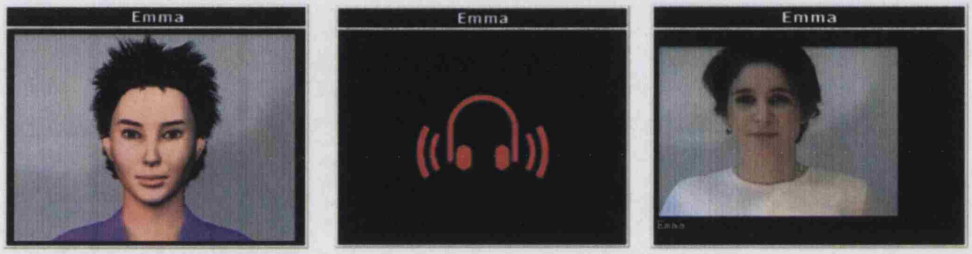


Figure 8.2: *Avatar*, *audio*, and *photo+text* advisor

8.2.3 Pilot Study

A formal pilot study with 16 participants was conducted, because Experiment 4 introduced a novel experimental approach. The outcome of the pilot study resulted in several improvements to the design of Experiment 4:

1. The pilot study allowed participants to ask both advisors on each question. Seeking advice from one advisor was thus not a strong expression of trust, as asking one advisor did not mean that advice from the other advisor was missed out on. To be able to use ADVICE SEEKING (see 8.2.6.1) as an indicator of trust, it was decided to allow participants access to only one advisor for each question in Experiment 4.
2. The advisors in the pilot study gave advice by referring to the letters associated with the answer options (i.e. A – D). Whilst this approach allowed a high level of experimental control over the advice given, participants in the pilot study said that this answer format made the advice seem unrealistic or *"staged"*. Hence, it was

decided to include the actual answers in the individual pieces of advice in Experiment 4, rather than the answer option label.

3. The pilot study had a trained *expert* advisor and an untrained *non-expert* advisor. Some participants in the pilot study said that the *expert* advisor seemed *"unreal"*, because she always gave confident advice, even when the questions had been extremely difficult. Hence, for Experiment 4, the *expert* advisor also included some less confident, untrained pieces of advice (see 8.2.5.1).
4. It was found that some of the questions used in the pilot could be answered by the participants without any advice. Hence, the questions used in the main study were selected from a larger pool and pre-tested for their difficulty (see 8.2.4).
5. Feedback received from pilot participants in qualitative interviews was used to create some of the post-experimental questionnaire items that elicited participants' subjective assessment of the advisors (S6, S7, S9; see Table 8.3).

8.2.4 Questions Pre-Test

To minimize the effect of participants' prior knowledge, extremely difficult questions were used in the experiment. To select the 30 most difficult questions from a pool of 50, an online pre-study was performed with 80 pre-testers who did not take part in the main part of Experiment 4. The most difficult questions were defined as the ones where the two most often picked answers had the smallest difference in their frequency of being chosen. Selecting questions that resulted in ties, rather than questions for which the correct answer had the lowest probability of being chosen, ensured that no questions were included for which the correct answer seemed unlikely to most respondents. For the 30 questions that were included in the main study, the mean probability for giving a correct answer was .31 (SD = .11), based upon pre-test results. This value is only marginally above chance (.25), indicating that very difficult questions had been picked. The questions and answers are reproduced in Appendix D.1.

8.2.5 Independent Variables

8.2.5.1 Expertise

The *non-expert* and *expert* advisors were created by recording advice from the same individual before and after training, respectively. Hence, the *expert* and *non-expert* advisors only differed in the ratio of correct to incorrect advice and in their interpersonal cues to confidence about the answers. As each participant only had access to one *rich media*

representation of the advisor, they were unaware that both advisors were in fact the same individual recorded at different levels of *expertise*. To the participants, the advisors were presented as different individuals named Katy and Emma. In the interest of ecological validity, the phrasing of the advice was not prescribed. To avoid creating an artificially perfect advisor (see 8.2.3), 6 incorrect (and less confident) pieces of advice from the untrained recording were added to the *expert* (Table 8.1; transcripts of the advice can be found in Appendix D.2).

	Correct Advice	Incorrect Advice
Expert Advisor	24 (0.8)	6 (0.2)
Non-Expert Advisor	11 (0.33)	19 (0.67)

Table 8.1: Correct and incorrect advice by advisor *expertise*

8.2.5.2 Media Representations

The *media representations* were created from the same video clips that ranged from 1 sec. to 8 secs. in length. The original clips were used for the *video* representation. The *avatar* was created with a commercially available animation tool (V1 by DA Group[24]) directly from the audio stream without any manual scripting of non-verbal behaviour. The tool synchronized lip movements and added cues of liveliness (e.g. blinks). *Video* and *avatar* were streamed with Windows Media Encoder (350 kbps, 320x240). *Audio* was encoded with 48 kHz, 16 bit, mono. *Photo+text* included a facial photo of the advisor, but was otherwise identical to the *text-only* representation. In both representations that contained text, it appeared dynamically with a delay of 107 ms per letter to ensure that all representations had equal playing time. To account for network and media player delays in the rich representations, a delay of 1500 ms was introduced before anything was displayed for the *text* and *photo+text* advisors. All advice was presented within a black frame (350 x 285 pixels) with the advisors' fictional names (Emma, Katy) shown at the top. Table 8.2 gives an overview on all media representations.

[24] www.dagroupplc.com

		Description
Rich	*Video*	320 x 240, Windows Media Encoder, 350 kbps, Audio: 48 kHz, 16 bit, mono
	Avatar	320 x 240, Windows Media Encoder, 350 kbps, Audio: 48 kHz, 16 bit, mono
	Audio	48 kHz, 16 bit, mono
	Photo+Text	270 x 202 JPEG from video, dynamic text
Text	*Text-only*	Dynamic text

Table 8.2: Technical details of advice representations

8.2.5.3 Risk

Participants' pay was linked to the number of correctly answered questions and thus to their ability to identify the *expert* advisor from interpersonal cues, as the quiz questions were extremely difficult. Pay varied between £8 and £15. To investigate the effect of level of risk, a final high-stakes question, worth an additional £3, was included. Adding the high-stakes round at the end of the quiz did not allow disambiguating effects of the level of risk from potential order effects. This design decision, however, ensured that participants' development of trust over the first 29 rounds could be observed without introducing any noise by varying levels of risk. This aspect is critically discussed in section 8.4.3.

8.2.6 Dependent Variables

As in the previous experiments, Experiment 4 measured trust by observing decision-making under financial risk. Whilst this approach did not fully model complex risk as it is present in situations outside the laboratory (see 4.3.1) it could be expected to constitute an improvement over self-reports (see 4.2). The approach in Experiment 4 was further removed from trust rating measures than the measures introduced in Experiments 2 and 3. The main measure, ADVICE SEEKING, captured participants' tendency to seek advice from one advisor over the other in a situation of limited choice. The measure ADVICE UPTAKE recorded to what extent a participant followed the advice she received.

8.2.6.1 Advice Seeking

Advice seeking could be interpreted as an indicator of trust in one advisor over the other, because on each question only one advisor could be asked. The choice to seek advice from a specific advisor could be expected to depend upon the information accumulated from previous pieces of advice. It was thus assumed to be relatively arbitrary in first interactions,

but to exhibit a clearer preference for one advisor over the other, as more information was gained as the study progressed.

Figure 8.3 shows ADVICE SEEKING in the terms of the framework established in Chapter 3. A participant accumulates signals regarding an advisor's confidence as the study progresses (1). These signals will affect her choice of advisor in the next round (2a, 2b). After selecting an advisor, she will realise whether she made a good choice. She will see, whether the advisor gave confident advice on this instance (3a) or whether the advisor gave poor, unconfident advice and she thereby lost a chance to gain potentially better advice from the other advisor (3b).

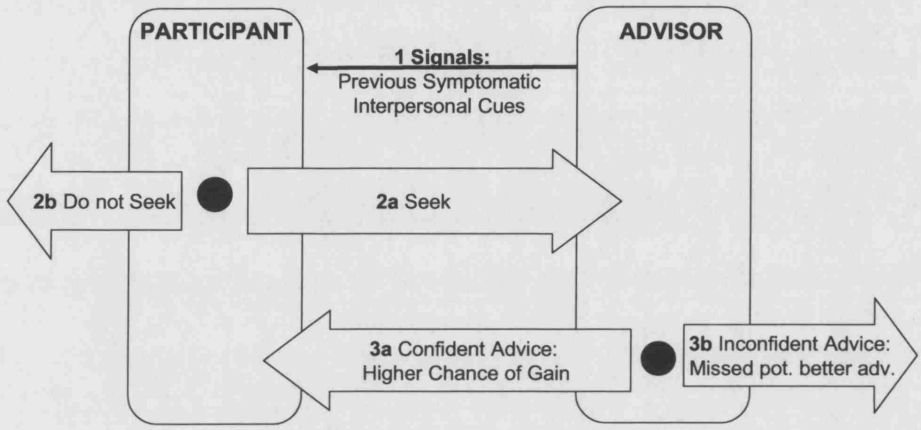


Figure 8.3: ADVICE SEEKING expressed in the terms of the trust framework

The measure ADVICE SEEKING was defined as the proportion of the number of times one advisor was asked relative to the total number of times advice was sought by a participant. As each participant had two advisors, but could choose only one of them for each question, the following relationships hold for each participant's ADVICE SEEKING:

Expert ADVICE SEEKING = 1 – *non-expert* ADVICE SEEKING
Rich media ADVICE SEEKING = 1 – *text-only* ADVICE SEEKING

Figure 8.4, illustrates P1 and P2 for the measure ADVICE SEEKING. In the hypothetical case of total media bias (P1, Figure 8.4), one would expect participants to always seek *rich media* advice, irrespective of *expertise*. In the case of perfect discrimination (P2, Figure 8.4), participants would always prefer *expert* advice.

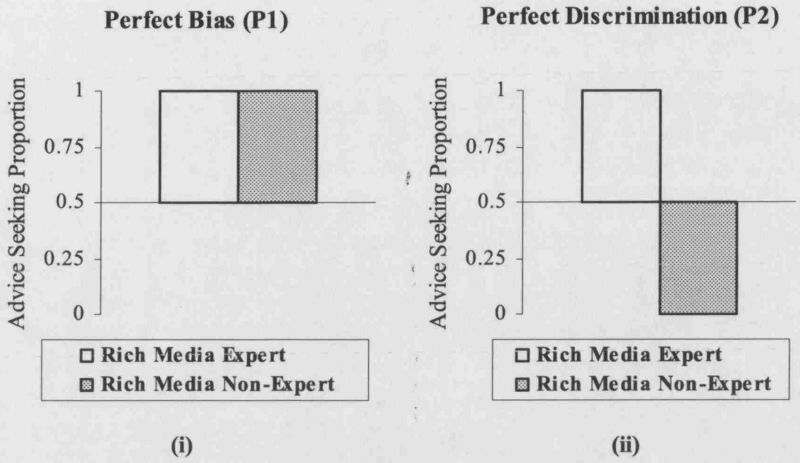


Figure 8.4: Illustrations of predictions P1 and P2 for the measure ADVICE SEEKING in Experiment 4

8.2.6.2 Advice Uptake

The second measure taken from participants' behaviour was their advice uptake, i.e. whether they followed advice they had received from a particular advisor. Again, following advice can be seen as trusting behaviour. In contrast to advice seeking (see 8.2.6.1), advice uptake is indicative of trust in specific pieces of advice, because a participant's decision on whether to follow a piece of advice occurs after the piece of advice has been perceived. Hence, advice uptake is determined by the signals received with an individual piece of advice and by accumulated knowledge from previous advice. Based upon this information, the participant will decide whether to follow the advice or to ignore it. Clearly, this decision can also be expected to be affected by the participant's assumptions about the correct answer. However, pre-testing the questions for their difficulty sought to minimise this effect (see 8.2.4). The measure ADVICE UPTAKE was defined as follows:

ADVICE UPTAKE = (Number of times advice from advisor X followed) /
(Number of times advisor X asked)

Whilst ADVICE SEEKING contrasted P1 and P2 (see Section 3.2.1) within one measure, advice uptake gave individual measures for each advisor. Applying the predictions to advice uptake, P1, would lead to a higher ADVICE UPTAKE for rich *media representations*, whereas P2 lead to a greater effect of *expertise* on ADVICE UPTAKE in richer representations (i.e. an interaction effect between *expertise* and *media representation*).

8.2.6.3 Sensitivity to Correct Advice

One of the main interests of this research is to investigate users' ability to place trust well (Research Goal 1). Thus, users' SENSITIVITY to correct advice was calculated from the ADVICE UPTAKE measure. The SENSITIVITY measure takes in account the correctness of the advice received. Participants had to assess the correctness of a piece of advice from the interpersonal cues they perceived. This can be understood in terms of a sender and receiver model: the advisor's *media representation* determined the types and number of cues transmitted (see 2.3.2.3). Employing a signal detection paradigm (Thurstone, 1927), SENSITIVITY *to correct advice* is a measure of the Receiver Operating Characteristics (ROC). The SENSITIVITY measure adopted is p(A), a non-parametric variant of d'(McNicol, 1972). p(A) is the area under a ROC-curve (Figure 8.5), which is defined by the proportion well-placed trust and misplaced trust (Table 4.5).

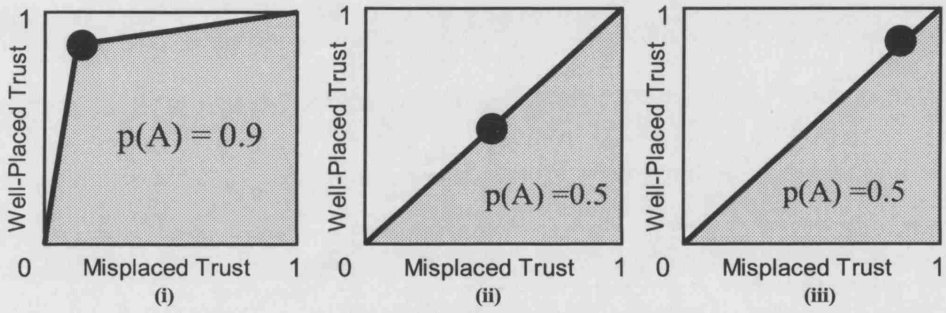


Figure 8.5: Illustration of p(A)

Three examples are illustrated: in Figure 8.5(i) the participant almost always follows correct advice and almost never follows incorrect advice. In this case the area under the curve, p(A), approaches 1.0 – the participant has a high SENSITIVITY. In Figure 8.5(ii) the user decides randomly whether to follow advice independent of whether it is correct or not. In this case, the area under the curve, p(A), is 0.5, indicating that she cannot detect correct advice (low SENSITIVITY). In the final example, the participant has a tendency to follow any advice given. In this case, p(A) is again 0.5, as there is no evidence of SENSITIVITY to correct advice. This measure is thus independent of individual response bias. It can range from 0 to 1; any value > .5 can be seen as an indication for SENSITIVITY for correct advice. Applied to the measure SENSITIVITY, P2 predicts that richer media result in higher SENSITIVITY scores. P1 predicts that richer representations result in higher ADVICE UPTAKE than poorer ones without affecting SENSITIVITY.

8.2.6.4 Auxiliary Measures

Participants' self-reports were recorded as auxiliary measures. For each question, each participant was asked to rate his or her CONFIDENCE in the answer they had given. After completion of the study, participants' subjective ASSESSMENT of the two advisors was elicited with a questionnaire. This questionnaire was based on items used in CMC studies that aim to identify media effects on interpersonal perception (Garau, 2003). Three items (S6, S7, S9, Table 8.3) that were more specific to the advisor-advisee situation were added based on qualitative feedback in a pilot study (see 8.2.3). Agreement with the statements was elicited on 7 point Likert scales with the anchors 1 ("Strongly disagree") - 7 ("Strongly agree"). The questionnaire is reproduced in Appendix D.3. In a final open-ended question participants were asked to state the reasons for deciding which advisor to ask. Table 8.4 provides an overview on all measures taken for Experiment 4.

	Post-Experimental Assessments
Statement S1	"X was very friendly."
Statement S2	"I was very aware of X."
Statement S3	"I trusted X's advice."
Statement S4	"I enjoyed playing with X."
Statement S5	"I would like to meet X face-to-face."
Statement S6	"X gave good advice."
Statement S7	"I could tell when X was certain about the answer."
Statement S8	"I liked X."
Statement S9	"I relied mostly on X's advice."

Table 8.3: Statements in the post-experimental assessment of the advisors

	Measures
Behavioural	**ADVICE SEEKING** Range 0-1, values > 0.5 indicate preference over competing advisor
	ADVICE UPTAKE Range 0-1, values > 0.25 indicate uptake above random
	SENSITIVITY to Correct Advice p(A): range 0-1, values > 0.5 indicate sensitivity
Self-Report	**CONFIDENCE** "Please rate your confidence with this answer" Range 1 "Not at all confident" – 7 "Extremely confident"
	Post-experimental ASSESSMENT Agreement with statements (S1-S9, Table 8.3) Range 1 "Strongly Disagree" – 7 "Strongly Agree"
	Open question "Please describe how you decided on which advisor to rely on."

Table 8.4: Overview on experimental measures in Experiment 4

8.2.7 Design

The experiment had a 4 (*rich media representation*: *video, avatar, audio, photo+text*) x 2 (*expertise*: *rich media* advisor is *expert vs. text-only* advisor is *expert*) design, resulting in 8 between-subject conditions with 20 participants each (Table 8.5). All participants had access to two advisors (Figure 8.1). In all conditions one advisor was represented as *text-only* and the other in one of the 4 *rich media representations* (*video*, *avatar*, *audio*, and *photo+text*; Figure 8.1 and Figure 8.2). This design allowed additional within-subjects comparisons between *text-only* and *rich media* advice and between *expert* and *non-expert* advice. Depending on the condition, either the *text-only* or the *rich media* advisor gave *expert* advice, while the other gave *non-expert* advice. The order of the questions and answer options (A-D, Figure 8.1) was randomized; the position (left, right) and names (Katy, Emma) of the advisors were counterbalanced.

	Advisor 1			
	Video	*Avatar*	*Audio*	*Photo+Text*
	Advisor 2			
	Text-only	*Text-only*	*Text-only*	*Text-only*
Advisor 1 is the *expert*	20	20	20	20
Advisor 2 is the *expert*	20	20	20	20

Table 8.5: 8 between-subject conditions with 20 participants each

8.2.8 Procedure

Experiment 4 was conducted with 17" TFT screens set to a resolution of 1024 x 768, and mono-headsets. Experimental sessions were held at the UCL ELSE Lab with approximately 20 participants per session. As they were assigned to individual cubicles, participants were not able to see other participants during the course of the experiment. They first read a printed instruction sheet detailing their pay and explaining the experimental system. The instructions emphasized that participants could take their time to answer the question, but that it was important to do as well as possible to maximise pay. The instructions are reproduced in Appendix D.4. Prior to starting the assessed part of the experiment, they completed two training rounds that consisted of easy to answer questions. For these, both advisors gave identical and correct advice. After 29 assessed questions, participants were informed that the next would be the *high-stakes* question (see 8.2.5.3). After completing all rounds they were presented with the post-experimental questionnaire eliciting their subjective assessment of the advisors. The last screen showed their performance and pay.

8.3 Results

On average, participants sought advice on 26 out of 30 rounds (87%). Only 51 participants (32 %) sought advice in every round, even though there was no cost associated with seeking advice. One participant (in the *audio expert* advisor condition) did not ask for advice at all. Participants spent on average 23 secs. on each question. If they asked for advice, they did so on average 13 secs. after the question had been displayed, indicating that they first formed their own opinion before asking an advisor.

8.3.1 Advice Seeking

8.3.1.1 Aggregate Results

Figure 8.6 shows a main effect for *expertise* on participants' likelihood for seeking rich media advice (F (1, 154) = 51.56, $p < .001$). This demonstrates that the *experts* were chosen more frequently than *non-experts* for all types of representation. There is also some marginal indication for a main effect of the between-subjects factor *type of rich media representation* (F (3, 154) = 2.50, $p = .062$). This suggests that the type of rich media representation had an influence on rich media advice seeking – thus providing some support for P1. However, there is no indication that media bias outweighs preference for expert advice in any of the rich media representations (cf. Figure 8.4i). There is also no indication for an interaction of the between-subject factors *type of rich media representation* and *expertise* (F (3, 151) = 0.577, *ns*.) and hence no support for P2.

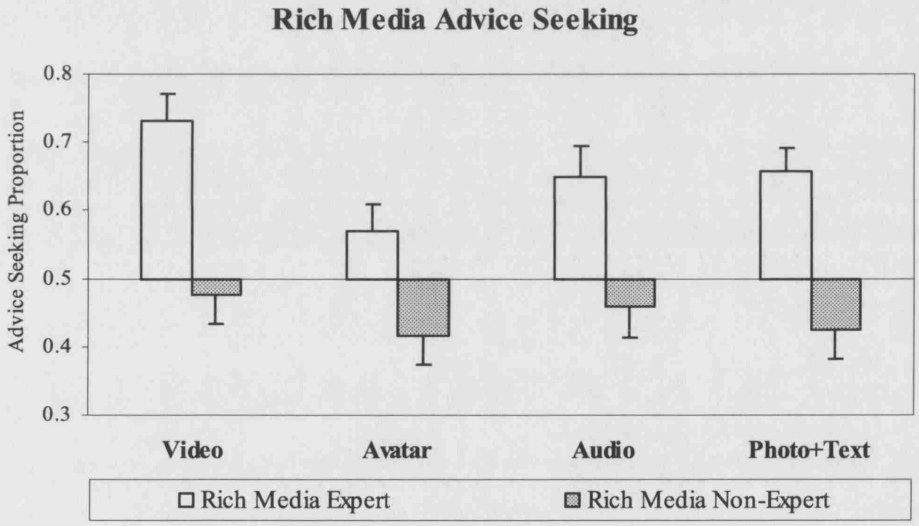


Figure 8.6: ADVICE SEEKING for the *rich media* advisor

There is evidence for a preference for *video* on the ADVICE SEEKING measure: *video expert* advice was chosen more often than *text-only expert* advice (t (38) = 3.60, $p < .001$, two-sided; see Figure 8.7). This effect was not present for the other types of rich media representations. *Avatar expert* advice was sought less frequently than advice from the other *rich media experts* combined (t (77) = 2.45, $p = .017$, two-sided).

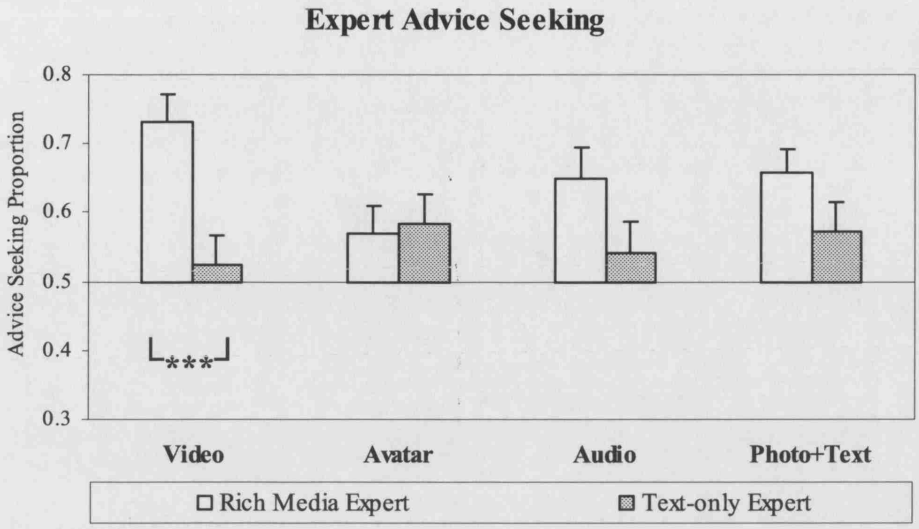


Figure 8.7: ADVICE SEEKING for the *expert* advisor

8.3.1.2 Effects of Time and Risk

As discussed in section 8.2.6.1, the decision which of the two advisors to ask for advice may be relatively arbitrary in initial rounds, but can be expected to become more distinct towards the end of the study based upon an increasing amount of information from accumulated interpersonal cues. This assumption is supported by the data presented in Figure 8.8. The graph shows ADVICE SEEKING for the *expert* (*rich media* and *text-only*) in the four different *rich media* conditions. It indicates that the proportion of participants who sought advice from the *expert* increased over time in all conditions. Whilst the probability for seeking *expert advice* initially is not clearly above 0.5, a clear preference develops towards the final high-stakes round. Participants increasingly sought advice from the *expert,* independent of whether it was represented as *text-only* or in one of the rich *media representations*, as they gained experience with the advisors (Figure 8.8). The proportion of participants who sought advice from the *expert* advisor in round 29 is significantly higher than the proportion in round 1 (McNemar Test: χ^2 (1, N = 130) = 4.83, p = .028).

