



**Investigation of the design of personal avatars in online  
shopping for effective virtual try-on applications**

A thesis submitted for the degree of Doctor of Philosophy

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## **Abstract**

Personal avatars are an aspect of visual marketing that is intended to provide consumers with individualised product information. The concept is to show products in relation to virtual, graphical representations of the individual online shopper in order to provide them with a more direct product experience than is possible with conventional product photos or textual information.

Existing research on the requirements for personal avatars in online shopping settings and the resulting effects on consumer behaviour are inconsistent and somewhat limited and incomplete. Therefore, this research aimed to determine greater insight into the design of such personal avatars.

The research considers the effect of different avatar design on marketing outcomes; undertaking an investigation with potential female users of a virtual try-on application using three designs of personal avatar in a typical scenario of online shopping of clothing. Attitudes and preferences of the participants concerning the personal avatars and the impact on pertinent marketing-related outcomes were collected, analysed and discussed.

The three experimental conditions did not generate significant differences on the investigated marketing outcome factors of informativeness, telepresence, “shopping enjoyment”, “decision support satisfaction”, “attitude towards the website” and “perceived risk of purchase”. Neither did the different avatar designs yield significant differences in perception of “avatar similarity to self” by the participants.

However, “avatar similarity to self” did have a positive effect on the investigated marketing outcomes of informativeness, telepresence, “shopping enjoyment” and “attitude towards the website”. Whilst these results did not yield hints on avatar design, the data collected on attitudes and preferences of consumers towards their avatar did.

A central insight is that the imitation of body measures, body shape, skin colour and hair colour are of essential importance for women. For the aspects body shape, hairstyle, face and posture, a preference for an approximate representation over an exact, detailed representation was identified. Based on the research findings, practical basic design recommendations are derived.

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## **Glossary**

ANOVA	Analysis of variance
AVE	Average variance extracted
CFA	Confirmatory factor analyses
CR	Composite reliability
DV	Dependent variable
E-commerce	Electronic commerce
EFA	Exploratory factor analysis
EVA	Embodied virtual agent
IS	Information systems
IT	Information technology
IV	Independent variable
VTO	Virtual try-on

## **Declaration**

I hereby declare that this thesis entitled “Investigation of the design of personal avatars in online shopping for effective virtual try-on applications” is my own work and effort, and has not been previously written by another person, published or submitted for the award of any academic degree.

Rainer Blum

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# **1 Introduction and Background**

## **1.1 Personal avatars in online shopping**

In Information Technology (IT), an avatar is defined as a graphical representation, either static or animated, of a user. Sometimes the term avatar is also used for a different, though related, concept called agent or embodied virtual agent (EVA). Like avatars, EVAs are most often virtual human figures. Whilst they are steered by computer programs (Nowak, 2004), an avatar is controlled by the user (Garnier & Poncin, 2013b). This study addresses solely the concept of avatars as a graphical representation of the user and is therefore not directly related to EVA.

Two categories of avatars exist in the marketing domain and in online shopping: “model-avatars” and avatars as “inhabitants of virtual worlds simulating life”. For model avatars, as found in this research, explicit use has been identified for product presentation in online clothing shops (Nantel, 2004), followed by entertainment (Kim & Forsythe, 2008, 2009; Malter, Rosa, & Garbarino, 2008). They are deemed to have the potential to help compensate for the absence of touch (Rosa, Garbarino, & Malter, 2006) and the lack of direct experience when appraising products (Crete, St-Onge, Merle, Arsenault, & Nantel, 2009). Thus, they are often designed with considerable realism, in order to imitate relevant aspects of the individual appearance of the consumer (Merle, St-Onge, & Senecal, 2011; Suh, Kim, & Suh, 2011).

The second category, avatars as inhabitants of virtual world simulations, is only of secondary interest for this research. This is because, typically, the major part of commercial activities, including product consumption, takes place within the boundaries of these worlds without a direct connection to the real world (Garnier & Poncin, 2013b). However, use cases similar to model avatars, namely product appraisal for real-world purchase, are possible as well.

Pertinent research on avatars in the marketing domain often investigates aspects of the relationship of consumers to their virtual counterparts, for example self-perception (Malter et al., 2008), self-congruence (Merle et al., 2011, 2009), or identification (Suh et al., 2011).

This study focuses on avatars of the model avatar type as found in online shopping and uses the terms “avatar” or “personal avatar” to refer to them. Whilst part of the

existing literature recommends that avatars of this type should be designed with high similarity between avatar and user, considerable work exists that provides arguments against overly true to detail avatar similarity. Actually, existing research on the requirements for personal avatars in online shopping settings and the resulting effects on consumer behaviour and marketing outcomes appears inconsistent and somewhat limited and incomplete (see also Garnier & Poncin, 2013b). However, it is evident that different visual characteristics have different effects on consumer behaviour. Besides, the relevant parts of the published work do not go into the required detail, do not differentiate between different aspects of the visual appearance of personal avatars or various design options, and therefore remain too superficial to be able to guide avatar design specifically (e.g., Calhoun, Ashdown, & Lyman-Clarke, 2010; Zagel & Süßmuth, 2013).

With regard to the thematic classification of core research in IS as provided by Sidorova, Evangelopoulos, Torres, and Johnson (2013), this research relates to the thematic areas of Online Consumer Behaviour (a sub-category of Marketing and Consumer Behaviour) and Virtual Worlds and Virtual Communities.

## **1.2 Research purpose and statement of the problem**

In view of the gaps that have been identified in the existing research on the topic, systematic and comprehensive studies are required to clarify how the desired effects on marketing outcomes may be achieved with personal avatars and to consolidate existing findings. For example, an explicitly abstract appearance comparable to typical shop window mannequins has so far not been considered in existing research.

The term “design” is used throughout this thesis to mean the purposive forming of the visual and functional dimensions of “personal avatars” as interactive objects to support specific online shopping tasks. Questions relating to design as a process, for example, the methods of design are not considered. First and foremost, this work covers the visual aspects, dimensions, shape and colouring of the different exterior, visible elements of avatars and their presentation to the user. Secondly, interactive functional features are considered, for example, rotating the avatar, zooming in and out, or changing body pose, that enable and support the perception of the presented product information by the customer, together with the autonomous, targeted utilisation of their avatar by customers. Also, additional objects, such as fashion

accessories, that may accompany such avatars in order to optimise their effectiveness for their users in the context are discussed where appropriate.

The issue was to identify which are the most important aspects of an avatar that is intended for consumer-centred, customised product representation in a retail shopping context, and how these should be designed. The research had to take into account that the self-evident, ultimate purpose of such a measure of visual marketing is to support product sales. Although this goal originates from the point of view of the retailers, the avatar design must first and foremost be geared to the effects on the attitudes and behaviour of the consumers.

Consequently, the main purpose of this work was to further the knowledge on how different aspects of personal avatars affect consumer behaviour, to what extent this happens and which aspects most contribute to desired marketing outcomes.

Online shopping of clothing was chosen as application context. Due to its relation to the individual body image of consumers, clothing constitutes a rather rewarding product category for research on personal avatars, see comparable work by, for example, Merle, Senecal, and St-Onge (2012) or Suh et al. (2011). Furthermore, a sophisticated virtual try-on system had been developed and was available at Fulda University (Blum, Bomsdorf, Khakzar, & Rupprecht, 2010) for this research. The term virtual try-on (VTO) is used for technology that presents users realistically rendered digital clothing on their personal digital body model, i.e., their avatar. Typically, users select garments and see them worn by their virtual twin. Depending on the functional features and the technological maturity of a given VTO application, this enables consumers to determine the fit and the look of clothing to a more or less reliable extent.

As an innovative marketing approach, this concept has gained significant attention in the media (see Figure 1-1 as a frivolous example, but with serious background), although it is still not widely used in today's online shops.

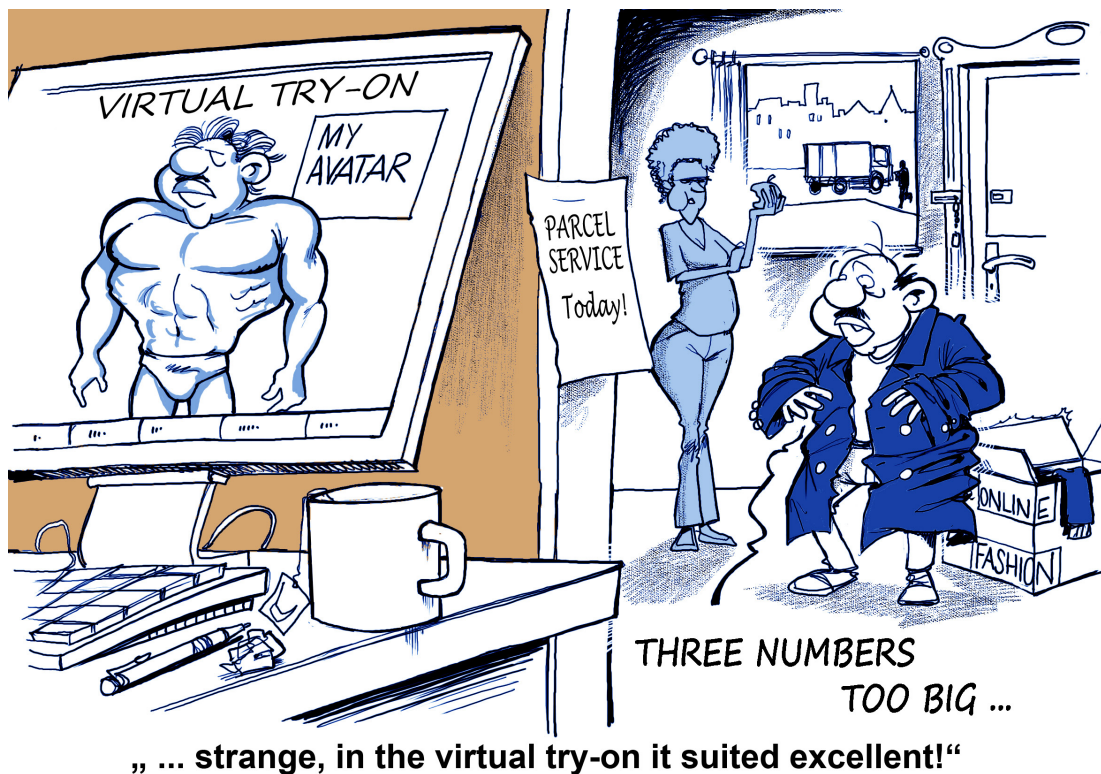


Figure 1-1: Cartoon by Wiedenroth (2009) caricaturing possible problems (related to body image) of VTO in online clothing shopping.

The VTO with personal avatar used for this research has been previously evaluated with several usability-centred tests that also yielded qualitative data on the opinions and preferences of consumers and shop owners on the design and presentation of the included avatars (Blum et al., 2010; Blum, Häberling, Khakzar, & Westerman, 2007). These preliminary insights caused the motivation to investigate the topic more intensively as done in this study.

### 1.3 Research aims and objectives

The aim of this study was to investigate how personal avatars as part of virtual try-on applications in online shopping must be designed in order to be effective for consumers and retailers.

The objectives were:

1. To investigate which individual visual characteristics of a consumer should be imitated by a personal avatar as part of a virtual try-on (VTO) of clothing or similar application in online shopping in order to achieve positive effects on pertinent consumer reactions.



2. To investigate in what way these aspects should be presented by a personal avatar in order to achieve positive effects on pertinent consumer reactions.
3. To identify potential discrepancies between expectations or preferences of consumers on the design of personal avatars compared to actual effects on desired marketing outcomes.
4. To assess if sensing an avatar as personal image, in the sense of identification of the consumers with their avatar, has a positive effect on marketing outcomes, and to investigate which characteristics assure an avatar is sensed as personal image.
5. To derive practical basic design recommendations for personal avatars in VTO applications.
6. To derive practical basic design recommendations for VTO applications other than the personal avatar (a secondary objective).

This work is unable to investigate all visual design options, rather it concentrates on basic design principles in greater detail than currently published work.

Potential users of this work are on the one hand the scientific community that can build on the results when framing further research. On the other hand, managers in online retail may rely on the findings for choosing or creating details of specific implementations of VTO applications in practice.

## **1.4 Structure of the thesis**

This thesis is organised into six chapters, together with several appendices. The content of each chapter is:

- Chapter 1 gives an introduction to the topic of this study including basic background information. The purpose of the research is explained and the research problem is stated, followed by the presentation of the research aims and objectives.
- Chapter 2 presents the relevant literature and existing findings, including detailed background knowledge. It also explains the theory and hypotheses upon which this research is based.
- Chapter 3 describes how the study was conducted, including approach, method, design and techniques employed. Implications of research paradigms are explained and the chosen mixed method approach is motivated. The

methodological steps that have been followed for this study are given in detail, comprising operationalisation of factors, stimulus design, sampling of participants, experimental procedures, collection of data and data analysis.

- Chapter 4 presents the actual data collection, analysis and results of each research method. The quantitative data collected with questionnaires are presented first, followed by the results of the qualitative analysis of the interviews. Their integration is undertaken as part of chapter 5.
- Chapter 5 discusses and merges the quantitative and qualitative results of this study and relates them to the research objectives specified at the beginning of the thesis.
- Chapter 6 summarises the main findings of this study and provides a conclusion. Also, the contributions to the state of the art and to the practice of online shopping are outlined, and possible future research avenues are given.

The Appendices include the ethical approval letters, the permission to conduct the experiment, the participant documents, namely information sheet, consent form, initial questionnaire and main questionnaire, and the interview guide, each in English and German versions. Moreover, the publications resulting from this work are added, as well as a publication list of the author of this thesis.

## **2 Literature and Theory**

The chapter reviews literature with relevance for this research and presents the theory that underlies its research model. First, a classification of this research in IS is given, followed by an overview of the concept of avatars and their usage. Then, relevant aspects of the activity of shopping, including shopping experiences and consumer behaviour are explained, and the avatar concept is associated with that context. This is followed by remarks on the online retail of clothing that also cover the concept of virtual try-on with (personal) avatars. The issue of “avatar similarity to self” in online shopping is considered subsequently.

The research model and hypotheses are presented in this chapter as well. This includes the marketing outcome factors and specific shopping-related consumer characteristics considered for this research. Finally, the chosen design for the avatars used as stimuli in this experimental study is explained and motivated.

### **2.1 Classification of this study in Information Systems (IS) Research**

This research follows the thematic classification of core research in information systems (IS) by Sidorova et al. (2013), and is defined as being located in the thematic areas of Online Consumer Behaviour (a sub-category of Marketing and Consumer Behaviour) and Virtual Worlds and Virtual Communities. That survey was based on the research articles of ten premier research journals over a 20-year period (up to 2011). It was recently complemented by the work of Moqri, Bandyopadhyay, and Cheng (2015).

Two aspects of their summary of the body of research on online consumer behaviour are relevant for this work, namely, the richness of product presentation and the use of virtual reality. Richness of product presentation is represented by the use of pictures, audio and virtual reality-based product presentations with the objective to enrich the online shopping experience of consumers. They cite the work of Jiang and Benbasat (2007), who have shown that vividness and interactivity of presentation influences positively the perception of diagnosticity of the consumers. These authors define perceived diagnosticity in the context of online shopping as the extent to which consumers believe a website is helpful for them to appreciate and evaluate the quality and performance of products. Higher perceived diagnosticity leads to a more positive “attitude towards the website”, which in turn can increase intention to purchase. Suh

et al. (2011) have shown that the use of avatars that look closely like the consumer, as investigated in this research, improves ability to appraise the quality and performance of clothing products.

Sidorova et al. (2013) explain further that the use of virtual reality has the potential to ameliorate the presentation experience and to effect purchase behaviour. They accentuate two aspects that contribute to these outcomes:

- Consumer learning about a product:

Consumer learning can be enhanced with the help of virtual reality when important product features are explicated specifically through visual and auditory cues. According to Suh and Lee (2005), consumer learning is best enhanced by virtual reality when the products are highly experiential in nature, such as clothing products, as found in this study.

- Perceived diagnosticity:

Virtual reality-based product presentations can provide visual control (ability to manipulate product images), and functional control (ability to explore functionality of the product) to the consumer, which helps to increase the perceived diagnosticity of the consumers (Jiang & Benbasat, 2004). Both aspects are realised in the virtual try-on application used as the experimental system for this study.

With respect to the thematic area termed Virtual Worlds and Virtual Communities, Sidorova et al. (2013) state that IS research has shown that virtual world environments can support the selling of real goods. They also cite the work of Suh et al. (2011) on personal avatars as an example. Consequently, the avatar-based application concept is considered to be appropriate for shopping situations where the consumer is required to envision using a product. Typically, this is the case for clothing.

Garnier and Poncin (2013b) have presented a multidisciplinary overview of the literature on the graphical representation of the online consumer in the marketing domain. Based on their work, there is significant potential to improve the online experience through the avatar concept. Generally, advancing the online customer experience is deemed crucial for the growth of e-commerce (Rose, Clark, Samouel, & Hair, 2012). However, research on avatars still estimates its use as being limited

both in quantity and reach, although the theme has already been widely covered in the academic literature in psychology, sociology, education sciences, human-computer interaction and IS (Garnier & Poncin, 2013b).

## **2.2 Avatars and their forms and usage**

The word avatar originates from Indian mythology, namely the Sanskrit word “avatara” and designates the descent to Earth of deities in Hinduism as incarnations or bodily manifestations (Ahn, Fox, & Bailenson, 2011; Garnier & Poncin, 2013b). The term became popular in the context of IT with its usage in the science fiction novel “Snow Crash” (Stephenson, 1992). In this narrative, humans are able to step into virtual worlds and interact with one another, in the form of virtual representations, termed avatars.

In IT, the avatar is defined as a graphical representation, either static or animated, of the user. Often, avatars come as characters, though this is not essential for the concept. Also, an avatar need not necessarily look or behave like the user (Bailenson, Yee, Blascovich, & Guadagno, 2008). Any form of graphics and content can serve as an avatar, for example a photo or an icon. However, according to Ahn et al. (2011), past and present research has concentrated predominantly on avatars in human form.

Sometimes the word avatar is also used for a different, though related, concept called agent or embodied virtual agent (EVA). Like avatars, EVA are most often virtual human figures. Whilst they are steered by computer programs (Nowak, 2004), an avatar is controlled by the user (e.g. actuating movements, changes of scene, reactions and expressions) (Garnier & Poncin, 2013b). Examples of EVA in the marketing context are virtual salespersons or advisors (Holzwarth, Janiszewski, & Neumann, 2006). Different theoretical and strategic issues exist between EVA and avatars and these are mainly related to the control of the virtual character. This study addresses solely the concept of avatars as a graphical representation of the user and is therefore not related to EVA.

In the past, typically, avatars were simply used as visual indicators of their users. The actual interaction was not directly related to the avatar, but relied on different, separate modalities, for example textual communication (Taylor, 2002). Today, avatars can be highly interactive and they can serve as the interface itself, realizing

the concept of “avatar as an interface”, e.g. in gameplay (Barr, Biddle, & Brown, 2006, p. 84).

Initially, avatars comprised coarse graphics and primitive forms and users had only simple options for individual customisation, such as selecting the sex of the avatar or the colour of clothing. Over time, avatars have become more complex creations. Today, they come rendered in 3D and can offer a plethora of options for individualisation. This includes detailed physical features, such as height, body shape, skin and eye colour, hairstyle, and even facial expressions. Also, animated movements are possible (Ahn et al., 2011), in contrast to motionless postures.

The visual forms applied cover a wide spectrum, from 2D images to 3D figures rendered in high detail, and from photo-realistic (or actually photographic) to stylised or cartoon-like appearance. Different degrees of similarity to the user are possible, from abstract objects or beings, to highly stylised self-portraits (Hamilton, 2009; Wood, Solomon, & Englis, 2005).

The forms of use or function of avatars on the Internet or generally in digital environments are manifold today as well, ranging from decorative purposes to proactive behaviour (Wood et al., 2005), and the number and complexity of applications advances constantly. This includes film and game characters, inhabitants of virtual worlds of education or of work-related collaboration, representations of users in Internet communities – and, as in this research, online models for trying on clothes (Garnier & Poncin, 2013b; Hamilton, 2009).

The features of avatars can be used to express the personality of its user and may be useful in different scenarios where distinctive personalities, unique appearances, and even individualised behavioural patterns are beneficial, for example for social interaction in digital environments (Ahn et al., 2011).

Often, the avatar seems to be the key element of the experience of the users (Biocca, 1997; Tisseron, 2009) because it represents the individual person on the screen and it returns the human body to an environment from which it has previously been absent (Vicdan & Ulusoy, 2008). Anthropomorphic avatars have the potential to counteract the common criticism of the Internet regarding its virtuality and its “inhumanity” (Garnier & Poncin), and support a “humanization of the Internet” (2013b, p. 87).

Shopping is a typical example for a setting where this aspect seems to be of avail: in the online case, direct body-related experiences are not possible for the consumer, whereas in traditional bricks-and-mortar stores people use their body to touch and feel products. From this point of view, it appears natural to provide the online shopper with a virtual body.

Positive effects of using an avatar on the virtual experience and its components such as presence or immersion and its consequences, including satisfaction, intention, attitude, etc., have been proven repeatedly in the literature (e.g. Garbarino & Rosa, 2012; Garnier & Poncin, 2013a; Jin & Park, 2009; Lim & Reeves, 2010; Suh et al., 2011; Taylor, 2002). A striking example of the physical and emotional reactions triggered by an experience mediated by an avatar exists in the health domain: using a virtual body can provoke physiological reactions (Fox, Bailenson, & Ricciardi, 2012) and help stimulate changes of behaviour (Cui, Aghajan, Lacroix, van Halteren, & Aghajan, 2009; Fox & Bailenson, 2010).

In general, according to Pena, Hancock, and Merola (2009), digital self-representations of people affect their cognition and behaviour, making it possible to increase the probability that they will think and behave in predictable ways without arousing suspicion.

The influence of the appearance of an avatar on the behaviour of its user when interacting with others is described as the Proteus effect. It was first introduced by Yee and Bailenson (2007) and proposes that the visual characteristics and traits of an avatar are linked to specific behavioural and attitudinal expectations and stereotypes: when individuals believe that others will expect certain behaviours and attitudes from them because of the appearance of their avatar, they will engage in those expected behaviours and attitudes. For example, in a study by Yee, Bailenson, and Ducheneaut (2009) users that were assigned taller avatars negotiated more aggressively than users with shorter avatars. The authors also discovered that these behavioural changes, after being activated in the virtual environment, persisted in subsequent face-to-face interactions.

To sum it up, the body of knowledge in different domains, including e-commerce, suggests that consumer behaviour is influenced by appropriate avatars. At the same

time, the marketing literature stresses the importance of the body in the experience of consuming (Garnier & Poncin, 2013b).

According to the overview by Garnier and Poncin (2013b) the use of avatars on the Internet is increasing, however this still raises a range of questions for researchers and practitioners; one of them being the relevance and detailed functioning of the concept for shopping experience and outcome.

### **2.3 Shopping goals, shopping experiences and consumer behaviour**

As researchers often conceptualise consumer behaviour as being goal-directed, they have investigated extensively the potential goals of online shopping (Chiu, Wang, Fang, & Huang, 2014). It is a common notion that obtaining both value for money and quality constitutes one of the goals of shopping for customers. The differentiation into utilitarian and hedonic shopping values constitutes established knowledge (Jones, Reynolds, & Arnold, 2006) and research supports the view that online shopping can provide both.

The shopping experience, which is also termed the consumer experience or customer experience, is defined as “the internal and subjective response that customers have to any direct or indirect contact with a company” (Meyer & Schwager, 2007, p. 118). Theorised as a psychological construct, it is a holistic, subjective response that results from the contact of the customer with the retailer (Rose et al., 2012).

The benefit received from the multi-sensory and emotional aspects of the shopping experience is termed hedonic. It reflects the value found in the shopping experience itself. Hedonic consumers (also called experiential shoppers) look for a shopping experience that provides entertainment and enjoyment, in a similar way to brick-and-mortar window shoppers (Childers, Carr, Peck, & Carson, 2001). In contrast, utilitarian shopping value is about the acquisition of products and/or information in an efficient and timely manner, with minimum irritation. It depicts the more task-oriented, functional, cognitive, and non-emotional goals of consumers (also called goal-oriented shoppers) (Jones et al., 2006). Figure 2-1 contrasts the utilitarian with the hedonic category.