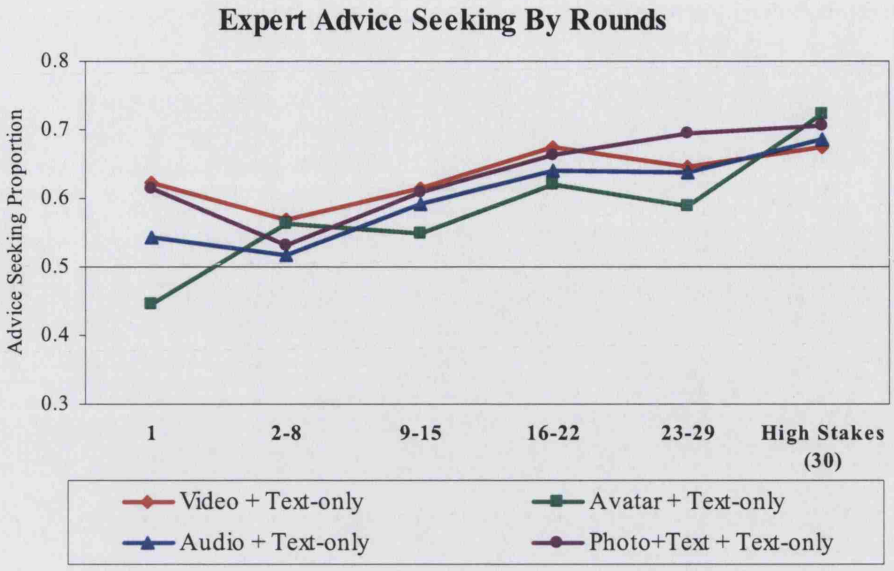


Figure 8.8: *Expert* (*rich media* + *text-only*) advice seeking over time

Figure 8.9 shows ADVICE SEEKING from rich *media representations* irrespective of *expertise* over time for all rich *media representations*. It shows that the increase in financial risk in the high-stakes round resulted in an increase in seeking advice from the *rich media* advisors. Aggregating the data across all *media representations*, participants sought more advice from the *rich media experts* in the high risk round than in the previous round (McNemar Test: χ^2 (1, N = 131) = 6.25, p = .012).

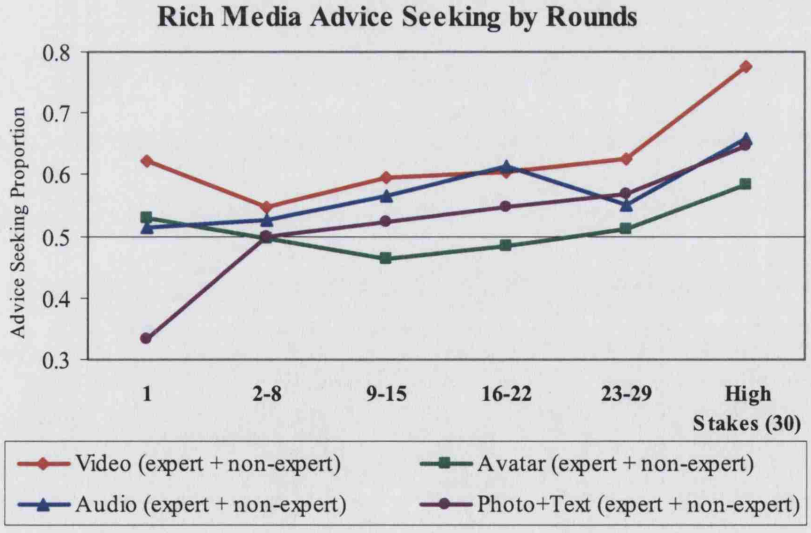


Figure 8.9: *Rich* (*expert* + *non-expert*) ADVICE SEEKING over time

8.3.2 Advice Uptake

As discussed in section 8.2.6.2, media bias (P1) in ADVICE UPTAKE is present if one *media representation* leads to a higher proportion of uptake than another. Figure 8.10 shows ADVICE UPTAKE for all media and *expertise* conditions (plotted against .25 which would be random uptake in the presence of 4 answer options, see section 8.2.6.2). In addition, it includes aggregate data for the *text-only* advisor, which was present with each of the other *media representations* (see 8.2.7). In line with findings for ADVICE SEEKING, the data for ADVICE UPTAKE shows a strong effect for *expertise* (F (1, 144) = 83.65, $p < .001$). In contrast to the findings for ADVICE SEEKING, a between-subject analysis yields no indication of an impact of *media representation* (F (3, 144) = 1.78, *ns.*). As for ADVICE SEEKING there is also no interaction between the two factors for the measure ADVICE UPTAKE (F (3, 144) = 0.31, *ns.*).

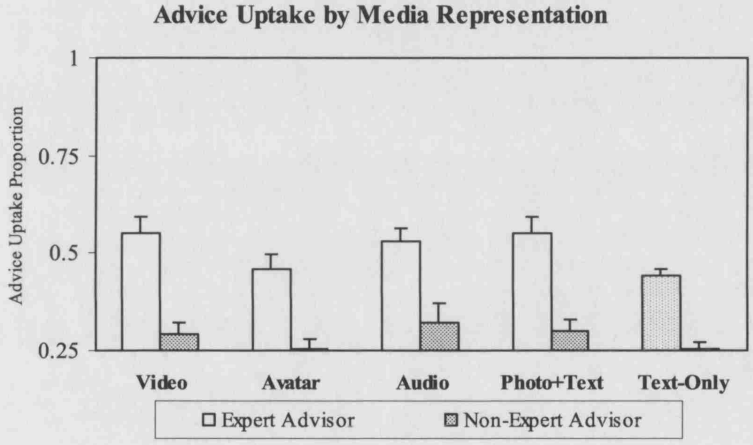


Figure 8.10: ADVICE UPTAKE by *media representation* and *expertise*

8.3.3 Sensitivity to Correct Advice

The SENSITIVITY measure gives values between 0 and 1. A value <= .5 means that a participant could not differentiate correct from incorrect advice. The SENSITIVITY for advice delivered in the different *media representations* are shown in Figure 8.11. An ANOVA for the measure SENSITIVITY of rich media representation with the between-subject factors *expertise* and *type of rich media representation* yields a main effect for *expertise* (F (1, 144) = 21.87, $p < .001$). There is no effect for *media representation* (F (3, 144) = 1.71, *ns.*) and no interaction between the two factors (F (3, 144) = 0.33, *ns.*).

For each *media representation*, it was tested, whether the SENSITIVITY was greater than 0.5, i.e. whether participants were able to discriminate between correct (i.e. confident) and incorrect (i.e. less confident) advice (Table 8.6). When the *rich media advisor* was an *expert*, participants were sensitive to the differences between correct and incorrect advice.

Interestingly, when the *text-only advisor* was the *expert* (and thus paired with any *rich media non-expert advisor*, see section 8.2.7), it also resulted in a SENSITIVITY score higher than 0.5. There was no SENSITIVITY for advice given by the *non-expert*.

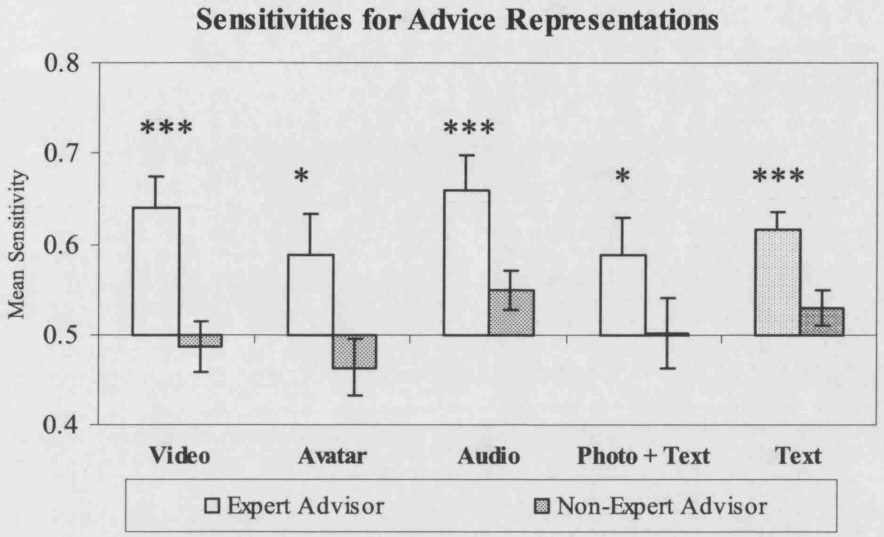


Figure 8.11: Sensitivities in experimental conditions (*text-only* advisors in one bar)

	Video	Avatar	Audio	Photo+Text	Text-only
Expert	$t(19) = 4.86$	$t(19) = 2.82$	$t(17) = 7.14$	$t(19) = 2.27$	$t(73) = 6.13$
	$p < .001$	$p = .011$	$p < .001$	$p < .035$	$p < .001$
Non Expert	*ns.*	*ns.*	*ns.*	*ns.*	*ns.*

Table 8.6: Two-sided tests for *expert* and *non-expert* advisors (H_0: SENSITIVIY = .5)

8.3.4 Auxiliary Measures

While the focus of this research is on behavioural measures, users' self-reports were also analysed as auxiliary measures. Receiving advice from an *expert* resulted in higher self-reported CONFIDENCE with an answer (Wilcoxon Signed Rank Test: Z (N=156) = 5.911, $p <$ .001), but there was no effect of *media representation* on CONFIDENCE. Within-subject tests were also conducted for participants' ratings of the *rich media advisor vs. the text-only advisor* (see Table 8.7) for the individual statements (S1-S9) and rich media representations. The comparisons were conducted irrespective of *expertise*. Significant differences in interpersonal assessment are thus indicators of media bias (P1) in a specific media representation.

	Video	Avatar	Audio	Photo+Text
S1: X was very friendly.	$Z(40) = 4.26$, $p < .001$	$Z(40) = 3.37$, $p < .01$	$Z(39) = 2.19$, $p < .05$	$Z(40) = 2.35$, $p < .05$
S2: I was very aware of X.	$Z(40) = 4.31$, $p < .001$	$Z(40) = 2.55$, $p < .05$	$Z(39) = 2.37$, $p < .05$	$Z(40) = 2.58$, $p < .05$
S3: I trusted X's advice.	$Z(40) = 2.75$, $p < .01$	*ns.*	*ns.*	*ns.*
S4: I enjoyed playing with X.	$Z(40) = 3.69$, $p < .001$	$Z(40) = 3.64$, $p < .001$	$Z(39) = 2.29$, $p < .05$	$Z(40) = 1.94$, $p = .052$
S5: I would like to meet X face-to-face.	*ns.*	*ns.*	*ns.*	*ns.*
S6: X gave good advice.	$Z(40) = 2.73$, $p < .01$	*ns.*	*ns.*	*Ns.*
S7: I could tell when X was certain about the answer.	$Z(40) = 3.61$, $p < .001$	*ns.*	$Z(39) = 2.26$, $p < .05$	*Ns.*
S8: I liked X.	$Z(40) = 3.73$, $p < .001$	$Z(40) = 1.94$, $p = .052$	$Z(39) = 2.93$, $p < .05$	*Ns.*
S9: I relied mostly on X's advice.	$Z(40) = 2.16$, $p < .05$	*ns.*	*ns.*	*Ns.*

Table 8.7: Comparisons for *rich media* advisor *vs. text-only* in participants' self-reports (two-sided)

Video and *audio* were rated as being better suited for assessing certainty (S7, Figure 8.12) than *text-only*, irrespective of *expertise*. This finding from the non-parametric tests given in Table 8.7 is supported by the results from an ANOVA: for S7 this analysis found a clear main effect for the within-subject factor *text vs. rich representation* ($F(1, 155) = 22.71$, $p < .001$) and an interaction effect with *type of rich media representation* ($F(3, 155) = 2.86$, $p = .039$). No main effect for *type of rich media representation* was found ($F(3, 155) = 0.19$, *ns.*).

All rich *media representations* resulted in higher ratings for friendliness (S1), interpersonal awareness (S2), and enjoyment (S4). Figure 8.13 illustrates this result for the rating of enjoyment (S4). An ANOVA for S4 confirms this finding from the non-parametric tests reported in Table 8.7. There is a clear main effect for the within-subject factor rich *vs. text representation* ($F(1, 155) = 45.58$, $p < .001$), but no effect of the between-subject factor *type of rich media representation* ($F(3, 155) = 0.84$, *ns.*) and no interaction between these factors ($F(3, 155) = 1.81$, *ns.*).

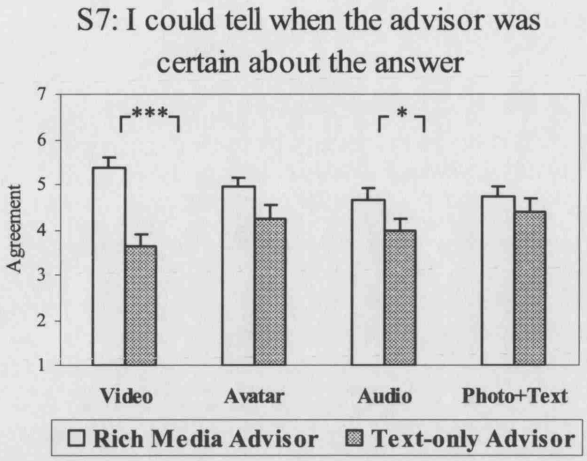


Figure 8.12: Participants' self-reports for inferring advisor certainty (S7)

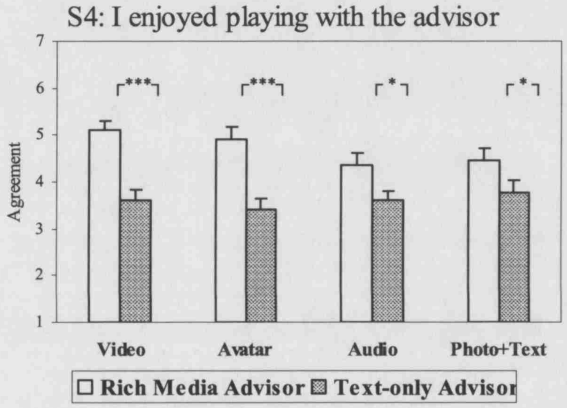


Figure 8.13: Participants' self-reports for enjoyment (S4)

8.4 Discussion

Experiment 4 sought to clarify whether different *media representations* induce a bias (P1) or increase users' discriminative ability by giving additional insight into trust-warranting properties (P2). Support for P1 came from studies that showed that mediated interpersonal cues can prompt immediate visceral reactions. These may build unwarranted affective trust and thus induce a media bias relative to representations that transmit fewer such cues (see 2.3.3). P2 is supported by an analysis of the function of interpersonal cues (see 3.4.2.4): richer representations give more insight into trustees' trust-warranting properties, and can thus be expected to allow better discrimination between trustworthy and less trustworthy trustees. Experiment 4 was designed to contrast P1 and P2. Experiment 4, like Experiments 2 and 3, manipulated trustworthiness in terms of the trust-warranting property ability, rather than motivation. This focus departs from existing HCI research on trust in human trustees, which

is predominantly concerned with wilful non-fulfillment (e.g. deception or lack of cooperation in Prisoner Dilemma games, 2.3.4). The discussion in Chapter 3 showed that risk in many everyday situations does not mainly arise from the fact that one could be deceived, but from dealing with a trustee who lacks ability or expertise.

This section discusses the findings of Experiment 4 and relates them to the overarching research goals of this thesis. First, results for the individual *media representations* are discussed individually (see 8.4.1). Once the specific findings are established, section 8.4.2 discusses them in the view of the P1 (media bias) and P2 (ability to discriminate). The discussion closes with methodological considerations about the newly introduced measures (see 8.4.3).

8.4.1 Individual Media Representations

This section discusses findings for the different *rich media representations*. It should be remembered that no clear between-subject effects for the different rich *media representation* were found: there was only a weak indication on the ADVICE SEEKING measure and some clearer differences on the post-experimental self-report measures.

8.4.1.1 Video

Video expert advice was more often sought than *text-only expert* advice. Hence, in some cases users' preference for receiving *video* advice led them to disregard better *text-only* advice. This preference for *video* is particularly problematic as *video* did not result in a higher SENSITIVITY for correct advice than *text-only* advice. This finding opposes prediction P2 – that rich media lead to better discrimination. Participants' own post-experimental assessments, however, appear to support P2: they rated their ability to infer certainty (S7) higher for *video* than for *text-only* advice. One participant expressed this in her reply to the open-ended question:

> *"Since I could see Katie speak and look at her expressions while she answered, I could guess with more confidence when she was correct and thus I chose Katie more number of times (sic)."* (Participant 36)

This disparity between self-reports and actual performance corroborates a similar finding by Horn et al. (2002) in a study on lie detection over video channels (see 2.3.4). In that study participants had over-estimated their own ability in detecting lies over video. In the same study, Horn et al. (2002) also found that a severe degradation of the visual channel led to an increase in participants' ability in detecting lies. They hypothesized that the visual identification induces a *truth bias* that may lead individuals to commit gullibility errors (see

2.3.4.2). There is no clear indication in the behavioural data in Experiment 4 for such an effect of the visual channel in particular.

In summary, participants were able to identify *expert* advice in the *video* representation, but the data suggest that the additional cues received in *video* compared to *text-only* did not increase their SENSITIVITY to correct advice (P2). Instead, there is some evidence (in ADVICE SEEKING and in the self-reports) that participants had a tendency to trust *video* (P1), which interfered with their ability to detect expertise.

8.4.1.2 Audio

Participants over-estimated their ability to detect certainty (S7) in *audio*, as they did for *video*. *Expert audio* advice resulted in good SENSITIVITY for correct advice, but it was not significantly better than the SENSITIVITY in the *text-only* or any other *media representation* (P2). In summary, there is some evidence for interference from a preference for *audio* representations on users' ability to discriminate, but less interference was detected for *audio* than for *video*.

8.4.1.3 Avatar

The *avatar* did not result in a positive bias. On the contrary, *avatar expert* advice was less often sought than other types of *rich media expert* advice. No effect was found for ADVICE UPTAKE or SENSITIVITY relative to *text-only* or any other representation. The subjective assessments corroborate the notion of a negative bias resulting from the *avatar*. Participants did not think it had been easier to assess the *avatar's* certainty relative to the *text-only* advisor's (S7). For the *audio* advisor, which provided the same audio cues, but not the synthetic visual ones, they considered themselves able to do so. In the words of one participant:

> *"Katy didn't seem real so I stopped picking her for advice."*
> (Participant 119)

Clearly, these findings cannot necessarily be generalized to other avatar representations. Previous studies showed strong differences in user reactions to animated characters due to relatively small differences in behaviour, appearance, or context of use (see 2.3.4.3). Nonetheless, the findings indicate that using an avatar created with an off-the-shelf tool from the audio stream may not be an advisable strategy for building trust with the current state of the art. If the *avatar's* behaviour had been carefully scripted, it might have appeared more

trustworthy. Finally, it was found that the *avatar,* like all other rich media representations was perceived as providing a more enjoyable experience (S4) than the *text-only* advisor.

8.4.1.4 Photo+Text

The *photo+text* representation allowed the comparison of results from Experiment 4 to those from Experiments 2 and 3, which looked for the effect of a photo on trust in an e-commerce vendor. Those experiments found that a facial photo added to the homepage could bias users' self-reported trust after gaining a first impression of the homepage. These findings provided evidence for P1 in the context of trust in e-commerce vendors.

In Experiment 4, the *photo+text* advisor offered the fewest additional interpersonal cues relative to the *text-only* advisor. The static visual cues given in a photo did not carry any information about expertise or confidence with individual pieces of advice. Hence this representation could not be expected to increase participants' ability to discriminate between advisors based on their *expertise* (P2) compared to other rich *media representations*. Only a bias (P1), arising from the presence of static interpersonal cues, could be expected. No such bias was found on any of the measures, but the *photo* did result in higher ratings for enjoyment (S4) compared to *text-only*. This suggests that photos can be used to prompt positive reactions and make interactions more engaging, although a lasting effect on trust measured through people's behaviour appears as unlikely from the results in Experiment 4, as it did in Experiments 2 and 3.

8.4.2 Media Bias (P1) and Ability to Discriminate (P2)

Over all media representations, users' ability to discriminate between *expert* and *non-expert* was good, independent of the media representation (P2). Investigating the rich media representations individually, a preference for seeking *video expert* advice over *text-only expert* advice was found. However, this effect was not so strong as to supercede preference for *expert* advice. Nonetheless, it led to participants receiving less trustworthy advice than they otherwise would have. In other words, in some instances their preference for *video* led them to disregard good advice that was given in *text-only*. There are real-world scenarios in which such a preference for video or audio representations could have negative repercussions for the user. Consider, for instance, a user browsing a community site that offers health advice (Sillence et al., 2004). Some of the postings contain advice videos; others are text-only. Extrapolating from the results of Experiment 4 to this scenario, a preference for video advice would carry the risk of missing out on potentially better text-only advice.

Participants' self-reports show that they preferred to seek *video* and *audio* advice, because they thought these representations allowed them to make better trust assessments of individual pieces of advice. They considered their ability to infer advisor certainty in *video* and *audio* representations as higher than in *text-only* (S7). Whereas effects on advice seeking behaviour and users' self-reports are important, one could argue that the real test for media bias is whether someone acts on advice. Hence, ADVICE UPTAKE was also investigated. Whilst there was an effect of advisor *expertise* on ADVICE UPTAKE, no effect of media representation, i.e. no media bias was found (P1). This result shows that users' trust, measured by ADVICE UPTAKE, cannot be easily swayed by choice of media representation. On the other hand, the lack of effect of *media representation* also showed that the richer representations *video* and *audio*, which participants evidently – based on their ADVICE SEEKING behaviour and self-reports – considered to give more insight into trustworthiness, did not allow an improved discrimination between trustworthy and less trustworthy pieces of advice. This conclusion is also supported by the results of the SENSITIVITY measure, which did not investigate participants' ability to detect the expert, but their SENSITIVITY to the correctness of individual pieces of advice. There was no significant difference in SENSITIVITY to correct advice between all the *rich media* representations and *text-only*. Good performance in detecting the correctness of *expert* advice in all *media representation* suggests that most information was conveyed in lexical cues and that little extra information could be gained by the interpersonal cues (para-verbal and visual cues) conveyed in the *rich media* representations. Hence, whilst participants thought that richer *audio* and *video* offered them superior SENSITIVITY, no such effect was found.

The lack of support for P2 stands in contrast to existing studies such as the one by (Swerts et al., 2004), who found that users' ability to detect certainty was linked to the number and type of cues transmitted by a medium. Variations in the type of questions asked, the number of trials and advisors, and the measurement of the dependent variables may explain such contradicting results. Swerts et al. (2004), for instance, elicited participants' judgement of perceived certainty of the stimulus with a rating scale, rather than by having them engage in a game that induced financial risk. One result that gives some insight into the potential causes for such divergent results is the clear effect of *expertise* on participants' SENSITIVITY. As the SENSITIVITY measure is independent of the ratio of correct to incorrect advice, this clear effect of *expertise* was surprising. It can only be explained by differences in the composition of advice: the *non-expert* advisor contained only untrained advice, whereas the *expert* advisor consisted of trained and untrained advice. Consequently, the lack of SENSITIVITY for the *non-expert* advisor may result from the advisor being relatively uncertain about the correctness of her advice on most pieces of advice and therefore not giving off interpersonal cues that allow

distinguishing between correct and incorrect advice. The *expert* advisor, which had a stronger contrast between correct and incorrect advice in terms of confidence (as it combined trained and untrained advice), on the other hand contained interpersonal cues that clearly differed between correct (i.e. trained) and incorrect (i.e. untrained) pieces of advice. This suggests that the context in which users' discriminative ability is investigated and the type of stimulus material used influences how different media affect users' trust. A one-dimensional media richness model that links trust to the number of cues transmitted is thus unlikely to be helpful. Experiment 4 showed that there are differences in effect on trust in an advisor (ADVICE SEEKING) and trust in advice (ADVICE UPTAKE and SENSITIVITY). It further showed differences between users' behaviour and their self-reports, and that media effects are highly dependent on the context of use and the type of information conveyed. Finally, it should be noted that Experiment 4 did not investigate the trust-warranting property motivation, i.e. it did not manipulate the advisor's willingness to give a truthful insight into her level of confidence. A different picture may emerge, when studying wilful deception – i.e. situations in which individuals engage in mimicry (see 3.3.1): verbal cues (e.g. phrasing) are easier to control than non-verbal cues (e.g. pitch; see 2.3.1). As a result in a study on deception, audio or video might clearly outperform text on the measure of SENSITIVITY.

8.4.3 Novel Trust Measures

Experiment 4, as the experiments previously conducted for this thesis, measured trust not just based on users' self-reports but by observing participants' decisions under financial risk. Experiments 2 and 3 used an ASSESSMENT measure that resulted in a loss for an inaccurate trust rating and an INVESTMENT measure, which allowed participants to invest part of their pay in actors they considered trustworthy.

The approach taken in Experiment 4 was less similar to a standard rating measure. Participants were asked to participate in a quiz and financial incentives were given for good performance. The questions included in the quiz were extremely difficult (see 8.2.4), so that good performance required seeking advice. Participants had two advisors but could only ask one for each question. In this scenario, asking one advisor rather than the other (ADVICE SEEKING) and following the advice received (ADVICE UPTAKE) can be understood as trusting behaviour. ADVICE UPTAKE in conjunction with information about the correctness of each piece of advice was also used to calculate the measure SENSITIVITY to correct advice. This measure was taken from signal detection theory (see 8.3.3). Participants' self-reports were elicited in a post-experimental questionnaire. This allowed a comparison of the novel behavioural measures with established interpersonal rating measures.

Using measures from signal detection theory to establish effects on users' ability to differentiate correct from incorrect advice is a novelty in HCI trust research. As discussed in section 2.2.3, most researchers in this area focus on how different design approaches or media representations can increase user trust, rather than on enabling correct trust decisions. While Experiments 2 and 3 investigated effects of photos on the correctness of users' trust decisions through comparisons of mean trust scores (see 6.3.1 and 7.3.1.1), the SENSITIVITY measure gave direct insight into users' ability to discriminate. An additional advantage is that this signal detection measure is free from individual response biases, a problem that was particularly prominent for the INVESTMENT measure (see 6.4.3). Finally, signal detection theory is a well-established research area and the future development of this measure in HCI trust research can draw on the extensive methodological literature in this field (see 10.4 on future work).

Whilst it was possible to find effects of *expertise* and media bias on the novel measures, these measures were also subject to a relatively high error variance. Based on participants' feedback to the final open question, this variance may be partly due to participants' own reasoning about the likelihood of an answer being correct. The rather long delay (13 sec., see 8.3) between participants being presented with a question and their subsequent request for advice certainly supports this inference. Based upon the responses to the open-ended question, participants also seemed to form an impression of each advisor's field of expertise, in the sense that e.g. some considered the *text-only* advisor to be an expert on historical or geographical questions, whereas the *rich media* advisor was considered to be knowledgeable on questions relating to art and culture. These inferences were based upon advice received in early rounds and appear to have influenced the subsequent strategy for asking for advice. While randomising the order of the questions ensured that such effects did not systematically bias the results, they may have increased error variance. Investigating the interplay between such ascriptions and media format is certainly an interesting avenue for future research. Alternatively, future studies can aim to minimise such ascriptions by using more difficult questions from one domain only (e.g. specialist medical knowledge, or knowledge about a fictional scenarios), or by using a problem solving scenario (e.g. van Mulken et al., 1999), rather than a knowledge-based quiz.

Experiment 4 gave several encouraging results for the use of financial incentives to thus elicit trust responses in a more ecologically valid way by creating risk in laboratory settings:

1. The frequency of participants' asking for advice was higher in Experiment 4 than in other advice studies that had not created financial risk. In Experiment 4, participants asked for advice on 87% of all question; in a study by Gardner & Berry (1995) without financial risk, for instance, advice was sought only on 44 % of questions.
2. Experiment 4, in eliciting standard self-report measures as well as behavioural measures of trust showed that these measures do not necessarily give the same results. Self-report measures, for example showed a clear bias for *video* representations, which was not confirmed in the behavioural measure ADVICE UPTAKE.
3. There were significant differences between the final round, which carried an additional stake of £3, and the penultimate round, which did not have such an extra incentive. On the final high stakes question, significantly more participants sought *rich media* advice compared to the penultimate round. Whilst the experimental design did not allow disambiguating effects of the level of risk from effects of question order, it is justifiable to ascribe the effect observed on the final high-risk question to the level of risk for several reasons. First, the study did not employ a symmetric game-theoretic paradigm, endgame-effects as they are common in such studies (see 4.3.1), could thus not be expected here. Second, the effect commonly expected towards the end of iterated studies is a lack of participants' motivation in taking part. Consequently, one would predict a lower ratio of participants to seek advice towards the known end of the study. In Experiment 4, however, the final round resulted in 90.6% of participants seeking advice (see 8.3.1.2).
   The increase in *rich media* ADVICE SEEKING suggests that participants preferred – under increased risk – to take advice from an advisor, who they believed to be easier to judge as it provided additional interpersonal cues (see 8.3.4). For most of the participants in the rich-media *non-expert* conditions, this meant taking advice from an advisor who gave inferior advice. Expressed more poignantly, individuals appeared to be willing to pay a price in terms of expected quality of advice for being able to judge an individual piece of advice in detail. The results on SENSITIVITY, however, indicate that no such increase in ability to judge was realised through seeking *rich media* advice.
   The strong effect of increased stakes suggests that varying pay-offs and thus risk would provide an interesting further avenue for research. Different levels of risk may result in different depths of processing and thus in different effects of surface and interpersonal cues (see 10.4 on future work).

8.5 Chapter Summary

Experiment 4 investigated the overarching research goals of this thesis, but addressed them for a human trustee rather than for an organisational one. This variation in the type of trustee allowed an investigation of whether mediated interpersonal cues biased users' trust perceptions (the focus of Experiments 2 and 3, P1), and in addition also whether they allowed for better discrimination between trustworthy and less trustworthy actors (P2). Whilst trust in human trustees had been widely researched (see 2.3.4), no previous study contrasted P1 and P2 directly. Beyond *photo+text*, Experiment 4 also investigated *video*, *avatar*, and *audio* representations.

It was found that individuals had good discriminative abilities in all media representations. They mainly sought advice from the *expert* advisor, irrespective of media representation, and they had a good SENSITIVITY to correct advice given by the *expert* in all representation. There was some indication for a preference for seeking *video* advice. Users' self-reports indicated that this preference resulted from the belief that *video* and also *audio* representations would allow better trust assessments. However, no media effect was found for SENSITIVITY to correct advice, indicating that the richer representations did not allow better assessments. In fact, in some cases users sought *rich media* – in particular *video* – advice, where they would have been better off by seeking *text-only* advice. Hence, the findings provide some support for Horn's et al. (2002) hypothesis that real dynamic visual interpersonal cues can induce a bias. An increase in risk increased the preference for seeking *video* advice. The *avatar* was not found to have a positive effect on trust. Using an avatar without careful scripting non-verbal behaviour may not be an advisable strategy for building trust with the current state of art of avatar development. However, the *avatar*, and even just a simple photo led to higher ratings of friendliness and enjoyment than *text-only*. So, if the design goal is engagement rather than inducing trust, Experiment 4 suggests such representations can be effective.

From a methodological point of view, Experiment 4 demonstrated the effect of financial incentives. The final round with high stakes resulted in significantly different ADVICE SEEKING behaviour. Higher risk led to an increase in users' tendency to seek *rich media* advice – even though this format did not increase their discriminative ability.

Chapter 9

Commercial Implications of this Research

This chapter departs from the linear flow of the thesis. It is included as a part-requirement for the CSEL London Business School Scholarship, which allowed the author to take electives at London Business School. The aim of the chapter is to evaluate the commercial implications of the research presented in this thesis. Its main focus is on applying the framework for trust in mediated interactions, introduced in Chapter 3, to e-commerce marketing.

9.1 Introduction

Whilst information technology was initially mainly sold to corporate customers, computer systems in today's world are increasingly aimed at a consumer or leisure market (Nielsen, 1994). As an example, the games console software market is now worth more than $18 billion – equal to cinema box office takings (Economist, 2002). A high dissemination of Internet access (50m US users with home broadband access; Economist, 2004a) allows delivery of many types of services to consumers' living rooms that previously required a high street branch network. Business-to-consumer E-commerce, which now constitutes a market worth 5 bn. in the UK (Economist, 2004a) is probably the best example.

Whilst optimising human-computer interaction was initially often considered as an afterthought in bespoke software systems development (Mayhew, 1999; Nielsen, 1994; Garrett, 2002), it is now – in its wider understanding as user experience – becoming a unique differentiator in a competitive consumer products market. A closer alignment with marketing and product management in terms of terminology, methodology, and substantive knowledge is therefore crucial. Donald Norman, a leading figure in HCI, advocated this closer integration for several years (Norman, 1998; Anderson, 2005; Shneiderman et al., 2002). The growing importance of user experience in the value creation process is also reflected outside the field of HCI. The Economist (2004b), for example, devoted a recent survey to the discussion of *ease of use* as a differentiator. However, whilst the need for a closer alignment between marketing and HCI is widely recognised, Norman (in Shneiderman et al., 2002) also noted a shortcoming in HCI researchers' and practitioners' ability to communicate effectively in the language of marketing professionals. In view of these developments this chapter seeks to help

bridge the existing gap between marketing and HCI. In doing so, this chapter links the research conducted for this thesis – in particular the framework for trust in mediated interaction (see Chapter 3) – to marketing concepts and practice.

The question of user trust in mediated interactions can be seen in the wider context of maintaining or winning customers' trust in services, brands, and organisations. Indeed, trust has also recently gained prominence in marketing and branding literature: Roberts & Lafley (2005), for instance, argue for conceiving trademarks as *trustmarks*. Chaudhuri & Holbrook (2002) support this claim empirically with findings from a large-scale study involving more than 11,000 respondents and 137 brands, in which they found that trust was a strong predictor for brand commitment.

While HCI and marketing share an interest in trust, the perspective taken in the field of marketing differs from that taken in this thesis. Marketing focuses on one trustworthy trustee, i.e. a vendor that needs to attract trusting customers in a competitive environment with many competing trustees (i.e. other vendors), some of them potentially untrustworthy. Hence the focus from a marketing perspective is on increasing perceived trustworthiness of one vendor. This view is mirrored by many of the guidelines for trustworthy interface design that have been compiled in the field of HCI. However, it stands in contrast to the systemic view taken in this thesis (see 2.2.3 and Chapter 3). This view had focused on the levels of correctly placed trust in a socio-technical system – by many trustors and towards many trustees of variable trustworthiness.

In aligning the different perspectives, this chapter first gives an overview of the main issues and concepts in marketing, and discusses their implications for trust in e-commerce (see 9.2). This is followed by an overview on HCI research that focuses on increasing the perceived trustworthiness of e-commerce vendors (see 9.3). The main part of the chapter is devoted to employing the framework for trust in mediated interactions (see Chapter 3) for an analysis of existing HCI and marketing guidelines on trust in e-commerce (see 9.4).

9.2 Overview on the Marketing Process

This section introduces some core concepts in marketing and relates them to trust in e-commerce. It forms the foundation for the analysis of e-commerce trust guidelines in section 9.4. The section covers generic marketing strategies (see 9.2.1), the marketing mix (see 9.2.2), service marketing (see 9.2.3), positioning and branding (see 9.2.4) and consumer decision-making (see 9.2.5).

9.2.1 Marketing Strategies

Marketing experts delineate three generic marketing strategies: *cost leadership* (also called *price competition*), addressing *niche markets* (also called *focus*), and *differentiation* (Porter, 1985; Kotler, 2002; Lynch, Jr. & Ariely, 2000). A short overview on these generic strategies is given below.

Economists sometimes invoke the idea of a *perfect market* (e.g. Brynjolfsson & Smith, 2000). In such a hypothetical market buyers and vendors have complete information (i.e. information search cost is negligible), products are standardized and can be easily compared, and the markets are liquid, i.e. supply and demand can be instantly matched. As a result, vendors would be expected to compete on price. Commodity markets (e.g. oil, steel, electricity) are seen as examples for markets that are a relatively good fit of such a model (even though in reality price competition is sometimes distorted by regulatory intervention, tariffs, or cartels). Price competition can also be seen as a marketing strategy in consumer markets: low-cost airlines are probably the most prominent recent example; another would be supermarket "Value" brands. Price competition is a strategy in mature markets; i.e. in those where buyers do not perceive major differences in product quality.

Another marketing strategy is to address niche markets, thereby avoiding intense competition and fulfilling the needs of a very specific customer segment more fully than a generic, high volume vendor could do. In this way a niche provider can act as a quasi-monopoly in the specific segment he is addressing and can therefore charge higher prices.

Differentiation is the most commonly used marketing strategy – and the focus of this chapter. It refers to giving products real or perceived attributes that differentiate them from the offerings of the competition. If these attributes fulfil a consumer need, a premium over the commodity market price can be achieved. This strategy is often seen as preferable to price competition, as it insulates profits from potentially ruinous price wars. However, differentiation only creates a sustainable competitive advantage, if the source of differentiation can be guarded, i.e. if it is not easily copied or mimicked (see 3.3.1).

In the early days of e-commerce, it was predicted that the reduction of information search cost, the fact that the competition was always just "one click away", and the ease of copying functional attributes of web sites would create an environment more akin to the perfect or frictionless market described above (e.g. Brynjolfsson & Smith, 2000). As a result, a stronger focus on price-competition, even in consumer markets, and a decline in the applicability of a differentiation strategy was predicted (Brynjolfsson & Smith, 2000; Gatti et al., 2004). However, we have observed the rise of strongly branded (i.e. differentiated) e-commerce vendors such as Amazon.com or Expedia.com, indicating that we are not facing a commodity

market. The economists Brynjolfsson & Smith (2000) and Gatti et al. (2004) found variation in consumer preferences for online retailers that cannot be explained by price alone. Instead, part of this variance was explained by differences in the services offered (e.g. depth of product catalogue) and by differences in intangible attributes, such as brand. Brynjolfsson & Smith (2000) consider trust to be one key factor amongst these intangible differentiators. Their reasoning is that a heightened perception of risk (see 2.2.2) on the Internet allows online retailers to differentiate themselves on the factor trustworthiness. This view is supported by Chaudhuri & Holbrook (2002), who identified that perceived risk in a product category increases the weight of trust on consumers' brand commitment. The evidence from HCI research (based largely on interviews with individual users) in support of the relevance of trust in e-commerce is therefore complemented by research in marketing and economics (based on a macro-analysis of markets and brands) that also underlines the relevance of trust as a source of differentiation.

9.2.2 The Marketing Mix

The *marketing mix* is a catchphrase that summarises the activities necessary to execute a marketing strategy (see section 9.2.1). The widely accepted view is that the marketing mix has four main components: *product*, *price*, *promotion*, and *place* (Kotler, 2002).

Product summarizes the activities that are necessary to differentiate a product on tangible and intangible attributes. Following the discussion in section 9.1, a good user experience is now increasingly seen as an important differentiator, as a growing number of products rely on complex digital technologies. E-commerce in particular is a service product where nearly all customer contact is mediated through an online system. Hence, HCI can provide substantial knowledge on how to differentiate such products on tangible (e.g. functionality) and on intangible (e.g. aesthetics and trust) attributes. This topic will be discussed in more depth in the section on positioning and branding (see 9.2.4).

Price relates to setting the optimal price for a product taking into account – amongst other factors – demand elasticity (the extent to which demand diminishes with an increase in price; Lynch, 2002). Individuals vary in how much they value a product and subsequently in how much they are willing to pay for it. A marketing professional's challenge therefore is to find the optimal price to make the maximum number of sales without selling too cheaply to customers who would have been willing to pay a higher price. Traditional consumer marketing is limited in the extent to which it can differentiate prices. Simple forms of price differentiation include charging different prices to different markets (e.g. prices for jeans in the US *vs.* the UK, or flights for students *vs.* business travellers) or offering slight variations

in the product (e.g. branded packing *vs.* generic packaging). In e-commerce, prices can be differentiated further, as the offerings can be adapted dynamically, taking in account a customer's interaction history with a site (Shenk, 1998). Clearly, as noted by Shenk (1998), the use of such detailed knowledge about customers' behaviour and price sensitivity to the advantage of the vendor raises ethical concerns.

Place refers to the efforts undertaken in distributing the product. The web fundamentally transformed this aspect of the marketing mix, as it freed retailing services from an expensive high street branch network. The product, i.e. the online shopping service, can now be accessed from any place via an Internet connection. In addition, the growth and accessibility of online technology makes it possible to deliver products electronically that were previously sold in a physical format. Apple's iTunes[25] store for electronic music downloads and Tivo's[26] electronic movie rental service are examples of how online technologies targeted at consumers can revolutionise the distribution of service or entire industries. These new distribution channels need to have good usability, but they must also allow secure transmission and the control of copyrights (digital rights management, DRM).

Promotion summarises *advertising*, *public relations*, *sales promotions*, and *personal selling*. These different types of promotional activities address different stages of the consumer decision-making process (see 9.2.5). Mass media *advertising*, in particular in television, is traditionally the main instrument to create a high level of awareness for mass-market consumer products. With an increasingly fragmented audience (Roberts & Lafley, 2005) perusing many different media, such a strategy becomes increasingly difficult to sustain. In this situation, electronic media offer a unique chance to the marketer, as they can be used to improve the targeting of promotional activities. Rather than sending a standardised message to millions of people, who may not be interested in buying the product, keyword advertising (as e.g. offered by Google) can be used to address only potentially interested users. Similarly, e-commerce vendors can build up user profiles to send their customers tailored recommendations and sales promotions. The concern in HCI research for the trustworthiness of an e-commerce interface is reflected in the weight that is given to personal selling in marketing. As e-commerce systems replace human sales interactions, they need to achieve many of the goals of personal selling – beyond just presenting the goods (see 9.3).

This section showed that the increasing availability of digital online services has the potential to transform every aspect of the marketing mix (product, price, place, promotion). It therefore further underlined the importance of integrating HCI and marketing to ensure that marketing activities in online channels are not compromised by a poor user experience. The

[25] www.itunes.com
[26] www.tivo.com

next section will look more specifically into marketing strategies for service products, such as retailing and, by extension, e-commerce.

9.2.3 E-commerce as a Service Product

It is well established in marketing theory that service products carry more risk and uncertainty than tangible products, as they cannot be inspected prior to the purchase decisions (Kotler, 2002; Murray, 1991). Furthermore, as they traditionally rely upon the performance of human actors they have a higher variability in quality than physical products that can be produced with standardised industrial processes. The classic approach to the marketing of services is to put strong emphasis on the *people* executing the service, on the *physical environment* in which the service is performed, and on standardised business *processes* (Kotler, 2002). Writing on the factor people, Kotler (2002) notes that service marketing requires a strong focus on selecting, training, and motivating the individuals executing the service. The motivation for paying much attention to the physical environment in which services are performed is that – in the absence of tangible product features – it allows potential customers to make inferences about the expected quality of service. A clean, modern environment will create other expectations than a cluttered, run-down space. In the case of e-commerce, the sales assistants and the physical environment are replaced by a web site. These are the only parts of a business the potential customer can inspect prior to a purchase decision, and hence they are of extremely high importance. It is at this point that the research goals of this thesis most closely overlap with marketing concerns: section 2.2.4 noted that in an attempt to overcome the lack of interpersonal interaction, many e-commerce vendors use photos or more advanced media representations (e.g. video, audio, or avatar) with the aim to build consumer trust in a situation of heightened risk perception.

9.2.4 Positioning and Branding

As discussed in section 9.2.1, products can be differentiated by tangible (functional) and intangible attributes. In the case of an e-commerce service, tangible attributes would be the depth of the product catalogue, the speed of conducting searches, or the ease of use of the interface. Examples for intangible product attribute are aesthetic design, a trustworthy and dependable service, or a likeable brand personality. The concept of *positioning*, introduced by Ries & Trout (1981), holds that customers will map any product in the space defined by a few tangible and intangible product attributes that are relevant to them. As only very few products can inhabit the relevant top positions in buyers' minds, *product positioning* refers to marketing activities that aim to control the relevant attributes and the product's position on

them. Given the difficulty of defending positions that are related to tangible product features, the marketing literature advices on differentiating on brand and image (Kotler, 2002; Lynch, 2002; Porter, 1985).

Initially, the term *brand* referred to the symbol added to a product to identify the producer. In today's understanding it encompasses the brand image, i.e. the set of associations, beliefs, values, and benefits of a specific product or company (Risch, 2003). While brand and image are partially related to product features, they are also created by advertising, public relations, appearance or design, as well as corporate culture, mission, environment, and style. A brand has visual, emotional, rational, and cultural aspects (Risch, 2003). Table 9.1 shows McKinsey's approach towards analysing the properties of brands (Risch, 2003, p. 21).

	Benefit of the Brand	Attribute of the Brand
Intangible	Emotional Benefit - Self representation - Self Actualisation	Intangible Attributes - Provenience - Reputation
Tangible	Rational Benefit - Product Features - Business Process	Tangible Attributes - Presence

Table 9.1: McKinsey's *brand diamond* tool to structure brand properties

From the perspective of a HCI researcher, it is interesting to note that the concept of emotional or affective benefit is firmly ingrained in the analysis of brand properties in marketing research. Whilst the realisation of the importance of emotional aspects is just gaining ground in HCI (see e.g. Norman's book on Emotional Design; 2004) and in HCI trust research (see 2.2.4), marketing and branding have long established frameworks to measure, plan, and define emotional benefits of brands. The concept of *brand equity,* for instance, aims to quantify the value of a brand in terms of a price premium that can be attained over a functionally indistinct but unbranded product. The brand equity of global brands such as Coca Cola, Mercedes, and also Amazon.com, constitutes a considerable asset of companies that own the brand. High brand equity has a positive effect on customer loyalty, awareness, and perceived quality and thus supports the marketing process at several stages of consumers' decision-making process.

9.2.5 Consumer Decision-Making Process

The way in which buyers reach a decision on their purchases has important implications for marketing. Hence, it has received much research attention in this discipline. There is wide agreement that the decision making-process consists of several stages and that distinct marketing activities are required at each stage to guide potential buyers along these steps. Figure 9.1 shows a model by McKinsey (Risch, 2003).

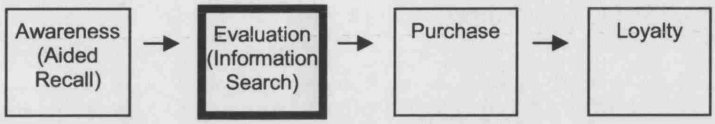


Figure 9.1: McKinsey's step-model of consumer decision-making

From the point of view of a HCI researcher investigating e-commerce, the *evaluation* step is of most relevance as the interface of an e-commerce system will provide a large part of the information that will be taken into account in that step (see 9.3). Whilst classic decision making models hold that an evaluation consists of the careful weighting of alternatives, there is also evidence that consumers employ other decision-making strategies, depending on product, situational, and personal factors (Aaker, 1996). Assael (1987) differentiates four main types of consumer decision-making strategies. They are categorised along the dimensions *involvement* (Petty & Cacioppo, 1996) and *differentiation* (see Table 9.2).

	High Involvement	Low Involvement
Significant differences between brands	Complex	Variety Seeking
Few differences between brands	Dissonance-reducing	Habitual

Table 9.2: Consumer decision-making strategies

Differentiation refers to the degree to which buyers perceive relevant differences between the suppliers and products in a market. If the perceived differences are very small, a detailed evaluation will not be worthwhile for a buyer, as a decision in either direction will have little impact on the outcome. The more interesting concept in the context of this thesis is involvement. It denotes the depth of users' information processing prior to a purchase and it is influenced by perceived risk (e.g. due to product cost), uncertainty of the buyer, and frequency of purchasing among other factors. Involvement can thus be expected to be high in situations that are described as being subject to a *lack of trust* (see 2.2.2).

The final step in the consumer decision-making model (Figure 9.1), loyalty, exemplifies the shift from a single transaction view to a relationship view of marketing. The reason for this shift is the cost structure of marketing activities (Reichheld & Schefter, 2000). In many

cases the cost of attracting a customer for a first-time purchase is so great that it cannot be recouped by a single sale. Rather, the customer needs to be retained for several repeat purchases. Hence, marketing costs are commonly offset not by individual sales margins, but by projections of a customer's expected lifetime value. Several models of e-commerce user trust emphasise the importance of customer relationship management efforts to gain a users' loyalty.

9.2.6 Marketing and HCI Trust Research

The overview on marketing concepts given above allows positioning the question of trust in e-commerce in the wider frame of marketing strategy. The apparent success of differentiation strategies for e-commerce, which contradicts initial predictions by economists, suggests that trustworthiness can be a differentiator in the competition for online shoppers. E-commerce vendors pursuing a differentiation strategy can aim to position their service on several tangible and intangible attributes. The vendor's interface is one of many channels that can be used for positioning, others include e.g. classic advertising or public relations effort. Focusing on the e-commerce system, one can differentiate on functional benefits (e.g. ease of use or size of product catalogues), and also on intangible ones, such as style, aesthetics – or trust.

Service products, such as e-commerce, require specific marketing approaches, as they are traditionally characterized by uncertainty, risk, and variability. These result from the fact that buyers have to reach purchasing decisions prior to experiencing the service. Hence, trust in an e-commerce vendor can be a promising attribute for differentiating it from competitors to command a price premium and to attract customers. Service marketing classically emphasised people, physical environment, and process as areas for differentiation. Whilst the move from face-to-face retailing to e-commerce allows standardising processes to a higher extent, it also removes the physical environment and sales staff as sources of differentiation and trust. These factors are now subsumed in the interface, further underlining the increasing importance of HCI for marketing. Replacing personal selling with an e-commerce system results in a loss of interpersonal cues – with several consequences for trust-building (e.g. the absence of symptomatic cues, see 3.3.2). Aiming to use pre-recorded or synthetic interpersonal cues as a standardized surrogate for real (and costly) face-to-face service staff, is thus a predictable response in an effort to regain sources for differentiation (see 9.2.4). The relationship between involvement and decision-making strategies indicates that buyers who perceive the Internet as risky will spend more time gathering information about a potential vendor than those for whom online shopping is a habitual activity.

This section gave a brief overview on concepts of marketing that are relevant in the context of e-commerce. The next section reviews existing guidelines for the design of trustworthy e-commerce interfaces that mostly originate in the field of HCI. The final section of this chapter then discusses the marketing concepts and design guidelines in the terms of the framework introduced in Chapter 3.

9.3 Interface Design Guidelines for Trust in E-commerce

Prompted by reports about a *lack of trust* on the Internet and in particular in e-commerce (see 2.2.2), many HCI researchers investigated how the user interface design could contribute to building customer trust. These efforts were based largely upon established HCI methods, such as user interviews or observation. The resulting guidelines have been very helpful to practitioners and one can see them implemented in many current e-commerce sites. However, they have also been criticised (see 2.2.3), for focusing too narrowly on surface cues that are currently perceived as signifiers of trustworthiness rather than aiming to increase correctly placed trust in the long term. There is no evidence for the reliability of these surface cues, for their stability over time, or for their portability to other technological platforms (see 2.2.3). These issues will be discussed in section 9.4, in which the framework for trust in mediated interaction is used to analyse existing guidelines. A brief overview on the design recommendations resulting from these guidelines is given below.

In one of the earliest studies on consumer trust in e-commerce, Jarvenpaa & Tractinsky (1999) identified perceived size and perceived reputation of existing e-commerce vendors as predictors for trust and willingness to buy. These findings were, however, not linked to specific e-commerce system design elements. One of the earliest studies that focused exclusively on the effect of surface cues on consumer trust was conducted by Sapient & Cheskin (1999). The fundamental building blocks of trust identified in this study are *seals of approval*, *quality of presentation*, *navigation*, *branding*, *fulfillment* and use of *secure, error-free technology*. The findings that relate to interface elements are included in Table 9.3. The most comprehensive e-commerce trust model linked to interface design guidelines has been developed by Egger (2001). Factors in his MoTEC model include:

Pre-interactional Filters. This element captures the factors that affect a new customers' *a priori* trust. These are personal propensity to trust, knowledge about the industry and the brand, as well as trust transferred via recommendations.

Interface Properties. Surface cues that determine the first impression of a web site; they are included in Table 2.