*Figure 2-1: Typical descriptions of utilitarian versus hedonic shopping benefits/values/goals and shopping experiences*

Shopping experience on the Internet has been studied for over 20 years, and marketing practitioners constantly strive to improve this virtual experience (Garnier & Poncin, 2013b). A selection of important elements of the online experience are: entertainment and escapism (Pine & Gilmore, 1999), immersion (Garnier & Poncin, 2013a; Li, Daugherty, & Biocca, 2001), interactivity (Fiore, Jin, & Kim, 2005), the feeling of being active and in control (Rose et al., 2012), (tele)presence (Fiore, Kim, & Lee, 2005; Song, Fiore, & Park, 2007), learning and knowledge (Pine & Gilmore, 1999), personalisation or customisation (Rose et al., 2012), and aesthetics (Rose et al., 2012). These factors have been shown to positively affect the pleasure of shopping and to support attitudes and behaviours (e.g. satisfaction, loyalty, trust, purchase intention, recommendation intention) that are favourable for retailers (Fiore & Jin, 2003; Harris & Goode, 2010; Rose et al., 2012).

## **2.4 Avatars in online shopping**

According to the literature review by Garnier and Poncin, the research in marketing on avatars has concentrated on two categories of avatar: “model-avatars” and avatars as “inhabitants of virtual worlds simulating life” (2013b, p. 87).

Two aspects seem to be critical to the interest in the first category, model avatars, as found in this research: first, explicit use of these avatars has been identified for online clothing shops (Nantel, 2004), and accompanied, second, by entertainment value (Kim & Forsythe, 2008, 2009; Malter et al., 2008).

Such virtual humans are deemed to have the potential to help compensate for the absence of touch (Rosa et al., 2006) and the lack of direct experience when

appraising products for online purchase (Crete et al., 2009). Thus, they are often designed with high realism, in order to convincingly imitate relevant aspects of the individual appearance of the consumer (Merle et al., 2011; Suh et al., 2011). Figure 2-2 shows two exemplary avatars from the research of these authors. Consequently, pertinent research in the marketing domain often investigates aspects of the relationship of consumers to their virtual counterparts, for example self-perception (Malter et al., 2008), self-congruence (Merle et al., 2009, 2011), or identification (Suh et al., 2011), see subsequent sections for details.



*Figure 2-2: Exemplary avatars as used in the work of Merle et al. (2012) (left), realised with My Virtual Model technology (see section 2.5.4), and Suh et al. (2011) (right)*

The second category, avatars as inhabitants of virtual world simulations, such as the temporarily rather popular “Second Life” world provided by the company Linden Lab, is only of secondary interest for this research. This is because, typically, the major part of commercial activities, including product consumption, takes place within the boundaries of these worlds without a direct connection to the real world. Therefore, in this domain, marketing research is mostly centred on virtual products and brands (Garnier & Poncin, 2013b). Of course, use cases similar to model avatars, namely product appraisal for real-world purchase, are possible as well, and such work has been considered for this research.

This study focuses on avatars of the model avatar type and uses the term “avatar” or “personal avatar” to refer to them.

Existing studies indicate that the form of use of an avatar is closely interconnected with the context of use and the task to be accomplished with the help of the avatar. Avatars differ significantly in design, type of use, and objectives, depending on whether they are employed for, say, gaming, collaboration or life simulation in a virtual world (Garnier & Poncin, 2013b). Also, the extent of identification with an avatar depends on how well it fits to the purpose at hand (Hamilton, 2009). Therefore, research on avatars in e-commerce must pay close attention to the particular characteristics of the context of the application, as these might affect or be affected by the use of an avatar (Suh et al., 2011; Zagel & Süßmuth, 2013). As a result, outcomes are not necessarily transferable to other application domains.

The prototype online clothing shop that has been used for this research has been previously evaluated with several usability-centred tests that also yielded qualitative data on the opinions and preferences of consumers and shop owners on the design and presentation of the avatar (Blum et al., 2007).

Shop owners raised concerns about the appearance of the avatar; there were possible perceived quality shortcomings; and it could be more attention grabbing than the presented product itself. In fact, participants often made remarks about specific characteristics of their avatar, for example its hairstyle or body posture, and about what could be improved in its appearance, rather than concentrating on the product. As a result, preliminary insight gained was: avatars should not distract the consumer from the product on sale, and they should not become an end in itself. Instead, they

should primarily support the actual shopping-related tasks of the consumers. At the same time, the design of the functional and visual features of the avatar should support the objectives of the retailer, which is first and foremost product sale.

Shopping websites are above all utilitarian systems that are expected to help consumers to achieve their goals, rather than enjoy the interaction with the application as such (Visinescu, Sidorova, Jones, & Prybutok, 2015). Consequently, the same applies for a feature of a shop such as virtual try-on with an individualised avatar, as is considered in this work. It is a place where a real problem is solved with the help of a realistic, task-focused virtual reality presentation (Suh et al., 2011).

## **2.5 Online retailing of clothing**

As detailed in section 2.4, research on avatars in e-commerce has to consider the characteristics of the context of the application, as these might affect or be affected by the use of an avatar. The commercial context, the topic of this research, is characterised by the connection between virtuality (the graphical, 3D presentation of a product through the help of an avatar) and the impact on shopping outcome, including actual decisions to purchase products and the shopping experience. Therefore, the following subsections examine the product and its value to consumers, the presentation of clothing in the shopping context and the visual merchandising feature termed virtual try-on that is the specific topic of this research.

### **2.5.1 Clothing and body image**

Clothing is a daily-used commodity that fulfils multiple purposes for humans at the same time. The three basic human needs that are served by clothing are (Wolfe, 2012):

- i. Protection, a physical need,
- ii. Identification and adornment (or decoration), which are mainly psychological needs, and
- iii. Modesty and status, related to social needs or social role.

People use clothing as an artefact to support the construction of their identities and to present it to their environment. Textiles and clothing style, but also the fit of garments, contribute to this creation and presentation of an image (Faust & Carrier,

2009). As “a second skin” (Faust & Carrier, 2009, p. 20), clothing becomes part of one’s body image.

The concept of body image stands for the “multifaceted psychological experience of embodiment” (Cash, 2004, p. 1), which is especially related to one’s physical appearance, though not exclusively. Body image incorporates body-related self-perceptions and self-attitudes of humans, including thoughts, beliefs, feelings, and behaviours (Cash, 2004). These perceptions and attitudes are influenced by a combination of social relationships, cultural ideals, normative prescriptions, and moralistic meanings. Furthermore, the literature of psychology, sociology and marketing describes the human body as a means to present the self, to socialise and to communicate (Thompson & Hirschman, 1995). As it makes the individual “manifest” to the world (Anderson, 2000), it is an important indicator of a person's identity (Schultze, 2010). In view of that, it can be speculated that in a realistic, task-focused context like shopping for clothing as found in this study, an avatar that resembles the customer will positively influence the usefulness of this virtual twin.

Wood (2002) describes a two-dimensional taxonomy of clothing products which includes:

- *Private versus public*, which is about where the garments are primarily consumed; and
- *Expressive versus functional*, indicating the basic purpose of the garment for the wearer.

In the case of functional clothing, for example working clothes, the functionality is more important than the look. In contrast, garments of an expressive nature are chosen by customers based on their symbolic attributes rather than tangible features. Clothing of this type may be used to emphasise the personality and lifestyle of the consumer. Due to its close relation to the identity of the person, expressive clothing is of special interest to this research.

A factor often mentioned in the context of online retail clothing, both in practical consideration and in research, is the concept of the need for touch. As clothing varies appreciably on the properties of the material and is worn directly on the human body, it exhibits a higher need to be inspected by touching it or actually trying it on before

purchase, compared to many other products. Additionally, consumers differ in terms of their tactile needs and concerns about fit, which affects their evaluation of products (Grohmann, Spangenberg, & Sprott, 2007). Peck and Childers (2003) have shown that consumers with a higher need for touch judge products more confidently when touching the products is possible, and that they are more frustrated if not.

Retailers offer a mix of different measures to persuade consumers to buy clothing online without touching it or trying it on first:

- Free shipping and returns;
- In-store pickup and returns;
- Option to buy multiple sizes of the same item.

In addition, the information presented about a product is intended to help to compensate for the inability to try on clothes physically before buying them. This includes:

- Detailed and high-quality product photos;
- Textual information; and sometimes a
- Virtual try-on such as in this study (see subsequent sections).

Clothing is involved in a complexity of personal and highly individual perceptions, attitudes, purposes, goals and values. Many factors influence the behaviour of consumers when shopping for clothing, as well as the success of any marketing measure in this context. This study tries to include and consider a significant subset of these factors.

### **2.5.2 Product imagery and 3D product presentation**

The effects of website imagery to promote products are much studied in e-commerce. Product images are a very important source of information for customers, especially when buying clothing or accessories. A recent study (HookLogic Inc., 2015) claims that, after price, product images are the next most important factor that influences purchase decisions: “Clearly consumers want detailed images that show exactly what the items look like, and potentially on them ... for apparel, a picture really is worth a thousand words” (HookLogic Inc., p. 6).

Moreover, research has demonstrated advantages of three-dimensional images over conventional 2D imagery. According to the early work of Li, Daugherty, and Biocca

(2002), 3D images of products initiate visual mental imagery that enhance product presentation and can influence product knowledge, brand attitude, and purchase intention of consumers. They explain that observing a virtual 3D product model can facilitate many of the same experiences as in a real store and that this virtual experience consists of more active cognitive and affective activities than is achieved with 2D product information (see also Choi and Taylor, 2014). Additionally, purposeful object interactivity elicits vivid mental images of product use regardless of the customers' goals (utilitarian versus experiential) and therefore positively influences intention (Schlosser, 2003). According to Choi and Taylor, message acceptance is enhanced, likely, because consumers are enabled to form specific mental models simulating actual product experience (e.g., product trial) by causing "illusions or quasi-sensory experiences somewhat akin to direct product experience." (2014, p. 2169).

The work of Kim, Fiore, and Lee (2007) concentrates on image interactivity technology (IIT), such as close-up views, zoom-in, mix-and-match functions, and 3D virtual models. In the context of online clothing shopping, they found that the level of IIT is positively related to the experience of pleasure-oriented shopping, such as shopping enjoyment, shopping involvement, a desire to stay, and patronage intention. Li and Meshkova (2013) confirmed that interactivity of 3D product images, such as 360-degree rotation, significantly increases purchase intention.

Reliable and high-quality 3D product information is obviously an effective means for online retail clothing. The virtual try-on feature used in this study is specifically intended to provide consumers with such information.

### **2.5.3 Mannequins**

In retail, one important means of presenting clothing to the customer is by dressed models or mannequins. Brick-and-mortar stores use display mannequins in their shop windows and inside the shop, whilst printed or online catalogues most often display their products with human fashion models.

The majority of mannequins in the stores of major retail chains have human-like forms, either with or without a head. In the former case, their facial features vary from abstract to realistic; the same applies for the shape and colour of the mannequin (see Figure 2-3). Despite their ubiquity, research on the effect of specific visual

aspects of store mannequins that can impact consumer response is sparse (Lindström, Berg, Nordfält, Roggeveen, & Grewal, 2016).



*Figure 2-3: Exemplary mannequins from real shops, with different designs*  
(license information, left photo: “Mannequins at the Holt Renfrew store in Montreal, Canada” by Colin Rose, CC BY 2.0; middle & right: CC0 1.0)

Mannequins are one aspect of visual merchandising. Visual merchandising is about how visual measures are used to communicate the product and the brand to the consumer and also whether these messages are received as intended by the consumer to ultimately convince them to purchase (Kerfoot, Davies, & Ward, 2003).

First of all, showing garments worn by a human or human-like figure simply results in a more informative and realistic display, as they are demonstrated three-dimensionally and in use, compared to a presentation of the clothing draped on a flat surface.

Mannequins in stores provide a wide variety of information about the presented products, as well as the store (Anitha & Selvaraj, 2010). Features of a product are more visible on a mannequin and customers learn how specific garments can be worn and be combined with other garments and accessories. Mannequins can present consumers a complete look to aspire to. They can reflect an overall image,



showcasing, for example seasonal fashion, and also demonstrate how the store itself is up-to-date (Anitha & Selvaraj, 2010).

The work of Jain, Sharma, and Narwal (2012) suggests that mannequins are important, especially to female consumers, and that their look should be appealing in order to attract customers. According to the authors, women give a lot of attention to what is exhibited by such mannequins. Nearly half of the women surveyed stated that mannequin displays help them to be inspired what to buy.

Being based on typical fashion models of today, mannequins are most often idealised, possessing a small dress size and being considerably slimmer than the average woman (Cohen, 2014). For many years, there has been extensive criticism on the use of thin models in advertising and visual communication. The main complaint is about the problematic body image conveyed, with negative consequences for people's perception of fashion, beauty, satisfaction with their own body and attitudes towards food (e.g., Yu, 2014; Kim and Damhorst, 2010; British Medical Association, 2000). However, the fashion industry seems to be committed to its approach, arguing that it simply responds to the actual consumer demand and that this type of model leads to higher sales (Audrey Gillan, 2000; Cohen, 2014).

In contrast, Sen, Block, and Chandran (2002) suggest that more life-like mannequins inform consumers better about fit, by reflecting more closely the measures and proportions of the major target group(s) of the store. Similarly, Ghaffari (2011) proposes that the use of average-sized models in online clothing visualisations reduces return rates and increases purchase intention. Bian and Wang (2015) found that consumers, dependent on their self-esteem and on the brand, evaluated this type of models as being more attractive than size-zero models.

Finally, the research on virtual try-on features in online shopping contains evidence that the imitation of pertinent body-related characteristics of customers has positive effects on consumer experience and behaviour (see the following section).

#### **2.5.4 Virtual try-on**

The term virtual try-on (VTO) is used for technology that enables users to “try on” realistic virtual clothing on their personal, realistic virtual body model, respectively mannequins (avatars). Typically, consumers select garments and see them “worn” by their virtual twin. Depending on the functional features and the technological

maturity of a given VTO application, it enables consumers to determine the fit and the look of clothing to a more or less reliable extent. However, the degree of imitation of a real try-on of the real product varies significantly between different technological solutions.

Numerous research institutions and business companies have worked on the technology of the VTO concept. They have taken diverse approaches with different degrees of complexity. These applications fall broadly into three categories:

1. Simple photo mix-and-match of avatar and clothing
2. Parametric avatars, i.e., avatars with adjustable body measures and a choice of generalised appearances (e.g., regarding skin colour or hairstyle), plus likewise adjusted clothing
3. Highly individualised and detailed figures and clothing.

However, often applications cannot be assigned clearly to one of these categories, as they include technological components of each. Polvinen (2012) provides an overview of the different approaches and application domains of VTO technology that remains up-to-date.

Typically, a photo mix-and-match VTO application is realised in 2D (e.g., front and back images), and consists of a simple overlay of images of avatar and garment, with some photo scaling to cater for different body proportions and to generate a correct masking of clothing over the avatar. Similar applications in the field of augmented reality, i.e., based on live video recording of the consumer are already available (e.g. Zugara, Inc., n.d.). These techniques do not reach the level of simulation of the real, individual fit of the garment in reality, though they may provide the consumer with a helpful impression of the look of a piece of clothing in combination with their individual appearance.

Parametric avatars and clothing form a more sophisticated solution, with more options for avatar individualisation (basic body shapes and body measures, and sometimes integration of a real portrait photo), giving potentially a more realistic depiction of the worn clothing and several pre-defined viewing angles, also named pseudo 3D (e.g., Metail, n.d.; Nantel, 2004). With the help of a parametric 3D model of a human figure, nearly any arbitrary body shape can be synthesised by adjusting a

few parameters (e.g., body measures, weight, muscle mass). Such a VTO application allows provision of size recommendation, together with a certain, though rather limited degree of individualised depiction of the look of the outfits (Zagel & Süßmuth, 2013). Customers may obtain an impression about whether the chosen clothing suits them but, in actuality, individual fit and visual appearance is hardly conveyed (Calhoun et al., 2010).

The technological top level is VTO applications in real 3D. Avatars are generated based on body scans of customers (e.g., Human Solutions GmbH, n.d.b; Loker, Ashdown, & Carnrite, 2008; Styku, n.d.) or highly sophisticated parametric models (Qvit, n.d.) that are able to consider many body measures and body shapes, and with textures produced from several photos of the consumer. Depending on the technical effort made, detailed faces and heads, even with individual hairstyles are possible. The virtual clothing is based on real sewing patterns. With the dressed avatar displayed in 3D scenery, an unlimited number of different viewing angles can be provided.

This research investigates a virtual 3D try-on application. It joins avatars and clothing in a physically-based, three-dimensional simulation. The garments are entered as 2D, CAD-derived pattern data plus several physical cloth parameters, such as stretch-ability or friction. These several aspects are combined to create the final avatar with garments. The resulting 3D visualisation closely approaches the real appearance of the clothing due to the physical cloth simulation that takes into account the shape of the avatar, the parameters of the cloth and the way it falls and moves, and due to the sophisticated visual rendering techniques (Blum et al., 2010). The VTO solution used in this study, originally developed by Fuhrmann (2006), has become part of the commercial product Vidya (Human Solutions GmbH, n.d.a), see also D'Apuzzos's (2009) overview. Figure 2-4 shows two exemplary VTO scenes that were realised with Vidya technology. The avatars employed in this study were developed by the working group of the researcher at Fulda University.



*Figure 2-4: Exemplary VTO scenes realised with Vidya technology: Promotional image taken from the Vidya website (Human Solutions GmbH, n.d.a) (left) and model avatar as used in this study (right)*

Naturally, VTO applications provide 2D or even 3D product imagery of garments, often with interactive features. The advantages of product information of that type have been discussed in section 2.5.2. Research on VTO has, on the one hand, contributed to that knowledge, and on the other hand, it has provided recommendations for features and design of such applications.

Due to its wide-spread popularity, several researchers have employed the My Virtual Model (MVM) technology (My Virtual Model Inc., n.d.; Nantel, 2004) for their studies (e.g., Garbarino & Rosa, 2012; see Figure 2-2, page 14 for an example).

However it has almost disappeared from the market now, with the websites of Model My Outfit Inc. (n.d.) and Model My Diet Inc. (n.d.) being two exceptions.

Calhoun et al. (2010) demonstrated MVM to be able to raise online turnover, as consumer confidence in purchasing is improved. They also presented participants with their high-resolution body scans, displayed as a 3D model but without colour and texture information. Participants voiced many criticisms of the MVM avatars, particularly that the body was too smooth, lacked variation in appearance with respect to the input of body measurements and that it looked more like a model than a real person, resulting in an unrealistic image. In contrast, many participants stated that their body scan was too detailed and realistic. However, unlike the research reported here, the study of Calhoun et al. (2010) was not conducted using a systematic variation of avatar appearance for comparison.

Whilst clothing constitutes a very prominent use case for virtual try-on, other product categories including eyewear, make-up, hairstyles and accessories are also significant today (ACEP TryLive, n.d.; FaceCake Marketing Technologies, Inc., n.d.). However, as they either concentrate on the face and head, or, in the case of accessories, are less concerned with body measures and body shapes, these application contexts differ considerably from the virtual try-on setting researched in this work.

## **2.6 Avatar similarity in online shopping**

This section examines existing research on the design of personal avatars that relates to avatar similarity, i.e., the similarity between the physical appearance of the avatar and that of its user (Suh et al., 2011). In the literature different concepts and terms are used to denote the concept including, realism of avatars, similarity to self or likeness to self, self-congruence, isomorphism, anthropomorphism and avatar homophily; which are closely related or even congruent.

Various terms including “personalised”, “personalisation”, “personal” are used in the literature to describe how avatars may be adapted to mimic aspects of the visual appearance of their user (e.g., Crete et al., 2009; Merle et al., 2012). Though an application that employs such avatars may be regarded as being “personalised” in this respect, the term “personalised” in Information Systems has taken on many connotations, and may be considered to include a greater range of user characteristics than visual. One example are recommender systems (Ricci, Rokach, Shapira, &

Kantor, 2011) that quantify the interest of users towards specific objects in order to select the most interesting ones from the range of available objects and present them to the user, for example, products in online shops. Such systems rely on sophisticated user data models being refined constantly during the interaction of the user. Although the avatars in this research incorporate personal data (body measures and photos); they do not include the much richer user models of some applications. In order to distinguish the somewhat narrower sense of personalisation adopted in this research, the terms “personal avatar” as well as “individualised” and “individualisation” are used in this thesis.

Generally, avatars of the type and application domain investigated in this research are recommended to feature high avatar similarity as perceived by the user (e.g., Kim & Forsythe, 2008, 2009; Merle et al., 2012; Suh et al., 2011).

However, it must be noted that similarity to self from the point of view of the user can differ significantly from actual self as might result from a body scan or as perceived by other people. This is because body image is a very subjective perception (see section 2.5.1).

One rationale for high similarity is that the task at hand, namely reliable, trustworthy product appraisal, requires provision of meaningful product information. Theorists, practitioners, and consumers consistently explain perceived trust as essential to online shopping intention (Harris & Goode, 2010). In a virtual try-on application, clothing and avatar form a whole, and it seems intuitive to also imitate relevant aspects of the individual appearance of the consumer – at least to the extent that is required for a convincing product presentation.

Garbarino and Rosa (2012) explain that the product appraisal within a VTO involves an abstract perceptual process where customers need to mentally extrapolate the consumption experience from the virtual scenery. They state that the creation of such a mental representation is not only dependant on the perception of the product but also on the avatar and its ability to accurately represent the body of the consumers in the way they individually perceive it.

### **2.6.1 Design options for personal, human avatars**

There are a number of aspects of the appearance of an individual person that a personal avatar can imitate or omit, whether purposefully or due to technical restrictions:

- Body measures, e.g., body height, breast girth,
- Body proportions or shape, e.g., muscle mass, body fat,
- Head with face and hairstyle,
- Body colours, including skin, hair, eyes etc.,
- Posture, e.g., hollow back, tilting.

Each aspect can be imitated in great detail or, instead, can be depicted with a more or less precise approximation. Another option is to specifically smooth, slenderise or sugar-coat the avatar compared to its human template in reality. Additionally, stylised designs are possible, such as comic-style rendering, or a uniform colour for the whole body.

Also, different design approaches could be chosen for different parts of an avatar, such as representing only the basic face shape, whilst mimicking exactly the remainder of the body. Indeed, body parts may even be omitted, such as the head, as known from window shopping mannequins.

Personal avatars can be animated, such as: constantly showing some slight motion like a living person; varying the posture on demand, for example stretching arms forward, sitting, or taking a dynamic pose; or showing different emotions, for example smiling, neutral, serious. They may even mimic the individual behaviour of a person.

This research focused exclusively on static visual aspects, similar to the majority of the existing work on the topic (e.g., Calhoun et al., 2010; Merle et al., 2009; Suh et al., 2011). It seems reasonable to clarify these more fundamental aspects first, particularly as they can be realised with justifiable technical effort, before considering further design options.

In principle, an extensive range of design options and their combination exists. Some are more complex and costly to realise than others, especially in an online shopping context. Some may not be worth the effort, as no added value may exist or may be

too small. Therefore, it is reasonable for this research to determine and investigate the effects of design options that might be perceived to have significant impact on consumer behaviour.

### **2.6.2 Pro avatar similarity**

Cui et al. (2009) report that in virtual worlds, people are likely to concentrate more closely on a task and to be motivated to perform it better if they are represented by an avatar that looks like themselves.

Zagel and Süßmuth (2013) report from a study and survey on avatars that participants emphasised that avatars should show best possible closeness to reality for body features when used in task-oriented applications, i.e. services that are geared to specific tasks like, for example online shopping, training or medical applications. Their research does not go into detail concerning the different possible aspects of avatar realism, but is content to make this general statement.

Merle et al. (2009) and Merle et al. (2012) tested several types of individualisation within the options offered by the My Virtual Model (MVM) technology (see section 2.5.4). The experimental condition with the highest level of individualisation involved imitation of the consumer face. The MVM face feature utilised was a simple overlay onto the avatar of the face of the person cut from an uploaded 2D photo, meaning that the individual face was only available in the front view. In practice, the degree of individualisation of the employed MVM system is very high, but much development potential remains (Calhoun et al., 2010), especially when employed as an experimental test system, for example greater variation of appearance and true 3D. In the research of Merle et al. (2012), participants recorded highest values for self-image congruence (or self-congruity) and also for the investigated consumer behaviour related constructs, i.e., utilitarian and hedonic value of the website, confidence in apparel fit and purchase intention on the website, for the most individualised models. However, two of the four conditions used avatar types that likewise imitated body measures and the face was individualised in only one of these two groups (Merle et al., 2012). Figure 2-5 depicts two examples of these avatars.





*Figure 2-5: Exemplary personal avatars as published in Merle et al. (2012); while both avatars feature individual measures, the avatar on the right has an individualised face (implemented as an overlay of a photo of the face of the user)*

When analysing their collected data, the researchers decided to put the two groups together as no significant variance between these groups for perceived level of individualisation was identified. Merle et al. (2012) concluded that the perceived resemblance between the consumers and their avatars should be maximised in order to increase the positive impact of VTO on marketing outcomes. The authors did not derive specific recommendations for personal avatar design from their experimental study. Rather, they recommend future research to investigate in more detail the effects of different VTO individualisation levels and features on consumer behaviour.

Suh et al. (2011) show with their study based on a VTO scenario that the more closely avatars reflect the physical appearance of their users, the more the intention to use this feature is positively affected. The same applies for emotional aspects (e.g., affection, connection, and passion) toward the avatar. They further state that the ability to evaluate the quality and performance of garment products increases, termed in their work as perceived diagnosticity.

The authors argue that, in order to explain these effects, it is essential to consider two perspectives: a utilitarian or task-focused perspective and a value expressive viewpoint. Additionally, the former is influenced by the latter, at a less conscious

level. Consequently, Suh et al. (2011) distinguish functional congruity and self-congruity as the two factors of resemblance of the avatar with its user: On the one hand, they rely on the theory of self-congruity developed by Sirgy (1986) to explain the search of users for consistency of their avatar with their physical and/or psychic self-concept. Sirgy's self-congruity theory explains the effect of congruity between self-concept and product-concept on consumer attitudes and behaviours, for example purchase intention. It proposes that consumers compare psychologically their personal image of a product and their self-concept (e.g., actual self-image, ideal self-image, social self-image). High self-congruity is experienced when consumers perceive their image of a product to match their self-image, and vice versa (Sirgy et al., 1997). According to the authors, self-congruity affects consumer behaviour through motives of self-concept such as the needs for self-consistency and self-esteem.

On the other hand, functional congruity is the match between the perceived utilitarian attributes of a product or service and criteria or desired functional attributes of an individual (Sirgy & Johar, 1999).

In their study Suh et al. (2011) divide avatar similarity, i.e., the perceived similarity between the physical appearance of the avatar and the user, into facial similarity and body similarity, in order to be able to find differences in the usefulness of both constructs. Therefore, they conducted a laboratory experiment with a  $2 \times 2$  factorial design with two between-subject factors: facial similarity and body similarity, each with two levels, i.e., high similarity and low similarity. The high similarity face was realised with a textured 3D scan, whilst for the low level part participants had to choose one of four generic faces (as found in many commercial virtual shops and in online role-playing games). Similarly, the high level of body similarity was realised with a 3D body scan, whilst the other condition was composed of a choice of 4 to 6 different body shapes, with this choice being a preselection, based on height, weight and age, specified by the participant, from 100 available body shapes. Figure 2-6 shows an avatar as used in the study of Suh et al. (2011).



*Figure 2-6: Exemplary avatar from the work of Suh et al. (2011)*

The authors state that their results show that via the mediating effect of avatar identification, people perceive positively an avatar that corresponds to their self-concept, and that this positive attitude and the utility of the avatar are significant factors for increased intention to use the avatar.

However, closer consideration of their statistical test results on the mediating effects in their research model shows that the effect of face similarity on perceived diagnosticity is fully mediated by avatar identification, with only a small to medium effect size and a lower coefficient of determination,  $R^2$ , than obtained for most of the other paths of the model. In contrast, avatar identification mediates the effect of body similarity on perceived diagnosticity only partially, and with considerably higher  $R^2$ . This means there is a direct effect of body similarity on perceived diagnosticity. Therefore, the results seem to demonstrate a lower importance of face similarity compared to body similarity for perceived diagnosticity.

### **2.6.3 Contra avatar similarity**

Malter et al. (2008) report a study where the VTO experience made participants more confident in their online evaluation of product items. Also, it changed their preference for the presentation of product items, from an ideal image of a fashion model, to an avatar that looks like them. However, the isomorphism of the virtual model neither led to a more positive product evaluation nor increased purchase intention.

In a study on similarity and self-identity in advertising by Lutchyn, Duff, Faber, Cho, and Huh (2009), participants rated models (represented only as the face) that were less similar in appearance to themselves (concerning ethnic matching) as more trustworthy, attractive, likeable and even as more similar to themselves. As an explanation for this effect, the authors suggest, referring to an assimilation-contrast reaction according to Mussweiler's (2003) selective accessibility model that the degree of similarity acts as a cue whether to compare or contrast oneself to the model. In the case of high congruence, people compare themselves and therefore, mainly consider differences and thus the inappropriateness of the model. When differences are dominant the similarities come to the fore, resulting in a more favourable attitude to the model. Hamilton (2009) argues in a similar way, drawing on findings by Nowak and Biocca (2003) on factors for identification with the avatars of others. The author states that a more generalised avatar makes it easier for oneself to project traits of similarity onto it, as opposed to difference.

It seems intuitive to assume that a personal avatar that is intended as a portrait of the user should mimic the visual appearance of its owner in as much detail and exactitude as possible. However, in contrast, drawing upon theories of portraiture, a convincing portrait in the traditional sense is characterised by whether it depicts the essence of the subject, and not just provides a precise representation of the look of a person (van Alphen, 1997). By emphasising key characteristics, a depiction can retain and even accentuate essential qualities of the portrayed subject, with minimal graphical means, e.g. only lines. As this strategy of reduction of visual complexity is highly prevalent today, in pictograms, way-finding and screen icons, people are already heavily accustomed and experienced to it (Hamilton, 2009). The author further points out that abstraction and reduction of visual specificity can increase

identification, as it may provide a more familiar representation of identity in certain contexts than a precise 3D self-portrait.

Wood and Solomon (2011) caution about the risk of failing to match the expectations of users concerning interactivity when offering highly anthropomorphic characters. According to them, people would expect such avatars to mimic the behaviours of a real person as well. It must be noted though, that this recommendation applies to avatars in the form of EVA.

#### 2.6.4 Uncanny valley

The notion of the “uncanny valley” describes the negative reactions, for example the sense of unease or eeriness that viewers exhibit when seeing a figure that is almost – but not perfectly – human. Whilst empathy levels felt toward a figure increase as it leaves from basic design and approaches a more human form, negative effects have been observed when a level of near-complete humanity is reached (Smirnov & Pracejus, 2011).

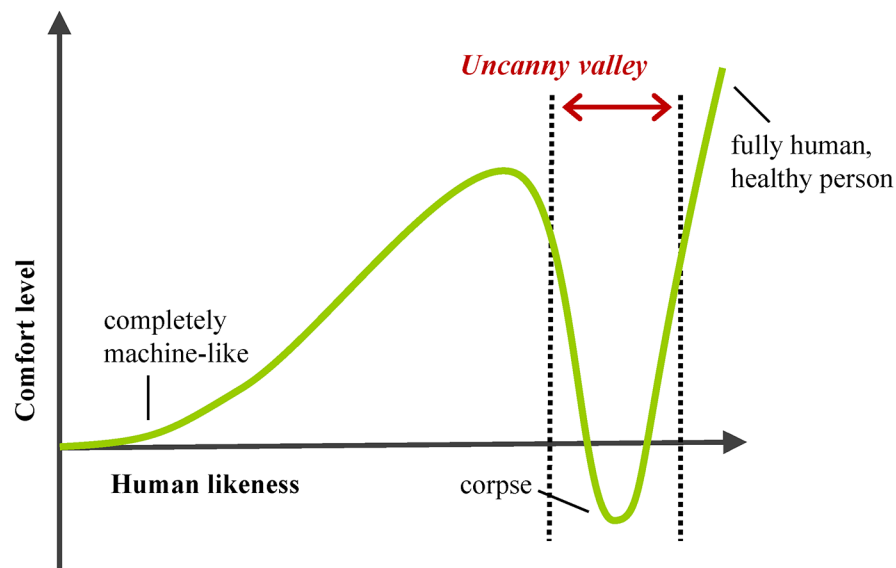


Figure 2-7: Dependence of the emotional response towards a virtual human on its anthropomorphism, and the “uncanny valley”, adapted from (MacDorman, Green, Ho, & Koch, 2009)

The effect was first identified by roboticist Mori (Mori, MacDorman, & Kageki, 2012), in the 1970s, who associated it with robots. Later, it has been extended to different forms of depiction of human beings, including highly realistic 3D computer animation (MacDorman et al., 2009). The empirical literature for the uncanny valley

hypothesis remains inconsistent, but suggests at least that the uncanny valley exists under specific conditions (Katsyri, Forger, Makarainen, & Takala, 2015). This study has taken the phenomenon into account for the design of its avatars (see section 3.5.3.2), as well as in the analysis and discussion.

### **2.6.5 Avatar creation**

In many applications and services that comprise anthropomorphic avatars, users can create and individualise their personal avatar at their own discretion. The available options for customisation range from a simple choice of different pre-configured avatars to fine grained and complex modifications of nearly any detail of the avatar, for example height, body and face shape, skin and eye colour, hairstyle, and even facial expression.

Often, for example in virtual universes, such as “Second Life”, creating the avatar is the first task a new user has to accomplish (Garnier & Poncin, 2013a). Also, this can be a relatively long decision process (Tisseron, 2009), especially in virtual universes or in online games. For these two contexts, researchers have identified the avatar creation process to influence strongly the experience lived by the consumer (Feldon & Kafai, 2008; Lim & Reeves, 2010).

According to Messinger et al. (2008), who analysed data from residents of the virtual world “Second Life”, people tend to make their avatars look similar to themselves, with moderate enhancements (e.g., slightly younger or older, thinner or taller). This is caused by the tendency of users of “balancing motives for self-verification and self-enhancement” (Messinger et al., 2008, p. 15). Self-verification is about maintaining a consistent self-concept and truth about oneself. In contrast, self-enhancement is the tendency to either promote a positive self-concept (simple self-enhancement) or to distort negative personal information in a more positive direction (compensatory self-enhancement) (Kaplan, 1976). Then, with an enhanced appearance of an avatar, compared to the actual self of the user, the Proteus effect comes into play (Yee et al., 2009), i.e., confidence and social behaviour is impacted (see section 2.2). However, the Proteus effect is not relevant for the work reported here, as the application context does not involve a social component, i.e., interaction with other users.

In contrast, Garnier and Poncin (2013a) see a risk for task-oriented commercial contexts of diminishing credibility if playful aspects of avatar creation are exaggerated as compared to the utilitarian side.

Generally, it may be speculated that the mere effort of the customisation invested by the user contributes to the positive effects of personal avatars as well. However, in this work the creation process was omitted in order to strictly control the appearance of the avatar stimuli and to ensure comparable stimuli within the groups.

### **2.6.6 Conclusion**

In summary, existing research on the requirements for personal virtual humans – taking the role of digital consumer representations – in online shopping settings and the resulting effects on consumer behaviour appears inconsistent and somewhat limited and incomplete (see also Garnier & Poncin, 2013b). At least, it seems evident that different visual characteristics have different effects on consumer behaviour. However, the significant parts of the published work do not go into the required detail, do not differentiate between different aspects of the visual appearance or various design options, and therefore remain superficial (e.g., Calhoun et al., 2010; Zagel & Süßmuth, 2013) and do not fill these gaps in knowledge.

More systematic and comprehensive studies to clarify how to achieve desired effects and to consolidate existing findings appear advisable. For example, an explicitly abstract appearance comparable to typical shop window mannequins, as in this study, has so far not been considered in existing research.

## **2.7 Research model and hypothesis**

### **2.7.1 Selection of factors**

The first step towards selection of factors was to inspect the pertinent literature on purchase-related consumer behaviour on the Internet (see also section 2.3). The body of research has investigated a plethora of factors that impact on the online shopping experience with respect to their influence on attitudes and behaviours, and how to achieve these effects with marketing stimuli. These factors range from purely utilitarian aspects to experiential, emotional, multi-sensory stimulation and immersion. Today, one of the main concerns of marketing practitioners is to improve this online shopping experience (Garnier & Poncin, 2013b), in order to convey favourable outcomes to consumers and retailers.

For this research, several well-investigated factors of favourable marketing outcomes were selected and the ones deemed most significant were selected as the factors for the theoretical model of this research (see Table 2-1). In addition to factors that account for the utilitarian character and qualities of the personal avatar try-on feature, experiential factors were added, in order to cover the complete identified range. These marketing outcome factors also support the goal to explain the effects that were identified.

*Table 2-1: Overview of marketing outcome factors selected for investigation*

<i>Name</i>	<i>Category</i>
Informativeness	Utilitarian value
Telepresence	
Attitude towards the website	Attitude overall
	<i>ABC model of attitudes:</i>
Shopping enjoyment	A: Affective response
Purchase intention	B: Behavioural intention
Decision support satisfaction	C: Cognitive response
Perceived risk of purchase	

The first category of factors concerned the utilitarian value of personal, avatar-augmented clothing shopping. On the one hand it was gauged via an “informativeness” construct. This scale measures the degree to which a website provides a person with information that they perceive as resourceful and helpful. Furthermore, as the purpose of the VTO is to simulate the product experience that is possible and common in retail stores, the so-called telepresence construct was taken into account. It provides a subjective perception of how closely the online sensory information and interaction with the product (with the help of and via the personal avatar) approximates information and interaction with a real product in a brick-and-mortar store.

The second category was attitudinal measures. A psychometric scale was used for each of the three attitudes differentiated in the common ABC model of attitudes (Solomon, Bamossy, Askegaard, & Hogg, 2010): shopping enjoyment as affective response; purchase intention as behavioural intention; and “decision support satisfaction” as cognitive response; plus attitude towards the website as a general attitudinal evaluation.



The third category of purchase-related consumer behaviour factors was the perceived risk that relates to the nature and amount of uncertainty perceived by a person in making a particular purchase decision.

Whilst actual purchase would be the outcome factor of primary interest in real business situations and motivated the investigation of personal avatars as the marketing measure discussed here, actual purchase behaviour is difficult to elicit reliably in a laboratory experiment. For this, the factor “purchase intention” was included.

As a matter of course, the factor “avatar similarity” was incorporated (see also section 2.6). It was expected that each of these factors varies significantly between the three individualisation groups, respectively avatar types. The following sections introduce and motivate each considered factor in more detail and list the corresponding hypotheses.

### **2.7.2 Informativeness**

The “website informativeness” construct is defined as the degree to which a website provides a person with information that they perceive as resourceful and helpful (Chen & Wells, 1999). The greater the informativeness of a website, the more customers will feel capable of understanding products and of making better informed purchase decisions. Consequently, it can be expected that they are more satisfied with the retailer, more positive about the product, and more likely to purchase the product (Holzwarth et al., 2006).

Several other constructs bear a nearly identical or rather similar meaning, which include “perceived amount of information” (Kim & Lennon, 2000), and especially “perceived diagnosticity”, which is defined as the capability of an application to convey relevant product information for evaluation of quality and performance (Jiang & Benbasat, 2007; Suh et al., 2011). Therefore, this study simply uses the term “informativeness” for this factor.

A specific avatar design that claims to be more effective for consumers in a commercial context, as considered in this study, should produce a significantly higher degree of informativeness.

Thus, this study hypothesised that:

H1: Informativeness varies between different avatar designs.

### **2.7.3 Telepresence**

Biocca (1997) defined telepresence, developed by interacting with a virtual environment, as the sense of being at another location or of being in a mediated space other than where the physical body is located. The construct is similar to presence, i.e., the feeling of presence or of being “there” in a virtual space (Garnier & Poncin, 2013b; Klein, 2003).

As the purpose of the VTO is to simulate the product experience that is possible and common in retail stores, the telepresence construct has relevance also in the context of this study. Here, it indicates the subjective perception of consumers how closely the computer-mediated sensory information and interaction with the product (with the help of and via their personal avatars) simulates and approximates information and real-world interaction with real clothing products, for example, in brick-and-mortar stores (Shih, 1998). In this regard, telepresence is rather congruent with closeness to reality.

In turn, telepresence has positive effects on other favourable marketing outcomes, namely, for example, attitude toward the online retailer, willingness to purchase from the retailer, and willingness to visit the online retailer again (Fiore, Kim et al., 2005).

As the personal avatar is an inherent, significant part of the VTO experience it seems probable that telepresence will differ between different degrees of avatar individualisation, because they should generate a different degree of telepresence.

Thus, this study hypothesised that:

H2: Telepresence varies between different avatar designs.

### **2.7.4 Shopping enjoyment**

Shopping enjoyment constitutes a person’s enjoyment of the shopping experience. It stands for the extent to which a person perceives the shopping experience with an online shop to be enjoyable in its own right, apart from any performance consequences that may be expected (Davis, Bagozzi, & Warshaw, 1992; Kim et al., 2007). According to Kim et al. (2007) shopping enjoyment arises from pleasure and excitement triggered by the store environment.

Shopping enjoyment is a favourable marketing outcome as it positively influences other marketing outcomes, for example, the desire to stay (in this case, in the shop, i.e., to continue to shop) (Kim et al., 2007).

For this study it is speculated that the degree of individualisation of an avatar has an effect on the enjoyment perceived by its user. For example, a highly personal avatar may lead to more pleasure and excitement than other avatar designs.

Thus, this study hypothesised that:

H3: Shopping enjoyment varies between different avatar designs.

### **2.7.5 Decision support satisfaction**

Decision support satisfaction evaluates how satisfied a person is with the decision support received from an information system, including the ability of the system to deliver relevant information for decision making and to improve the person's decisions. In a commercial context, decision support capabilities comprise structuring, analysing, and implementing a purchase decision (Garrity, Glassberg, Kim, Sanders, & Shin, 2005). According to the authors, the construct covers one dimension of the perceived usefulness of a system, besides task support satisfaction.

Alternative avatars that are individualised to different degrees may convey different amounts of information with relevance for purchase decision making to the consumer.

Therefore, this study hypothesised that:

H4: Decision support satisfaction varies between different avatar designs.

### **2.7.6 Purchase intention**

Purchase intention represents what and where a person believes they will buy (Kim & Lennon, 2000). This construct is generally considered to be highly indicative for actual purchase behaviour.

Whilst actual purchase would be the outcome factor of primary interest in real commercial contexts, actual purchase behaviour is difficult to elicit reliably in a laboratory experiment. In its place, the factor purchase intention was selected, as a better measure of purchase behaviour compared to the other marketing outcome factors. To consider separately all the marketing outcome factors that affect purchase

intention, would require numerous studies. Therefore, using purchase intention in this study may enable all to be included at the same time, although indirectly.

Schlosser (2003) found out that purchase intention resulted from the direct manipulation of a product in the virtual space, which resembles the actions with the product in the real world. Such a product experience is enabled by a VTO, as investigated in this study, and the personal avatar plays a central role within it. Therefore, it may be speculated that resulting purchase intention varies in relation to avatar individualisation.

Thus, this study hypothesised that:

H5: Purchase intention varies between different avatar designs.

### **2.7.7 Attitude towards the website**

“Attitude towards the website” represents the general evaluation of a website by a person or their general favourability toward a website. It is considered as a key predictor of both consumer adoption and usage of a website, and the effectiveness of online marketing measures (Chen & Wells, 1999).

As a form of customisation, namely presenting information about products in a manner that corresponds to the individual needs of customers, VTO with personal avatars is expected to have a positive effect on the attitude of consumers toward such a website (Crete et al., 2009). Consequently, different individualisation types represented in avatar designs should produce different levels of “attitude towards the website”.

Thus, this study hypothesised that:

H6: Attitude towards the website varies between different avatar designs.

### **2.7.8 Perceived risk of purchase**

Perceived risk is the nature and amount of uncertainty perceived by a person in making a particular purchase decision. It constitutes a central issue in online retail (Tong, 2010) and is known to influence highly the intention to shop online: As product perception by means of physical inspection is not possible, online consumers suffer from evaluation difficulty – a cognitive and behavioural difficulty and effort required to judge and discriminate between alternatives. Perceived risks associated with online shopping negatively influence online purchase intention and behaviour.

Good information content is essential for reduction of perceived risk for individuals (Shin & Baytar, 2014).

Shim and Lee (2011) found that 3D virtual models can convey detailed product information that can reduce the perceived risk for consumers. Kim and Forsythe (2008) stated that consumers are likely to use VTO technology in order to reduce “perceived risk of purchase” by creating avatars that mimic their physical appearance. It seems intuitive that the information provided in a VTO context differs between differently individualised avatars.

Thus, this study hypothesised that:

H7: Perceived risk of purchase varies between different avatar designs.

### **2.7.9 Avatar similarity to self and assessment of avatar characteristics**

As a matter of course, the factor avatar similarity (see also section 2.6) was included, in order to survey how the participants actually perceived their individual avatar and how they identified with it. For this study, it was assumed that this factor shows consistent differences between the different avatar individualisation types. This might provide an explanation for variances in outcomes between the other investigated conditions as well as provide hints for avatar design.

Therefore, this study hypothesised that:

H8: Avatar similarity to self varies between different avatar designs.

Furthermore, it was supposed that “avatar similarity to self” has positive effects on the marketing outcome factors. Thus, this study hypothesised that:

H9: Avatar similarity to self is positively related to the investigated marketing outcome factors.

In the research model presented by Garnier and Poncin (2013b), which is based on a rather comprehensive literature review, identification with the avatar even constitutes the key mediating variable.

However, avatar characteristics should also be assessed in order to gain a more detailed picture about the attitudes of the participants to the details of the design of the presented avatars and of any other, potentially different avatars, and for secondary analysis purposes, namely:

- Preference for specific aspects of the appearance of the presented personal avatar, for example, body measures, body shape and posture (it was expected to find systematic differences for these variables between different avatar designs);
- Desired characteristics of a personal avatar, including importance or rejection of imitation of different characteristics of one's body and appearance by the personal avatar;
- Importance or rejection of specific optional characteristics and functionalities of the personal avatar.

#### **2.7.10 Consumer characteristics**

Identified differences in the marketing outcomes investigated with this study may not only be due to the variations in personal avatar design. Other possible factors that may have an influence are individual consumer characteristics such as age or habits and experiences concerning use of the Internet and online shopping (especially shopping of clothing). Individual people have different motivations and abilities to process information and to resist persuasion (Holzwarth et al., 2006). These factors were therefore included, in order to control them and for secondary statistical analyses.

For the same reason, the construct shopping orientation was considered. It represents the manner in which a person approaches the activity of shopping and is implemented as a value on a continuum between recreational shopping orientation and task orientation (Machleit, Meyer, & Eroglu, 2005). This corresponds roughly to the experiential versus utilitarian character of the VTO with personal avatar and may therefore bias its effects on the corresponding marketing outcome factors.

Furthermore, appearance orientation was included, as it covers the importance of appearance to the individual, with attention to appearance as well as thoughts and behaviour centred on appearance (Brown, Cash, & Mikulka, 1990). A biasing effect

on the marketing outcome factors, as well as the avatar similarity construct, was deemed possible.

### 2.7.11 Research model overview

Figure 2-8 depicts the complete research model, showing the different relations that were investigated in this study.