Informational Content. Surface cue that require a more detailed exploration of the site, such as policies and company information – they are also included in Table 2.

Relationship Management. This element refers to the vendor's actions after a transaction occurred. Here, trust building activities include various channels of contact, rapid turnaround for questions, and order tracking.

Table 9.3 summarises the key elements from Egger's (2001) and Sapient & Cheskin's, (1999) model and adds findings from guidelines and reviews that were subsequently published (Grabner-Kraeuter & Kaluscha, 2003). The next section uses the framework introduced in Chapter 3 of this thesis to analyse the interface design guidelines presented in Table 9.3 as well as the marketing concepts discussed in section 9.2.

Recommendation	Source
Absence of errors (Absence of outdated information)	Nielsen (1999), Sapient (1999)
Aesthetic Design	Nielsen (1999), Egger (2001), Dayal et al. (2001), Sapient (1999)
Affiliations (Linking to others, link backs, cooperating with trusted brands, customer references, third party endorsements, trust seals, testimonials)	Nielsen (1999), Dayal et al. (2001), IBM (2003), Shneiderman (2000), Bailey et al. (2001), Grabner-Kraeuter & Kaluscha (2003), de Ruyter, Wetzels, & Kleijnen (2001), Ratnasingam & Pavlou (2004), Jarvenpaa & Tractinsky (1999)
Branding	Egger (2001), Bailey et al. (2001), Sapient (1999)
Detailed Product Information	Dayal et al. (2001), Egger (2001), Nielsen et al. (2000)
Information about past performance	Shneiderman (2000)
Openness / Transparency (Providing background on company, contact information, photographs)	IBM (2003), Egger (2001), Nielsen et al. (2000), Grabner-Kraeuter & Kaluscha (2003), Gefen (2005), de Ruyter et al. (2001)
People and Social Presence (Showing staff and customers – giving interpersonal cues, see 2.3.5)	Grabner-Kraeuter & Kaluscha (2003), Egger (2001), Nielsen et al. (2000)
Physical Assets (Showing or describing company's buildings)	Grabner-Kraeuter & Kaluscha (2003), Gefen (2005), de Ruyter et al. (2001)
Privacy Policy	Egger (2001), Cranor, Reagle, & Ackerman (1999)
Security (e.g. encryption)	IBM (2003), Egger (2001), Sapient (1999), Nielsen et al. (2000)
Size (Perceived size of the site / organisation)	Jarvenpaa & Tractinsky (1999), Bailey et al. (2001), Grabner-Kraeuter & Kaluscha (2003)
Trials (low risk initial interactions)	Dayal et al. (2001)
Upfront Disclosure (Privacy policy, shipping cost, corporate philosophy)	Nielsen (1999), IBM (2003), Shneiderman (2000), Egger (2001), Bailey et al. (2001), Nielsen et al. (2000)
Usability (Good Navigation)	Nielsen (1999), Egger (2001), Bailey et al. (2001), Sapient (1999), Grabner-Kraeuter & Kaluscha (2003), Lee & Turban (2001)
User control over information (Giving reasons / benefits for and control over captured personal information)	Nielsen (1999), IBM (2003), Egger (2001), Dayal et al. (2001)
Warranty Policy	Grabner-Kraeuter & Kaluscha (2003), Jarvenpaa & Tractinsky (1999), de Ruyter et al. (2001), Lee & Turban (2001), Ratnasingam & Pavlou (2004)

Table 9.3: Elements of trustworthy interface design guidelines

9.4 The Framework Applied to E-Commerce Marketing

This section employs the framework for trust in mediated interactions introduced in Chapter 3 for an analysis of the interface trust signals that were identified in the interface design guidelines listed in Table 9.3. In addition, the section links the design guidelines to relevant concepts in the marketing literature that were identified in section 9.2.

9.4.1 Risks

Section 9.2.3 identified service products as particularly prone to problems of uncertainty and risk. Table 9.4 illustrates this for e-commerce by giving an overview on the risks that have been mentioned by respondents in an earlier study by the author (Riegelsberger & Sasse, 2001). They are categorised as risks related to technology, vendor's actions, and users' own errors. This distinction is well-supported by the trust framework which allows analysing a situation with either the vendor, or the channel (i.e. the technology) in the position of the trustee (see 3.2).

1. Risks related to technology
a) Data confidentiality (e.g. credit card information is not intercepted)
b) Data integrity (e.g. orders are received as entered)
c) System availability (e.g. system does not become inaccessible during transaction)
2. Risks related to vendor
a) Future use of data (e.g. privacy)
b) Fulfillment (e.g. whether products will be delivered as promised)
3. Risks related to users' own errors
a) User errors (e.g. items are ordered inadvertently)

Table 9.4: Risks perceived by potential e-commerce customers

The most relevant risks from the perspective of the marketer are those that are related to the vendor. In a situation where buyers perceive many untrustworthy vendors to be present, trust can act as an effective differentiator. However, the other risks (*own errors* and *technology risks*) can also be addressed by interface and interaction design. For instance, the user can be assured that she does not accidentally commit herself to an order, and that all data has been received as intended. Examples include *status indicators, system feedback, displaying data already entered,* and *continuously displaying the products to be ordered* during the process. In overcoming barriers to the use of online-shopping, it is important to note that these

approaches reduce risks, rather than build trust in a retailer or his brand (Riegelsberger & Sasse, 2001). Another way of addressing risks are technological solutions that aim to curtail the room for action (and thus for untrustworthy behaviour) of the vendor or third parties. An example is the *Platform for Privacy Preferences* (P3P), a protocol that can limit the exchange of personal information and notifies the user about such exchanges (Cranor et al., 1999). However, these solutions will only be effective if the technologies – at least in their basics – are understood by users. Furthermore, these technological approaches may help to increase overall trust in a marketplace, but they are unlikely to provide a source of differentiation for an online retailer in a competitive market, as they require the collaboration of several actors to achieve a set of standards or protocols. The main focus in this section is on how to build trust in an individual vendor. Privacy (Table 9.3) and fulfillment (Table 9.3) are the core concerns here. However, it is worth noting that trust in a vendor can also help to mitigate other risks, e.g. their own errors – because customers may expect a benevolent response from a vendor when they committed an error (e.g. being allowed to cancel a mis-ordered item, as e.g. Amazon.com does).

In the following sections the individual properties proposed by the framework are used to analyse trust design guidelines and relevant marketing concepts. Figure 9.2 reproduces the model as it was introduced in Chapter 3 for ease of reference.

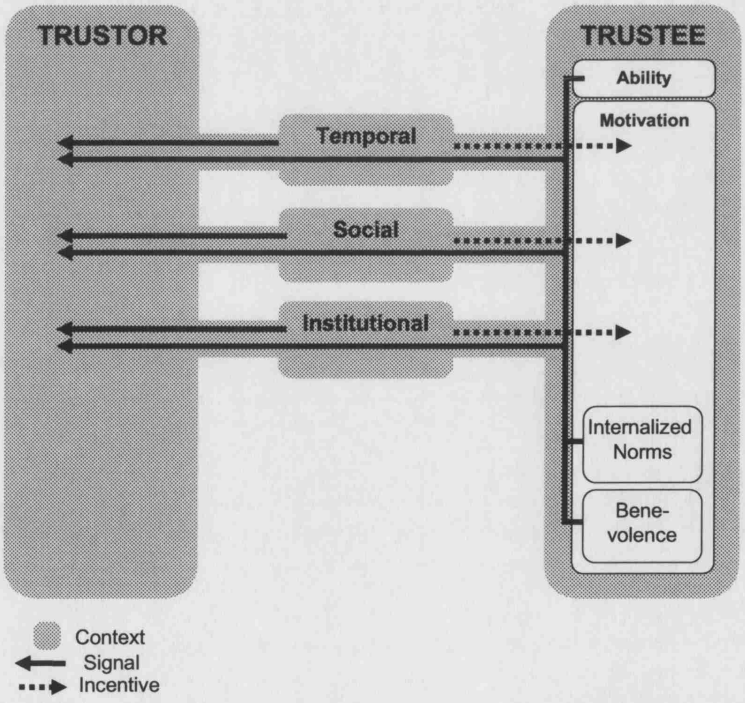


Figure 9.2: The framework for trust in mediated interactions

9.4.2 Temporal embeddedness

Vendors can signal trustworthiness in different ways in terms of temporal embeddedness (see Figure 9.2). The first is to indicate that they are in the market for the long term. This may be achieved by showing that the company has been in business for a long time, or that it is linked to a long-standing off-line brand, or even by making clear that considerable investment had been made in the site or the brand (e.g. through advertising). This aspect favours larger, well-known players in markets that are perceived to be risky (Gatti et al., 2004). Many HCI researchers identified professionalism of the website (Shneiderman, 2000; Nielsen et al., 2000; Fogg, 2003b; Riegelsberger & Sasse, 2003b, see Table 9.3) as a core indicator of trustworthiness. Professionalism signals – amongst other factors (see 9.4.5) – an interest in continued business and thus susceptibility to the effects of temporal embeddedness, i.e. an interest in customer satisfaction and loyalty (see Table 9.3). Interface signals for professionalism include absence of technical failures, absence of mistakes, breadth of product palette, aesthetic design, and information about physical assets. Corritore et al. (2003b) name perceived ease of use as an important factor for the perception of professionalism online and thus for trustworthiness. This is supported by findings reported by Egger (2001) and Sapient & Cheskin (1999). Another way to show trustworthiness in terms of temporal embeddedness is displaying an interest in a continued relationship with a specific customer. As discussed in section 9.2.5, this idea has been elaborated within marketing practice as customer relationship management and in the concept of customer lifetime value. Vendors can demonstrate an interest in a continued relationship by giving first-time purchase price incentives (e.g. Amazon's first time visitor's voucher), by eliciting feedback (e.g. publicly, as does Amazon.com on its site), or by offering loyalty schemes (Egger, 2001). Kotler (2002) mentions clubs and member magazines or newsletters as particularly relevant for service products to maintain a tangible relationship with the customer, even at periods when the service is not consumed.

9.4.3 Social Embeddedness

Social embeddedness, i.e. reputation, is an important factor for purchase decisions. In the earlier interviews conducted by the author (Riegelsberger & Sasse, 2001), users said that they paid much attention to their friends' and families' recommendations when deciding where to shop online. This finding is also reflected in marketing models of consumer decision-making. Kotler (2002) states that at the information search stage of consumer decision-making, commercial sources (e.g. advertising, media reporting) inform the potential customer about a product, but personal sources (e.g. recommendations from friends or family) legitimize the

purchase of a product. Personal sources are particularly important for service products – such as online retailing (Murray, 1991). Recognizing this process, several marketing methods have sprung up that aim to influence the dissemination of reputation information in informal networks. These include *viral marketing* (Wilson, 2000) and targeting opinion leaders (Kotler, 2002). The Internet itself can be used to facilitate the formation and dissemination of reputation information in informal networks: services such as *Epinions* or *Bizrate* (see 6.2.2.2) that collect customer feedback on many products and services aim to do just that. However, these approaches suffer from the additional cost users face when entering feedback after they received the ordered goods. A more usable system would be integrated in the user's browser and could record repeat purchases implicitly (McCarthy & Riegelsberger, 2004), thus reducing the cost of contributing reputation information. Amazon's *affiliate programme* is another example of using the Internet to communicate reputation information: providers of web sites are encouraged (with small commissions) to link to products on Amazon.com. Thus, they implicitly endorse Amazon.com. Informal friends and family networks can also be used by e-commerce marketers by giving out electronic vouchers to customers that these can email to others who have not yet bought from a vendor.

An individual vendor can display social embeddedness through *endorsements* (e.g. from well-known experts), or through positive *customer comments*. The impact of these measures is, however, limited by two factors. Firstly, they themselves depend on a basic level of trust and credibility, as they could easily be forged. Secondly, interface elements with no function beyond emphasising trustworthiness can also be interpreted as attempts at trust manipulation (Riegelsberger & Sasse, 2001). A way out of this dilemma is to incorporate elements that communicate such information – e.g. *"we have a large customer base"* – as a side-effect (i.e. in a symptomatic fashion, see 3.3.2). An example for this strategy is Amazon's *customer recommendations section*. This element has functionality in its own right (additional information on books); but at the same time, many customer recommendations also imply the presence of a large customer base.

9.4.4 Institutional embeddedness

The first factors that might come to mind when talking about institutional embeddedness in the context of e-commerce are regulatory or legislative approaches. Whilst these may be able to win some general trust in the market, they are unlikely to be a source of differentiation for individual vendors. Furthermore, with the globally dispersed market that is created by the Internet, a unified global regulatory approach seems unlikely. However, due to international differences in regulatory frameworks, information about the vendor's physical location can

build some level of trust (Egger, 2001; Shneiderman, 2000). While this is unlikely to be a substantial source of differentiation, it can help if the customer knows that the vendor is e.g. located in his home country and that the institutional rules that she is familiar with apply. This effect can be seen as one reason for the creation of localised sites (e.g. Expedia.co.uk, Expedia.com, Expedia.de) by global e-commerce vendors. However, possibility of legal recourse to ensure minimum levels of service is a relatively weak signal for trustworthiness. In this situation trust seal programs (Sapient & Cheskin, 1999) have been suggested as a way of institutionally assuring trustworthiness and building consumer trust in the market and in specific vendors. Such programs work by establishing rules of conduct (e.g. with regard to security technology or privacy policies) and by checking their members' performance against these rules. Complying members are awarded trust seals: small icons they can display on their site. These seals are commonly linked to the certifying body's site to enable a check of their veracity. The disadvantage of many seal programs is that the certifying organisations are not well known and thus have no trust (i.e. no brand equity) to transfer (Riegelsberger & Sasse, 2003b; Belanger, Hiller, & Smith, 2002). Trust seals given by well-known organisations that 'sublet' their trust by endorsing unknown vendors are more promising, because they put their own reputation at stake. Amazon's zShops go beyond seal-based endorsements by hosting independent vendors and enforcing codes of conduct. From a brand equity perspective (see 9.2.4) trust seals can be seen as risky, as they rely on outsourcing part of the online retailers brand equity to another organisation, thus relinquishing control over an intangible product feature that is of particularly high importance in the marketing of services such as e-commerce (see 9.2.3).

9.4.5 Intrinsic Properties

Intrinsic properties are easily identified in the case of human trustees, as they refer to personality and abilities. In the case of an organisation, products, and brands, the mapping is more difficult. An organisation can aim to influence its intrinsic properties by promoting appropriate values, norms, and performance targets through mission statements and training programs (Kotler, 2002). These intrinsic properties can then be communicated in the form of advertising, public-relations activities, and also through the e-commerce interface.

Ability. This property takes the shape of professionalism in the context of e-commerce. Whilst professionalism can signal an interest in continued business (see 9.4.2), it is foremost a signal for the intrinsic property ability. To appear professional, a vendor needs to comply with off-line business standards (e.g. *consistent graphic design, absence of technological failures,*

clear assignment of responsibilities, upfront disclosure of terms & conditions, shipping costs and availability) and with web standards (e.g. *easy to remember URL, good usability, privacy policy, similarity in interaction design to well known sites*; Egger, 2001 and Table 9.3).

Internalised norms. This property is easily identified in the case of human trustees - with an e-commerce vendor, however, the mapping is more difficult. An organisation can aim to influence the internalized norms of its employees by promoting appropriate values, norms, and performance targets through mission statements, training programs, and selection processes (Kotler, 2002). These intrinsic properties can then be communicated in the form of advertising, public-relations activities, but also through the e-commerce interface. Information about a company's intrinsic properties can be given in mission statements, privacy policies, and upfront disclosure of terms & conditions (e.g. shipping; Egger, 2001). However, these signals are symbolic (see 3.3.2), and can easily be mimicked by untrustworthy vendors at a relatively low cost. They are a source of differentiation that is hard to defend. If these *internalised norms* are, however, ingrained into the services the company offers, they can become a differentiator. Furthermore, potential customers – unless they are highly involved (see 9.2.5), are unlikely to read corporate mission statements or philosophies in detail. Hence, interface design must communicate these while users are fulfilling their task. This can be achieved through visual design, the use of language, and appropriate conceptual modelling. As an example, the way in which a system responds to user errors gives much insight into an organisation's attitude towards its customers (Cooper & Reimann, 2003). All design choices give information about the attitude the organisation's values and beliefs. Hence, they need to be evaluated to identify whether they give a coherent and the desired image.

Benevolence. Strong *benevolence*, identified in long-standing relationships between humans, does not apply to e-commerce. However, with a continued business relationship a form of *benevolence* between vendor and customer can grow. This can take the shape of strong brand loyalty (Riegelsberger et al., 2002a). Roberts & Lafley (2005) use the phrase *"loyalty beyond reason"* (p. 66). A vendor can express *benevolence* towards the customer through loyalty schemes, more lenient payment conditions, or access to internal information on the side of the vendor. Policies such as "returns with no questions asked" increase the vendor's vulnerability and can indicate that they want a benevolent relationship.

Interpersonal Cues and Intrinsic Properties. In the context of e-commerce marketing the use of symbolic interpersonal cues (e.g. in the form of photos or other media representations)

is another way of giving a product or a brand a personality. This approach was investigated as part of the empirical research undertaken for this thesis. The experiments showed that photos displayed on the homepage of an e-commerce vendor can sway users' self-reported trust after a superficial evaluation. The implications of these findings for e-commerce vendors are discussed in more depth in section 10.3.1.1.

Figure 9.3 summarises the discussion in this section and presents the key strategies for building user trust in e-commerce in the terms of the framework for trust in mediated interactions.

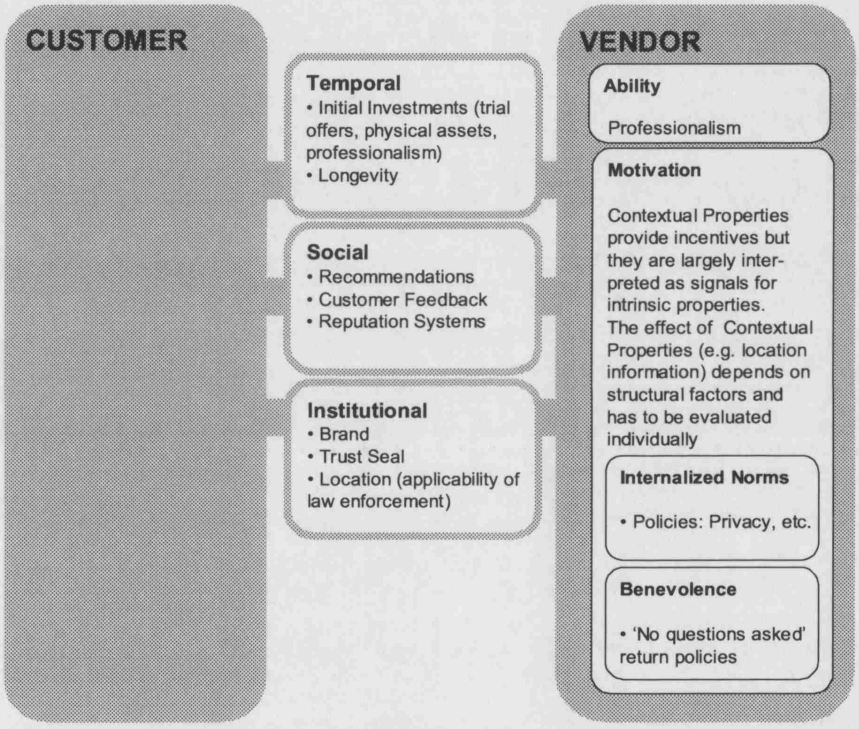


Figure 9.3: The framework applied to trust in e-commerce

9.5 Chapter Summary

As a part-requirement for the CSEL London Business School Scholarship, this chapter discussed the commercial implications of the research conducted for this thesis. The topic of this thesis, trust in mediated interactions, is of high relevance to the marketing of e-commerce services. Not surprisingly, this topic has received much attention in HCI research and marketing. However, as leaders in the field of HCI have pointed out, a gap remains between

marketing and HCI in terminology, methods, and perspective. This chapter aimed to help close this gap. It employed the framework presented in Chapter 3 as a tool for an analysis of e-commerce design guidelines and marketing concepts.

This chapter first introduced marketing concepts relevant to trust in e-commerce (section 9.2). The overview suggested that trust is a promising differentiator for an e-commerce service, which can be described in marketing terms as a service product. Service products are traditionally marketed with a high focus on the factors people, process, and physical environment. In the case of e-commerce the factors people and physical environment are replaced by the user interface. The interface thus becomes a source of differentiation based on tangible or functional attributes, but also based on intangible attributes – values and beliefs attached to the brand, such as trustworthiness.

The final part of this chapter was then devoted to analysing HCI and marketing guidelines for trust in e-commerce. For the contextual property *temporal embeddedness*, elements that signal interest in future business were discussed. These include professionalism in site design, investments in first purchases, and customer relationship management efforts. For *social embeddedness*, various forms of reputation building and trust transfer were discussed (e.g. affiliates programmes). Finally, *institutional embeddedness* covered regulatory approaches and trust seal programs. These, however, carry the risk of making part of a vendor's brand equity dependent on outside organisations.

Intrinsic properties were discussed next. In classic service marketing, customers can learn about those in contact with the staff executing the service. In the case of e-commerce these interactions are replaced by an e-commerce system. An interface can signal the intrinsic property *ability* by adherence to offline and online business standards. *Internalised norms* can be conveyed by mission statements, policy documents, or upfront disclosure of terms. Whilst these measures may have an effect for highly involved customers, their usefulness as a source of differentiation is limited. They can be easily copied by untrustworthy vendors or by competitors, and only peripherally involved customers are unlikely to look at them. Hence, *internalised norms* of an organisation must become clear in the aesthetics, interaction design, and language used in the interface. *Benevolence*, finally, applies only to a limited degree to interactions between organisations and individual customers. In face-to-face encounters, *benevolence* may result from intensifying social relations stemming from repeated interactions between a sales agent and customers. If face-to-face interactions are however replaced by an e-commerce system, *benevolence* is reduced to customer-relationship measures such as loyalty discounts or customer clubs.

In this situation several e-commerce vendors aim to create positive affective reactions and trust by using mediated interpersonal cues that are known to create immediate visceral

reactions in face-to-face situations. Researching the effect of such an approach was one of the empirical goals of this thesis. The results showed that such efforts, in the form of photos, can increase users' self-reported trust based on superficial evaluations for customers with little involvement. Finally, it should be noted that the approach of this chapter differs from that in the main part of this thesis. There, the focus was on researching conditions that enable users to make correct trust decisions – thus increasing correctly placed trust in a market place overall. In this chapter, the view of an individual vendor aiming to increase its market share was taken. However, it should be noted that a concern for the overall market, as expressed in the systemic view taken in the main part of this thesis is also of high relevance to marketing. In many cases, a vendor may not focus on increasing just his market share but on heightening sales volume by enlarging the overall market. Increasing the rate of well-placed trust in the whole market, i.e. allowing would-be online shoppers to rely on their own perceptions of trustworthiness, and thereby enabling them to overcome a hurdle to adoption, can thus also benefit an individual e-commerce vendor.

Chapter 10

Conclusions

The widely publicised *lack of trust* in mediated interactions is commonly attributed to an increase in risk and uncertainty, which results from conducting interactions over spatial and temporal distance with complex technologies that are often poorly understood. Uncertainty is often associated with a reduction in the number of signals that are available for judging an interaction partner's trustworthiness. In this situation, many researchers and practitioners aim to increase user trust in technology and the actors it represents. This thesis has contributed to the debate by posing a different question: it asked how technology can ensure that trust is well-placed, i.e. how technology can improve users' ability to differentiate between trustworthy and less trustworthy actors they encounter online. The reasoning behind this shift in perspective is that long-term trust in a technology will only be won if users learn that they can rely on their own trust perceptions. In supporting such a focus on well-placed trust, this thesis contributed a framework for trust in mediated interactions that abstracts from specific interface elements that are currently perceived as signifiers of trustworthiness (Research Goal 4). As a first step in addressing this new focus of HCI trust research empirically, the research conducted for this thesis investigated users' ability to place trust well in interactions with e-commerce vendors and with a human advisor (Research Gaol 1). The empirical results provided by this thesis on users' ability to act on signals of trustworthiness – and the factors that influence this ability – are of high relevance for researchers, practitioners, and regulators who are interested in maintaining trust in mediated interactions in the long term.

One particular aspect of mediating human-human interactions, or replacing them with human-computer interactions, is that this process reduces the number of interpersonal cues compared to face-to-face interactions. This aspect is often made responsible for the observed lack of trust in such interactions, and consequently we can observe many efforts at gaining trust by re-introducing such (real and synthetic) interpersonal cues. This thesis investigated such approaches in two domains: the use of photos on e-commerce sites and various media representations (*video*, *avatar*, *audio*, *photo+text*, *text*) in online advice.

E-commerce vendors commonly add photos of sales assistants in an effort to win user trust. While such cues give no insight into the trust-warranting properties of a vendor, they are used with the aim of positively biasing users' trust in the vendor (P1; see 2.3.3). Empirical

evidence for the effect of such efforts on user trust and on the usability of interactive systems is scarce. To contribute towards the closure of this gap, this research investigated the effect of commonly used facial photos on e-commerce sites on user trust and on the usability of such systems (Research Goals 2 and 3).

Growing network bandwidth to users' homes will also increasingly allow the use of richer representations in online services, such as professional advice. In the case of a human advisor, the interpersonal cues transmitted can not only expect to bias trust by their mere presence (P1), but also to give additional insight into the advisor's trust-warranting properties (P2). This thesis contrasted these two predictions in an experiment designed to address gaps in the existing literature. The results are of high relevance for practitioners who want to include rich media representations into their systems, and also to user advocates, who may be concerned about the manipulative effect of such implementations (Research Goal 2).

Section 10.1 briefly summarises the results of the experiments that were conducted to answer these questions. Section 10.2 then re-states the research goals of this thesis in detail, before section 10.3 presents the substantive empirical and theoretical, as well as the methodological contributions of this research. The thesis closes with an outline of future work that is given in section 10.4.

10.1 Overview of the Experimental Results

The experiments conducted for this thesis (Chapters 5 to 8) were discussed in chronological order. Issues that arose in earlier experiments influenced the design and analysis of subsequent experiments. Despite this inter-connectedness, the experiments were independent investigations that explored different subsets of the overarching research questions in different application contexts.

Experiment 1 (Chapter 5) and Experiment 3 (Chapter 7) used eye-tracking to investigate the effect of facial photos included in e-commerce pages on visual attraction, task performance, and user cost. It was found that photos attracted visual attention on a first-time exposure to a page, indicating that they could potentially have an effect on user trust. Similarly, negative effects on task performance in a *search task* were only found on first-time exposure. No effects on user cost (inferred from the eye-tracking measures scanpath-length and backtracking) were found.

Experiment 2 (Chapter 6) and Experiment 3 (Chapter 7) investigated users' ability to discriminate between trustworthy and less trustworthy e-commerce vendors. Trustworthiness in these experiments was controlled through previous customers' ratings that had been aggregated by *Bizrate*[27] and *Epinions*[28]. The experiments also tested the effect of adding 8 facial photos – one by one – to 12 different vendors' homepages on trust in the vendor. These photos gave no additional information about the trustworthiness of a vendor, but they are commonly used with the aim of increasing users' trust (P1, see 2.3.3). These experiments found that, on average, users trusted trustworthy vendors more than less trustworthy ones. The distinction was, however, only possible after a detailed exploration the sites. Trust assessments based on a *superficial exploration* of the homepage alone were not better than chance. Conversely, a positive effect of a photo on users' self-reported trust in a vendor was only found for a *superficial exploration* of the homepage.

Experiment 4 (Chapter 8) investigated trust in a human trustee (an advisor) rather than in an organisational trustee (an e-commerce vendor). This allowed investigating the symptomatic function (see 3.3.2) of interpersonal cues, i.e. their function as a signal for the presence of trust-warranting properties (P2). It included photos as well as richer media representations (*video, audio*) and synthetic interpersonal cues (*avatar*). Trustworthiness was controlled in terms of expertise by contrasting a trained (*expert*) advisor with an untrained (*non-expert*) advisor. It was found that users could identify *expert* advice in all media representations, including *text-only*. However, there was some indication that *video* interfered with users' preference for seeking *expert* advice. All rich representations (*video*, *audio*, *avatar*, *photo+text*) led to higher ratings for friendliness, awareness, and enjoyment than text.

All Experiments that investigated trust as a dependent variable observed decision-making under risk to overcome the shortcomings of self-reports, such as interviews or questionnaires. This approach was explored with several measures. The relevance of inducing risk in a laboratory setting was illustrated in Experiment 4, which found an increase in media bias as a result of increased risk (see 8.4.3). Table 10.1 gives an overview on all experiments and key findings.

[27] www.bizrate.com
[28] www.epinions.com

	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Chapter	Chapter 5	Chapter 6	Chapter 7	Chapter 8
Research Goal	3	1,2,4	1,2,3,4	1,2,4
Trustee	E-Commerce Vendor	E-Commerce Vendor	E-Commerce Vendor	Human Advisor
Prediction	n/a	P1	P1	P1 / P2
Interpersonal Cues	Symbolic	Symbolic	Symbolic	Symptomatic
Key Topic	Eye-Tracking	Trust	Trust & Eye-Tracking	Trust
Key Independent Variables	*Presence of a Photo* Time (*Exposure order*)	*Trustworthiness of a Vendor* *Presence of a Photo* *Trustworthiness of a Photo*	*Trustworthiness of a Vendor* *Presence of a Photo* *Trustworthiness of a Photo* Time (*Exploration Depth* and *Exposure order*)	*Trustworthiness of Advisor* *Media representations* (*video, avatar, audio, photo+text, text-only*) Time (*Repeated Encounters*)
Key Dependent Variables	TASK TIME VISUAL ATTRACTION (LOOKED / FIXATED)	INVESTMENT in Vendor ASSESSMENt of Vendor	INVESTMENT in Vendor ASSESSMENT of Vendor TASK TIME VISUAL ATTRACTION (LOOKED / FIXATED) BACKTRACKING SCANPATH-LENGTH	ADVICE SEEKING ADVICE UPTAKE SENSITIVITY

Table continued on next page

	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Key Findings	- Photos attract visual attention on *first exposure* to a page only - Photos negatively affect search time on *first exposure* to a page only - No effect of task-type	- Users can discriminate between trustworthy and less trustworthy vendors - No effect of photos	- Users can discriminate between trustworthy and less trustworthy vendors only after detailed exploration of the site. - A photo has a positive effect on users' self-reported trust after a *superficial exploration* of the homepage - Photos attract attention on first exposure in an exploration task - No effects of a photo on task performance and visual user cost measures	- Users can infer *expertise* in all media representation. - There is a high sensitivity to correct advice given by the *expert* in all *media representations* - There is a preference for seeking *video* advice - An increase in risk increases preference for *rich media representations*. - Users' self-reports show a bias for *video* and *audio* advice - All *rich media* representations were rated as more likeable, enjoyable, and resulting in higher interpersonal awareness than *text-only*
Publication	Riegelsberger et al. (2002b)	Riegelsberger et al. (2003a)	Riegelsberger et al. (2003c)	Riegelsberger et al. (2005a) Riegelsberger et al. (2005c)

Table 10.1: Overview on experiments and key findings

10.2 Research Goals Revisited

Designing novel technologies in a way to support trust in mediated interactions poses several challenges for HCI researchers. Chapter 1 introduced and structured this problem space and formulated 5 research goals to scope and guide the research undertaken in this thesis. Below, these research goals are revisited before the contributions of this thesis are presented.

Research Goal 1 (Empirical)

Investigating users' ability to correctly identify the trustworthiness of other actors online.

Much current HCI trust research is focused on identifying how to increase users' trust in technologies or companies. However, long-term trust requires users to be able to make correct judgements about those they encounter online. Mediating interactions or replacing them with human-computer interactions often results in fewer signals being available for an assessment of trustworthiness than in face-to-face encounters. As a first step towards shifting the perspective of HCI trust research, the experiments conducted for this thesis investigated users' ability to discriminate between trustworthy and less trustworthy actors online. This research goal was investigated for trust in e-commerce vendors and trust in human advisors.

Research Goal 2 (Empirical)

Investigating the effect of mediated interpersonal cues on user trust.

In face-to-face interactions interpersonal cues are considered important signals for trustworthiness. Not surprisingly there are now many efforts undertaken to include such cues in mediated interactions. In the area of e-commerce one can observe many vendors who aim to increase user trust by displaying *photos* of assistants on their web pages. As these *photos* do not provide any insight into the trust-warranting properties of the vendors, they can only be expected to bias users' trust (P1). For trust in e-commerce Research Goal 2 investigated whether such photos do really increase user trust.

Interpersonal cues are also being integrated into other types of mediated interactions: with network bandwidth to home users increasing, richer representations such as *video* or *audio*, as well as synthetic representations such as *avatars* become more widely used. Here, interpersonal cues may have two functions. They may increase social presence and prompt visceral reactions, thereby increasing trust (P1). Conversely, they may act as symptoms of trustworthiness, leading to an increase in information leakage (i.e. give additional information about trust-warranting properties) and thereby improve users' ability to discriminate between trustworthy and less trustworthy actors (P2). The combination of Research Goal 1 and Research Goal 2 allowed contrasting these predictions.

Research Goal 3 (Empirical)

Investigating the effect of interpersonal cues on visual gaze, task performance and user cost.

Web usability guidelines suggest that adding non task-related elements to task-oriented e-commerce sites, may have negative effects on task performance and user cost. Facial photos in particular are considered to attract visual attention and thereby impede users' search processes. Users' comments in earlier studies (Riegelsberger et al., 2002a) also supported this prediction. As practitioners need to balance designing for trust and designing for usability, eye-tracking was used to address this practical research goal in the area of e-commerce.

Research Goal 4 (Theoretical)

Creating a framework for trust in mediated interactions.

The literature review (see 2.2) observed a lack of coherence in the definitions, approach, and methods used in HCI trust research. This situation has led to many researchers referring to trust without specifying which aspect they are investigating. In response to this situation it was decided that the empirical investigation into trust in HCI should be preceded by establishing a framework of trust in mediated interactions. The specific goals set out for such a framework were as follows: it should accommodate existing research (4.1); it should include actor and context variables (4.2); it should show the limits of generalisation for individual empirical findings (4.3); and it should provide the theoretical underpinning for the methods used to measure trust (4.4).

Research Goal 5 (Methodological)

Exploring new methods for measuring trust in mediated interactions.

In addressing trust in mediated interactions many researchers use self-report methods such as qualitative interviews or questionnaires. A critical review of these methods, however, showed that they are subject to several limitations. The most prominent ones were users' limited capacity for introspections and their tendency for post-hoc rationalisation. In addition, most researchers do not investigate trust in the presence of risk. To overcome some of these limitations, this research explored several novel measures of trust that relied upon observing decisions under financial risk.

10.3 Contributions

Trust in mediated interactions is a relatively novel field of enquiry within HCI but has already received considerable research interest. The next sections present the empirical (see 10.3.1),

theoretical (see 10.3.2), and methodological (see 10.3.3) contributions that were made by this thesis to the growing body of HCI trust research.

10.3.1 Empirical Contributions

This section presents the empirical contributions made by the experiments reported in this thesis. It first introduces the contributions to the research area of *trust in e-commerce vendors* (see 10.3.1.1). This is followed by the presentation of the contributions to the area of *trust in human advisors* (see 10.3.1.2). For both types of trustees, it was found that users did indeed trust trustworthy actors more than less trustworthy ones. The findings are also consistent across these research areas insofar as it was found that users' assessments improved with the time spent evaluating the actors (i.e. with the number of cues they perceived). Table 10.2 summarises the main empirical contributions of this research. They are discussed in detail for the respective types of actors and research areas below.

	Empirical Contributions	Research Goal	Experiment	Trustee
1.	Users can correctly identify the trustworthiness of e-commerce vendors based on surface cues after an exploration of the site beyond the homepage.	1	2, 3	Vendor (Organisation)
2.	Facial photos can only sway first impressions of e-commerce vendors.	2	3	Vendor (Organisation)
3.	Facial photos attract eye-gaze only on first time view of a page and have only short-term negative effects on task performance.	3	1, 3	Vendor (Organisation)
4.	Users can identify expertise in *video*, *avatar*, *audio*, *photo+text*, and *text-only* representations.	1	4	Advisor (Human)
5.	A preference for seeking *audio* and *video* advice interfered with users preference for *expert* advice.	2	4	Advisor (Human)

Table 10.2: Overview of the empirical contributions of this thesis

10.3.1.1 Trust in E-commerce Vendors

Users' ability to identify trustworthy e-commerce vendors affects their long-term trust in e-commerce. Knowledge about this ability and the factors that affect it is crucial in designing trustworthy technologies. Information about users' discriminative ability has also important

implications for public policy and regulatory approaches. Experiments 2 and 3 investigated users' ability to distinguish trustworthy from less trustworthy vendors based on the cues they perceived in the interfaces of these vendors. This question had not been addressed in previous research in e-commerce trust, which largely focused on establishing guidelines for increasing perceived trustworthiness. Specifically, this thesis investigated users' ability to distinguish vendors based on their putative post-order quality of service (trust-warranting property *ability*).

Experiments 2 and 3 showed that users could differentiate trustworthy vendors from less trustworthy vendors after they had explored the sites beyond the homepages. This finding indicates that the interface does give reliable signals for a vendor's trustworthiness, thus disconfirming statements by users in earlier studies. However, superficial exploration of just the homepages (conducted in Experiment 3) did not result in any discrimination between the trustworthy and less trustworthy vendors. For researchers interested in identifying the surface cues that allow reliable assessments of trustworthiness, these findings indicate that the most promising area to look for such cues is not the content and spatial layout of the homepage but the factors that require an exploration beyond the homepage, such as the information architecture, site navigation, or the content of pages lower down in the site hierarchy (e.g. policies). For e-commerce vendors, who – under the constraints of limited resources – have to decide which approach to use (e.g. advertising, trust seals, interface design), the findings underline the importance of an impeccable user interface as an indicator of trustworthiness. For user advocates who wish to enable users to reach correct trust decisions, the practical conclusion is to educate users to explore the pages they are evaluating in depth before committing to a transaction. While it is encouraging that users can – with some effort – differentiate vendors based on the surface cues they perceive in the user interface, this does not mean that trust in e-commerce is bound to grow without further intervention. First, while *on average* the trustworthy vendors were trusted more than the less trustworthy ones, users made many gullibility and incredulity errors. Acceptable levels of these types of error have to be established for specific application areas, taking into account the consequences of each type of error, before drawing more general conclusion about the emergence and stability of trust in e-commerce (see 7.4.1.1). Finally, the scope of this research was limited to investigating trustworthiness with regard to existing and legitimate vendors' post-order quality of service. Users' ability to identify fraudulent *phishing* sites that have recently grown in number is an important future research goal in this domain (see 10.4). The methods explored in this research can be fruitfully employed for such an investigation.

Many e-commerce vendors add photos of people to their pages in an attempt to increase user trust and to overcome the de-personalised character of mediated interactions. This

approach is also recommended by several guidelines for trustworthy interface design (see 9.3). Evidence for their effect on user trust is, however, scarce and contradictory. This thesis found a positive effect of a photo only for users' self-reported trust after a *superficial exploration* of the homepage of an e-commerce vendor (see 7.4.1.2). Once users engaged in an exploration of the site beyond the homepage, no effect for a photo was found. Further, it was not possible to find consistent effects of photos across several sites, even for photos that had been pre-rated as trustworthy. These results should discourage the notion that adding a photo is a straightforward way for winning user trust. Nonetheless, the finding that a photo could sway superficial impressions indicates that photos – if pre-tested for the page on which they are to be used – could win customers: in a situation where users follow a link and decide based upon first impressions whether to further engage with a vendor or not (i.e. whether to make an investment in terms of time and effort to explore the site in more depths), performing well on first impressions is a necessary (but not sufficient) condition for an online sale. Taking the view of a user advocate concerned with users' ability to correctly identify vendors' trustworthiness, the findings indicate that users' judgement is not easily manipulated by simple means such as the addition of a photo. Highly involved – i.e. risk-aware – users are more likely to invest more time into evaluating a vendor's site in-depth (see 9.2.5).

An additional concern for the use of facial photos in e-commerce sites was their effect on usability. Their widespread use conflicts with established usability guidelines and with some users' preferences, who – in an earlier qualitative study by the author (Riegelsberger & Sasse, 2002a) – stated that such photos cluttered the interface. As designers need to balance optimising interfaces for usability and for trust, this thesis investigated effects of photos on visual attraction, task performance, and user cost to clarify the trade-off decisions that may be required. It was found that facial photos attracted visual attention only on a first time view of a page, irrespective of whether users were engaged in a visual *search task* (Experiment 1, 5.4.2) or an *evaluation task* (Experiment 3, 7.3.2.1). A negative effect on task performance was only found on *first exposure* to a photo, and only when users were engaged in a *search task* (Experiment 1). No effects were found on user cost, however, further research is necessary to identify long-term effects (see 7.4.2).

10.3.1.2 Trust in Human Advisors

The second area of trust in mediated interactions addressed by this thesis is trust in a human advisor. Several media representations (*video, avatar, audio, photo+text, text-only*) were investigated. The framework for trust in mediated interactions showed that the balance of trust-warranting properties and their signals change with the type of trustee. In contrast to the use of photos on e-commerce vendors' homepages, the interpersonal cues given off by the

human advisor could be expected to give relevant information about the trustee's trust-warranting properties (through information leakage, see 2.3.1). They could, in other words, have a symptomatic function. Hence, the richer representations could be expected to increase users' ability to discriminate between trustworthy and less trustworthy actors (P2) *and* to induce a media bias (P1). Whilst previous studies had investigated these potential effects in isolation, Experiment 4 was designed to contrast them directly. Trustworthiness was varied in terms of expertise (i.e. the trust-warranting property *ability*). Experiment 4 investigated trust in an advisor (ADVICE SEEKING) and trust in individual pieces of advice (ADVICE UPTAKE). It further measured participants' SENSITIVITY (see 8.4.3) to correct advice.

The results on all behavioural measures used in Experiment 4 indicate that users are able to identify *expert* advice. Participants preferred to seek advice from the *expert* (ADVICE SEEKING), their ADVICE UPTAKE was higher for *expert* advice, and they showed a good SENSITIVITY to correct advice if it is given by the *expert*. This ability proved to be largely independent of media representation. It was found for all representations, including *text-only*. In other words, the additional information given in visual and para-verbal interpersonal cues did not significantly add to what could be inferred from lexical cues alone.

Users' self-reports reflected models of media richness. They stated that their ability to rate advisor confidence was higher in *video* and *audio* than in *text-only*. This self-report was supported by the finding that preference for *video expert* advice was higher than for *text-only expert* advice. This preference could have negative consequences for users who might focus on video advice in a situation where better advice in other media representations is available. Taking the view of a user advocate, users' willingness to forego *expert* advice to get *video* or *audio* advice gives reason for some concern. In particular as this preference became more pronounced as risk was increased. One practical conclusion to be drawn from this finding would be to ensure that all actors in an environment are represented by the same media – to avoid such effects of media interference.

The *avatar* was not found to increase trust, and there is even an indication in the data that it reduced trust relative to other representations. A generalisation from this finding to other animated characters or the use of synthetic visual interpersonal cues in general is not possible, as previous research had shown that small differences in implementation led to sometimes starkly different user reactions (Fogg, 2003a; Garau, 2003).

Avatar technologies are used by online services, which want to increase the social presence of individuals by adding visual interpersonal cues, without incurring the cost of producing video content. The *avatar* used for this research was a commercial product that created synthetic visual behaviour from an audio stream without any manual scripting. The results indicate that if the design goal is inducing trust, such off-the-shelf avatar technology

should not be used with the present state of the art. Better trust responses to avatars or animated assistants may possible with carefully scripted visual interpersonal behaviour (e.g. of eye movements Garau, 2003). Based upon the results of the experiments conducted for this thesis, *audio* and in particular *video* are better suited to inducing trust. Finally, if the design goal is entertainment or engagement, rather than trust, the use of avatars, even in a simple implementation as tested in Experiment 4, can be effective. The *avatar* was rated as more enjoyable, friendly, and as resulting in a higher awareness than the *text-only* representation. However, similarly positive ratings were achieved by adding just a photo – an approach that is much cheaper in terms of implementation and bandwidth usage.

This research broke new ground in contrasting two distinct effects of interpersonal cues: their potential to increase discrimination (symptomatic function, P2) and their potential to induce a bias (P1) by prompting immediate visceral reactions. In the discussion of media richness, these distinct effects are not commonly separated. Experiment 4 was a first step in contrasting these functions in an empirical study. The findings provide an indication, but they do not conclusively answer whether an increase in the number of interpersonal cues transmitted leads to an increase in bias (P1) or an increase in discriminative ability (P2). Further studies will need to investigate individual cues in isolation (e.g. separating surface and behavioural realism for avatars) and with varied tasks and contextual conditions (see 10.4).

10.3.2 Theoretical Contributions

The review of HCI trust research revealed its current fragmented state. Many researchers choose approaches, definitions, and measures without discussing their applicability and without embedding their work into the wider trust debate in HCI (see 2.2). As trust is a term in everyday language and as other disciplines also lack a widely accepted theory of trust, this has led to a situation where researchers refer to the term trust without clearly stating which aspect of trust they are investigating. Such a situation makes it difficult to resolve seemingly contradictory findings, or to find appropriate boundaries for generalisation. To assist in overcoming this hurdle and to contribute towards building a cohesive body of HCI trust research, this thesis proposed a framework for trust in mediated interactions (see Table 10.3).

	Main Theoretical Contribution	Research Goal
1	Creation of a framework for trust in mediated interactions that ...	4
1.1	... accommodates the existing literature	4.1
1.2	... covers actors and context	4.2
1.3	... allows positioning research	4.3
1.4	... gives a conceptual basis to measures of trust	4.4

Table 10.3: Overview of the theoretical contributions of this thesis

The framework drew on research in psychology, sociology, and experimental economics and it incorporated existing models of trust (Research Goal 4.1). It identified contextual and intrinsic trust-warranting properties – and how their presence can be signalled. Signals form the basis for the trustor's perception of the trustee's trustworthiness. However, these signals are subject to mimicry, because non-trustworthy trustees will aim to be perceived as trustworthy. Two types of signals were identified: symbols and symptoms. Symptoms are signals of trustworthiness that are given as by-product of behaviour. They are preferable to symbols, which may be costly to emit and are less reliable. This distinction has proved helpful in clarifying the function of interpersonal cues in different contexts (trust in an e-commerce vendor and trust in human advisor; see 3.5.3). Several instances of the framework can be used to analyse the many vulnerabilities and trustees in a given trust-requiring situation. It also facilitates analysing trust in first-time, one-time, and continued interactions.

The framework showed that the different types of trust that were identified by previous research can be identified by specific configurations of contextual and intrinsic trust-warranting properties. In addition, the framework was used to analyse existing guidelines for trustworthy design and e-commerce marketing approaches (see 9.4; Research Goal 4.2). The framework also allowed the positioning of the empirical research undertaken in this thesis on relevant dimensions such as type of trustor (human *vs.* organisational), trust-warranting property (ability), and types of signals (symbols *vs.* symptoms). Positioning research on dimensions proposed by the framework enables drawing appropriate boundaries for generalising results (Research Goal 4.3). Finally, the framework facilitated the creation of new behavioural trust measures and allowed linking them to trust-requiring situations outside the laboratory (Research Goal 4.4, see 6.2.3 and 8.2.6). Overall, the framework aids researchers in interpreting results from studies within a larger frame of reference. For designers, the benefit of the framework is that it provides a domain-independent tool to explore the available design space for technologies that encourage trust and trustworthy

behaviour. Further research is necessary to test and elaborate the framework; the immediate steps will be discussed in section 10.4.

10.3.3 Methodological Contributions

	Main Methodological Contributions	Research Goal
1	Introduction of novel behavioural trust measures to HCI research:	5
1.1	INVESTMENT: participants invest part of their pay in a trustee being trustworthy	
1.2	ASSESSMENT: incentive scheme to encourage accurate guesses	
1.3	ADVICE SEEKING: participants seek advice in a situation of uncertainty, limited advice, and financial risk	
1.4	ADVICE UPTAKE: participants' decision to follow advice in a situation of uncertainty and financial risk	
1.5	SENSITIVITY: a measure from signal detection theory to analyse participants' discriminative ability	

Table 10.4: Overview of the methodological contributions of this thesis

A critical discussion of the methods currently employed in HCI trust research revealed several limitations (see 4.2). The main point of criticism was that many rely on users' self-reports in the form of interviews or questionnaires. This approach is particularly problematic for research into the effect of interpersonal cues on trust. Trust is known to be partially based on affective elements and visceral reactions, but these aspects are likely to be missed out by measurement approaches that are subject to the limitations of introspection and post-hoc rationalisation. Another typical form of measuring trust in HCI research are social dilemma games with a Prisoner's Dilemma structure. These overcome the problems of self-reports, as they observe decisions made under risk. However, they have been criticised for creating a rather artificial situation that does not allow disambiguating effects on trust and trustworthy behaviour (see 4.2.3).

To overcome these methodological problems, this thesis explored novel ways of measuring trust (see Table 10.4). These novel measures observed participants' decision-making under risk to overcome the limitations of self-reports, but care was taken to preserve ecological validity to avoid repeating the problems of Prisoner's Dilemma studies. In total five novel measures of trust were proposed: INVESTMENT (6.2.3.1) and ASSESSMENT (6.2.3.2) as well as ADVICE SEEKING (8.2.6.1), ADVICE UPTAKE (8.2.6.2), and SENSITIVITY (8.2.6.3). Common to all measures was that they created considerable financial risk for the participants. Engaging in trusting action with a trustworthy actor resulted in financial gain, placing trust in an untrustworthy actor resulted in financial loss. The clear effect of increasing the risk in

Experiment 4 (see 8.4.3) indicates that the level of experimental financial risk indeed influences participants' information processing and thus the way they react to cues of trustworthiness. The use of behavioural trust measures is further advocated by differences between participants' self-reports and their actual behaviour (Experiment 4), a result that confirms findings in lie detection (Horn et al., 2002) and user cost research (Wilson & Sasse, 2004). The measure SENSITIVITY constituted a particular innovation in HCI trust research. It gave direct insight into users' ability to place trust well (Research Goal 1). It was calculated with p(A), a non-parametric variant of d' – taken from signal detection theory (see 8.3.3). Framing problems of trust as problems of signal detection allows drawing on the rich body of methodological knowledge in this research area and promises to be a fruitful avenue for further research.

Finally, whilst the measures introduced in this thesis helped increase the ecological validity of laboratory experiments, it is worth noting that trust research must also engage in field studies. Only outside the laboratory is it possible to investigate trust in the presence of real complex risk over an extended period of time. As such, the relationship between these methods should be one of complementation rather than substitution.

10.4 Directions for Future Work

The framework for trust in mediated interactions was successfully used to accommodate existing categories of trust, to analyse existing guidelines for e-commerce marketing and interface design, and to position the empirical research of this thesis in the wider trust debate. However, it still needs to be further tested and elaborated. This requires testing the predicted relationships (1) in different application domains, (2) with different methods, and (3) including more framework variables. Suggestions for application areas in which the framework could be used to generate hypotheses are online gaming (Riegelsberger, Sasse, & McCarthy, 2005b) or ambient technologies (Marsh, Briggs, & Wagealla, 2004; Riegelsberger et al., 2004).