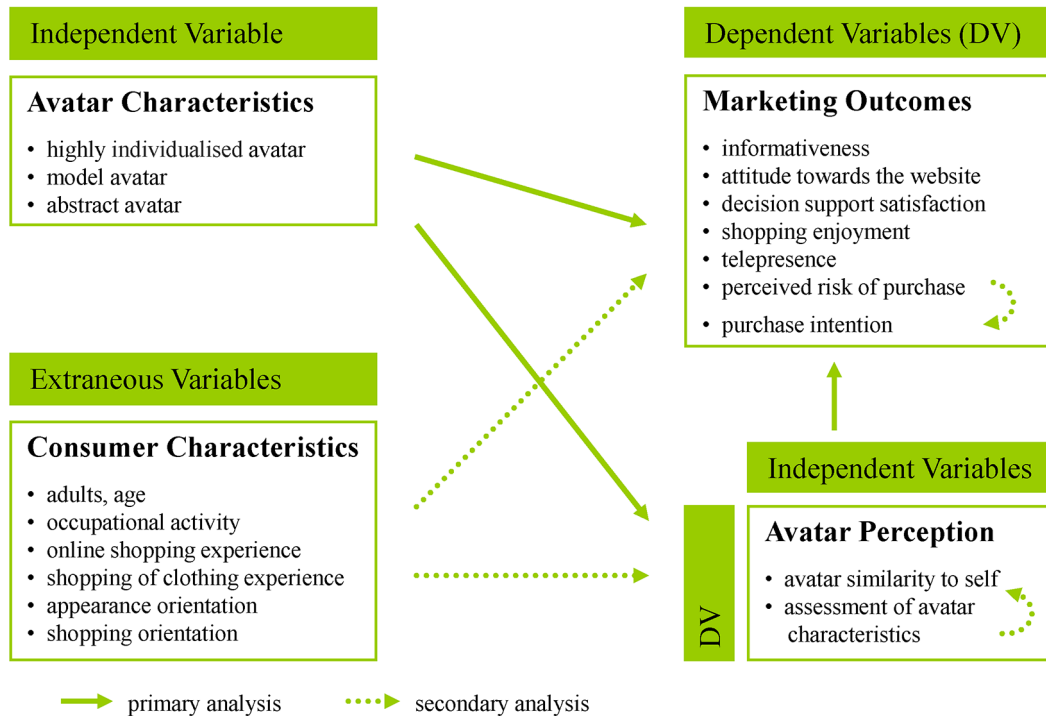


Figure 2-8: Research model overview

Based on their literature review, Garnier and Poncin suggest an “Integrative model for the study of the impact of an avatar in a commercial context” (2013b, p. 92) that is intended to depict the most important elements for research on the type of avatars that are also found in this work. Their model is made up of five parts (see Figure 2-9):

1. Antecedents related to the design of the avatar, namely individualisation options, degree of anthropomorphism, self-representation strategy of the user;
2. Relationship between the individual and its avatar, i.e., identification with the avatar, as central mediating factor;
3. Virtual experience, examined via the concepts of immersion and perceived presence, both being consequences as well as mediators;

4. A range of marketing-related and individual consequences, linked to avatar identification as well as virtual experience;
5. Moderator variables, namely familiarity with avatars, age etc.

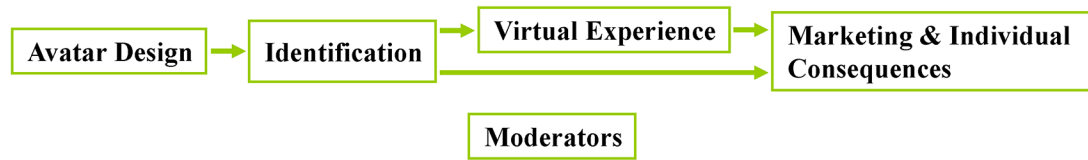


Figure 2-9: Integrative model for avatar-related studies in commercial contexts; adapted from Garnier and Poncin (2013b)

The research model presented in this work is similar to this integrative model:

- Avatar characteristics relate to “avatar design”,
- Avatar perception to “identification”,
- The marketing outcome factor telepresence to “virtual experience”,
- The remaining marketing outcome factors to “marketing & individual consequences” and
- Consumer characteristics to “moderators”.

Accordingly, each aspect is considered, though, naturally, by reason of practicality of the study, not in complete depth. In contrast to the integrative model, this research focuses more on the utilitarian aspects of the investigated marketing measure VTO, rather than putting avatar identification in the centre.

### 2.7.12 Qualitative investigation

In addition to the quantitative research that was implemented through the research model, a qualitative part was also included in this study. Its purpose was to cover and understand aspects that, due to their nature, could not be incorporated into the research model and that required a more explorative approach.

The objectives of the qualitative investigation were to explore motivations for responses given by the study participants in the quantitative part and to seek explanations for the identified effects and trends. Therefore, the aspects addressed were directed to the topics covered by the research model, namely, attitudes towards specific characteristics of the avatar, utility of the VTO functions, “avatar similarity to self”, as well as further desired characteristics and functionalities of the VTO with personal avatar.



## 2.8 Avatar stimuli design

Three different types of avatar design were chosen for the study (see Figure 2-10):

1. Highly individualised avatar,  
featuring a high degree of individualisation with individualised head, namely face and hairstyle, and a photorealistic style, specifically detailed and realistic (and individual) colours for skin, hair and eyes;
2. Model avatar,  
consisting of a typical, non-famous fashion model with a photorealistic style, namely detailed, realistic colouring and an idealised appearance typical for fashion models, consistent with ideal of beauty (Wood, Solomon, & Englis, 2003);
3. Abstract avatar,  
with an abstract look-and-feel, specifically a uniform light grey colour for the whole body, whilst retaining a rather realistic, though simplified head shape (i.e., reduction of details, e.g., of the ears); comparable to a typical shop window mannequin.



*Figure 2-10: Three exemplary personal avatars as used in this study – highly individualised avatar, model avatar and abstract avatar (from left to right)*

These conditions were selected to cover a broad spectrum of fundamental categories of visual appearance: high individualisation versus no individualisation, realistic/unprettified versus idealised, anthropomorphic/lifelike versus explicitly abstract.

The core characteristics of the appearance of each avatar type were elaborated clearly and with comparable quality. This study utilised unique, high-quality visualisations in true 3D, so far only present in similar research by Suh et al. (2011).

As the approach of the proposed experiment was to vary the characteristics of the avatar and not those of the presentation of the garment, care was taken that the

visualisation of the garments was identical between the three avatar types. In a highly realistic VTO, as featured in this study, the shape of an avatar directly influences the shape of a worn garment. Therefore, all the avatars were individualised in a similar manner regarding body measurements: They retained the individual body measurements of their owner, namely body height, chest girth, waist girth, hip size and arm length. These are typical values for determining the clothing size.

In doing so, all the participants could experience a clothing presentation that was individualised to their body measurements. Moreover, as accurate as possible VTO rendition for an individual was considered of key importance for the utilitarian value of the whole system.

## **3 Research Methodology**

This chapter describes how the study was conducted and discusses in detail the approach, the method, the design and the techniques employed. Implications of research paradigms are explained and the chosen mixed method approach combining quantitative and qualitative methods is motivated and described. The methodological steps that have been followed for this study are explained, encompassing the design of the quantitative and qualitative instruments, ethical approval, data collection and data analysis.

### **3.1 Research approach**

The research approach of a specific research undertaking consists of plans and procedures for research. It comprises commitment to specific philosophical assumptions or research paradigms, to procedures of inquiry and to research methods of data collection, analysis and interpretation (Creswell, 2014).

This study adopted a positivist approach, i.e., it followed the paradigm of positivism. The positivist research philosophy underpins the so-called “scientific method” and the method of experimental testing, as applied in this work.

Two general research approaches are predominant in the literature on IS research, the quantitative approach and the qualitative approach (Avison & Malaurent, 2013; Oates, 2006). The work reported here relied on the so-called mixed methods approach, which combines quantitative and qualitative components.

The primary data source was an empirical study conducted as a controlled experiment in a laboratory setting with a random sample of participants. It used an unrelated (between-subjects) design to determine differences in outcomes between three different experimental conditions. Quantitative and qualitative data were collected in the study. Several pertinent consumer behaviour factors, as well as evaluations and preferences of the participants were assessed quantitatively with questionnaires. Demographics were also captured. Open-ended questions were used in addition to explore motivations for the responses given in the questionnaire and to seek explanations for effects and trends that were identified.

This project was based on a prototype online clothing shop that had been previously developed by the researcher. This was used as the instrument for the laboratory

experiment, and allowed several usability-centred tests to be conducted that included the opinions and preferences of the participants on the design and presentation of the avatar (Blum et al., 2007; Blum et al., 2010; Blum & Khakzar, 2009; Blum, Khakzar, & Frank, 2005; Rupprecht, Blum, & Khakzar, 2009), see also section 2.4.

### **3.1.1 Positivist research paradigm**

A research paradigm or epistemology is characterised by philosophical assumptions or ways of thinking about the nature of reality, the purpose of research, and how knowledge can be gained (Oates, 2006). It comprises "... a broad and high-level outline of the reasoning process by which a school of thought performs its logical and empirical work" (Lee, 2004, p. 6).

Positivism and interpretivism are still the two prevalent research paradigms in IS research (Avison & Malaurent, 2013; Oates, 2006). The positivist research paradigm is based on the assumption that reality is given objectively and that, therefore, objective facts can be discovered (Avison & Malaurent, 2013; Myers, 2013). In contrast, interpretivism "assumes the world researched is subjective and open to different interpretations" (Avison & Malaurent, 2013, p. 77). For that reason, only social constructs, such as language, consciousness, shared meanings, and instruments, are believed to grant access to reality (Myers, 2013).

Consequently, positivist research is characterised by the following aspects (Myers, 2013; Oates, 2006; Orlikowski & Baroudi, 1991):

- It often examines naturally occurring phenomenon, which exist independently of humans. Nevertheless, the respective methods used in the natural sciences are also deemed to be suitable for studies in social and organisational contexts.
- Novel or existing models are utilised and tested using measurements and observations, with the aim to explain particular aspects of the world and identify objective "truth". For that purpose, hypotheses are confirmed or refuted, in order to advance theory. These formal propositions typically include independent and dependent variables and the cause-effect relationships between them.
- The applied measurements are supposed to be "objective" and independent of the personal values and beliefs of the observers and researchers and their

instruments. Therefore, methods and conclusions are examined thoroughly for bias.

- As a logical and objective approach, data collected with quantifiable measures is most often analysed with mathematical modelling and statistical analysis.
- The main aim is to identify unique, best fitting laws or patterns and deduce irrefutable facts about a phenomenon that can be generalised from the investigated sample to a stated population in other situations in the real world.

The positivist research paradigm underpins what is called “the scientific method”. As the accepted positivist approach to research, the scientific method is typically applied in the natural sciences. It is based on the two assumptions that

- The world has a structure and follows regular laws and patterns, not random behaviour, and that
- It can be investigated rationally and objectively, i.e., independently of personal attitudes and feelings of the researcher (Oates, 2006).

Doing research with the scientific method comprises an iterative workflow: the researcher

1. starts with a theory,
2. collects data that,
3. when analysed, either supports or disproves the assumed theoretical models,
4. makes revisions to the theory and data generation methodology,

and, by entering the next iteration, creates further data (Creswell, 2014). This procedure serves the aim to identify the universal laws, patterns and regularities, and it is mainly implemented with the experimental methodology (Oates, 2006).

The purpose of the experiments is to search for evidence of cause and effect, i.e., to test if a specific approach affects an outcome (Creswell, 2014; Oates, 2006) – as described in more detail later in this chapter.

The decision to rely on the positivist paradigm for this research was taken based on the following considerations, following Oates (2006) and Orlikowski and Baroudi (1991).

The nature of the research question posed in this work leads to the experimental methodology and, thus, the positivist paradigm as the first choice. Individualised avatars are still very rarely employed in practice in e-commerce or comparable settings, therefore, study participants already having practical experience with such concepts can hardly be found. An experiment made it possible to allow the formation of the required experiences. Furthermore, with the method adopted, these experiences could be controlled systematically and, by varying the conditions between groups of participants, be matched to the requirements of the research question.

Moreover, by using the university, the population from which an adequate sample of suitable participants could be recruited was large, so that recruitment was not problematic.

Practical considerations related to the environment available for the research and the efficient use of available resources influenced the choice of experimental study: An experiment, in combination with adequate data generation methods, generally facilitates a well-planned, systematic and foreseeable data collection in a given time frame. Furthermore, the author of this work has experience of the experimental methodology (Blum et al., 2005; Blum et al., 2007; Blum & Khakzar, 2009; Khakzar, George, & Blum, 2009; Rupperecht et al., 2009).

The aim of the research was to develop recommendations for the design of avatars in the specific context of online shopping of clothing and to generalise where possible to provide guidelines for similar application contexts. In the goal of achieving generalisable findings, i.e., regular laws or patterns, the specific scientific method was selected for this research.

A further reason is comparison with similar relevant work on the topic, for example Merle et al. (2012) and Suh et al. (2011), who each used the positivist approach. Indeed, comparison with literature with similar research questions, but from a wider context, indicates this research approach as typical.

### **3.1.2 Mixed methods methodology**

Two basic research methodologies are used in the positivist approach; quantitative and qualitative. In some cases, the so-called mixed methods approach uses a

combination of both quantitative and qualitative research methods. This study adopts the mixed methods design.

### **3.1.2.1 Quantitative Research**

As a matter of principle, quantitative research is positivist (Avison & Malaurent, 2013; Creswell, 2014). Originally developed to study natural phenomena, quantitative research methods are widely used in the natural sciences. Nevertheless, many quantitative methods are also well accepted today in the social sciences, including the IS discipline, among them laboratory experiments and survey methods (Myers & Avison, 2002).

Quantitative methods rely on numeric data, or on data that can be converted into numeric information. The numeric data is collected by measuring sets of variables identified as relevant for the research question. Typically, their relationship is analysed using statistical procedures, with the aim to test objective theories or explanations (Creswell, 2014). Key aspects of quantitative research are the adherence to standards of validity, objectivity and reliability, in order that inferences may be drawn from the sample to the stated population.

In particular, the resulting focus on avoiding uncontrolled effects (or bias) has been criticised as a disadvantage of quantitative research in the social sciences. It is argued that, as a consequence, rigorous, unbiased experimental design requires simplification and abstraction. Thereby, valuable context information is inevitably removed that would otherwise facilitate a deeper understanding of the researched phenomena (Kaplan & Duchon, 1988).

Given the underlying research paradigm of this study, then the experimental method to be used is defined. Experiments constitute one of the main quantitative research methods and, as such, provide the possibility to obtain generalisable findings, upon which avatar design recommendations can be based. Also, a quantitative approach makes it possible to summarise data and to deliver outcomes in the form of figures and trends about objective factors of consumer attitudes and behaviour.

### **3.1.2.2 Qualitative Research**

Qualitative research can be positivist or interpretive, depending on the chosen research paradigm of the researcher (Avison & Malaurent, 2013). This study selected the positivist approach for its qualitative components.

The qualitative research methodology originated in the field of social sciences, with the purpose to investigate social and cultural phenomena, i.e., to explore and understand people, situations and organisations, the social and cultural contexts in which they exist, and the meaning people ascribe to a social or human problem (Avison & Pries-Heje, 2005; Creswell, 2014). It is employed widely in many different academic fields, amongst others in the IS discipline (Myers & Avison, 2002).

Qualitative methods rely on non-numerical data, for example words, images, sounds and so forth, arising from data generation methods such as interviews, documents or participant observations. Qualitative researchers make interpretations of the data, and, in doing so, bring in their personal values and position themselves in relation to the phenomenon of interest (Creswell, 2014). Also, they interact directly with the participants of their study, which enables them to respond to the individual setting and context of each person in order to gain an even deeper understanding.

Whilst quantitative measurements tell the researcher how much or how often a certain effect occurs, for example how often people behave in a specific way, qualitative methods are employed for the purpose of discovering underlying meanings and patterns of relationships, i.e., to explain and understand phenomena.

Therefore, qualitative research methods can be appropriate for exploring and explaining new domains where issues are not yet (fully) understood and for investigating how people experience something which may be new to them (Hancock, Windridge, & Ockleford, 2007). This was the case for this study.

As part of this work, qualitative data was collected through interviews with the participants of the experiment and analysed using thematic analysis. The purpose of the procedure was to explore motivations for the responses given in the quantitative questionnaires and to seek explanations for identified effects and trends.



### **3.1.2.3 Mixed Methods**

The two fundamental types of research methodologies, quantitative and qualitative, exhibit distinct characteristics and are used for different purposes. Nevertheless, in many research settings, a combination of both can be advantageous. Advocates of this form of investigation argue that the combination of quantitative and qualitative techniques in the same study enables a more complete understanding of a phenomenon of interest than could be achieved with only one of the two approaches alone (Creswell, 2014). Indeed, using these generally distinct methodologies together is a common practice in many social science disciplines, but still rare in IS research (Avison & Malaurent, 2013; Venkatesh, Brown, & Bala, 2013). Recently, the approach is predominantly called mixed methods (Venkatesh et al., 2013). Other terms are multi-method, mixed methodology, and quantitative and qualitative methods (Creswell, 2014).

Core characteristics of the mixed methods approach can be described as follows (Creswell, 2014; Johnson, Onwuegbuzie, & Turner, 2007):

- Both qualitative and quantitative data is collected and analysed.
- Data collection and analysis procedures must be executed thoroughly for both forms, including suitable sampling and appropriate data analysis.
- For integrated analysis of two forms of data, the distinct databases are merged, connected, or embedded.
- An explicit mixed methods design is followed that incorporates these procedures as well as the timing of the data collection (concurrent versus sequential) and the emphasis (equal versus unequal) for each form of data.

Hence, mixed methods research involves collecting and integrating both quantitative and qualitative data, which enables two kinds of inferences: on the one hand, numerical calculations and statistical models are applicable to the collected quantitative data, so that resulting findings can be generalised from the sample to a stated population; and on the other hand, a profound or more complete understanding of the investigated phenomenon or situation for the concerned group of people may be gained (Creswell, 2014).

In addition, having multiple data sources may allow further considerations:

- Different, possibly contradictory perspectives or facets resulting from quantitative and qualitative data can be compared and may need explaining.
- Quantitative results can be explained with a qualitative follow-up data collection and analysis.
- Experimental results may be understood (better) when also considering the perspectives of individual persons.

It should be noted that diverse controversies exist about the approach (Creswell, 2011). This includes the difficulty of the potential mix of research paradigms or doubt of existence of added value beyond the benefit gained through quantitative or qualitative research alone. However, Falconer and Mackay (1999) state that a mixed method inquiry within a positivist paradigm can be a sound approach. Furthermore, many authors support the value of mixed methods research, which outputs both qualitative and quantitative data (e.g., Creswell, 2014; Falconer & Mackay, 1999). Robson (2011) and Creswell (2014) attest the mixed methodology to be a systematic, principled approach, being superior in making sense of and extracting meaning from “the real world”. Therefore, a more comprehensive understanding of the problem can be gained that potentially leads to findings applicable in a practical sense (Axinn & Pearce, 2006).

Creswell (2014) discriminates between three basic mixed methods strategies:

- Convergent parallel mixed methods design:  
The researcher analyses the collected quantitative and qualitative data separately, followed by a comparison of the findings in order to identify conformity or difference of both result sets.
- Explanatory sequential mixed method design:  
Its purpose is to use the qualitative data to help explain the quantitative results. This is typically accomplished with two sequential phases, where quantitative data collection and analysis precedes and informs subsequent qualitative data gathering and analysis.
- Exploratory sequential mixed method design:  
This type of mixed methods strategy operates in reverse, i.e., the quantitative

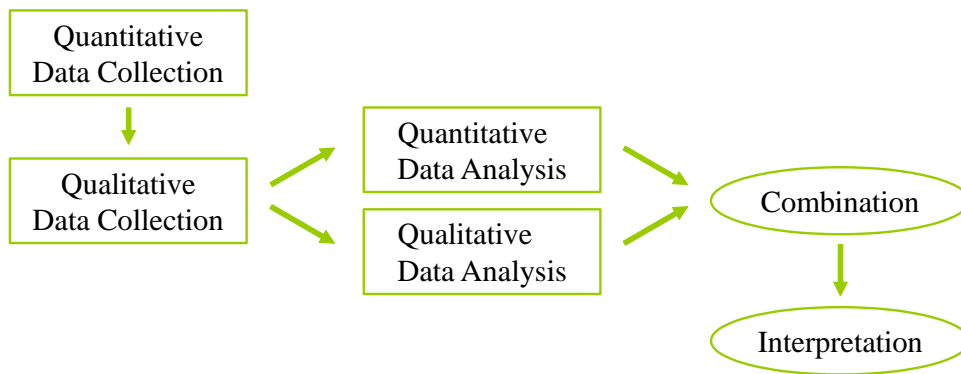
phase follows and builds upon the results of the qualitative stage. Here, the prevalent purpose is to develop quantitative instruments based on qualitative data that, subsequently, can be used to gather quantitative results generalisable from a sample to a population of interest.

The convergent parallel mixed methods approach is also termed method triangulation (Oates, 2006) and helps to increase the credibility and validity of research data and findings. Consistent data across data generation methods can increase confidence in results, indicating that they hold true independent of a particular data generation method. Defining triangulation as a technique to identify similar findings from different data sets implies the positivist perspective that there is a single truth to be observed (Falconer & Mackay, 1999). A second, alternative view on the triangulation metaphor, which seems to fit especially for mixed methods, indicates that it is an enlargement of perspectives that enables a more complete treatment, description and explanation of the subject domain (Kelle & Erzberger, 2004).

The mixed methods approach was chosen for this study for the following reasons:

- It was assumed that the approach enables a more comprehensive understanding and better interpretation of the complex reality of the targeted usage scenarios based on customer-individualised avatars and of the related consumer behaviour – than either quantitative or qualitative data alone.
- The detailed views from participants collected in the interview part promised to deliver hints on the implications of the quantitative findings.
- These combined findings, which are expressed not only as figures and trends, but also backed with individual statements of participants, should make it possible to derive practically applicable recommendations for avatar design.
- The study should also profit from both readings of triangulation, validation and enlargement of perspectives.

Figure 3-1 illustrates the mixed methods design that was chosen for this study. It follows the explanatory sequential category, though it also shows some characteristics of other mixed methods design types, especially the convergent type. This choice of research design corresponds to the intended purpose of the qualitative data to help explain the quantitative results. Therefore, a sequential approach was planned, with the two databases combined and building on each other.



*Figure 3-1: Mixed methods design of the study*

Such a design typically involves two phases where quantitative data is collected and analysed first, followed by a second qualitative phase (Creswell, 2014). Often, the results of the intermediate analysis of the quantitative data are used to inform, i.e., for example, plan the qualitative data gathering. This may include using the results of the quantitative analysis to select a specific, interesting sub-sample to be included in the qualitative data collection, for example based on extreme or outlier cases. In contrast, in this study, both types of data were collected in one pass and analysed together afterwards, for the following reasons:

- The design of the experiment was for the participants to experience the concept of a high-quality virtual try-on of clothing with their own personal avatar. This was a novel experience for them, due to the lack of availability of such systems in real shopping facilities. Therefore, it was essential to gather their impressions and attitudes using both instruments, quantitative and qualitative, immediately after the experience. If two distinct data collection phases had been used with several days between, the participants' impressions of use of the avatar would probably have faded or could become biased by other influences in between, for example exchanging views with friends and peers. In order to reduce uncontrollable and untraceable aspects, a one pass approach was chosen to ensure a consistent reference base for both forms of data in order to allow for a meaningful combined, explanatory analysis.
- Combining both in one session reduced effort for the participants (they only needed to attend one session), ensured that all participants completed both types of data collection (participants may not have attended the second session), and reduced effort for the researcher (reduced chasing follow up).

Although both forms of data were collected in the same session, the approach is considered sequential as the qualitative questions strictly followed the quantitative data collection and referred to the quantitative items. In addition, individual answers given by participants in the questionnaires were addressed in the interviews, together with any specific aspects or comments observed or uttered in the experimental session, and in this way were incorporated to the qualitative analysis.

The participants included were identical in both parts. This constitutes a prerequisite for the explanatory type of mixed method design, due to its purpose to explain the quantitative results through a qualitative follow-up. Using different samples for each phase can compromise the validity of a study (Creswell, 2014). The actual sample size originated from the quantitative part, i.e., from the requirements of the intended analysis of variance between experimental conditions. Despite the significant effort, it was decided to gather qualitative data from the complete sample. The intention was:

- To gain a continuous, complete picture based on all the participants,
- To have a complete data set for each participant, avoiding restrictions if deciding to choose specific cases for in-depth qualitative data analysis later,
- To produce a significant amount of qualitative data from each of the three experimental groups or, if indicated, from other groupings derived from the analysis,
- To collect sufficient data for significant statistical analysis of the qualitative data.

Following Creswell's (2014) typology, the chosen mixed methods design is also related to the embedded experimental design type, as a laboratory experiment forms the core of the overall research design and the qualitative part is intended to support the understanding of the experimental results.

### **3.1.3 Experimental method**

The main data source of this work was an empirical study conducted as a controlled experiment in a laboratory setting with a random sample of participants.

Experiments are one of the main research strategies used in IS and computing research, alongside surveys, design and creation, case studies, action research and

ethnography (Oates, 2006). Their primal purpose is to investigate cause-and-effect relationships. A well-conducted, valid experiment is used to prove or disprove a causal link between one or more factors and an observed outcome, i.e., to make causal inferences (Creswell, 2014), and to prove generalisability of these findings (Gray & Salzman, 2009). Therefore, experiments constitute a means of testing theories or explanations of phenomena, i.e., universal laws, patterns and regularities, and are the most significant research strategy of the scientific method and of the positivist research paradigm (Oates, 2006).

The basic approach is to systematically vary the assumed cause of an outcome and measure any changes to that outcome. Consequently, the typical procedure of an experimental study is as follows (Barnes, 2007; Eschweiler, Evanschitzky, & Woisetschläger, 2007; Oates, 2006):

1. A theory about the topic or problem of interest is developed.
2. A statement is made based on this theory, in the form of a hypothesis, following the scheme “factor A causes outcome B” that can be tested through an experiment.
3. The actual experiment is designed to confirm or refute the hypothesis. Care is taken to exclude (or at least control) all factors other than the factor of interest.
4. The experiment is conducted and outcome data is collected carefully, for example precise measurements and detailed observations.
5. Finally, the collected data is analysed to determine whether it supports or disproves the hypothesis.

The causal relationship, i.e., which factor is the cause (called the independent variable, IV) and which the effect (called the dependent variable, DV), is determined by the theory, and the hypothesis that is based on it.

Typically, the experiment involves the following steps (Oates, 2006):

1. Observation or measurement of an outcome factor (dependent variable),
2. Systematic manipulation of conditions (independent variable), and
3. Re-observation or re-measurement of the dependent variable, in order to identify the expected changes of the dependent variable.

It is also the case that experiments might be biased by unforeseen or unconsidered factors, including faulty equipment or measurements (Eschweiler et al., 2007). Therefore, firm conclusions should not be drawn until further experiments by the original researchers or others yield the same results (Oates, 2006). This aspect is called repeatability and demands for a precise, thorough description of published research, in order to allow reproducibility by others. It is a central premise of the scientific method (Oates, 2006).

In order to prove the assumed relationships between factors using the experimental method, it is essential to control all the variables that might affect the outcomes. This requirement is typically met by

- Eliminating factors, for example excluding participants that do not have the desired characteristics,
- Holding factors constant, for example including solely participants of the same gender or age,
- Selecting subjects randomly; random selection in combination with adequate sample size ensures that differences in uncontrolled factors cancel each other out across the whole sample.

Controlling variables is one important measure to ensure the internal validity of findings (Eschweiler et al., 2007).

In summary, the nature of the research problem in this work leads to the experimental methodology being the first choice: a laboratory experiment designed to manipulate the experience of the personal avatar between the groups of participants. Moreover, related published work also relies on experiments. Finally, the potential for the methodology to provide generalisable recommendations for the design of the avatars motivated this approach.

#### **3.1.4 Data generation methods**

In research, empirical data or evidence is produced using data generation methods (Oates, 2006). Various data generation methods are available and, naturally, each exhibits different strengths and weaknesses, as well as purpose and type of data generated (quantitative or qualitative). Typical data generation methods in IS research are questionnaires, interviews, observations and documents (Oates, 2006).

In order to produce strong evidence research studies must adopt high-quality data collection.

This study pursued a mixed method data collection strategy: it relied on quantitative and qualitative data, generated using questionnaires and interviews.

#### **3.1.4.1 Questionnaires**

Questionnaires are one of the most widely used data gathering methods. Many research approaches rely on questionnaires. With this method participants are requested to respond to a pre-defined set of questions (or items) in a predetermined order (Gray, 2014). So, people can be asked for their opinions in a structured manner and measurements can be obtained on how many people think, act or feel in a particular way.

A central advantage of questionnaires lies in the option to use standardised, closed-ended questions, i.e., multiple choice, or some other form of rating scale that make it simple to compile and analyse the generated data. The participants are typically not able to modify the given choices on their own or provide additional ones.

It is important to note that a questionnaire must be carefully designed and constructed in order to yield valid and reliable data (Oates, 2006) (compare section 3.2).

For this research, the factors of interest in the research model (see section 2.7) were to be investigated by measuring latent variables via questionnaires. In addition, socio-demographic data and other personal information, i.e., shopping-related experiences, habits and attitudes, needed to be collected for the purpose of descriptive statistics and for statistical inferences.

Two questionnaires were prepared:

1. An initial questionnaire covering socio-demographic and personal information (see section 3.6.1),
2. A main questionnaire comprising measurements of: the potential effects of avatar design on favourable marketing outcomes, for example satisfaction with decision support; perception of the personal avatar; and ratings on different aspects of the actual appearance of the avatar (see section 3.6.2).



Both questionnaires relied almost entirely on closed questions, as the following interview allowed for open questions.

In creating the questionnaires, several guidelines were taken into account in order to achieve good quality and avoid common mistakes such as vague formulation and to make the questionnaires free of bias (Bühner, 2011; Oates, 2006).

#### **3.1.4.2 Interviews**

Interviews constitute a specific type of conversation and are often carried out between two people: One person (the interviewer) aims to gain information for a particular purpose from another person (the interviewee). Therefore, typically, research interviews are thoroughly planned and possess a more or less predefined structure. It is normally implicit for the involved persons that the researcher, i.e., the interviewer controls the specific agenda and steers the conversation (Oates, 2006).

The interview method offers the possibility

- To obtain detailed information,
- To ask complex and open-ended questions whose order and logic can be adjusted to different interviewees,
- To explore feelings, attitudes and experiences that are hard to prompt via questionnaires.

It is common practice to use follow-up interviews to gain more detailed data about questionnaire answers (Oates, 2006) – as was the case in this study. In line with the planned mixed method approach of the explanatory sequential type, see section 3.1.2.3, the main purpose of the interview instrument in this study was to explore the motivations for the questionnaire responses and determine explanations for discovered effects and trends.

The semi-structured interview was used in this research. A semi-structured interview is typically based on a list of topics and questions to be covered, though their order can be changed by the interviewer during the sessions. Also, additional, not pre-defined questions can be asked, in order to follow up on interesting issues being raised by the interviewee (Gray, 2014; Oates, 2006). Within a semi-structured interview, researchers can also give information to the participant, if they consider it advantageous for the purpose and outcome of the interview. Conceptually, this kind

of interview lies between the two other common types, i.e., structured and unstructured interviews. The semi-structured interview type was considered most suitable for this work for the following reasons:

- The participants experienced the avatar design for the first time in the experiment, and therefore would not have much time to think about it. It was expected that they would need support and direction in the form of a pre-defined set of questions in order to be able to express the details of their personal thoughts about their experience with the concept (Oates, 2006).
- At the same time, the researcher wanted to enable the interviewees to make any comment on the issues raised and to allow them to introduce additional topics of their own – thereby making it possible for new aspects not envisaged by the researcher to be discovered. This was highly likely given the novelty of the topic.
- And, naturally, the researcher desired to be able to elaborate further on received responses and new topics introduced by the interviewees (Gray, 2014).

Several guidelines were considered for the creation of the interview questions (Oates, 2006) in order to achieve high quality and meet the intended aims. The interview questions were designed to be purposive, succinct and unambiguous (see section 3.6.3). Also, the researcher paid attention to present them to the interviewees in a neutral and unbiased manner.

The interview sessions were audio recorded, in order that the interviewer could concentrate fully on the process of the interview (Oates, 2006).

### **3.2 Validity and reliability**

Validity is an essential criterion for quality of research and ensures soundness and rigour. For positivist research, this quality can be broken down into the four aspects (Oates, 2006):

- Objectivity,
- Reliability,
- Internal validity and
- External validity.

Objectivity is concerned with researcher bias, distortion and individual beliefs of the researcher that may influence the results. To be objective, research has to avoid these influences.

Reliability essentially centres on repeatability: under the positivist perspective there should be a single truth to be observed; a reliable study should be replicable with similar results. This implies that the applied research instruments are neutral, unambiguous, accurate, repeatable and reliable. For example, the questions of a questionnaire must not suggest particular answers to the participants (Bühner, 2011).

Internal validity refers to how well the research is designed and carried out, including all the steps involved from data collection to data analysis and interpretation, and, in consequence, how much confidence can be placed on the findings, for example in identified cause and effect relationships (Oates, 2006).

External validity is about generalisability: looking for general laws or patterns, positivist research aims to gather findings that are generalisable to different people, settings and times. An experiment exhibits good external validity if the obtained results are not unique to the particular setting of the experiment but the same results can be predicted for other occasions and situations. In general, experimental research strives for high external validity. The criterion essentially depends on the representativeness of the researched cases or participant samples (Oates, 2006). For example, when humans are involved, as is the case with this study, the researcher must rely on subjects that are typical of the wider population that is under research. External validity can therefore be compromised by too small sample sizes, over-reliance on specific types of participants or non-representative participants. These sampling pitfalls were carefully considered for this research, as detailed later in this chapter (see section 3.4)

Internal validity of experimental results is achieved if the obtained measurements are induced by the systematic manipulation of the independent variable, and not by other, so-called confounding factors (Oates, 2006). Therefore, the internal validity of experiments can be compromised by

- Inherent differences between the experimental groups,

- Faulty data collection instruments, for example inaccurate measuring devices, or non-uniform interviewing,
- Intentional or unconscious changes of the reactivity of the participants due to the test situation,
- Experimenter effects, i.e., bias due to the interaction of the researcher with the participants.

For questionnaires and interviews, the two data generation instruments used in this study, the concept of internal validity can be broken down further into (Oates, 2006):

- Content validity,
- Construct validity and
- Reliability.

To achieve content validity, the applied questions must generate well-balanced data sets about the concepts being researched. Content validity is endangered, when only a subset of the relevant aspects of the researched phenomenon is covered. One central approach of this study to ensure content validity was to rely on established questionnaires where possible for the investigated latent variables. Furthermore, content validity was assessed with the help of a panel of qualified experts from the research domain comprising experienced researchers from Fulda University, Germany and the first supervisor of this research project from Brunel University, United Kingdom. Based on their valuable feedback, the wording of some of the questionnaire items was amended and the interview structure was rearranged for a more logical flow.

Construct validity deals with the concern that questions intended to measure a specific factor actually measure that aspect (Bühner, 2011; Oates, 2006). Reliability is about whether a questionnaire or interview produces the same results if done repeatedly with the same participants (Bühner, 2011; Oates, 2006). This study relied on established statistical test values that assess construct validity and reliability. These test values were considered when selecting questionnaires for latent variables (i.e., variables operationalised with psychometric scales respectively Likert scales) from the literature and, partly, rechecked with the collected data:

- Construct validity, and its subtypes
  - Confirmatory Factor Analysis (CFA) indicating the level of fit between model and data (Bühner, 2011)
  - Exploratory Factor Analysis (EFA) measuring discriminant validity (Bühner, 2011)
  - Average Variance Extracted (AVE) measuring convergent and discriminant validity (Henseler, Ringle, & Sarstedt, 2015)
- Reliability
  - Cronbach's alpha quantifying internal consistency (Finn & Kayande, 1997)
  - Composite Reliability (CR) gauging internal consistency (Suh et al., 2011).

Concerning the interview instrument, the researcher was aware that the hardly evitable variation of his interaction with the participants and inherently individual context of a particular interview can negatively influence consistency and objectivity, thus reliability (Oates, 2006) – and tried to avoid this as much as possible.

The validity and reliability of a mixed methods approach (compare section 3.1.2.3) relies, first of all, on the validity and reliability of each of the parts, quantitative and qualitative (see above). Then, especially for the chosen explanatory sequential type of mixed methods, the researcher must ensure that all options for following up on the quantitative results using the qualitative data are considered (Creswell, 2014). Therefore, this study paid attention that it did not overlook promising explanatory variables that required further understanding. Another aspect of validity was to ensure the use of the same sample for both parts, quantitative and qualitative, of the study.

For this study, further procedures were applied to reduce potential shortcomings:

- Triangulation method, used in order to validate findings and to compensate for any potential errors by using more than one data source (Creswell, 2014; Kaplan & Duchon, 1988; Oates, 2006).
- Pilot testing (Oates, 2006), as mentioned later in this chapter.
- Being present with the respondents during completion of the questionnaires in order to be able to respond to any issues raised by the participants.

### 3.3 Study design

The study took place at Fulda University, Fulda, Germany. Participants were randomised to one of three experimental groups (see Figure 2-8, p. 43):

1. Highly individualised avatar
2. Model avatar
3. Abstract avatar.

It was decided to allow each participant to experience only one of the three different types of avatar design. Thus, the experimental design was “unrelated”, also called “between-subjects” or “parallel”. This study design implies that a participant is exposed to only one experimental condition and that the measurement takes place only one time.

In contrast, during a “crossover” study, also termed “within-subjects” design, participants encounter two or more of the investigated conditions, and the same data is collected within each pass (Raghavarao & Padgett, 2014). In order to avoid confounding effects due to the sequential order of the experimental conditions, the order of presentation is systematically varied between participants, which gives the name “crossover” to this category of study plan. Crossover studies have two advantages over between-subjects designs: the potential influence of confounding covariates is reduced because each participant serves as his or her own control; and smaller samples are required due to the higher statistical efficiency. This form of study design works well when the participant is unaware of the identity of the different forms of condition or intervention, for example between active drug and placebo in a double-blind clinical trial.

However the “crossover” design of study has the disadvantage of the so-called “carry-over” effect between the different conditions, especially when the participant is able to distinguish between them, and this can act as a confounding factor to the measurements. This effect can be mitigated by use of a “wash-out” period between the presentation of the conditions, but it is not certain that they will entirely forget the previous experience.

For these reasons, this research determined that the parallel study was the more appropriate and had the further advantage that it reduced the demand on the individual participant, even though more participants were required.

As the experiment environment, a prototype, but typical business-to-consumer-style online shop was used, offering a range of contemporary and fashionable women's clothing items. The usual product catalogue and shopping cart was augmented with a virtual try-on (VTO) feature. This enabled the participants to try-on clothing items in a virtual reality space by dressing their personal avatar with digitised versions of the garments (see section 3.5.3 for details).

It must be noted that the experiment did not include all the steps that would be needed to complete the transaction of the conventional online shopping process, rather it was restricted to the selection of products in the experimental online shop. This also excluded the participants having the opportunity to see, feel and try-on the real products (these did not exist in reality).

This was not considered to be an issue, as this project was not intended to determine the quality and reliability of the VTO to imitate the real clothing. Rather this work concentrated on the design of the personal avatars. Shortcomings of product presentation, for example, discrepancies between the real and virtual would only have distracted from the focus of this research and confounded the outcome.

Of course, in practise, the aspects of accuracy of representation between real and virtual product would be relevant for the acceptance and success of such a marketing measure as a whole and should be considered in further research. It would then be ideal to cooperate with existing shops that already use high-quality VTO, but, at the time of this work, such a test bed was not available.

All participants were first asked to complete an initial questionnaire and were introduced to the system. They were then requested to undertake the experiment, during which they were asked to complete a typical shopping task, including intensive use of the VTO feature with their personal avatar. The aim was to allow the participants to experience the avatar concept, to familiarise them with it and to stimulate and give them the opportunity to develop an individual attitude towards its

use. The only difference between the stimuli of the three groups was the characteristics of the personal avatar.

During the stimulus phase, the test assistant took notes of any possibly relevant reactions of the participant (e.g., emotional reactions or verbal comments). Also, he observed the interaction of the participant with the system, in order to be able to directly offer support and explanation in case of any problems. The purpose of this measure was to ensure that problems of usability did not affect the results.

On completion of the experiment, the participants were asked to answer the main questionnaire that was mainly composed of psychometric scales. Subsequently, they were interviewed. Audio recording was used throughout the entire test sessions.

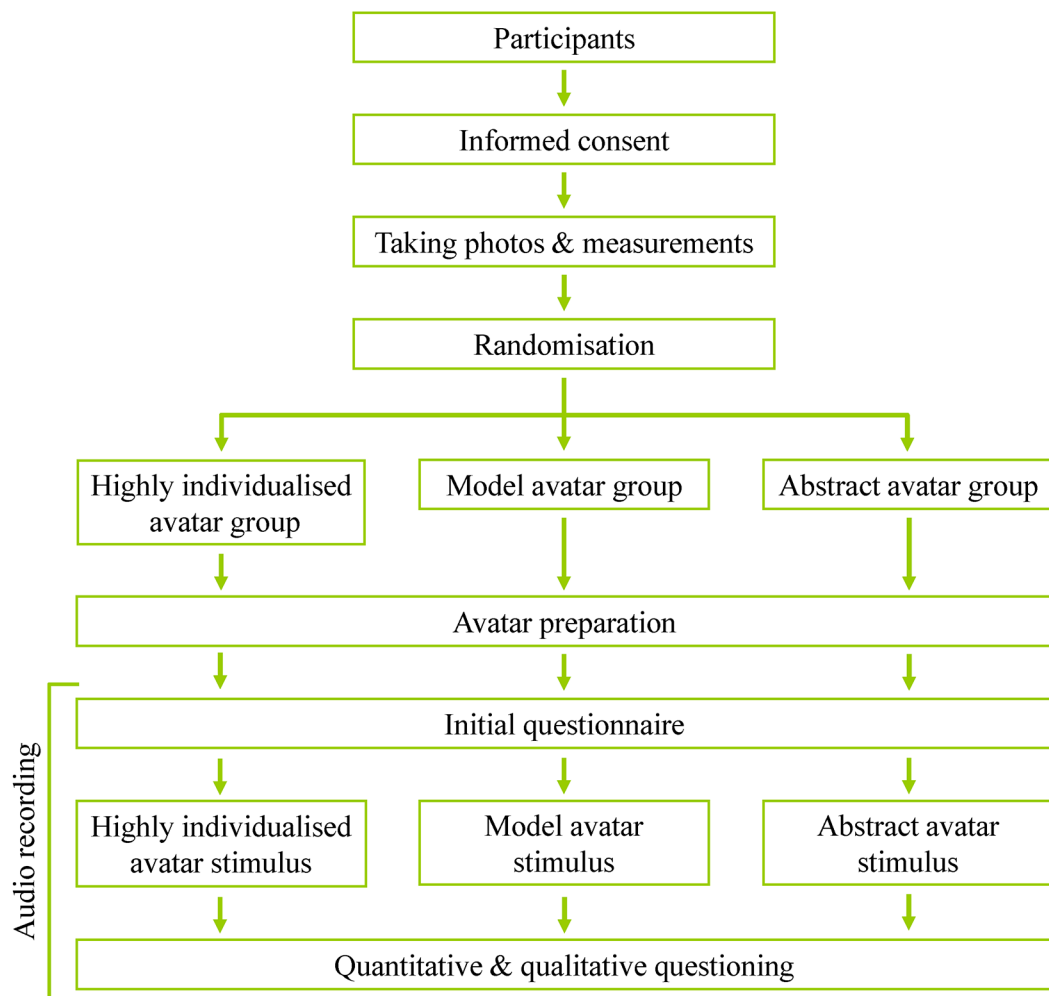


Figure 3-2: Study plan

Section 3.5 describes the experimental procedures in detail.



### **3.4 Study participants**

#### **3.4.1 Characteristics and recruiting**

The gender of the study population was restricted to only female. Gender may have an effect on the outcome, but gender-related differences were not to be considered in this research. Inhomogeneity of the participant group due to gender and potentially resulting bias was thus avoided (Garbarino & Rosa, 2012).

The focus was on women for several reasons:

- Women are known to have a greater interest in fashion, especially clothing, and thus are expected to express richer feedback than men (Kwon, 1992; O'Cass, 2004).
- In Germany, women were the largest market segment of online clothing retail in 2014 (Altrogge, 2015).

This should facilitate acquiring insights into the effects of the personal avatar. In a similar study, Merle et al. (2012) likewise used only female participants. Future studies can build on the results to investigate men.

The participants were recruited on a voluntary basis from the university of the researcher, namely Fulda University in Germany, from several different faculties. Although students do not precisely represent the whole population of potential users of online clothing shopping with personal avatar, these young adults have the potential to become heavy users of such online services, due to their Internet and online shopping affinity (Suh et al., 2011; Zagel & Süßmuth, 2013). In this respect, taking advantage of a rather convenient in-house recruiting and relying on voluntariness, the sampling suffered from some bias, though care was taken to ensure randomness in the selection of the participants.

Furthermore, comparable to the case described by McKnight, Choudhury, and Kacmar (2002), the situation simulated in the experiment was neither unrealistic nor unfamiliar to them. Therefore, the use of students was not considered as a significant threat to external validity.

The simulated online shop and the research instruments were implemented in the German language, and so participants were selected as being able to speak the German language fluently in order to ensure full comprehension of all the presented

oral and written information. Other demographic characteristics were not considered as inclusion and exclusion criteria for this study.

Further, participants preferably had to have done online shopping regularly or at least several times in the past twelve months, and had to have had some experience with home shopping of clothing – via Internet, catalogue or TV sales channel – in order to be familiar with the typical benefits, short-comings, problems and so forth in these domains. Therefore, bias due to not having basic knowledge or fundamental experience of online shopping and home shopping of clothing should be avoided. This would also assist in view of the prototypic nature of the experimental system. Potential participants were contacted by email (with the help of existing departmental mailing lists), which specified the inclusion and exclusion criteria.

This approach was used as the number of potentially available students was fairly large, and in a university a high interest to participate in such a study can be expected. There was no supervisor-relationship with the participating students.

Conformance to the inclusion and exclusion criteria was rechecked with a second email to each person that had expressed interest in taking part. Where participants conformed to the criteria, each was invited to take part; otherwise they were notified that they could not be considered.

Prospective participants were emailed an invitation to participate together with an information sheet and a link to a website with a range of possible dates for the individual photo and measurement sessions and the individual test sessions.

Each participant received a financial allowance of 20 € cash payment as compensation for their time and inconvenience.

It was explained to participants that they could leave the study at any time and for any reason if they wished to do so without any consequences. There was no aspect of the experiment that would cause a person to be withdrawn from the trial, except if the person requested to withdraw consent. None of the participants withdrew from the study.

### **3.4.2 Sample size**

The number of participants was planned to be 60, in the form of 3 groups of 20 participants each. The chosen sample size originated from the quantitative part, with

analysis of the likely variance between experimental conditions and to give sufficient power to the study and allow it to be undertaken by this researcher. It was decided to gather equal qualitative data from the complete sample (see section 3.1.2.3).

Equal group sizes are generally recommended, as they overcome issues with some central assumptions of statistical analysis concerning certain characteristics of the data to be analysed (Hair, Black, & Babin, 2010). The sample size was determined with the help of sample size calculation based on the statistical power calculation using the software G\*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). Assuming interval data, and conducting analysis of variance between experimental conditions with ANOVA (F tests family), and choosing usual and reasonable values of

- 0.05 for level of significance  $\alpha$ ,
- 0.80 for statistical power (1- $\beta$ )
- and 0.4 (exact value: 0.4119) for effect size  $f$ ,

the latter constituting a large effect, according to Cohen's rule of thumb (Cohen, 1988), results in a total sample size of 60.

Using an alternative calculation method as described by (Bortz, 2005), an exemplary, practically significant, though relatively moderate effect may be characterised as a difference of, for example, a minimum of five sum points between two of the three groups, i.e., the "best" and the "worst" group, when measuring a given construct with five 5-point scale Likert items. For a theoretical case of only one person per group, such a difference would occur, for example if one person chose the highest score of "5" (representing, e.g., "completely true") for each of the five evaluation questions, compared to a second person ticking the second highest score ("4", representing, e.g., "mostly true"). Hence, with 5 and 25 sum points as smallest and largest possible point sum, an estimated variation  $\sigma$  of 20/6 results in an effect size of 0.61. This would constitute an even larger effect and therefore need for an even smaller sample size.

Furthermore, considering the chosen sample sizes of comparable studies, Suh et al. (2011) relied on a similar number of participants (23 subjects per group). The research design of their study on self-congruity and functional congruity of avatars

exhibits many similarities with the work reported here (see section 2.6.2). However, other comparable work has used larger sample sizes, for example (Merle et al., 2012) with 36-40 subjects per group.

Finally, the chosen number of 60 was deemed reasonable in light of the given resources, the calculated power, and that 20 participants per group is generally accepted as a recommended minimum sample size (Bortz & Döring, 2006; Hair et al., 2010).

Following the rule of thumb of Hair et al. (2010), the chosen sample size was also adequate for univariate and multivariate regression analysis, which was applicable for particular, subordinate parts of the research model (see section 3.7.1).

### **3.5 Experimental procedures in detail**

The experimental procedures that were applied can be considered under the following three main areas of activity (see also Figure 3-2, p. 68):

- Taking photos and measurements,
- Experiencing the stimulus,
- Completing the questionnaires and doing the interview.

The researcher took the role of the test assistant and was present at all the activities and ensured a well-regulated progression of the individual experimental sessions.

Taking photos and measurements, as well as the test sessions, were conducted in an office room at Fulda University in Germany. The room was furnished with the required furniture and IT equipment plus decorative accessories such as house plants aimed at providing a comfortable, homelike atmosphere. The goal was to simulate a realistic home-shopping setting, and thus receive realistic reactions from participants when confronted with their personal avatar.