With a view to methodology, there are several specific questions that should be addressed in future research. First, the novel measures introduced in this research should be tested more thoroughly. Such a test would employ between-subject comparisons to avoid effects of consistency bias that may arise from taking them from the same individual in close temporal proximity. Further, the level of risk induced with the measures should be systematically varied, to get a more reliable insight into the effect of financial risk in laboratory settings. While behavioural measures can give more valid and convincing insights, they have also been shown to be subject to a high level of error variance, which can make it difficult to detect

effects with relatively small groups of participants. In aiming to elaborate the measures, minimising the level of error variance should be a prominent goal. In the case of the INVESTMENT measure, this research identified participants' willingness to invest in a chance event as a promising control variable. More generally, this thesis demonstrated the successful use of behavioural measures with financial incentives and thus advocates their wider use in HCI trust research to complement established measures.

Furthermore, the spectrum of methods used in HCI trust research needs to be widened in at least two more ways to afford a more comprehensive understanding of trust and how it can be supported by design. First, it would be desirable to gain more detailed insight into the way in which surface cues affect trust and behaviour. Hence, further techniques – beyond eye-tracking – to measure low-level effects should be employed. Researchers have used physiological measures (Garau, 2003) and even functional magnetic resonance imaging (fMRI; Singer et al., 2004) to record cognitively un-mediated responses to stimuli such as photos. Such approaches will be essential in formulating a theory of trust that links low-level responses to cognitive and emotional attitude constructs and finally to observable behaviour. Second, this research was exclusively conducted in the form of laboratory experiments. This approach had several benefits such as the possibility of controlling potential sources of error variance and experimentally manipulating the trustworthiness of trustees. However, it put limitations on the level and type of risk that could be observed. Furthermore, the limited length of laboratory sessions made it impossible to study long-term effects. The effect of time in the short-term (e.g. in the form of exposure order or exploration depth), shown to have a significant impact in most of the experiments conducted as part of this research, suggests that it will indeed be important to investigate user trust over longer periods of time.

The empirical contributions of this thesis raise several further questions in the area of trust in e-commerce and online advice. First – in the area of e-commerce – the effect of exploration depth on users' ability to place trust well needs to be investigated further to identify the surface cues that allowed correct trust assessments. A study investigating this issue would use a large pool of existing sites of known trustworthiness, and categorise them on several interface and system design dimensions. A further aspect that is related to exploration depth and that should be investigated further is user involvement, an established construct in consumer decision-making research (see 9.2.5), that – with the exception of Fogg's (2003b) prominence-interpretation theory – has received relatively little attention in HCI trust research. Experiment 4 found that an increase in involvement, brought about by higher financial risk, led to a more pronounced preference for *rich media* representations.

There are also several issues relating to trust in a human advisor (Experiment 4) that merit further attention. First, the lack of effect of a representation's richness on users' ability to

discriminate (P2) needs to be clarified. Secondly, different types of avatar representation should be tested with a similar experimental paradigm to identify which aspect of the avatar implementation (e.g. appearance *vs.* behaviour; Garau, 2003) lead to the marginally negative bias found in this research.

The empirical scope of this thesis covered only a small part of the total problem space that was sketched out by the framework on trust in mediated interactions (see Chapter 3). An important next step in widening the focus would be to include vulnerabilities that arise from wilful deception. This research only investigated trustworthiness with regard to ability (post-order professionalism and advice expertise) but not with regard to wilful non-fulfillment. Addressing the latter in the domain of e-commerce would mean investigating users' ability to detect the increasingly common spoof or *phishing* sites. Another way of broadening this research would be to investigate trust signals other than interpersonal cues. Promising areas are trust in roles or trust in testimonials. The methods introduced in this thesis could be employed for such an investigation. Furthermore, this research focused on trust in organisational (e-commerce vendors) and human actors (an online advisor). Questions of trust can also be investigated for further types of actors, such as institutions.

The framework for trust in mediated interactions illustrated that trust in any system is only sustainable if trustworthiness can be signalled and perceived with sufficient reliability (see 3.3). Hence, in the interest of technology providers *and* users, system designers should be concerned with identifying ways of reliably signalling trustworthiness, rather than just increasing perceived trustworthiness. This thesis contributed approaches towards investigating users' ability to differentiate between trustworthy and less trustworthy actors. These can be used to identify strategies for supporting long-term trust in e-commerce and online advice, but also in further emerging domains such as persuasive technologies, ambient services, or online gaming.

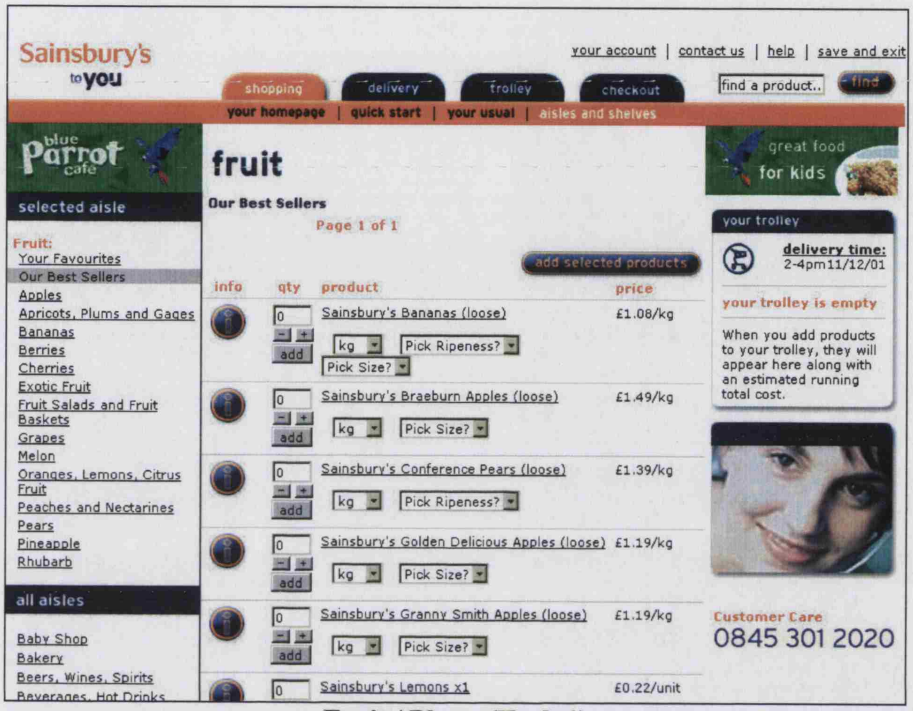
Appendix

Appendix A: Experiment 1

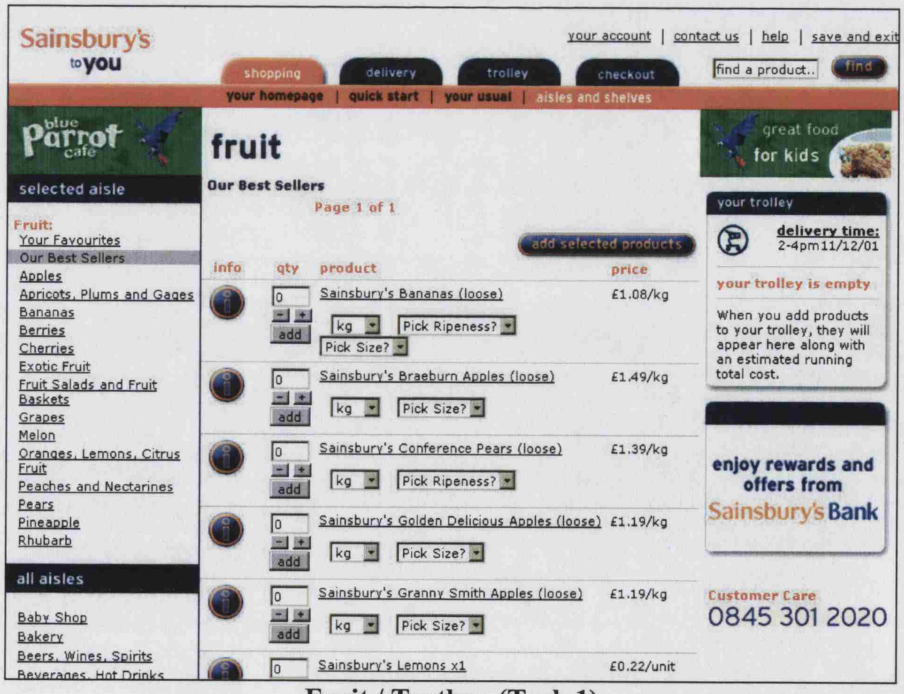
A.1 Stimulus Pages

Deli / Photo (Task 1)

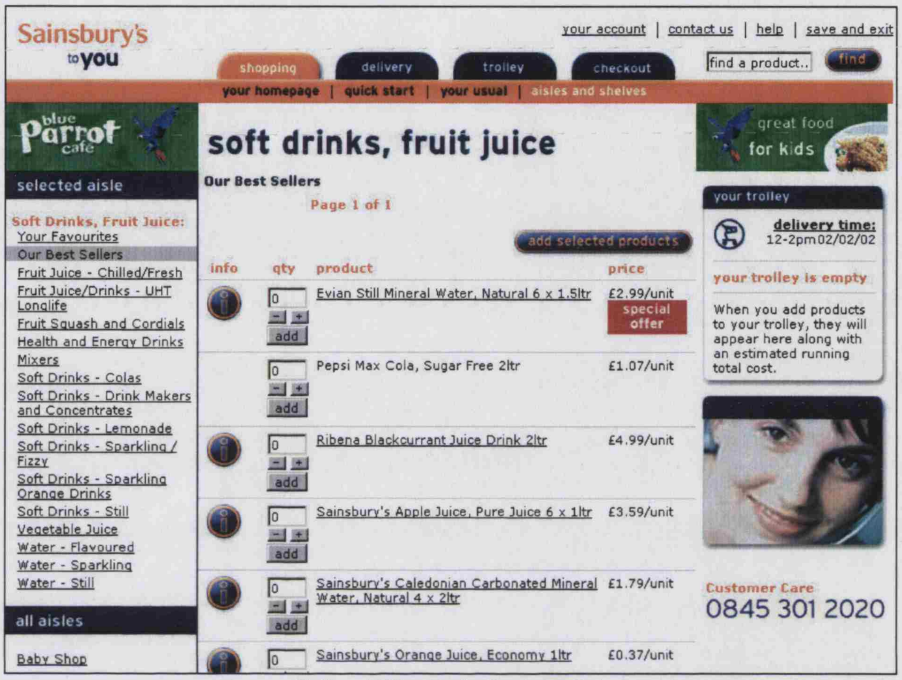
Deli / Textbox (Task 1)



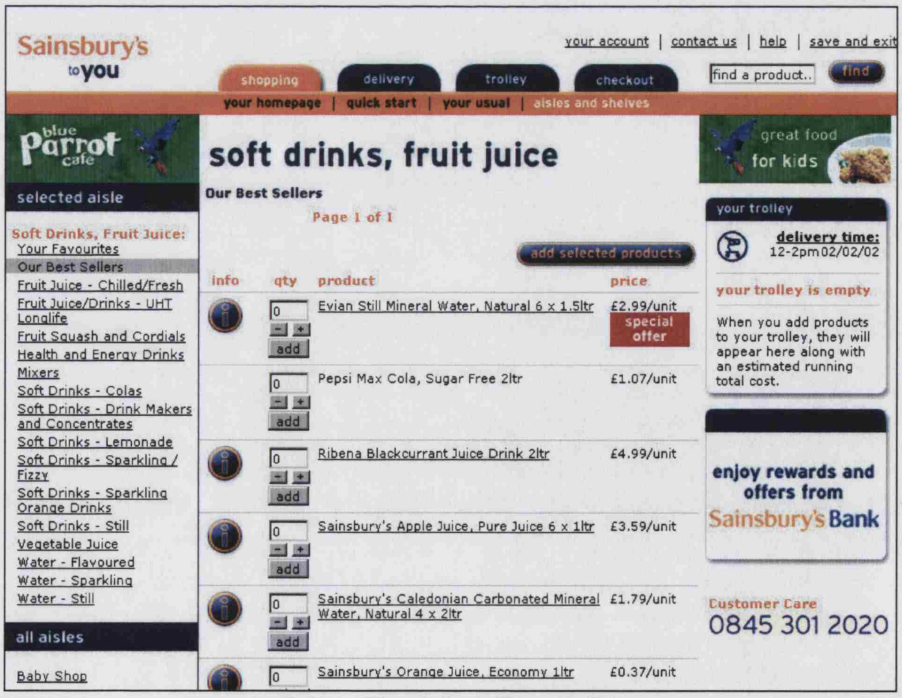
Fruit / Photo (Task 1)



Fruit / Textbox (Task 1)



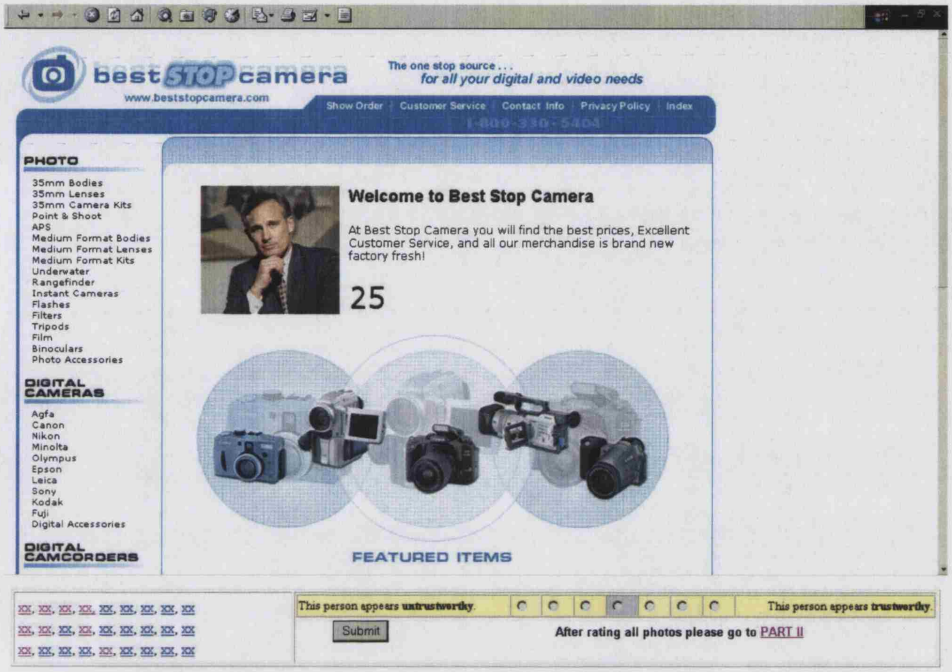
Juice / Photo (other tasks)



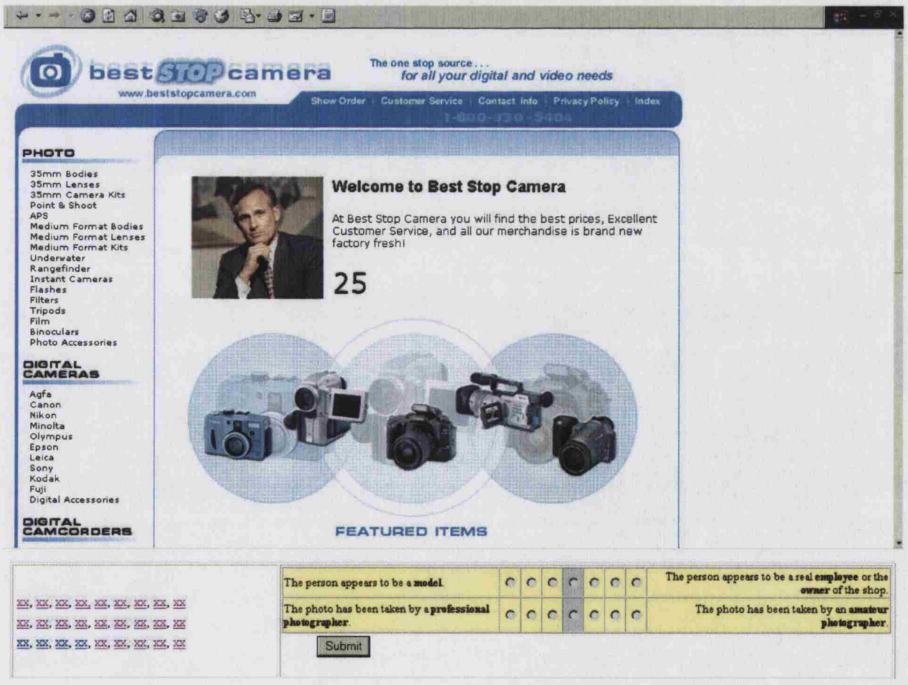
Juice / Textbox (other tasks)

Appendix B: Experiment 2

B.1 Photo Pre-Test



Participants were first asked to rate the trustworthiness of 30 photos

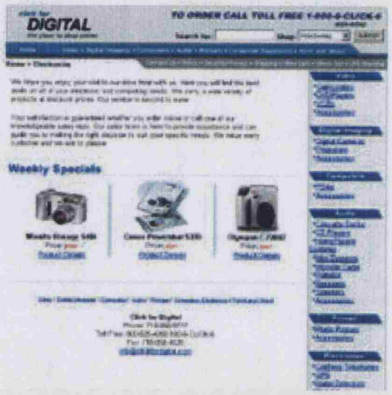


In a second round participants were asked to evaluate REALNESS and PROFESSIONALISM of the photographs

B.2 Trustworthy Photos Included in Experiment 2

B.3 Less Trustworthy Photos Included in Experiment 2

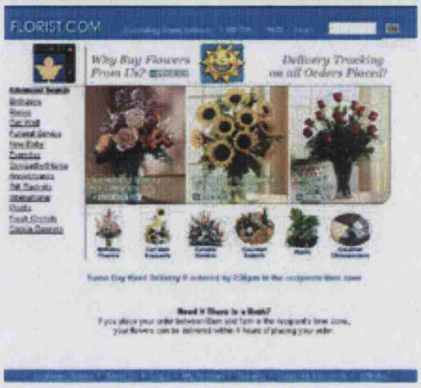
B.4 Sites With and Without Photo

Vendor	Without Photo	With Photo
Best Stop Camera (1)		
All for Digital (2)		
Broadway Photo (3)		
A&M Photo World (4)		

Ajump (5)		
Computer Geeks (6)		
EMS Computing (7)		
CompuVest (8)		

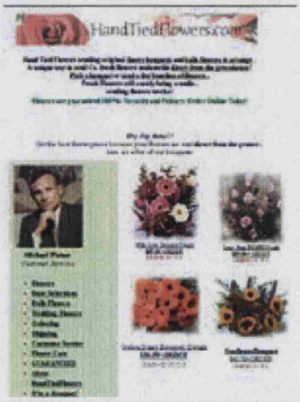
Pro-flowers.com (9)

Florist.Com (10)



Internet Florist (11)

Hand Tied Flowers (12)



B.5 Instruction Sheets

1. PREFERRED SITE

QUESTION 1.1: WOULD BUY?
For this question, please state for each site whether you would consider buying from that site.

QUESTION 1.2: PREFERENCE
For this question we want you to consider which site you would be most comfortable buying from.

Assuming that all sites offer the product you are looking for at the same price with the same conditions;

Which site would you feel most comfortable buying from?
Tick the box labelled 'First' for this site.

Then, in a next step, assume that the product is no longer available on your preferred site. Which would be the site you would be most comfortable buying from out of the remaining three? Please tick 'second' for that site.

Continue this process for the third and fourth site.

Please rank all four sites, even if you would not consider buying from some of them.

2. SERVICE RATINGS

For the online vendors you are looking at, a quality of service rating has been established by independent agencies. Ratings are given on a scale from 1 to 10.

> The ratings do not depend on a vendor's website but on the actual performance of the company.

Those shops with *high scores* provide an excellent service; are easy to deal with in case of complaints and generally fulfilled or exceeded customer expectations.

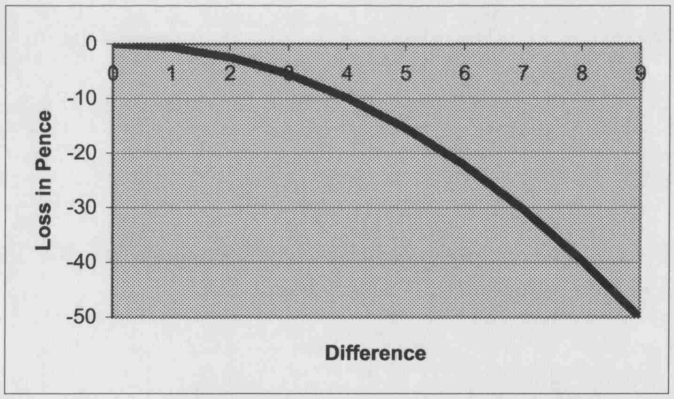
Those with *low scores* provide a poor service; they are difficult to deal with in case of complaints and generally disappointed customers who ordered from them.

For this task, we ask you to guess the ratings of the sites you have looked at. Please bear in mind that the rating of the shops is grounded on their actual performance and not on their website.

In order to motivate you to guess as accurately as you can, we will up your base pay to £11. We will deduct from that extra pay, if your guesses are not exact.

During the study you will make 12 guesses. For each guess you can loose 50 pence. If a guess is completely wrong (e.g. your guess is 1, but the real score is 10) you will loose the full 50 pence for that guess. If a guess is completely correct, you will be allowed to keep the 50 pence for that guess.

The graph below shows the reduction from your extra payment based on the difference between your guess and the actual score.



Loss = – 50pence *((1/81)*(your guess – real rating)^2)

The amount you will receive will be calculated at the end of the study.

3. BETTING

QUESTION 3.1: YOUR BET
For this task you can bet some of the money you've earned so far.

> Please note: You are not obliged to bet anything. However, by betting parts of your pay, you have the chance to earn considerably more money in this study.

Based on their quality of service ratings we have divided the sites in this study in GOOD sites and BAD sites.

For this study we have selected several bad and good sites – there could be any mix of the two kinds.

Please indicate how much you are willing to bet that a site is a good site. If the site you bet on really is a good site you will earn your bet on top of your final pay. If the site turns out to be a bad site we will deduct your bet from your final pay. **Hence you should bet 0 pence on sites you think are bad, as you will loose the money you bet on sites that turn out to be bad sites.**

Your maximum investment is 100 pence per site.

Example:
Let's assume your final pay is £11. If you bet 50 pence on a site that turns out to be a good one, you will be paid £11.50. If the site turns out to be a bad one you will be paid £10.50.

The amount you won will be calculated at the end of the experiment.

QUESTION 3.2: GOOD OR BAD
For second part, please indicate for each site, whether you think the site is a good site or a bad site. This decision does not have any influence on your final pay. This information enables us to find out what you think about the sites, even if you are not willing to bet any money.