#### **3.5.1 Taking photos and measurements**

This procedure was necessary in order to collect the data required to create the personal avatars. The body measurements needed to customise the body of the avatar comprised typical values to determine the size of clothing:

- i. Chest girth,
- ii. Waist girth,

- iii. Hip size,
- iv. Arm length and
- v. Body height.

They were taken using a conventional tailor's measuring tape and participants were not required to take off clothing. As body measurements are a sensitive topic for women, two female assistants collected them. None of the participants reported any displeasure about the photo and measurement session when asked later in the interview.

Preparation of the individual 3D humans for the highly individualised avatar group required several hours of work by skilled staff and, therefore, had to be accomplished in advance of the test sessions. This process required appropriate photos of the individual person to be taken to complete the avatar. Two high-quality photos of the whole, dressed body, one front, one side, and two equivalent photos of the head were taken. The body measurements were required for all the avatars, independent of the type of avatar. The model avatars and the abstract avatars could be generated within a few minutes by the experimental system (see section 3.5.3.2 for details on the avatar generation process).

In order to be able to take high-quality photos in a controlled setting and to have the time to prepare the highly individualised avatars, the participants were asked to come to the laboratory of the investigator for the photo and measurement session at least one week in advance of their scheduled test session.

As the randomisation took place after the photo and measurement procedure, the required data was collected from all the participants, even though the photos were required only for the highly individualised group. In this way, any potential bias due to differences in treatment and possible resulting differences in expectations towards the individual avatars was avoided.

Written consent was obtained at the first appointment with the participant, which was the photo and measurement session. This session took approximately 10 minutes on average. Please refer to Appendix 3 for the consent form.

### 3.5.2 Initial questionnaire

Immediately before experiencing the stimulus, all the participants were asked to complete an initial questionnaire that collected socio-demographic and other personal information. Please refer to Appendix 4 for the question items and section 3.6.1 for explanation.

### 3.5.3 Stimulus

#### 3.5.3.1 Online shop with VTO with personal avatar

The actual stimulus was a typical, business-to-consumer styled online shop that included the VTO feature. The system was developed as a prototype and covered only the functional parts of an online shop which were of interest for the experiment, namely the product catalogue and the VTO application including a shopping cart (see Figure 3-3).

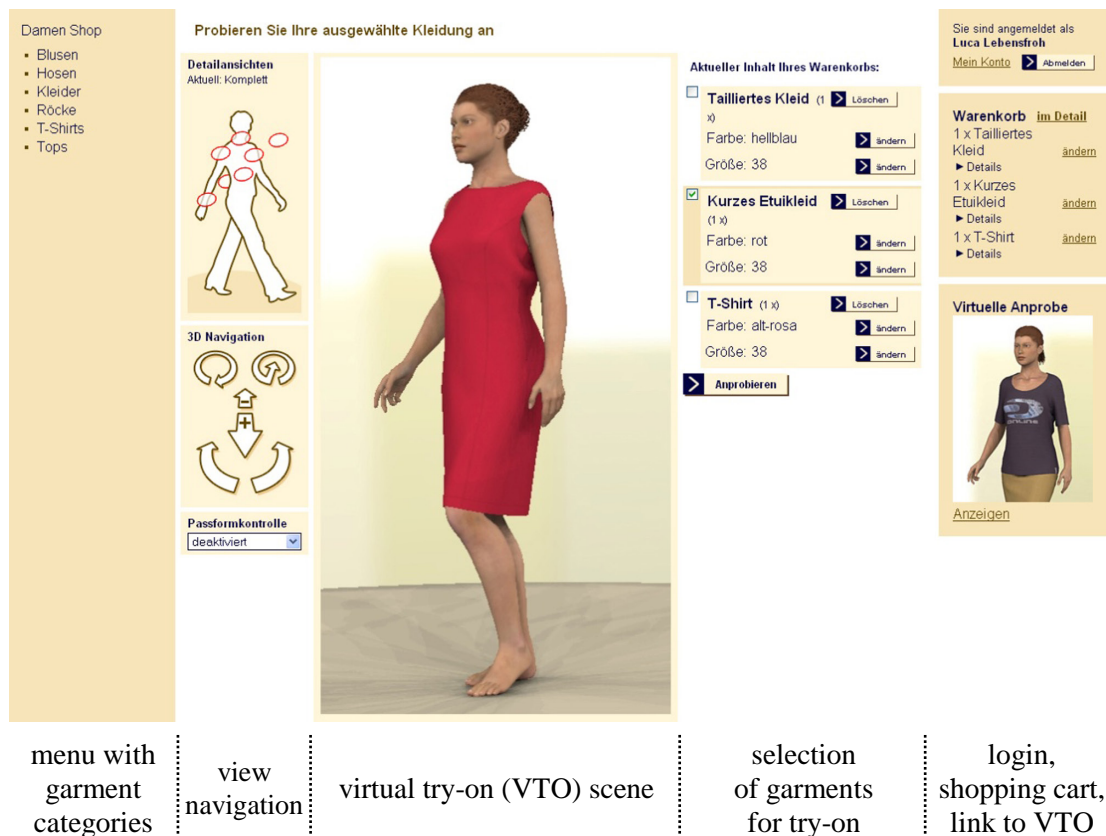


Figure 3-3: Screenshot of the online clothing shop website, and description of the different areas of the user interface

The graphical design of the stimulus online shop did not emulate any particular real-world clothing retail website, in order to avoid any established attitudes towards

existing online shops or brands in the current market influencing the attitudes of the participants towards the stimulus.

The usual product catalogue and shopping cart of the online shop was augmented with the VTO feature. It enabled the participants to try-on clothing items in a virtual reality space by dressing their personal avatar with digitised versions of the garments. They were able to:

- Select the garments in their shopping cart for try-on with their avatar,
- Change the colour and size of the separate garments as available in the experimental shop and have these changes reflected in the VTO,
- Zoom the scene in and out; turn the avatar around; and view it from different pre-configured points of view.

The zoom function moves the virtual camera closer to the avatar, in order to be able to inspect details, for example, cloth and seams, or fit at particular positions (see Figure 3-4). The turn function moves the virtual camera continuously around the avatar (around its vertical body axis), clockwise or counter-clockwise, and is not constrained to pre-defined steps or viewing angles. Additionally a full 360 degree rotation sequence and a rotation back to the initial standard position can be chosen. Detail views are a set of pre-defined camera positions from which the user can choose, for example, shoulder or neck, and serve as a shortcut compared to zooming and turning. Together with a function for fit evaluation, these options form the “view navigation” part of the VTO application.



*Figure 3-4: Exemplary detail views achievable with the view navigation functionalities, zoom, turn and detail view.*

The function to evaluate clothing fit visualises internal cloth tension as well as the distance between the body and the cloth for the different parts of a garment in the form of a heat map. In this way, participants could obtain an impression, in addition to the realistically rendered view, about areas where a specific clothing item might fit more loosely or more tightly (see Figure 3-5).



*Figure 3-5: Photo-realistic representation (left) versus visualisation of fit information (right)*

The VTO feature brings together avatars and garments in a physically-based, three-dimensional simulation. The garments are entered as 2D, CAD-derived pattern data, plus several physical cloth parameters, such as stretch-ability or friction. These several aspects are combined to create the final avatar with garments. The resulting 3D visualisation closely approaches the real appearance of clothing due to the simulation of the physical cloth that takes into account the shape of the avatar, the material parameters of the cloth and the way it falls and moves, and due to the sophisticated visual rendering techniques. In this way, the visual result is individualised to the extent that the avatar is individualised (Blum et al., 2010).

### **3.5.3.2 Personal avatars**

Trying to imitate shape and appearance of an individual customer would seem an obvious option for such a system. Following the metaphor of a “virtual mirror”, this can enable customers to check the individual correct fit and to appraise the visual appearance of the clothing in a similar way to a real try-on in front of a real mirror.

As the approach of the proposed experiment was to vary the characteristics of the avatar and not those of the garment product presentation, care was taken that the visualisation of the garments was identical between the three experimental conditions. However, as the shape of the avatar directly influences the shape of a



garment, the avatars of each group were individualised in a similar manner regarding body measurements: they retained the individual body measurements of their owner. In doing so, all the participants sampled a clothing presentation that was individualised to their body measurements. The following figure shows an exemplary avatar as used in this study, for each of the three conditions highly individualised avatar, model avatar, and abstract avatar. The variation in design between these three avatar types is motivated in section 2.8.



*Figure 3-6: Three exemplary personal avatars (belonging to different participants), namely (from left to right) highly individualised avatar, model avatar and abstract avatar*

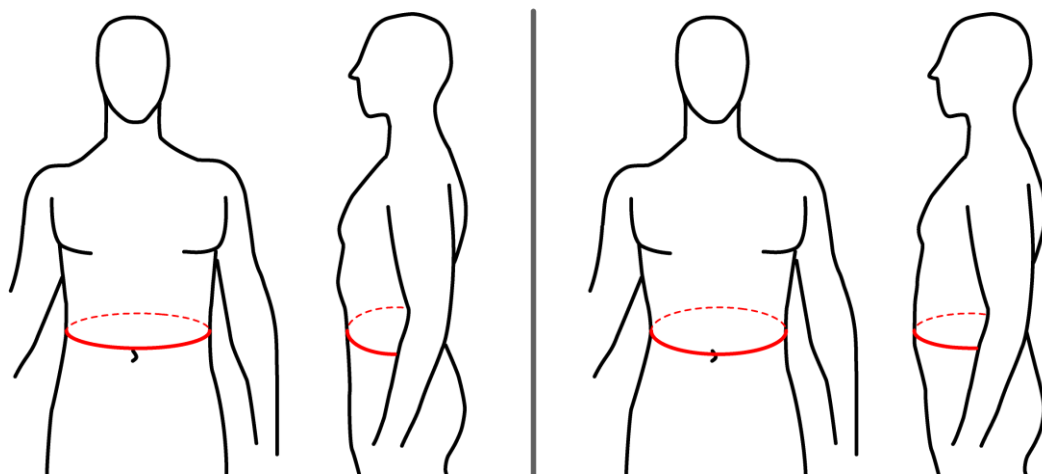
The highly individualised avatar was presented in mirrored form to the participants, as people generally prefer their own mirror images over true, un-mirrored images (as found, e.g., on photos), because this facial orientation is more familiar to them (Brady, Campbell, & Flaherty, 2005).

The model avatar and the abstract avatar were assessed concerning the uncanny valley effect (see section 2.6.4) by several members of the researcher's working group, and judged to not suffer from this phenomenon. For the highly individualised avatar, design principles intended to help avoid the effect were followed, as suggested by MacDorman et al. (2009). Also, the templating technique applied for the production of the avatars tends to reduce the uncanny valley issue by its averaging effect (Hamilton, 2009) and the resulting avoidance of mismatches in the

degree of human likeness of different elements. In the test sessions, the researcher paid attention to potential signs of uncanny valley effects on the part of the subjects.

The five body measures taken from the participants (i.e., chest girth, waist girth, hip size, arm length and body height) were represented exactly in the personal avatars of all three groups. For this purpose, a generic, female avatar template was adjusted to the individual body measures by a linear scaling of the body parts at which the four torso measures were taken. In the case of the body height, this linear scaling affected the whole body equally.

Within these given boundaries, the body shape of all the avatars was basically identical, as no further geometric manipulation of the resulting 3D model was performed. Hence, there was no individualisation of the shape in the sense of adjusting appearance or distribution of muscle mass or body fat, or posture. Figure 3-7 provides an example where identical measures, in this case waist girth, can derive from two different body shapes.



*Figure 3-7: Schematic depiction of two different waist forms that possess identical waist girths: waist with broad frontal silhouette and flat belly (left) versus more slender frontal silhouette but somewhat thicker belly (right)*

For the model avatar and the abstract avatar, no further adjustments were performed, as the avatars otherwise had an identical appearance (hair and colouring, i.e., texture). The body measurements were provided to the software developed by the working group of the researcher, and it generated automatically the human body based on the body measurements (Volz et al., 2007). Both model avatar and abstract avatar could be generated within a few minutes by the experimental system.

In comparison, the preparation of the individual 3D humans for the highly individualised avatar group was far more laborious and required several hours of work by skilled staff:

- The torso, including the limbs, was generated based on the body measures with the aforementioned software. The colouring of these parts was adjusted manually to the skin colour of the head and face (see next point).
- The head and face was produced using the commercially available software tool FaceGen Modeller (Singular Inversions Inc., n.d.).
- The hairstyle was modelled manually.

The photos taken of the participants (two high-quality photos of the whole, dressed body, one front, one side, and two equivalent photos of the head, see also section 3.5.1) were used as input for these steps. Figure 3-8 shows two of these photos for a participant together with the resulting highly individualised avatar.

The software tool FaceGen Modeller takes the two photos of a head as input and, after some preparative, manual steps (marking of feature points, e.g. corners of the mouth, etc.), automatically generates a textured 3D head. The software works with templates, based on statistical data and, from this data, it derives the 3D shape of the parts of the face that are not directly identifiable from the input photos, e.g. the detailed form of the cheeks. For the avatars produced for this research, some differences in the quality of the output of the software were observable and some face shapes proved to work better than others. It seems that shapes that deviate more from the statistical average are reproduced worse than more average face shapes, for example a thick nose would be more problematic than a more standard nose shape.

As the FaceGen software does not incorporate the hairstyle of a person, the scalp hair of the highly individualised avatars had to be modelled manually, i.e., based on existing hair models that were adjusted accordingly.



*Figure 3-8: Photos of participant (left) versus corresponding highly individualised avatar (right)*

### **3.5.3.3 Product assortment**

The experimental online shop presented a range of exemplary contemporary and fashionable women's clothing items that, in all probability, were attractive and resembled real-world offerings, and therefore would be considered for purchase by a broad range of female consumers in a real situation. The range can be classified as casual clothing intended for private occasions (see scenario description in Appendix 5): "You are looking for garments intended for private occasions that call for a rather formal clothing, for example the birthday celebration of your parents."). This means that the clothing on offer was not too extraordinary. On the other hand, it did not comprise items that were typically too basic in character, with no special fit or fashion properties, for example white underwear T-shirts.

Following the taxonomy of (clothing) products described by Wood (2002), garments of an expressive nature were selected for the product catalogue. Clothing of this type may be used to illustrate the personality and lifestyle of the consumer. The rationale is that clothing, which even in reality typically does not require a try-on and inspection in front of a mirror, would make the experimental VTO feature invaluable. In contrast, the range of garments was chosen with the aim that participants would feel the need to closely look at the individual fit as presented by the VTO.

For this research, the product catalogue comprised six basic garment categories:

- i. Skirts,
- ii. Trousers,
- iii. Dresses,
- iv. Blouses,
- v. T-shirts and
- vi. Tops.

Each category contained several exemplary garments that differed in colour, design and cut. The product assortment was intended to provide participants with a significant choice of products for the experimental shopping task. In practice it would be impossible to satisfy the tastes and preferences of a random sample of people. For this study, the product assortment was pilot tested and discussed with three female colleagues in order to ensure that it was at least adequate.

In addition each product item or product variant in the product catalogue was provided with basic product information in written text (e.g., product name, short description) and with product images. The product images were screenshots from the VTO, as real photos were not available because the garments did not exist in reality.

#### **3.5.3.4 Usability**

There was the possibility that the factors of greatest interest for this research could be affected by the usability of the system. However, the online shop prototype had been developed with the intent also to research usability requirements in other research projects. These studies have shown that it exhibits a good, state-of-the art usability level that, presumably, would not have significantly affected the outcomes of this study (Blum et al., 2005; Blum et al., 2007; Blum et al., 2010; Blum & Khakzar, 2009; Rupprecht et al., 2009).

Nevertheless, the experience of using the system for the first time could affect the attitudes of the participants towards the whole experience. Therefore, in order to reduce the effects of first-time use, the participants were introduced to the prototype (as explained further below), and the purpose of this introduction was explained to them in full.

#### **3.5.3.5 Stimulus presentation**

One purpose of the stimulus was to simulate a typical, preferably unbiased, online clothing shopping session for the participants. In order not to influence the reliability of the study, care was taken that the fictitiousness of the scenario only influenced the experience of the participants with the system, and therefore their attitudes towards it, to a minor extent. On the other hand, by concentrating on those parts of the shopping process that were relevant for the study, influences from extraneous variables could be avoided. In this case, the VTO was the focus; it allows participants to examine closely the visual attributes of selected products using their personal avatars, with the objective to make a (positive or negative) purchase decision.

The overall aim was to provide the participants with an experience of the avatar concept, to familiarise them with it and to stimulate and give them the opportunity to develop an individual attitude towards it.

A further measure to control extraneous variables was to remove all other stimulus material that may have had the potential to affect the information that the participants would gather by using the VTO. This includes the promotional information that is typical for real online shops, such as brand names, and banner advertisements.

The introduction of the participants to the experimental system marked the actual start of the stimuli presentation. This information was given verbally and through practical demonstration by the researcher whilst sitting together with the participant at the homelike computer workplace that was used as the experimental system environment. It mainly consisted of a short demonstration of all the relevant features of the experimental online shop. At that time, the VTO already displayed the individual avatar of the participant. The participants were also informed that the maturity level of the system was that of a prototype and that, therefore, small functional issues could arise or that, in case of the group with the highly individualised avatars, the personal avatars may have some flaws. They were asked to overlook obvious shortcomings, for example, substantial dissimilarity in hair style.

Subsequently, the researcher described a scenario – please refer to Appendix 5 for the specific scenario description. This encouraged the participants to think about buying several garments intended for private occasions. Then, the participants were asked to browse the stimulus shop with the aim to consider and pre-select one to four garments for later purchase. In doing so, it was essential that the participants used the VTO feature intensively in order to experience their personal avatar.

However, as this functionality was still new and unfamiliar to them:

- The scenario description instructed the participants the ways in which to use it,
- The experimental system integrated the VTO into the shopping process workflow naturally and in such a way that bypassing it would not make sense,
- The researcher reminded the participants to use the function when required, though, of course, he took care to do that unobtrusively.

The researcher accompanied the participants during the browsing of the stimulus shop. He observed the interaction of the participants with the system, in order to be able to offer immediate support in case of any problems with use. This ensured that

usability problems did not affect the results. At the same time, he took care to not influence the participants with his behaviour, for example give an opinion.

Also, the researcher encouraged each participant to use the stimulus for an approximately equal time (10 to 15 minutes). Of course, participants took a varied time for their shopping task and this should not be influenced too much by the investigator.

In addition, the thinking-aloud technique was employed: participants were asked by the researcher to say what they were looking at, thinking, doing, and feeling, as they went about their shopping task. With this measure, initial interesting comments about their personal avatars should be elicited from the participants, which could be referred to later in the interview or in the data analysis. However, this method did not turn out to be very effective with most of the participants, as, typically, they fell silent after some initial comments. The researcher avoided reminding them to think aloud too often in order not to disturb them.

During the interaction phase with the stimulus online shop the researcher took notes of prominent and possibly relevant reactions of the participants that were made either verbally or non-verbally (e.g., facial expressions, tone of voice, body language or gestures). It was possible to refer to these observations later in the interview. This data was not intended to be used or analysed any further after the experimental sessions.

Three females pilot tested the stimulus procedure to ensure clarity of instructions and to determine the time needed and the number of garments to be chosen to interact sufficiently with the online shop.

#### **3.5.4 Main questionnaire and interview**

After experiencing the stimulus, the participants were asked to complete the main questionnaire. This consisted mainly of Likert scales, i.e., multiple-item scales that were aimed at determining a measure of the underlying latent unobservable variables. There were also several separate Likert-type questions, employed as single items, though grouped thematically.

The participants filled in the questionnaire by themselves, but were instructed to ask the researcher for help in case of any comprehension problems. After completion of



the questionnaire, the researcher conducted an interview with the participants. Please refer to Appendices 5 and 6 for the specific items of the questionnaire and for the interview questions. Please see sections 3.6.2 and 3.6.3 for explanations and justifications.

During this phase of the experiment the participants could return to the stimulus online shop if they wished to do so to refresh their memory of an experience, as they remained at the computer workplace and the researcher instructed that this was possible. For example, for some questions, the participants wanted to take a closer look at a specific aspect of the experimental system. The investigator did not see any disadvantage in allowing this.

The three people that pilot-tested the questionnaire were also interviewed by the researcher in order to ensure comprehensibility and clarity of item wording as well as to provide interview training for the researcher.

### **3.5.5 Audio recording**

Audio recording was used throughout the complete test sessions. Specifically, the audio record comprised the initial questionnaire, the interaction with the online shop and the subsequent questioning (main quantitative questionnaire and interview). It therefore captured the interview and any verbal comments or answers to questions asked by the participants during the separate procedures.

## **3.6 Data collection**

This section describes the specific data collection measures in detail, including the survey instruments and the data management procedures.

### **3.6.1 Initial quantitative questionnaire**

The purpose of the data collected with the initial questionnaire was to:

- Obtain socio-demographic and shopping-related characteristics of the participants,
- Recheck inclusion and exclusion criteria,
- Perform statistical control of personal, potentially confounding variables, if required (see section 2.7.10),
- Analyse selected measures concerning potential effects on outcomes, for example via group comparison, as part of secondary analyses,

- Determine hints for interpretation and explanation of outcome.

Therefore, the participants were asked for:

- Age, language and profession,
- Usage habits and experience concerning the Internet,
- Habits and experience concerning online shopping in general,
- Habits and experience concerning shopping of clothing, especially home shopping,
- Two additional consumption-related attitudes, namely appearance orientation and shopping orientation (see section 2.7.10).

The initial quantitative questionnaire is attached as Appendix 4.

The following tables provide a description for each of the collected variables as well as details on the type of data collected. In the case of Likert scales, the name of the latent variable measured by the scale, the source of the scale in the literature, the origin of the applied German version and information on the quality of the scale, i.e., validity and reliability, is presented.

Where habits and experiences were questioned, the participants were asked to refer to the last 12 months in order to obtain the most up-to-date information from them.

*Table 3-1: Age, language, profession*

<i>Description</i>	<i>Details</i>
Age	
German language skills	2-point ordinal scale: whether German is first language or not
Occupational activity: <ul style="list-style-type: none"> <li>• Current status</li> <li>• Name of study course and current semester, or occupational title</li> <li>• Name(s) of further completed study courses or further considerable professional experience</li> </ul>	Each with open question

*Table 3-2: Usage habits and experience concerning Internet*

<i>Description</i>	<i>Details</i>
Frequency of use of the Internet	4-point ordinal scale: hours per week
Enjoyment of Web surfing or lack thereof	5-point interval scale

*Table 3-3: Habits and experience concerning online shopping in general*

<i>Description</i>	<i>Details</i>
Frequency of use of the Web for <ul style="list-style-type: none"> <li>• Work/study</li> <li>• Entertainment</li> <li>• Online shopping</li> </ul>	Each with 5-point ordinal scale
Number of months/years buying online	3-point ordinal scale
Satisfaction with utility of online shopping or lack thereof	5-point interval scale
Enjoyment of online shopping or lack thereof	5-point interval scale

*Table 3-4: Habits and experience concerning shopping of clothing*

<i>Description</i>	<i>Details</i>
Distribution channels used	5-point ordinal scale: breakdown in %
Frequency of use of the channels <ul style="list-style-type: none"> <li>• Online shops</li> <li>• Printed catalogues</li> <li>• Teleshopping/ TV sales channels</li> </ul>	3-point ordinal scale
Satisfaction with utility of home shopping when shopping for clothing or lack thereof	5-point interval scale
Enjoyment of home shopping for clothing or lack thereof	5-point interval scale

Table 3-5: Additional consumption-related attitudes

<i>Name, source</i>	<i>Description</i>	<i>Details</i>	<i>Scale quality evaluation</i>
Appearance orientation, Brown et al. (1990)	Attitude towards own appearance or body image: importance of appearance, attention to appearance, thoughts and behaviours centred on appearance	<ul style="list-style-type: none"> <li>• Psychometric (Likert) scale</li> <li>• 12 items</li> <li>• 5-point interval scale</li> <li>• German version: Mühlan and Schmidt (2006)</li> </ul>	<p>Original English version:</p> <ul style="list-style-type: none"> <li>• Validity: factor validity and external validity</li> <li>• Reliability: satisfactory or better internal consistency (Cronbach's alpha); good or better re-test reliability</li> </ul> <p>German version: confirmation of the above good results for several quality criteria (scale quality evaluation not completed yet)</p>
Shopping orientation, Machleit et al. (2005)	The manner in which a person approaches the activity of shopping	<ul style="list-style-type: none"> <li>• Psychometric (Likert) scale</li> <li>• 5 items</li> <li>• 5-point interval scale</li> <li>• German version: translation by investigator</li> </ul>	<ul style="list-style-type: none"> <li>• Validity: good/acceptable (level of model fit in confirmatory factor analyses, CFA)</li> <li>• Reliability: good internal consistency (Cronbach's alpha)</li> </ul>

Audio-recording was started before the participants began to fill in the initial questionnaire and continued throughout the experiment. The purpose of recording, even during the completion of the initial questionnaire, was to capture any remarks of the participants as well as the researcher that may have relevance for the objective of investigation. Although the subjects had not experienced the stimulus at this stage of the experimental session, nevertheless, having received some information on the topic and completed the photos and measurements session, they could make relevant remarks.