B.6 Auxiliary Variable Questionnaire

E-Commerce Study

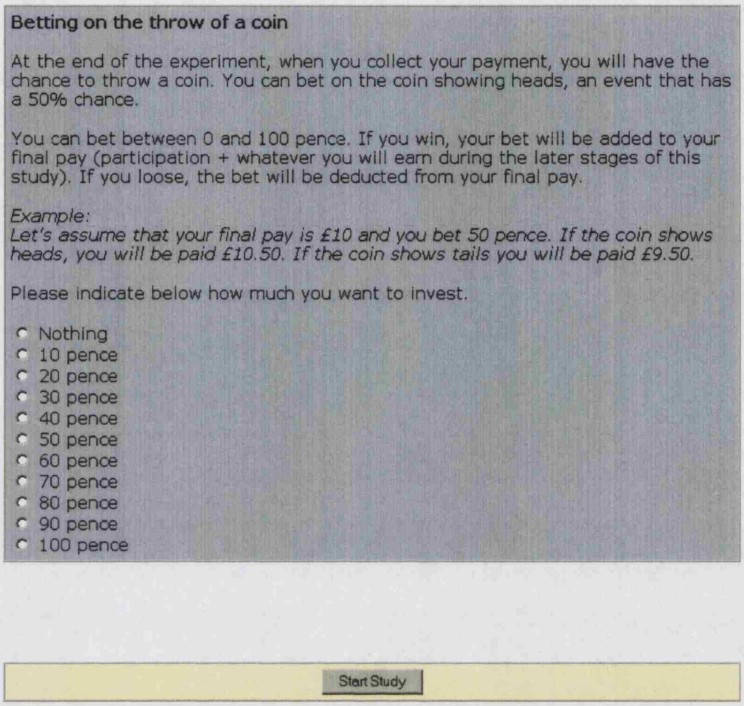
Personal Details

First Name	
Last name	
Age	
Gender	○ Female ○ Male
How often do you use the World Wide Web? *(e.g. Internet Explorer or Netscape)*	○ More than 2 hours per day ○ 30 min - 2 h per day ○ 10 min - 30 min per day ○ Less than 10 min per day
How often do you buy products or services for yourself on the Internet?	○ More than 4 times per month ○ 1 - 3 times per month ○ Less than 1 time per month
When you shop on the Internet, do you enter your credit card / debit card details online?	○ Yes ○ No

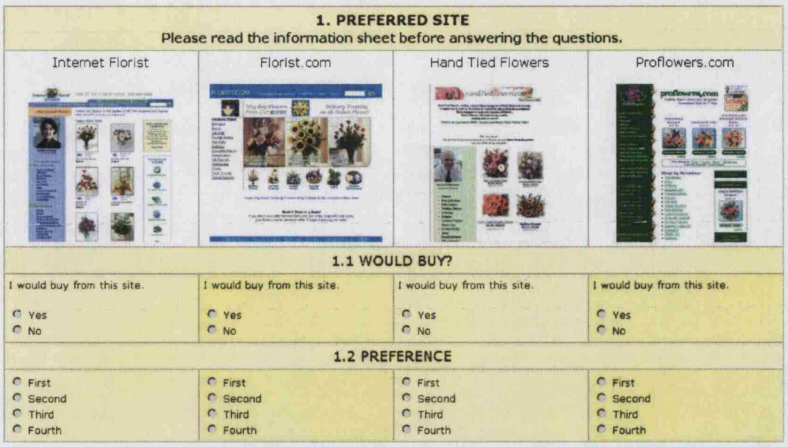
Please indicate to what extend you agree or disagree with the statements below.	strongly disagree	disagree	can't say	agree	strongly agree
The Internet makes work more interesting.	○	○	○	○	○
I enjoy using the Internet.	○	○	○	○	○
Working with the Internet is fun.	○	○	○	○	○
I use the Internet for fun.	○	○	○	○	○
I feel safe completing commercial transactions over the Internet.	○	○	○	○	○
There is too much uncertainty associated with shopping on the Internet.	○	○	○	○	○
Compared with other ways of shopping, buying on the Internet is more risky.	○	○	○	○	○
Most e-commerce sites are too cluttered.	○	○	○	○	○
I prefer e-commerce sites that focus on text and use very few graphics.	○	○	○	○	○
E-Commerce sites with many graphics are harder to navigate.	○	○	○	○	○
Graphics make e-commerce sites more appealing and more fun to use.	○	○	○	○	○

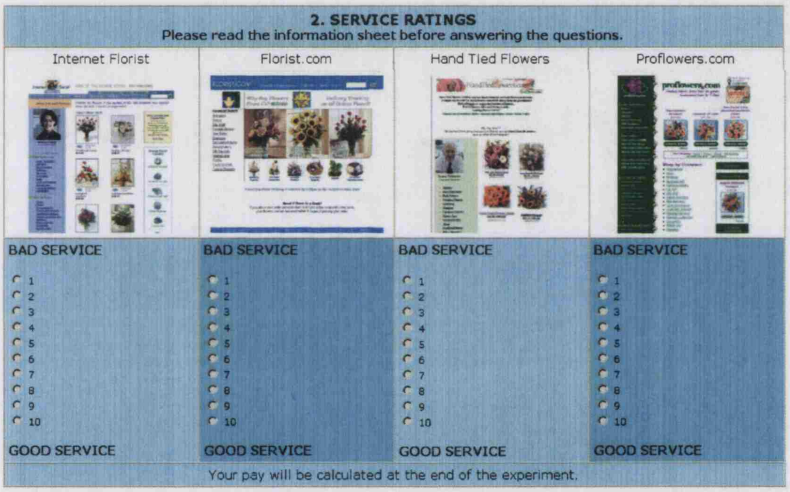
	Please indicate below whether you have seen the website or used the services of any of the companies on the left.		
proflowers.com	○ never seen the site	○ seen the site	○ bought from the site
click for DIGITAL	○ never seen the site	○ seen the site	○ bought from the site
	○ never seen the site	○ seen the site	○ bought from the site
	○ never seen the site	○ seen the site	○ bought from the site
AJUMP.com	○ never seen the site	○ seen the site	○ bought from the site
	○ never seen the site	○ seen the site	○ bought from the site
CMS Computing	○ never seen the site	○ seen the site	○ bought from the site
	○ never seen the site	○ seen the site	○ bought from the site
HandTiedFlowers.com	○ never seen the site	○ seen the site	○ bought from the site
Internet Florist	○ never seen the site	○ seen the site	○ bought from the site
CompuVest.com	○ never seen the site	○ seen the site	○ bought from the site
	○ never seen the site	○ seen the site	○ bought from the site

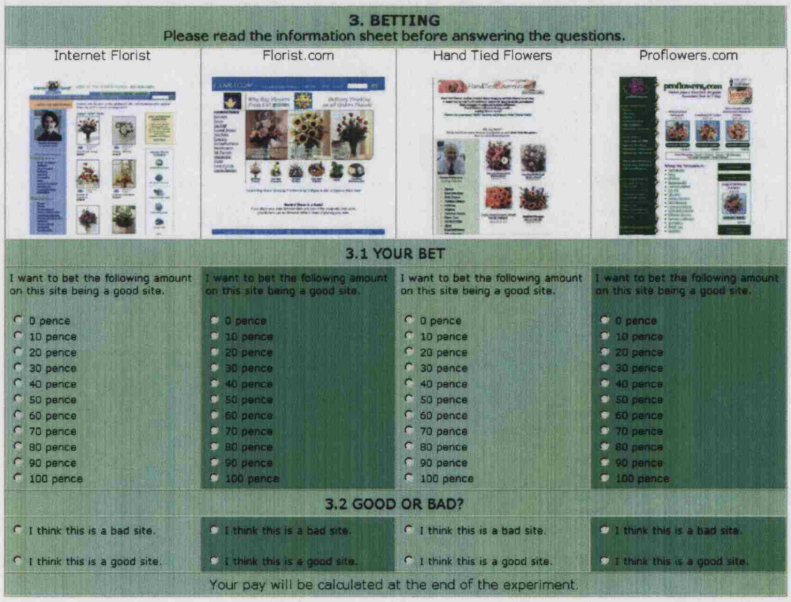
B.7 Chance Investment



B.8 Evaluation of Sites

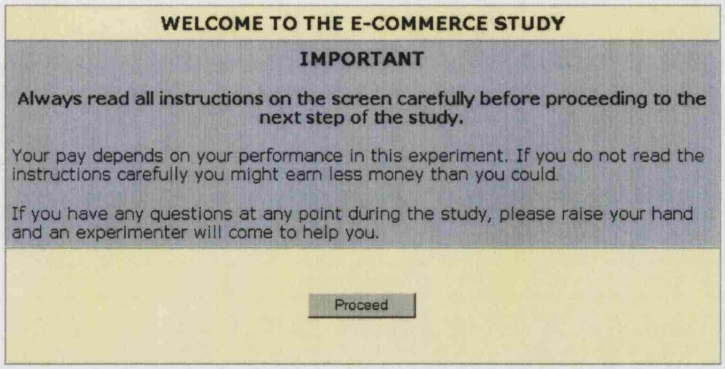




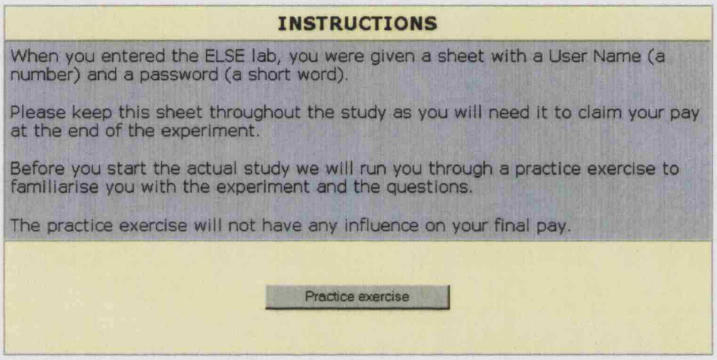


B. 9 Instruction Screens

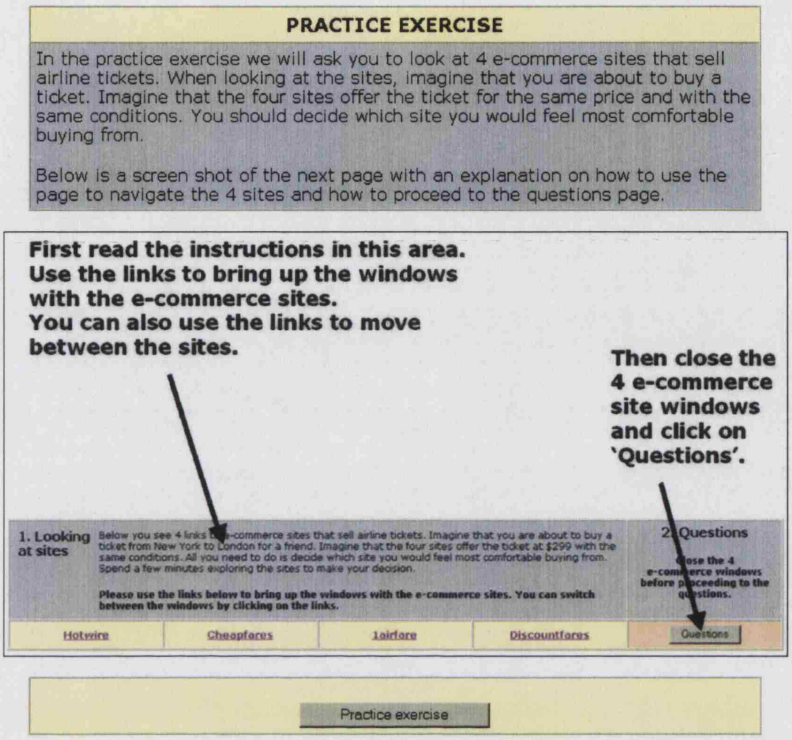
Welcome



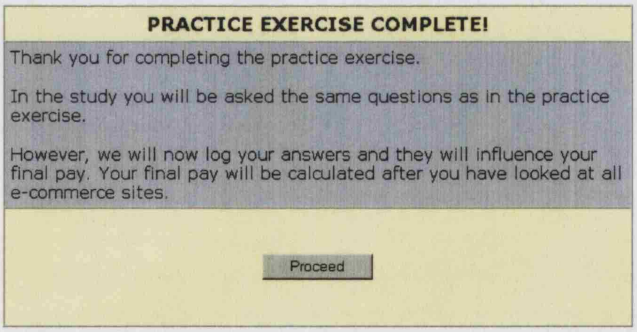
1st step screen



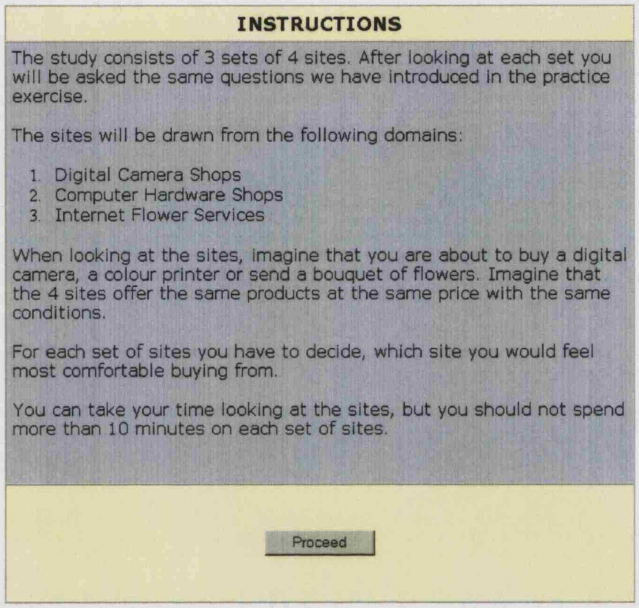
Introduction to the Practice Exercise



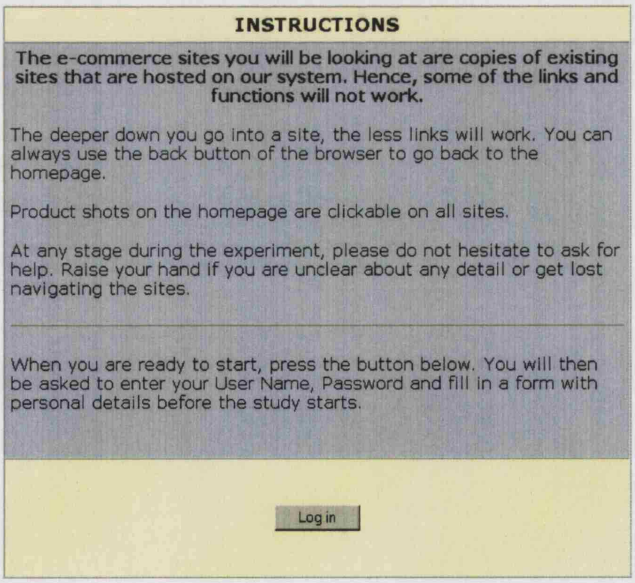
End of Practice Exercise



Preparation of Actual Study



Start Screen



B.10 E-Commerce Trust Questionnaire (Kammerer, 2000)

Please enter your experiment ID ID

Plase tick the shop you are rating

- ○ A&M Photo World
- ○ Click for Digital
- ○ Broadway Photo
- ○ Best Stop Camera

Please state to what extent you agree with these statements with reference to the online vendor you just looked at.	strongly disagree	disagree	can't say	agree	strongly agree
The vendor seems unprofessional and incompetent	○	○	○	○	○
The vendor's communications appear consistent, stable and do not contradict themselves	○	○	○	○	○
The vendor seems overbearing and tactless	○	○	○	○	○
The vendor seems conscientious, decent, and fair	○	○	○	○	○
The vendor seems upright and honest	○	○	○	○	○
The vendor seems relcutant to give information and seems to be hiding something	○	○	○	○	○
The site seems attractive, entertaining and positive	○	○	○	○	○
The vendor would admit his or her shortcomings	○	○	○	○	○
The vendor communicates in a way that is understandable, focussed and clear	○	○	○	○	○
The vendor takes an interest in the customer's needs and is open and approachable	○	○	○	○	○
You can rely on the promisses that this vendor makes	○	○	○	○	○
The vendor's communication does not appear to be convincing and the points made are not plausible	○	○	○	○	○
The vendor seems to act responsibly	○	○	○	○	○
The vendor seems polite and seems to anticipate the customer's needs	○	○	○	○	○
The vendor's advice seems impartial and objective	○	○	○	○	○
The vendor seems to have a personal interest in me and in doing future business together	○	○	○	○	○
The vendor seems trustworthy	○	○	○	○	○
The vendor seems reliable	○	○	○	○	○
The vendor seems untrustworthy	○	○	○	○	○
	strongly disagree	disagree	can't say	agree	strongly agree
If this site would offer the product I am searching for a good price, I would buy here	○	○	○	○	○
When buying from this vendor, I would give my credit card details	○	○	○	○	○
I would give my personal details and my email address (e.g. to be informed about news)	○	○	○	○	○
I would not like this vendor to analyse what I have looked at and selected on this page	○	○	○	○	○
I would bookmark this page or recommend it to a friend	○	○	○	○	○
If I am looking for a product on the Internet, I might come back to this page	○	○	○	○	○

Appendix C: Experiment 3

C.1 Instructions for Chance Investment

COIN THROW

At the end of the experiment, when you collect your payment, you will have the chance to throw a coin. You can bet on the coin showing heads, an event that has a 50% chance.
You can bet between 0 and 100 pence. If you win, your bet will be added to your final pay (participation + whatever you will earn during the later stages of this study). If you loose, the bet will be deducted from your final pay.

Example:
Let's assume that your final pay is £10 and you bet 50 pence. If the coin shows heads, you will be paid £10.50. If the coin shows tails you will be paid £9.50.

Please indicate below how much you want to bet.

Bet on HEADS: _____ PENCE (max 100)

C.2 Answer Booklet

Experimental Booklet

Eye-tracking Study January 2003

Participant Name: _____

Participant Code: _____

Condition: _____

1.1 PREFERRED VENDOR

For this question we want you to consider which vendor you would be most comfortable buying from.

Assuming that all vendors offer the product you are looking for at the same price with the same conditions;

Which vendor would you feel most comfortable buying from?
Tick the box labelled 'First' for this vendor.

Then, in a next step, assume that the product is no longer available from your preferred vendor. Which would be the vendor you would be most comfortable buying from out of the remaining two? Please tick 'second' for that vendor.

Please rank all three vendors, even if you would not consider buying from some of them.

Please enter the names of the vendors first.

1. Vendor: _____ ☐ FIRST ☐ SECOND ☐ THIRD

2. Vendor: _____ ☐ FIRST ☐ SECOND ☐ THIRD

3. Vendor: _____ ☐ FIRST ☐ SECOND ☐ THIRD

1.2 VENDOR EVALUATION

As a next step, we want to ask you to rate the vendors you looked at.

You can give between 1 and 10 points to a vendor.

1 point indicates that you think the vendor is very bad, i.e. offers very poor service and is likely to be unreliable.

10 points mean that you think the vendor is very good, i.e. offers very good service and is very reliable.

Please enter the names of the vendors first.

1. Vendor:_____: _____ (1 BAD – 10 GOOD)

2. Vendor:_____: _____ (1 BAD – 10 GOOD)

3. Vendor:_____: _____ (1 BAD – 10 GOOD)

GENERAL INFORMATION

Please tick as appropriate

Florist.com
- ☐ I have heard about this company before
- ☐ I have seen this site before
- ☐ I have used this site before

Hand Tied Flowers
- ☐ I have heard about this company before
- ☐ I have seen this site before
- ☐ I have used this site before

Internet Florist
- ☐ I have heard about this company before
- ☐ I have seen this site before
- ☐ I have used this site before

STOP

Please do not turn over until instructed

2.1 PREFERRED VENDOR

For this question we want you to consider which vendor you would be most comfortable buying from.

Assuming that all vendors offer the product you are looking for at the same price with the same conditions;

Which vendor would you feel most comfortable buying from?
Tick the box labelled 'First' for this vendor.

Then, in a next step, assume that the product is no longer available on your preferred vendor. Which would be the vendor you would be most comfortable buying from out of the remaining two? Please tick 'second' for that vendor.

Please rank all three vendors, even if you would not consider buying from some of them.

Please enter the names of the vendors first.

1. Vendor: _____ ☐ FIRST ☐ SECOND ☐ THIRD

2. Vendor: _____ ☐ FIRST ☐ SECOND ☐ THIRD

3. Vendor: _____ ☐ FIRST ☐ SECOND ☐ THIRD

2.2 VENDOR EVALUATION

As a next step, we want to ask you to rate the vendors you looked at.

You can give between 1 and 10 points to a vendor.

1 point indicates that you think the vendor is very bad, i.e. offers very poor service and is likely to be unreliable.

10 points mean that you think the vendor is very good, i.e. offers very good service and is very reliable.

Please enter the names of the vendors first.

1. Vendor:_____: _____ (1 BAD – 10 GOOD)

2. Vendor:_____: _____ (1 BAD – 10 GOOD)

3. Vendor:_____: _____ (1 BAD – 10 GOOD)

3. SERVICE RATINGS

For the online vendors you looked at, a quality of service rating has been established by independent agencies. Ratings are given on a scale from 1 to 10.

> The ratings do not depend on a vendor's website but on the actual performance of the company.

Those shops with *high scores* provide an excellent service; are easy to deal with in case of complaints and generally fulfilled or exceeded customer expectations.

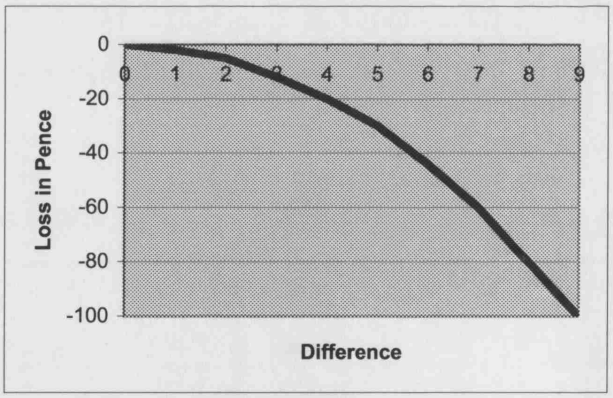
Those with *low scores* provide a poor service; they are difficult to deal with in case of complaints and generally disappointed customers who ordered from them.

For this task, we ask you to guess the ratings of the sites you have looked at. Please bear in mind that the rating of the shops is grounded on their actual performance and not on their website.

In order to motivate you to guess as accurately as you can, we will give you an additional pay of £3. We will deduct from that extra pay, if your guesses are inaccurate.

We ask you to guess the rating for each of the 3 vendors you looked at. For each guess you can loose £1 pound. If a guess is completely wrong (e.g. your guess is 1, but the real score is 10) you will loose the full £1 for that guess. If a guess is completely correct, you will be allowed to keep the £1 for that guess.

The graph below shows the reduction from your extra payment based on the difference between your guess and the actual score.



Loss = – £1 *((1/81)*(your guess – real rating)^2)

The amount you will receive will be calculated at the end of the study.

3. SERVICE RATINGS

If you have any questions with regard to this payment scheme, please do not hesitate to ask before completing the form below.

Please enter the names of the vendors first.

1. Vendor:_____: _____ (1 Bad Service Rating – 10 Good Service Rating)

2. Vendor:_____: _____ (1 Bad Service Rating – 10 Good Service Rating)

3. Vendor:_____: _____ (1 Bad Service Rating – 10 Good Service Rating)

4. BETTING

For this task you can bet some of the money you've earned so far.

> *Please note: You are not obliged to bet anything. However, by betting parts of your pay, you have the chance to earn considerably more money in this study.*

Based on the quality of service ratings given to the vendors by external agencies, we have divided the vendors in this study in GOOD vendors and BAD vendors.

For this study we have selected several bad and good vendors – there could be any mix of the two kinds.

We will ask you, how much you are willing to bet that a vendor is a good vendor. If you bet on a vendor that turns out to be a good vendor, you will earn your investment on top of your final pay. If the vendor turns out to be a bad vendor we will deduct your investment from your final pay. **Hence, you should bet 0 pence on vendors you think are bad, as you will loose the money you invest in vendors that turn out to be bad vendors.**

Your maximum bet is 100 pence per vendor.

Example:
Let's assume your final pay is £8. If you bet 50 pence on a vendor that turns out to be a good one, you will be paid £8.50. If the vendor turns out to be a bad one you will be paid £7.50.

The amount you won will be calculated at the end of the experiment.

4. BETTING

If you have any questions with regard to this payment scheme, please do not hesitate to ask before completing the form below.

Please enter the names of the vendors first.

1. Vendor:_____: _____ (Max 100 pence)

2. Vendor:_____: _____ (Max 100 pence)

3. Vendor:_____: _____ (Max 100 pence)

Appendix D: Experiment 4

D.1 Quiz Questions

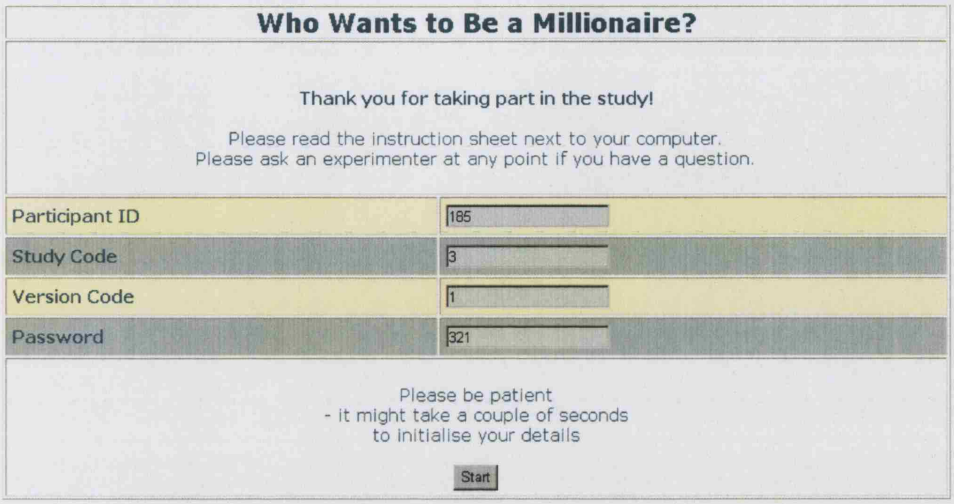
Num.	Question	Correct	False 1	False 2	False 3
Practice 1	In which 1942 movie does 'Rick Blaine' say the line "Of all the gin joints in all the towns in all the world, she walks into mine"?	Casablanca	The African Queen	North by Northwest	Ice Cold in Alex
Practice 2	In which Italian city is the Bridge of Sighs?	Venice	Florence	Milan	Naples
1	Which one of these is a coastal city in North Korea?	Sinp'o	Chingwa	Kanggye	Sunch'on
2	Which popular children's toy was invented by the American Donald F. Duncan in 1929?	Yo-yo	Frisbee	Kazoo	Water Pistol
3	How many heads did the Hydra have?	9	5	4	7
4	Herpetology is the study of what?	Reptiles	Skin disorders	Saints	The Sun
5	What name is given to a gelatine made from the bladders of freshwater fish?	Isinglass	Isatin	Isantigen	Isoglutin
6	Which European country has had the most battles fought on its land?	Belgium	Holland	Germany	France
7	Of what country was Andres Pastrana president in January 2002?	Columbia	Brazil	Peru	Uruguay
8	What country won the 2003 Wife-Carrying World Championship?	Estonia	Finland	Lithuania	Latvia
9	What was the Roman name for the city of York?	Eboracum	Deva	Lindum	Verulamium
10	Which king was the intended victim of the gunpowder plot?	James I	Charles II	James II	Charles I
11	What type of creature is a "Plymouth Rock"	Chicken	Horse	Goat	Pig
12	In which Gospel is the genealogy of Christ traced back to King David and Abrahm?	Matthew	Mark	John	Luke
13	What is the third longest river in the world?	Yangtze - Kiang	Congo	Mississippi	Amazon
14	How many US Presidents have been assassinated?	4	5	6	3
15	In literature, how many Pillars of Wisdom did T.E. Lawrence write about?	7	5	9	10
16	In nature, what name is given to the dried kernel of coconut?	Copra	Hubris	Kolo	Antime
17	What was golfer Payne Stewart's first name?	William	Thomas	Edward	Michael
18	Who designed the 'Barcelona Chair'?	Mies van der Rohe	Frank L. Wright	Le Corbusier	Santiago Calatrava
19	Who coined the term 'Philosophical Hermeneutics'?	Gadamer	Heidegger	Nietzsche	Kant
20	Daniel Cohn-Bendit is a member of the European Parliament for which country?	France	Germany	Austria	Belgium
21	Which of these Peruvian cities is not bordering on the Pacific Ocean?	Ica	Chimbote	Matarani	Talara
22	Which of these countries does not share a border with Benin?	Ghana	Burkina Faso	Niger	Nigeria
23	Which of these cities is the capital of Bahrain?	Manama	Sitrah	Ar Rifa	Jidd Hafs
24	Which country first claimed Aruba?	Spain	Portugal	Netherlands	England
25	In which US state was Marc Andreessen born?	Iowa	Montana	California	Washington
26	What subject did Bill Gates study at Harvard?	Law	Medicine	Computer Science	Mathematics
27	Who won the Turner Prize in 1984?	Malcolm Morley	Gilbert & George	Richard Deacon	Howard Hodgkin
28	Which New York Building featured a mural depicting Lenin?	Rockefeller Center	Chrysler Building	Empire State Building	Lincoln Center
29	Which of the following acronyms is used to classify Bach's music?	BWV	BMC	BML	BWM
30	Who won the 2003 European Contemporary Architecture Award?	Zaha Hadid	Norman Foster	Nicolas Grimshaw	Renzo Piano

D.2 Transcript of Advice

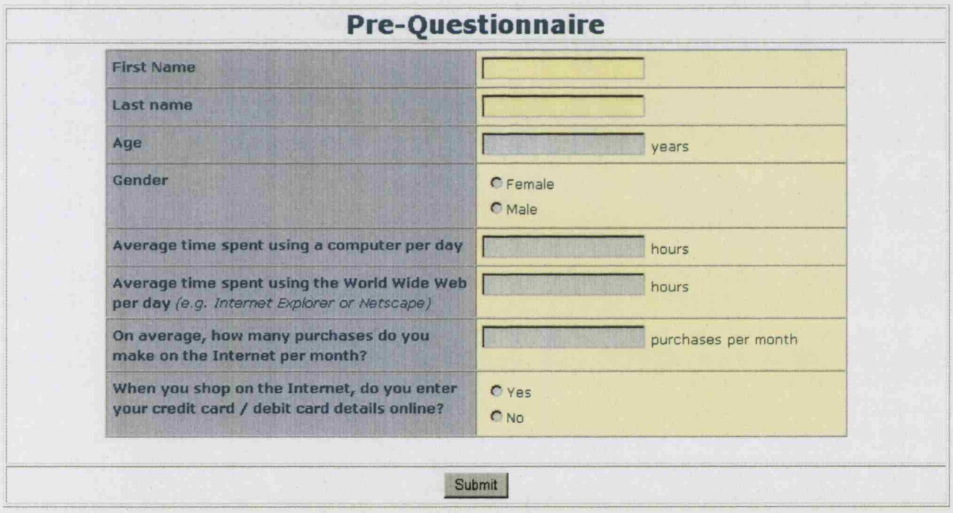
Num.	Question	Expert (Trained)	Non-Expert (Untrained)
Practice 1	In which 1942 movie does 'Rick Blaine' say the line "Of all the gin joints in all the towns in all the world, she walks into mine"?	The answer is Casablanca	The answer is Casablanca
Practice 2	In which Italian city is the Bridge of Sighs?	It is Venice	It is Venice
1	Which one of these is a coastal city in North Korea?	I think it might be Chingwa	I think it might be Chingwa
2	Which popular children's toy was invented by the American Donald F. Duncan in 1929?	The toy was the Yo-yo - I believe	I am going to guess Frisbee
3	How many heads did the Hydra have?	9 heads	I think I remember it having 9 heads
4	Herpetology is the study of what?	It is the study of reptiles	I think it must be skin disorders
5	What name is given to a gelatine made from the bladders of freshwater fish?	I think it is Isinglass	It might be Isoglutin
6	Which European country has had the most battles fought on its land?	Probably France	Probably France
7	Of what country was Andres Pastrana president in January 2002?	He was president of Columbia	I do not know this and I should - I am going to guess Peru
8	What country won the 2003 Wife-Carrying World Championship?	I will say Estonia	I will say Estonia
9	What was the Roman name for the city of York?	The name was - I believe - Eboracum	Possibly Verulamium
10	Which king was the intended victim of the gunpowder plot?	I will give it a try and say James I	I will give it a try and say James I
11	What type of creature is a "Plymouth Rock"	It is a type of chicken	I guess a goat
12	In which Gospel is the genealogy of Christ traced back to King David and Abrahm?	I believe it was the Gospel of Matthew	Just trying to think - I read all of them but I am not entirely sure - I do not remember clearly - I am going to guess Luke
13	What is the third longest river in the world?	Third longest is - I think - Yangtze-Kiang	Possibly the Yangtze River
14	How many US Presidents have been assassinated?	I am not completely sure but I am going to guess 3	I am not completely sure but I am going to guess 3
15	In literature, how many Pillars of Wisdom did T.E. Lawrence write about?	7 ... 7 pillars of wisdom	Instinctively - cause it rings a bell - I am going to say 7
16	In nature, what name is given to the dried kernel of coconut?	I think the answer is Copra	It might be Copra - I will try Copra
17	What was golfer Payne Stewart's first name?	I think the name was William	I am not sure at all - I am going to give it a guess and say Thomas
18	Who designed the 'Barcelona Chair'?	Oh that was Mies van der Rohe	Oh that was Mies van der Rohe
19	Who coined the term 'Philosophical Hermeneutics'?	I am going to answer Kant	I am going to answer Kant
20	Daniel Cohn-Bendit is a member of the European Parliament for which country?	He represents France	I think I will say Austria
21	Which of these Peruvian cities is not bordering on the Pacific Ocean?	Not bordering is Ica - I believe	I am going to say Chimbote
22	Which of these countries does not share a border with Benin?	A country that does not share a border with Benin is Ghana	I am trying to think - probably western-most - I say Ghana
23	Which of these cities is the capital of Bahrain?	The capital is Manama	I am pretty sure that it is Jidd Hafs - Jeddah
24	Which country first claimed Aruba?	I believe it was Spain	I think I would guess - actually - Spain
25	In which US state was Marc Andreessen born?	I am going to take a shot and suggest California	I am going to take a shot and suggest California
26	What subject did Bill Gates study at Harvard?	Law	Most likely Mathematics
27	Who won the Turner Prize in 1984?	That was Malcolm Morley	I want to say Gilbert and George - yes - I say Gilbert and George.
28	Which New York Building featured a mural depicting Lenin?	The mural was in the Rockefeller Center	I am going to guess the Rockefeller Center
29	Which of the following acronyms is used to classify Bach's music?	I just take a guess here - I am going to say BML	I just take a guess here - I am going to say BML
30	Who won the 2003 European Contemporary Architecture Award?	The award went to Zaha Hadid - I think	I think it might have been Zaha Hadid - I am not sure but I am going to guess Zaha Hadid

D.3 Experimental System

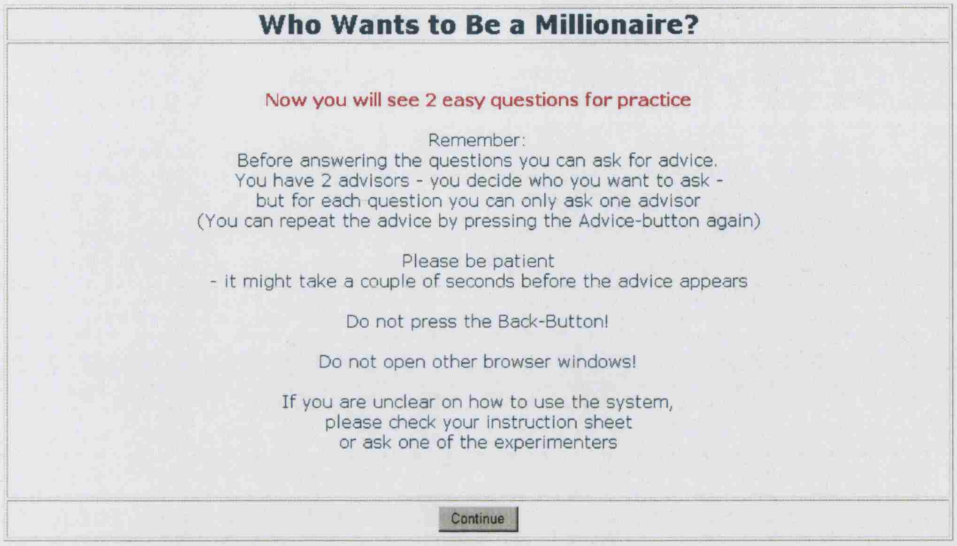
Login Screen



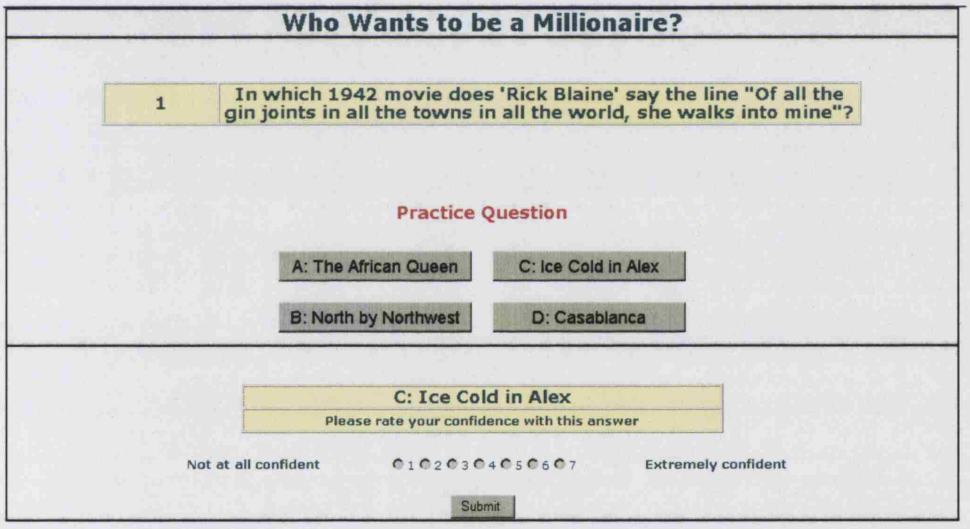
Pre-Questionnaire



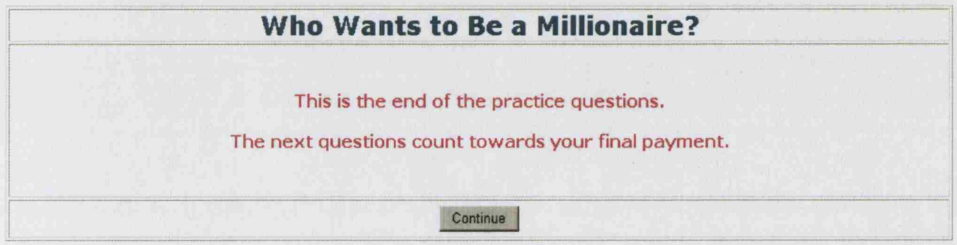
Practice Sessions Screen



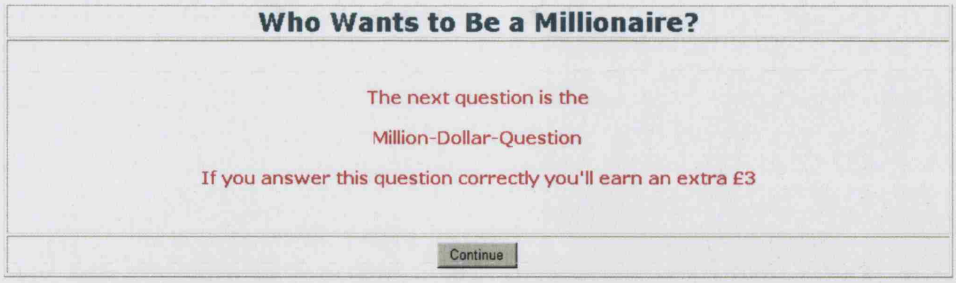
Elicitation of Confidence



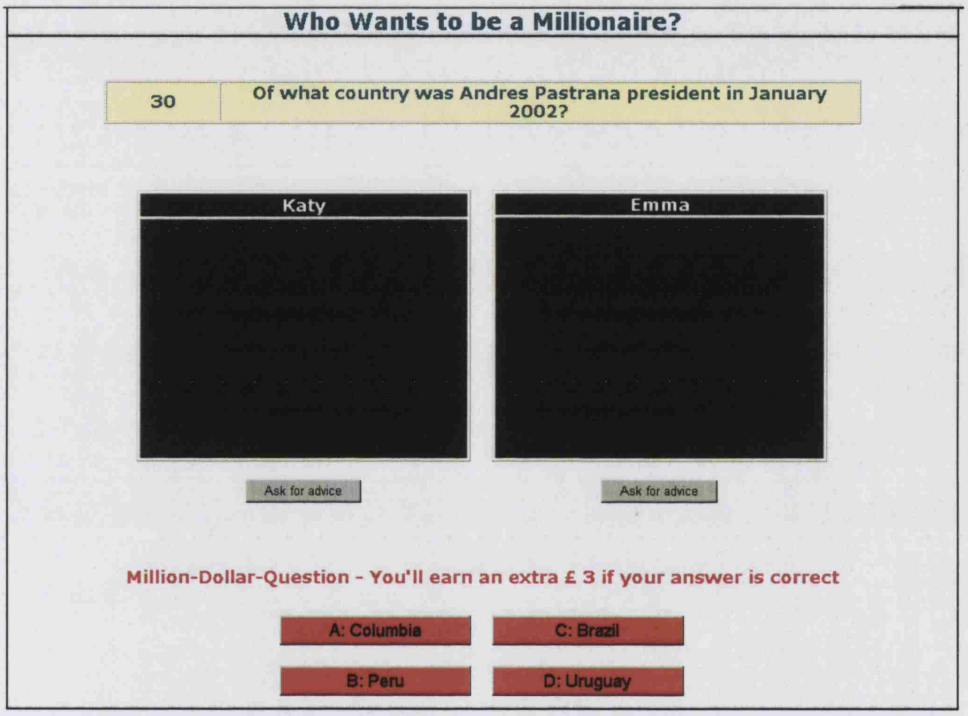
End of Practice Rounds



Warning for High Stakes Round



High Stakes Round



Post Experimental Assessment

Post Study Questionnaire

Please state to what extent you agree with the statements below.

Click '1' if you do strongly disagree.
Click '4' if you have no opinion/preference.
Click '7' if you strongly agree.

1 2 3 4 5 6 7

Strongly Disagree — No Opinion — Strongly Agree

	Katy	Emma
1	Katy was very friendly	Emma was very friendly
	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Strongly disagree 1 2 3 4 5 6 7 Strongly agree
2	I was very aware of Katy	I was very aware of Emma
	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Strongly disagree 1 2 3 4 5 6 7 Strongly agree
3	I trusted Katy's advice	I trusted Emma's advice
	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Strongly disagree 1 2 3 4 5 6 7 Strongly agree
4	I enjoyed playing with Katy	I enjoyed playing with Emma
	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Strongly disagree 1 2 3 4 5 6 7 Strongly agree
5	I would like to meet Katy face-to-face	I would like to meet Emma face-to-face
	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Strongly disagree 1 2 3 4 5 6 7 Strongly agree
6	Katy gave good advice	Emma gave good advice
	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Strongly disagree 1 2 3 4 5 6 7 Strongly agree
7	I could tell when Katy was certain about the answer	I could tell when Emma was certain about the answer
	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Strongly disagree 1 2 3 4 5 6 7 Strongly agree
8	I liked Katy	I liked Emma
	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Strongly disagree 1 2 3 4 5 6 7 Strongly agree
9	I relied mostly on Katy's advice	I relied mostly on Emma's advice
	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Strongly disagree 1 2 3 4 5 6 7 Strongly agree

Please describe how you decided on which advisor to rely on.

Submit

D.4 Instruction Sheet

Quiz Study

Instruction Sheet

- Please read carefully -

Please put on the headset
(It should be on the right side of your cubicle)

Real Stakes

For the next hour we'd like you to play 30 rounds of 'Who Wants to Be a Millionaire?' ... well nearly: It's not a million, but depending on your performance you can earn up to £17 in this study. Irrespective of your performance you will earn £ 8 minimum.
In each round of the game you will be presented with a question and 4 answer options. Among those options there will always be one correct answer and 3 incorrect ones. There is no time limit for answering the questions, but we expect experimental sessions to last 90 minutes max.

Practice Rounds

Before starting on the 30 assessed questions you will have access to two easy practice questions. The 'real' questions are much more difficult. However, they are in no particular order of difficulty.

Advice

Just like in the real show you can get advice before answering the questions. However, unlike in the show, you can ask for advice on every question.
You will have the same two advisors, Emma and Katy, for the whole study. However, for each question, you will only be able to ask one of them for advice. It is up to you, which one you ask.
Emma and Katy are both post-doc researchers at UCL. They have played the game previously and we have recorded their answers to include them in the quiz.
Please note: other sources of advice are not allowed and will disqualify you, if used. (I.E. Please switch off your mobile phones, please do not open other browser windows)

Post Study Questionnaires

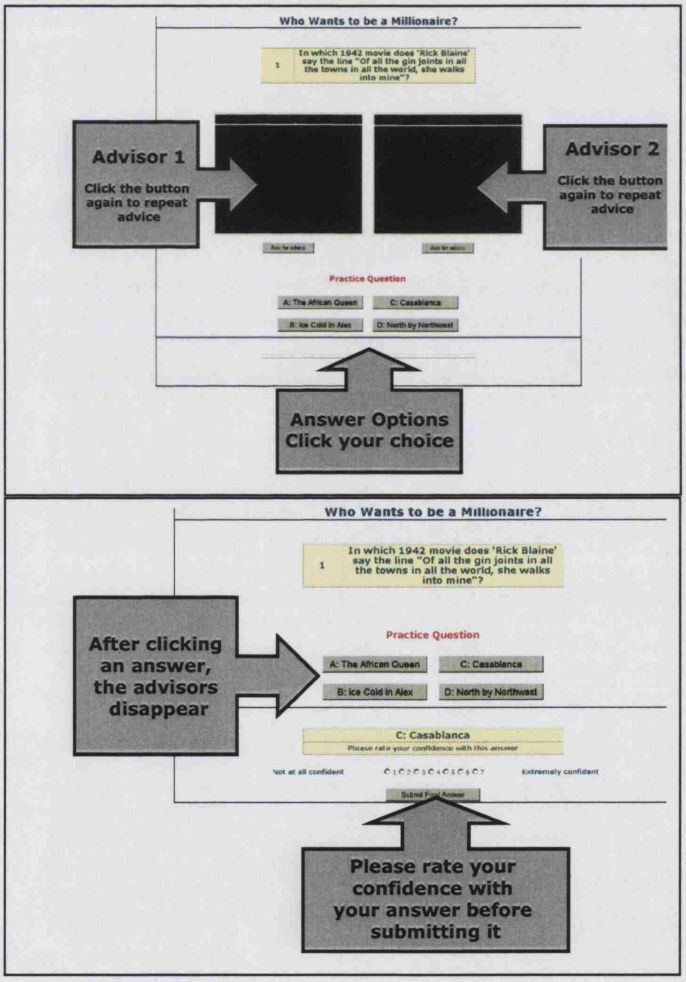
After you've completed the game we will present you with a questionnaire about your experience with the game and the advisors. In a second questionnaire we will ask you about your attitude to various aspects of life and decision-making. After this second questionnaire we will present you with an overview on your performance and your earnings. You can then take your login slip to the experimenter and collect your payment.

Please turn over

Game Rules

Number of correctly answered questions	Participation Pay
0 - 15	**£ 8**
16 - 20	**£ 10**
21 - 25	**£ 12**
26 - 30	**£ 14**
In addition, if you answer the final **'Million-Dollar-Question'** correctly you earn an extra **£3** on top of your participation pay.	

The Quiz Page Overview



Glossary

Ability	One of the two top-level trust-warranting properties (besides motivation). Also one intrinsic trust-warranting property. See 2.2.1 and 3.4.2.1.
Advice Seeking	Dependent variable in Experiment 4. The proportion of advice sought from one advisor out of the total number of times advice was sought by one participant. See 8.2.6.1.
Advice Uptake	Dependent variable in Experiment 4. The proportion of advice followed out of the total number of times one advisor was asked for advice. Random advice uptake would be .25. See 8.2.6.2.
Affective Trust	Synonymous with emotional trust, based on immediate affective reactions and personal relationships. Counterpart to cognitive trust. See 2.2.4 and 3.5.1.
Assessment	Dependent variable in Experiment 2 and 3. Participants' estimate of a vendor's post-order quality (trust-warranting property ability, 1-10). Incorrect estimates carry a penalty following a quadratic incentive scheme. See 6.2.3.2.
Benevolence	Intrinsic trust-warranting property providing incentives for trustworthy behaviour without contextual incentives. Trustees derive gratification from the good of the trustor, e.g. in long-standing relationships. See 3.4.2.3.
Cognitive Trust	Trust based mainly on safeguards and "good rational reasons". Counterpart to affective trust. See 2.2.4 and 3.5.1.
Contextual Trust-Warranting Properties	Contextual factors influencing (and giving signals for) the trustworthiness of a trustee in a specific situation. See 3.4.1.
Discriminative Ability	The trustor's ability to differentiate between trustworthy and less trustworthy actors. See 2.2.3.

Dis-embedding	The process of replacing personal face-to-face transactions with mediated interactions with organisations. Dis-embedding is a pervasive process in modern societies. See 2.2.
Exploration Depth	Independent variable in Experiment 3. This experiment distinguished between a superficial exploration of the homepage of an e-commerce vendor and an in-depth exploration including further pages. See 7.2.2.3.
Exposure Order	Independent variable in Experiment 1 and 3. These experiments distinguished between 1st and subsequent exposures to a page. See 5.2.3 and 7.2.2.3.
Fixation	A period (>= 100 ms) of spatially consistent gaze (<= 7 mm). See 4.4.1.
Fovea	The image of fixated objects is projected onto the fovea, the area with the highest visual resolution. Resolution decreases rapidly around the fovea. See 4.4.1.
Institutional Embeddedness	Contextual trust-warranting property. Captures incentives and signals by institutions (e.g. law enforcement agencies, trade organisations, or individual companies). See 3.4.1.3.
Internalised Norms	Intrinsic trust-warranting property providing incentives for trustworthy behaviour independent of contextual incentives. Trustees derive gratification from acting in accordance with their internalised norms, values, beliefs. See 3.4.2.2.
Interpersonal Cue	Para-verbal and non-verbal information exchanged in face-to-face situations that e.g. give insight into the sender's social background, affective state, honesty, integrity, and sincerity. See 2.3.1.
Intrinsic Trust-Warranting Properties	Intrinsic factors influencing (and giving signals for) the trustworthiness of a trustee in a specific situation. Includes ability and factors contributing to motivation. See 3.4.2.
Investment	Dependent variable in Experiment 2 and 3. The amount (0-100 pence) a participant is willing to invest in a vendor being a good vendor. See 6.2.3.1.
Motivation	One of the two top-level trust-warranting properties (besides

	ability). See 2.2.1 and 3.2.
Presence	Broad concept that describes the experiences of mediated interaction and virtual environments. The definition of presence is still controversially discussed. See 2.3.2.2.
Public good	A good whose consumption cannot be restricted or controlled. See 4.2.3.2.1.
Re-embedding	Supporting trust in dis-embedded interaction through personal trust in representatives of organisations. See 2.2.
Region of Interest (ROI)	Region in the interface defined as a unit of interest in an eye-tracking study. A photo or a navigation bar are examples of regions of interest. See 4.4.1.
Saccade	Rapid eye movements between fixations. Visual sensitivity is decreased during saccades. See 4.4.1.
Sensitivity	Measure from signal detection theory introduced in Experiment 4. It is calculated from advice uptake and information about the correctness of individual pieces of advice. See 8.2.6.3.
Social Embeddedness	Contextual trust-warranting property. Extends the effect of temporal embeddedness in a group of connected trustors. Captures the positive effect of reputation on trustworthy behaviour. See 3.4.1.2.
Social Presence	"... the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships ..." (Short et al., 1976). Now widely used to describe media effects on interpersonal perception. See 2.3.2.2.1.
Social Responses to Computer Technology (SRCT)	A concept developed by Reeves & Nass (1996) based on studies that replicated classic experiments from social psychology with computers as interaction partners. Also referred to as Media Equation. See 2.3.2.2.2.
Strategic Insecurity	A risk resulting from the symmetric structure of Prisoner's Dilemma Games where an actor's *lack of trust* results in defection. See 4.2.3.2.1.
Surface Cue	Signal for the presence of trust-warranting properties given in the interface of an e-commerce system (Egger, 2001). See 2.2.1.

Symbol	A symbol is a signal that is not firmly linked to a trust-warranting property. Commonly it has an arbitrarily assigned, inter-subjectively agreed meaning. A trustee must invest in displaying a symbol. See 3.3.2.
Symptom	A symptom is a signal that is causally linked to the presence of a trust-warranting property. It will always be emitted in the presence of the given property. See 3.3.2.
Task Time	Dependent variable in Experiment 1 and 3. The time taken to complete a search task used as a measure of user cost.
Temporal Embeddedness	Contextual trust-warranting property. The likelihood of future encounters provides an incentive for trustworthy behaviour in the present. See 3.4.1.1.
Trust Game	Introduced by Berg et al. (2003) as a game-theoretic model of trust-requiring situations that overcomes problems of symmetric games (e.g. Prisoners' Dilemma). See 3.2.2 and 4.2.3.2.1.
Trustee	The trusted actor.
Trustor	The trusting actor.
Trust-warranting properties	Properties of the trustee that lead him or her to forego situational temptations and act trustworthy. In most cases trust-warranting properties cannot be directly observed, but trustees have to rely on signals of their presence. See 3.2.4.
Visual Attraction (looked / fixated)	Dependent variable in Experiments 1 and 3. It gives the number of participants whose eye gaze was sampled in a ROI. Dependent Variable in Experiments 1 and 3. See 4.4.2.

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