### **3.6.2 Main quantitative questionnaire**

The dependent variable space, consumer behaviour, was evaluated mainly via variables that are known from the literature to be favourable marketing outcomes (see section 2.7). This included informativeness, “attitude towards the website”, “decision support satisfaction”, shopping enjoyment, telepresence and “perceived risk of purchase”.

Actual purchase is the outcome factor of primary interest in real business situations and motivates the investigation of avatar design as the marketing measure discussed here. However actual purchase is difficult to simulate in a laboratory experiment. For this reason, a direct measure of purchase behaviour, purchase intention, was included. The marketing outcome factors were selected in order to help explain the effects that were identified.

In addition, data regarding how the participants actually perceived their individual avatar was collected. Therefore, the latent variable avatar homophily (avatar similarity to self, see section 2.7.9) was measured. Participants were also asked to rate different aspects of the appearance of their avatar, including body dimensions, body shape, posture, face, hair, head as a whole, skin colour and appearance as a whole. Participants could name and rate further aspects not specified in the list, if required. It was expected to find systematic differences between these variables for the experimental groups.

In order to determine the demands and wishes of users for the characteristics of the avatar that go beyond the design of the individual avatars used in the experiment, participants were asked about other desired characteristics. They were asked to specify the importance or not of imitation of different characteristics of their own bodies and appearance by their personal avatar. This included aspects of clothing size, body measures, body shape, posture, face, hairstyle, skin colour, hair colour and eye colour. Where appropriate, subjects could differentiate their rating between an approximated and an exact, detailed representation. Also, more sophisticated characteristics and functionalities had to be rated, including variation of characteristics of body appearance (e.g., different hairstyles), setting the posture (e.g., arms stretched forward), and display of different emotions (e.g., smiling, neutral, and serious). It was also possible to describe and rate further aspects if participants desired.

The main quantitative questionnaire is attached as Appendix 5.

For each of the applied measures the following tables provide a short description and details on the type of collected data. For the Likert scales this includes the name of the latent variable, the reference from the literature, the origin of the applied German version and information on their validity and reliability.

Where necessary, the individual items of each scale were adapted to target better the scenario studied here, for example, “try-on with personal avatar” substituted for “website”.

*Table 3-6: Marketing outcome factors*

<i>Name, source</i>	<i>Description</i>	<i>Details</i>	<i>Scale quality evaluation</i>
Website informativeness, Luo (2002)	Degree to which a website provides users with information they perceive as resourceful and helpful	<ul style="list-style-type: none"> <li>• Psychometric (Likert) scale</li> <li>• 4 items</li> <li>• 5-point interval scale</li> <li>• German version: translation by investigator</li> </ul>	<ul style="list-style-type: none"> <li>• Validity: convergent and discriminant validity (CFA &amp; exploratory factor analysis, EFA)</li> <li>• Reliability: good internal consistency (Cronbach’s alpha)</li> </ul>
Attitude towards the website, Chen and Wells (1999)	Person’s general evaluation of a website or general favourability towards a website	<ul style="list-style-type: none"> <li>• Psychometric (Likert) scale</li> <li>• 6 items</li> <li>• 5-point interval scale</li> <li>• German version: translation by investigator</li> </ul>	<ul style="list-style-type: none"> <li>• Validity: convergent and discriminant validity (CFA &amp; EFA) (Luo, 2002)</li> <li>• Reliability: good internal consistency (Cronbach’s alpha)</li> </ul>

<p>Decision support satisfaction, Garrity et al. (2005)</p>	<p>Evaluation of how satisfied a person is with the decision support received from the system, including the ability of the system to deliver relevant information for decision making and to improve the decisions of a person</p>	<ul style="list-style-type: none"> <li>• Psychometric (Likert) scale</li> <li>• 3 items</li> <li>• 5-point interval scale</li> <li>• German version: translation by investigator</li> </ul>	<ul style="list-style-type: none"> <li>• Validity: reasonable convergent and discriminant validity (average variance extracted, AVE)</li> <li>• Reliability: adequate individual item loadings and internal consistency, sound composite reliability (CR)</li> </ul>
<p>Shopping enjoyment, Kim et al. (2007)</p>	<p>A person's enjoyment of the shopping experience; the extent to which a person perceives the shopping experience with an online shop to be enjoyable in its own right</p>	<ul style="list-style-type: none"> <li>• Psychometric (Likert) scale</li> <li>• 6 items</li> <li>• 5-point interval scale</li> <li>• German version: partly Siebecke (1998), partly translation by investigator</li> </ul>	<ul style="list-style-type: none"> <li>• Validity: construct validity (EFA)</li> <li>• Reliability: very good internal consistency (Cronbach's alpha)</li> </ul>
<p>Telepresence, Fiore, Jin et al.; Fiore, Kim et al. (2005; 2005)</p>	<p>Here in the sense of perceptions of how closely the online sensory information and interaction with the product approximate information and interaction with the real product in a brick-and-mortar store</p>	<ul style="list-style-type: none"> <li>• Psychometric (Likert) scale</li> <li>• 5 items</li> <li>• 5-point interval scale</li> <li>• German version: translation by investigator</li> </ul>	<ul style="list-style-type: none"> <li>• Validity: N/A</li> <li>• Reliability: good internal consistency (Cronbach's alpha)</li> </ul>

Perceived risk of purchase, Kim and Lennon (2000)	Nature and amount of uncertainty perceived by a person in making a particular purchase decision	<ul style="list-style-type: none"> <li>• Psychometric (Likert) scale</li> <li>• 16 items</li> <li>• 5-point interval scale</li> <li>• German version: translation by investigator</li> </ul>	<ul style="list-style-type: none"> <li>• Validity: convergent and discriminant validity (CFA)</li> <li>• Reliability: good internal consistency (Cronbach's alpha)</li> </ul> (Park & Stoel, 2005)
Purchase intention, Kim and Lennon (2000)	Represents what and where a person thinks they will buy	<ul style="list-style-type: none"> <li>• Psychometric (Likert) scale</li> <li>• 4 items</li> <li>• 5-point interval scale</li> <li>• German version: translation by investigator</li> </ul>	<ul style="list-style-type: none"> <li>• Validity: N/A</li> <li>• Reliability: good internal consistency (Cronbach's alpha)</li> </ul>

*Table 3-7: Perception of "avatar similarity to self"*

<i>Name, source</i>	<i>Description</i>	<i>Details</i>	<i>Scale quality evaluation</i>
Avatar homophily, Nowak, Hamilton, and Hammond (2008)	Avatar similarity to self	<ul style="list-style-type: none"> <li>• Psychometric (Likert) scale</li> <li>• 4 items</li> <li>• 5-point interval scale</li> <li>• German version: translation by investigator</li> </ul>	<ul style="list-style-type: none"> <li>• Reliability: good internal consistency (Cronbach's alpha)</li> </ul>



*Table 3-8: Assessment of different avatar characteristics*

<i>Description</i>	<i>Details</i>
Assessment of different aspects of the appearance of the personal avatar	<ul style="list-style-type: none"> <li>• 8 separate items (plus optional items)</li> <li>• 5-point ordinal scale (school grades)</li> </ul>
Importance or rejection of imitation of different characteristics of one's body and appearance by the personal avatar	<ul style="list-style-type: none"> <li>• 14 separate items</li> <li>• 4-point ordinal scale</li> </ul>
Importance or rejection of specific optional characteristics and functionalities of the personal avatar	<ul style="list-style-type: none"> <li>• 3 separate items</li> <li>• 4-point ordinal scale</li> </ul>

Audio-recording was also active whilst the participants filled in the questionnaire for the same purposes as in case of the initial questionnaire (see section 3.5.5).

### **3.6.3 Interview**

The interview was a guided, semi-structured interview and complemented the main questionnaire with open-ended questions. These questions were asked via the interview technique because the investigator expected to receive more comprehensive answers orally than compared to asking the participants to write down the information. Also, with this method, more comments could be expressed in the same amount of time and the researcher had the possibility to enquire further on specific aspects, for example in the case of a lack of clarity or in the case of an impression of incompleteness of the answers, superficial replies or when unforeseen, interesting aspects were raised by the participant (Oates, 2006).

According to the chosen mixed method approach of the explanatory sequential type, see section 3.1.2.3, the purpose of the interview was to explore motivations for the responses given in the main questionnaire and to seek explanations for identified effects and trends. Therefore, the aspects addressed in the interview were directed to the topics covered in the main questionnaire, namely, attitudes towards specific characteristics of the avatar, utility of these functional concepts, similarity of the avatar to self, as well as further desired characteristics and functionalities of the personal avatar.

Furthermore, potentially confounding factors were covered, namely those that are difficult to ask in detail with a questionnaire due to their diversity and complexity.

This included experience of personal avatars and virtual try-ons and liking (or disliking) the garments available in the stimulus online shop.

The interview guide also allowed the interviewer to respond to reactions that occurred during the interaction phase with the stimulus online shop. For example, a participant may initially have expressed a negative reaction non-verbally when confronted with her avatar for the first time, but became more positive subsequently. This would have been interesting to address in the interview.

The following topics were included in the interview:

- i. Experience concerning personal avatars and virtual try-ons,
- ii. Attitude towards specific characteristics of the personal avatar,
- iii. Usefulness of personal avatar and virtual try-on,
- iv. Assessment of garments offered and explanation of selection made,
- v. Recognition of oneself in the personal avatar and identification with the personal avatar,
- vi. Desired characteristics of the personal avatar,
- vii. Transfer to other products and to other contexts.

The main questions were prepared in the exact wording in the interview guide (see attached as Appendix 6).

The interview closed with a debriefing. It queried if the deficiencies of the prototype and the use of personal information had influenced the answers of the participant. Also, the participants were asked if they found anything unpleasant or if they had any other comments on the course of the test. Finally, they were asked to comment on how interesting they had found the topic of the study.

The researcher noted down essential aspects of the answers, mainly to be able to ask further when required. The interviews were audio-recorded in order to collect the complete comments of the participants during the dialogue between subject and researcher for later in-depth analysis.

#### **3.6.4 Audio recording and transcription**

Audio recording was used to capture all verbal remarks throughout the whole experimental session. The objective was to gather a complete audio record of the interaction session with the online shop and of the questioning (questionnaires and

interview). This included any relevant verbal comments or questions asked by the participants as well as answers given by the researcher, such as during completion of the main questionnaire. For the interview, audio capture was the central means of data collection.

Audio-recording was realised using software running on the PC that hosted the experimental system. A directional microphone was employed but arranged in an as unobtrusive as possible manner in order to affect the behaviour of the participants as little as possible.

After completion of the test sessions, the audio data was transcribed. This was done in the original language, namely German.

All the interviews were transcribed completely. In contrast, the audio records from the other phases of the test sessions, i.e., initial questionnaire, interaction with the online shop and answering the main quantitative questionnaire, were filtered for remarks with significance to the topics covered in the interview. These were integrated in the interview transcript accordingly. The same applies to any applicable notes that were taken by the researcher during the experimental sessions, as far as they were not already taken up and addressed in the respective interviews.

The qualitative analysis part of this study was based on the thematic analysis technique, with the focus set on the semantics of the textual data (see section 3.7.2). The transcript was created accordingly: it was confined to the content of the remarks and used simplified language. This was achieved by following a set of simple transcription rules based on Kuckartz, Dresing, Rädiker, and Stefer (2008); for example, verbatim transcription, translation of dialects, filtering/smoothing (e.g., omission of stutter), and short sentences wherever possible. This approach had a further advantage that the required effort was limited to a reasonable amount.

The major part of the interview data was not transcribed by the researcher, but by a student member of the working group of the researcher. Therefore, the investigator checked the transcripts against the original audio recordings for accuracy, at random.

### **3.6.5 Data management**

Any personal information or identifiers of the individual participants are kept separate from anonymous information such as responses to questions. Audio records,

photos and personal avatars of the participants will be destroyed upon completion of the study. Any information that could identify individual participants was removed from the database prior to analysis, write-up or presentation. The photos and screenshots of the highly individualised avatar reproduced in Figure 3-6, page 77, and Figure 3-8, page 80, are an exception, and explicit consent was obtained from the participant to include in this thesis.

Quantitative data, basically the answers to selection items, were transformed into digital format, stored and analysed with common statistical analysis software, namely IBM SPSS Statistics. Before analysing the data, any input errors were identified and corrected with the help of this software.

The handwritten data generated by the test assistant was entered digitally and stored with standard office software. The same software was used to transcribe the recorded audio data.

The digitised data was stored on an Intranet server of the working group of the investigator. Only the investigator and at maximum two selected work group members had access to the data. Paper-based data was destroyed after digitisation.

### **3.7 Data analysis**

The primary method of data analysis was analysis of variance between the separate conditions and followed from the experimental study that tested differences in outcomes between three different experimental conditions. However, the different types of data collected, quantitative and qualitative, required different treatment; and data analysis procedures had to be executed thoroughly for both forms. The following sections give an overview of the separate parts of the analysis and the integration of quantitative and qualitative results according to the chosen mixed methods approach (compare section 3.1.2.3). More details are presented later, together with the analytical results (see chapter 4).

#### **3.7.1 Quantitative data analysis**

This study used a number of techniques to analyse the quantitative data with the objective of identifying interesting patterns and drawing conclusions of relevance for the research questions. Visual approaches, including tables, charts and graphs, simple descriptive statistical techniques, and more complex, inferential statistical methods

were employed. In addition, the advice of Oates (2006) to avoid using overly complex statistical analysis methods was followed, and common techniques were used, as these are also prevalent in the pertinent literature. Nevertheless, advice from two statisticians was sought, and suitability and details of methods were discussed and checked with them.

The following descriptive statistics were used for the quantitative variables in this study, dependent on the type of data:

- The central tendency, for example mean for interval data or median for ordinal data,
- The distribution of the data, with range, and standard deviation for interval data or interquartile range (IQR) for ordinal data.

The primary purpose of the quantitative analysis was to determine relationships between the quantitative data and test for statistical significance, based on the proposed research model (see Figure 3-9) and the formulated hypothesis (compare section 2.7). With a nominal scale for the independent variable, namely avatar groups, and metric scales for the dependant variables, analysis of variance formed the most appropriate method (Backhaus, Erichson, Plinke, & Weiber, 2011). As is customary, data collected with Likert scales was considered as interval data (Bortz & Döring, 2006).

As there were three groups, one-way ANOVA was chosen (this belongs to the F tests family) (see Figure 3-9). The data was checked that it met the prerequisites of the method, which is normality, i.e., normal distribution of scores, and homogeneity of variance between groups. However, having equal group sizes would have remedied potential violations of these assumptions (Hair et al., 2010).

A statistical power ( $1-\beta$ ) of 0.80 was chosen, and 0.05 for level of significance  $\alpha$ , as stated for the sample size calculation described in section 3.4.2. It was decided that a significant test result should only be accepted if the effect size  $f$  was at least 0.4.

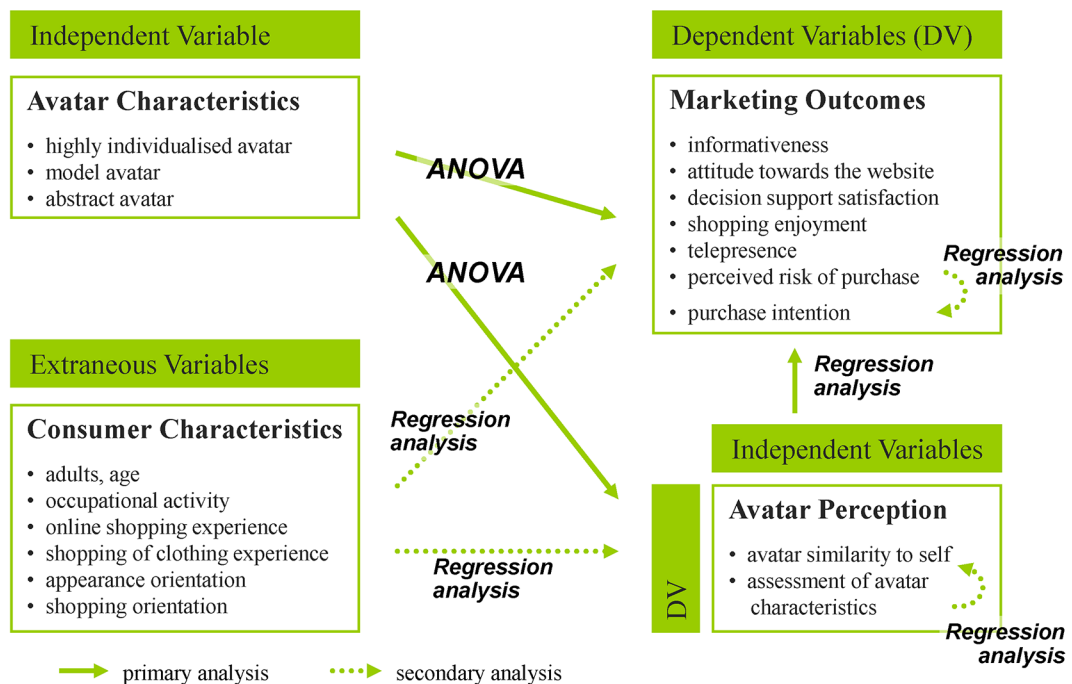


Figure 3-9: Research model overview, with statistical analysis techniques

Simple linear, univariate regression analysis was applied in addition to ANOVA (see Figure 3-9). Here, “avatar similarity to self” and some of the marketing outcome factors were interpreted as independent variables in different regression models. As in these cases, both independent and dependent variables comprised interval data, regression analysis was chosen (Backhaus et al., 2011). The experimental groups were not included in these calculations. The assumptions checked for the regression analysis concerning the quality of the data were:

- Linearity, i.e., a linear relationship between the independent and dependent variables,
- Multivariate normality, i.e., normal distribution of all included variables,
- Unbiasedness of model estimators (regressors) and error terms (residuals):  
No or little multicollinearity, i.e., mutual independence of independent variables (in the case that several are included in the regression model), and no or little correlation between independent variable(s) and error terms,
- Homoscedasticity, i.e., homogeneity of variance of error terms along the regression.

This work also considered additional secondary outcomes, such as contingent links between other variables. This included extraneous variables collected with the initial

questionnaire (see Figure 3-9), for example, appearance orientation and shopping orientation, and qualitative data after being coded and analysed. On the one hand, these were included as co-variates in the above-named ANOVA analyses. On the other hand, they were considered as independent variables in separate regression models. In one case, where the data to be analysed comprised ordinal data, the non-parametric Wilcoxon Signed Ranks Test was applied. It has no prerequisites concerning the data.

Variables represented with psychometric scales (Likert scales), i.e. the latent variables, were analysed with common statistical techniques for reliability, based on the collected data (see also section 3.2).

### **3.7.2 Qualitative data analysis**

In principle, qualitative data, be it words, images, sounds or whatever non-numeric type of data, can be analysed with two fundamental approaches: quantitatively or qualitatively. Quantitative or numerical analysis is based on counting the number of times certain artefacts occur in the data, for example particular words in a text, or specific sounds in an audio recording, as practised for example in content analysis (Joffe & Yardley, 2004). The most frequent approach in qualitative data analysis is to extract the themes and patterns (verbal, visual or aural) from the research data that are important to the research topic (Oates, 2006). In this way, the raw data is distilled and a more granular research and analysis can be conducted.

Several qualitative analytic methods exist that search for themes or patterns. According to Braun and Clarke (2006) they can be divided roughly into two groups:

- One includes methods that relate closely to particular theoretical or epistemological positions, such as interpretative phenomenological analysis (IPA), grounded theory or discourse analysis.
- The second group of methods can be applied across a range of theoretical and epistemological approaches as it is essentially independent of them. One frequently used method in this category is thematic analysis, which was used in this research.

Thematic analysis is used to identify, analyse, and report patterns (themes) within qualitative data, with the result that, minimally, the analysed data is organised and

described in (rich) detail, or going further, that various aspects of the research topic are interpreted (Boyatzis, 1998). Braun and Clarke (2006, p. 78) describe thematic analysis as “a flexible and useful research tool, which can potentially provide a rich and detailed, yet complex account of data.”. The method was considered suitable for this research, as, in addition to its main aim of interpretive analysis, it both quantifies the data and identifies themes which may be used in statistical analysis (Boyatzis, 1998; Joffe & Yardley, 2004). The latter aspect should facilitate integration with the quantitative part of this study.

Themes or patterns can be identified in several ways in thematic analysis (Boyatzis, 1998):

- i. Theory-driven, i.e., deductively,
- ii. Prior data or prior research-driven, and
- iii. Data-driven, i.e., inductively.

Deductive thematic coding relies on existing theoretical ideas. They are considered when developing a thematic coding (Braun & Clarke, 2006; Joffe & Yardley, 2004). The prior research-driven approach builds on a review of existing research findings, to identify suggestions for the thematic coding scheme (Boyatzis, 1998). In contrast, strict inductive coding identifies the themes solely from the raw information itself, i.e., it does not try to fit the data into any pre-existing scheme.

The analysis reported here started with a prior research-driven approach followed by a data-driven style. It was considered helpful and effective to begin with an initial list, as suggested by Boyatzis (1998), derived from the literature and the foundations of the quantitative part of the study. The data-driven approach could then be used to explore the subtler features of the data. Following Bauer’s (2000) advice on inductive coding, the text was not coded freely – rather themes were selected as being related to the principles that underpinned the research and its specific research questions.

The following steps or phases, adapted from Boyatzis (1998) and Braun and Clarke (2006), were executed. These steps, as indicated in the description here, were not conducted in linear fashion, simply moving one step to the next, rather they were executed iteratively as required.



1. Familiarising with the data:

The data were read and reread carefully in order to become familiar with the depth and breadth of the content. During reading, preliminary meanings, patterns, and trends were noted as ideas for coding.

2. Generating initial codes:

Codes as meaningful labels were assigned to each section of the raw data that appeared interesting with respect to the investigated phenomena. In this way, the raw data was categorised. Codes can refer to overt semantic content of the data or latent meaning. In this phase the analysis was conducted at a semantic level whilst in later steps, where the so-called themes come into play, it progressed to a latent or interpretative proceeding. Accordingly, the data codes generated in this step differ in scope from the themes. The latter are (often) broader than codes and they constitute units of analysis that are subject to the interpretative analysis and to which analysts relate their arguments about the investigated phenomenon (Boyatzis, 1998).

The total set of codes comprises the so-called coding book. Using the combination of prior research-driven and data-driven methods, a list of codes relating to pre-defined themes from the literature and the foundations of the quantitative part of the study was created, which was gradually supplemented with additional codes drawn inductively from the data.

3. Searching for themes:

In this phase, the analysis was re-focused at a broader level, i.e., themes, rather than codes. The codes were sorted into potential themes, and all the relevant coded data extracts were collated within the identified themes. A thematic map was produced and refined (see also next step), and visualises how groups of codes form particular themes or sub-themes. In a manner similar to the previous step, a pre-defined list of themes was extended in the course of the analysis.

4. Reviewing themes:

The themes identified so far were refined, i.e., certain themes were removed, merged into a new theme, or broken down into separate themes. This process was governed by the aim that “data within themes should cohere together meaningfully, whilst there should be clear and identifiable distinctions between

themes” (Braun & Clarke, 2006, p. 91).

This step was undertaken at two levels:

- (i) At the level of the coded data extracts, which meant, reading all the assembled extracts for a theme and considering if they form a coherent pattern, and
- (ii) At the level of the entire data set, i.e., on the one hand, rechecking whether the themes “function” in relation to the data set, and on the other hand, coding any additional data within themes left out so far.

#### 5. Defining and naming themes:

Based on a satisfactory thematic map resulting from the previous steps, a detailed analysis of each theme was undertaken in order to define and further refine it, including a revision of their previous working titles. For this purpose, all the themes were considered individually, but also in relation to the others, with the objective to tell the “whole story” about the data, in relation to the research questions.

#### 6. Producing the report:

This last step involved the final analysis and write-up. The result can be found in chapter 4.

The relatively high number of interviews and the random selection of the sample from a defined population made it possible to conduct meaningful statistical analysis on the coded qualitative data; primarily comparisons between the three experimental groups. Also, statements on generalisability and transferability could be made, for example counts or percentages to show the prevalence of typical phenomena. This also helps to avoid the danger of anecdotalism (Silverman, 2015), i.e., to report a theme or story based on one particularly interesting person, setting, or event, but ignoring and concealing that it is actually atypical and possibly unique in the data.

The NVivo computer software was used as a supporting tool to carry out the thematic analysis of the qualitative data of the study, for example, to retrieve relevant text segments or to administrate codes and to determine their co-occurrence and frequency. The alternative manual approach was deemed impractical considering the number of interviews and amount of raw data.

It was determined that the qualitative analysis should be limited to approximately one half of the interviews (30 of the 59). The main reason was due to data saturation, i.e., during thematic analysis, it was observed that no further themes were emerging with continued analysis, and so no further insight was being given.

Cases to analyse were selected on a statistical basis. Participants were placed in an ordered list based on the value gained for the “avatar similarity to self” scale. An equal number of cases with high and low values was chosen for analysis from each avatar group. In this way, a complete range of positive and negative statements with relevance for the research questions would be obtained.

### **3.7.3 Integration of quantitative and qualitative results**

The central motivation for adopting the mixed method approach was to use the qualitative data to help explain the quantitative results as well as better understand their implications for the research questions. Therefore, this study used the explanatory sequential mixed method design, though it also borrowed from the convergent parallel mixed methods approach for the purposes of triangulation (cf. section 3.1.2.3).

According to Kelle and Erzberger (2004) the combined use of qualitative and quantitative procedures may lead to one of three types of outcome:

1. Convergence, i.e., tendency of agreement of quantitative and qualitative results,
2. Complementarity, i.e., reciprocal supplementation of each other,
3. Divergence, i.e., mutual contradiction.

The quantitative and qualitative results of this study were integrated with respect to these potential outcomes and, having identified instances, elaborated thoroughly.

Naturally, a direct comparison of the two data sets, as pertinent for the convergent mixed method design, could only be conducted if variables or concepts were comparable, i.e., if they related to the same phenomenon (Kelle & Erzberger, 2004), for example the quantitative and qualitative evaluation of particular avatar characteristics by the interviewees. This corresponds to the theory in the triangulation concept that there can be reciprocal validation of results. In this research, comparison between quantitative and qualitative results was undertaken in

order to determine if the qualitative results confirm or disconfirm the statistical results. In the case of divergence between qualitative and quantitative results, revision and modification of the initial theoretical assumptions was considered. However, it was expected that, typically, complete convergent or divergent situations would occur infrequently and that, often, differences would relate only to a few concepts, themes, or scales (Creswell, 2014).

Complementary outcomes were used to help fill gaps in the explanation of quantitative, statistical results, by deriving additional assumptions from the qualitative results (Kelle & Erzberger, 2004). This applied for the major part of the integration of both parts of the data analysis. For this purpose, Creswell's (2014) recommended procedure for the interpretation of an explanatory sequential design was applied, i.e., reporting the quantitative results first, followed by the qualitative results, plus a third form of interpretation and discussion about how the qualitative findings help to expand or explain the quantitative results.

Most often, the qualitative questions of this study narrowed the scope of the quantitative queries, which means that they reflected different aspects that together produce an appropriate overall picture. This corresponds to the second theory of the triangulation concept that complementing different viewpoints will generate a unified picture of the object of investigation.

### **3.8 Ethical considerations**

Doing research in an ethical and professional manner is considered good research practise. Key ethical rules for research are (Brunel University London, 2014):

- Veracity, i.e., truthfulness or absence of deception,
- Privacy, i.e., freedom from unwarranted public intrusion,
- Confidentiality, i.e., non-disclosure,
- Fidelity, i.e., accuracy in recording and reporting of data.

Brunel University, United Kingdom and Fulda University, Germany, the sites that were involved in this research, require their researchers to obtain ethics approval for research that involves humans. The aim is to protect the rights, safety, dignity and well-being of the participants (Oates, 2006).

Ethics approval was granted for this research by the responsible Research Ethics Committees of both, Brunel University and Fulda University (see Appendix 1). The application for ethical approval included a full description of the study objectives, the study protocol, the selection of participants, as well as full disclosure of questionnaires and interview guide, and analysis methods. In addition, a support letter by Fulda University was submitted as part of the ethics application to the Research Ethics Committee of Brunel University to confirm permission to conduct the experiment on the premises of Fulda University (see Appendix 1).

The participants were informed that they have to read the research information sheet (see Appendix 2) and sign the consent form (see Appendix 3) before taking part in the study. The researcher adhered to the terms agreed with the participants and to the ethical regulations of the two concerned institutions during all stages of the project.

## **4 Data Analysis and Results**

The data analysis of this study comprises three components; quantitative and qualitative analysis plus the integration of these two result sets. As discussed in section 3.7.3, the data collected with questionnaires are presented first, followed by the results of the analysis of the interviews. The integration is done as part of the next chapter, i.e., the discussion of the results.

### **4.1 Participants**

Sixty (60) female participants were invited to participate in the study, which was conducted in May and June 2011. One participant was excluded as she did not meet the inclusion and exclusion criteria concerning basic knowledge and fundamental experience of online shopping and home shopping of clothing (see section 3.4.1). Fifty-nine (59) participants were finally included in the data analysis.

### **4.2 Randomisation**

The randomisation to the experimental groups was conducted using the following criteria that were adopted in order to overcome limitations of the avatar system and so avoid problems in the perception of the avatars by individual participants.

- Participants with glasses were assigned to the abstract avatar group, as it seemed acceptable that this avatar type did not wear glasses.
- Participants with hairstyles that were difficult to model realistically in 3D (e.g., hair covering the face or the ears, curls, long hair resting on the shoulders) were not assigned to the highly individualised avatar group, but to the model or abstract avatar group. An effort to avoid this issue was made at the photo session by asking participants to tie long hair back if possible and if not unfamiliar to them.
- All other participants were assigned randomly to the three experimental groups.

The researcher did not assume any bias from this randomisation process.

20 participants each were assigned to the highly individualised and to the abstract avatar group, whilst the model avatar group contained 19 participants.

### 4.3 Demographics

The following tables provide summaries of the socio-demographic data relevant for this analysis and of the shopping-related characteristics of the participants.

#### 4.3.1 Age

The age of the participants ranged from 20 to 35 years, with a mean age of approximately 24. German language skills were excellent, as all except one person was a native speaker. All participants were currently studying at Fulda University in different study courses in six departments. Fulda University has a broad range of departments. The researcher had no supervisor-relationship with the participants. Almost half of the participants had further significant professional experience in addition to their academic studies. Thus, the professional background of the sample was quite mixed and respective bias did not need to be taken into account.

*Table 4-1: Age, language, profession*

<i>Descriptions</i>	<i>Values</i>
Age	<ul style="list-style-type: none"> <li>• Range: 20-35 years</li> <li>• Arithmetic mean (M) <math>\approx</math> 24 years</li> <li>• 20-24 years <math>\approx</math> 66 %</li> <li>• 25-29 years <math>\approx</math> 29 %</li> <li>• 30-35 years <math>\approx</math> 5 %</li> </ul>
German language skills: whether German is first language or not	58 of 59 participants (P), the remaining participant showed an excellent German language proficiency
Occupational activity	<ul style="list-style-type: none"> <li>• 100 % currently studying at Fulda University, Germany; different number of study semesters</li> <li>• Department of study: <ul style="list-style-type: none"> <li>- Applied Computer Science: 9 P</li> <li>- Social and Cultural Sciences: 9 P</li> <li>- Business: 12 P</li> <li>- Nursing and Health Sciences: 18 P</li> <li>- Nutrition, Food &amp; Consumer Sciences: 8 P</li> <li>- Social Work: 2 P</li> </ul> </li> <li>• 25 P with further considerable professional experience</li> <li>• 6 P with further completed study courses</li> </ul>

A one-way analysis of variance (ANOVA) revealed no significant difference between the three experimental groups in terms of age.

#### 4.3.2 Internet experience and use

All participants had considerable experience with the Internet, with nearly all of them using it for at least 5 hours per week, and slightly more than 50 % for at least 15 hours per week. Concerning the question, if they enjoy surfing the Web, none of them made a negative remark, with approximately one third indicating that this statement was partly false and partly true for them, another third choosing mostly true and the remainder completely true.

A one-way analysis of variance (ANOVA) revealed no significant difference between the three experimental groups in terms of enjoyment of Web surfing.

*Table 4-2: Usage habits and experience concerning the Internet*

<i>Description</i>	<i>Values</i>	
Frequency of use of the Internet (hours per week)	Less than 5 hours	1.7 %
	5 to 15 hours	45.8 %
	15 to 30 hours	30.5 %
	More than 30 hours	22.0 %
Enjoyment of Web surfing or lack thereof	• Completely false (1)	0.0 %
	Mostly false (2)	0.0 %
	Partly false and partly true (3)	27.1 %
	Mostly true (4)	35.6 %
	Completely true (5)	37.3 %
	• M = 4.1, standard deviation (SD) = 0.803	

For the frequency of use of the Web for the purpose of work or study, around 80 % stated daily, and another 17 % one or several times a week; for the purpose of entertainment it was approximately 46 % daily and 41 % one or several times a week (see Table 4-3). So, work/study was by far the most frequent Internet activity, followed by entertainment.

#### 4.3.3 Experience of online shopping

Concerning online shopping, roughly 15 % of the participants specified that they engage in this activity for one or several times a week, 54 % one to three times a month and 27 % one to eleven times a year. All participants had experience of online shopping for at least one year, and 68 % for 3 years or longer. About 80 % said they were mostly or completely satisfied with online shopping. When asked about



enjoyment of online shopping, approximately 30 % chose the middle rank (partly false and partly true), and round about 60 % said they enjoyed it mostly or completely.

Thus, all the participants had considerable experience in online shopping and therefore they met this inclusion and exclusion criterion. Participants were mostly satisfied with online shopping, and enjoyment values were only slightly lower. However, development potential exists for both factors.

A one-way analysis of variance (ANOVA) revealed no significant difference between the three experimental groups in terms of satisfaction with utility of online shopping and enjoyment of online shopping.

*Table 4-3: Habits and experience concerning online shopping in general*

<i>Description</i>	<i>Values</i>
Frequency of use of the Web for:	
• Work/study	<ul style="list-style-type: none"> <li>• Daily 78.0 %</li> <li>One or several times a week 16.9 %</li> <li>One to three times a month 1.7 %</li> <li>One to eleven times a year 3.4 %</li> </ul>
• Entertainment	<ul style="list-style-type: none"> <li>• Daily 45.8 %</li> <li>One or several times a week 40.7 %</li> <li>One to three times a month 11.9 %</li> <li>One to eleven times a year 1.7 %</li> </ul>
• Online shopping	<ul style="list-style-type: none"> <li>• One or several times a week 15.3 %</li> <li>One to three times a month 54.2 %</li> <li>One to eleven times a year 27.1 %</li> <li>Less 3.4 %</li> </ul>
Number of months/years buying online	<ul style="list-style-type: none"> <li>0 to 12 months 0.0 %</li> <li>1 to 2 years 32.2 %</li> <li>Over 3 years 67.8 %</li> </ul>
Satisfaction with utility of online shopping or lack thereof	<ul style="list-style-type: none"> <li>• Completely false (1) 0.0 %</li> <li>Mostly false (2) 0.0 %</li> <li>Partly false and partly true (3) 22.0 %</li> <li>Mostly true (4) 52.5 %</li> <li>Completely true (5) 25.4 %</li> <li>• M = 4.03, SD = 0.694</li> </ul>
Enjoyment of online shopping or lack thereof	<ul style="list-style-type: none"> <li>• Completely false (1) 0.0 %</li> <li>Mostly false (2) 6.8 %</li> <li>Partly false and partly true (3) 30.5 %</li> <li>Mostly true (4) 28.8 %</li> <li>Completely true (5) 33.9 %</li> <li>• M = 3.9, SD = 0.959</li> </ul>

#### **4.3.4 Experience of online shopping for clothing**

With regard to habits and experiences in shopping for clothing, on average, participants stated that they buy the majority (around 55 %) of their garments in brick-and-mortar stores, about 30 % in online shops, and approximately 20 % via printed catalogues. Asked about the frequency of use of online shops for shopping for clothing, nearly 60 % specified regularly, i.e., at least once every three months, and 40 % sporadic, i.e., once or twice a year. In comparison, printed catalogues showed considerably lower frequencies.

Asked whether they find online shopping for clothing useful or not, approximately 30 % chose partly true and partly false, and 60 % mostly true or completely true. The values for enjoyment of home shopping for clothing or lack thereof were only slightly lower on average. For this study, it was assumed that the experiences of participants with shopping for clothing online or via printed catalogue, both being subsumed under the term home shopping, were of similar significance for the research questions. This is because the major challenge for the customer, namely not being able to try-on the clothing before ordering, is identical in both cases.

To summarise, participants had considerable experience of home shopping for clothing, i.e., via online shop or printed catalogue, and therefore met this inclusion and exclusion criterion. They found home shopping for clothing rather useful and also comparably enjoyable. However, development potential exists for both factors. Also, both values were a little lower than for online shopping in general (means differ by 0.3, see above).

A one-way analysis of variance (ANOVA) revealed no significant difference between the three experimental groups in terms of satisfaction with utility and enjoyment of shopping for clothing from home.

Table 4-4: Habits and experience concerning shopping of clothing

<i>Descriptions</i>	<i>Values</i>
Distribution channels used	Shops/ stores M ≈ 55 %, SD ≈ 21 % Online shops M ≈ 30 %, SD ≈ 19 % Printed catalogues M ≈ 20 %, SD ≈ 13 % Teleshopping/ TV sales channels n.a.
Frequency of use of the channels • Online shops  • Printed catalogues  • Teleshopping/ TV sales channels	• Regularly, i.e., at least once every three months 57.6 % Sporadic, i.e., once or twice a year 42.4 % never 0.0 % • Regularly 16.9 % Sporadic 54.2 % Never 28.8 % • Never 100 %
Satisfaction with utility of home shopping when shopping for clothing or lack thereof	• Completely false (1) 0.0 % Mostly false (2) 8.5 % Partly false and partly true (3) 30.5 % Mostly true (4) 40.7 % Completely true (5) 20.3 % • M = 3.73, SD = 0.887
Enjoyment of home shopping for clothing or lack thereof	• Completely false (1) 0.0 % Mostly false (2) 16.9 % Partly false and partly true (3) 27.1 % Mostly true (4) 33.9 % Completely true (5) 22.0 % • M = 3.61, SD = 1.017

#### 4.3.5 Shopping orientation

Shopping orientation, i.e., the manner in which a person approaches the activity of shopping, is implemented as a value on a continuum between recreational shopping orientation and task orientation (see section 3.6.1).

Table 4-5: Shopping orientation

<i>Description</i>	<i>Values</i>
Shopping orientation	• Range 2.0-5.0 • M = 3.76, SD = 0.78

Actual values from the available range of 1-5 ranged from 2, which represents a strong tendency towards task-oriented shopping, to 5, which represents complete recreational shopping orientation. The average was 3.76, which indicates a significant tendency towards recreational shopping.

A one-way analysis of variance (ANOVA) revealed no significant differences between the three experimental groups in terms of shopping orientation (see section 4.5.2 for prerequisite checks for ANOVA).

#### 4.3.6 Appearance orientation

Appearance orientation represents the attitude towards own appearance or body image, i.e., importance of appearance, attention to appearance and thoughts and behaviours centred on appearance (see section 3.6.1).

*Table 4-6: Appearance orientation*

<i>Description</i>	<i>Values</i>
Appearance orientation	<ul style="list-style-type: none"> <li>• Range 2.7-4.9</li> <li>• M = 3.7, SD = 0.51</li> </ul>

Actual values from the available range of 1-5 ranged from 2.7, which represents an appearance orientation that is only slightly lower than the middle of the scale (3), to 4.9, which is the maximum of appearance orientation. The average was 3.7, which indicates a considerable tendency towards appearance orientation for the sample.

A one-way analysis of variance (ANOVA) revealed no significant differences between the three experimental groups in terms of appearance orientation (see section 4.5.2 for prerequisite checks for ANOVA).

#### 4.4 Manipulation check

The purpose of the study was to understand the effect of objective differences in the design of the personal avatars between the three experimental groups. Therefore, it was deemed essential that the participants correctly perceived the type of their personal avatar, in order to evaluate it for what it actually was intended to be. For example, they should not mistake the model avatar (having a head of an arbitrary fashion model) as a highly individualised avatar, due to unintended similarities with their personal body image. Confusion over the abstract avatar was practically impossible due to its special design.

Several precautions were taken to ensure that the perception of the independent variable avatar group was as intended:

- Several members of the working group of the researcher had judged the avatars for this aspect prior to the experiment.
- During the experiment, when introducing the online shop with VTO to the participants, close attention was paid to the first reactions of the participants towards their avatar.
- If required, comments on the participants' perception of their avatars were carefully elicited and used to return them on the intended understanding with some explanation.

Generally, participants recognised the type of avatar from the beginning without any intervention.

The variable "avatar similarity to self" (see section 2.7.9) could not be used as an indicator for correct perception because the construct does not focus on aspects of visual appearance, but on identification and likeness in a broader sense. Indeed, it turned out to be independent of the avatar group (see section 4.5.4). However, the data on the assessment of different aspects of the actual personal avatars (see section 4.5.7) confirmed the success of the desired perception as well.

## **4.5 Quantitative analysis**

As described in section 3.7.1, the primary method of quantitative data analysis was analysis of variance (ANOVA) between the three different experimental conditions, namely the variation of the avatar design. An ANOVA was conducted for each of the dependent variables in the research model for which a hypothesis has been formulated. Validity and reliability of the questionnaire scales was also assessed.

### **4.5.1 Validity and reliability of questionnaire scales**

This study relied on established psychometric scales, respectively Likert scales, for the latent dependent variables in order to ensure content validity (see section 3.2). Audio data collected during completion of the main questionnaire did not indicate any misunderstanding or misinterpretation of the question items by the participants.

From the validity and reliability parameters given in the literature (see Table 3-5, Table 3-6 and Table 3-7, p. 88-92) the reliability in form of internal consistency was rechecked with the collected data using Cronbach's alpha as estimate.

*Table 4-7: Reliability statistics*

<i>Name of the scale</i>	<i>Number of items</i>	<i>Cronbach's alpha</i>
Informativeness	4	.869
Attitude towards the website	6	.767
Decision support satisfaction	3	.725
Shopping enjoyment	6	.711
Telepresence	5	.795
Perceived risk of purchase	17	.834
Purchase intention	3	<b>.407</b>
Avatar similarity to self	4	.860
Shopping Orientation	5	.845
Appearance Orientation	12	.838

All but one of the scales were found to have a good ( $\alpha > .8$ ) or acceptable ( $\alpha > .7$ ) reliability. Cronbach's alpha for "purchase intention" was below the threshold of  $\alpha = 0.5$  (see value in bold) indicating an unacceptable reliability. Although omitting the first item of this scale, i.e., "How likely would it be that you ... now buy one or more of the garment items you just viewed in this shop?" would have resulted in an improved reliability ( $\alpha = .643$ ), it would still have been below the acceptable threshold ( $\alpha > .7$ ). Nevertheless, the factor "purchase intention" was considered in the quantitative analysis, in order to identify reasons for this result. Of course, the outcomes related to "purchase intention" are discussed and interpreted with particular caution.

#### **4.5.2 Prerequisite checks for ANOVA**

The tests on the primary data to determine the prerequisites of the ANOVA method, namely normal distribution of scores both of the whole sample and within the different groups, and homogeneity of variance between groups, returned the following results.

Table 4-8: Tests for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests – whole sample

	Kolmogorov-Smirnov**		Shapiro-Wilk	
	Statistic	Sig.	Statistic	Sig.
Informativeness	0.125	<b>.022</b>	0.913	<b>.000</b>
Attitude towards the website	0.123	<b>.027</b>	0.965	.088
Decision support satisfaction	0.209	<b>.000</b>	0.915	<b>.001</b>
Shopping enjoyment	0.132	<b>.013</b>	0.945	<b>.010</b>
Telepresence	0.129	<b>.016</b>	0.976	.291
Perceived risk of purchase	0.092	.200*	0.977	.342
Purchase intention	0.235	<b>.000</b>	0.918	<b>.001</b>
Avatar similarity to self	0.080	.200*	0.979	.381
Shopping orientation	0.125	<b>.025</b>	0.952	<b>.024</b>
Appearance orientation	0.135	<b>.009</b>	0.975	.266
* This is a lower bound of the true significance.				
** Lilliefors Significance Correction				
df = 59 (shopping orientation: df = 58)				

In many cases one or both tests for normality, namely the Kolmogorov-Smirnov and the Shapiro-Wilk test, covering the whole group yielded a significant result ( $p < .05$ ), see values in bold in Table 4-8, indicating that the prerequisite of normal distribution was violated.

There are also several cases where one or both of these tests yielded a significant result ( $p < .05$ ) for the separate experimental conditions, see values in bold in Table 4-9, indicating that the prerequisite of normal distribution was violated.

Table 4-9: Tests for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests – per group

	Avatar Group	Kolmogorov-Smirnov**		Shapiro-Wilk	
		Statistic	Sig.	Statistic	Sig.
Informativeness	Highly individualised	0.150	.200*	0.933	.173
	Model	0.146	.200*	0.875	<b>.018</b>
	Abstract	0.140	.200*	0.898	.037
Attitude towards the website	Highly individualised	0.120	.200*	0.961	.558
	Model	0.129	.200*	0.979	.930
	Abstract	0.224	<b>.010</b>	0.907	.056
Decision support satisfaction	Highly individualised	0.248	<b>.002</b>	0.875	<b>.015</b>
	Model	0.166	.179	0.945	.319
	Abstract	0.282	<b>.000</b>	0.863	<b>.009</b>
Shopping enjoyment	Highly individualised	0.126	.200*	0.953	.422
	Model	0.222	<b>.014</b>	0.910	.075
	Abstract	0.190	.056	0.954	.432
Telepresence	Highly individualised	0.246	<b>.003</b>	0.922	.108
	Model	0.162	.200*	0.953	.449
	Abstract	0.119	.200*	0.983	.967
Perceived risk of purchase	Highly individualised	0.108	.200*	0.946	.307
	Model	0.133	.200*	0.971	.793
	Abstract	0.151	.200*	0.951	.386
Purchase intention	Highly individualised	0.220	<b>.012</b>	0.928	.144
	Model	0.196	.052	0.950	.398
	Abstract	0.272	<b>.000</b>	0.880	<b>.018</b>
Avatar similarity to self	Highly individualised	0.119	.200*	0.980	.931
	Model	0.165	.188	0.951	.407
	Abstract	0.121	.200*	0.973	.824
Shopping Orientation	Highly individualised	0.145	.200*	0.943	.272
	Model	0.140	.200*	0.943	.323
	Abstract	0.121	.200*	0.942	.267
Appearance Orientation	Highly individualised	0.107	.200*	0.954	.426
	Model	0.150	.200*	0.955	.471
	Abstract	0.170	.134	0.960	.540

\* This is a lower bound of the true significance.  
\*\* Lilliefors Significance Correction  
df = 20 for highly individualised and abstract group, df = 19 for model group  
(shopping orientation: df = 20 for highly individualised and abstract group, df = 18 for model group)



Concerning homogeneity of variances between groups, there is one case where the respective test, namely the Levene test, yielded a significant result ( $p < .05$ ), see values in bold, indicating that this prerequisite was violated.

*Table 4-10: Tests for homogeneity of variances using the Levene test*

<i>Variable</i>	<i>Statistic</i>	<i>Sig.</i>
Informativeness	1.613	.208
Attitude towards the website	0.016	.984
Decision support satisfaction	0.069	.933
Shopping enjoyment	0.945	.395
Telepresence	3.793	<b>.029</b>
Perceived risk of purchase	0.078	.925
Purchase intention	0.029	.971
Avatar homophily	0.292	.748
<i>df1 = 2, df2 = 56</i>		

Anyhow, the (nearly) equal group sizes of this study remedied potential violations of these assumptions (Hair et al., 2010). Therefore, the results on the prerequisite checks for other ANOVA tests in this study (see, e.g., section 4.5.7) are not reported.

### **4.5.3 Effects of factor avatar design on marketing outcomes**

This section presents the analysis of hypothesis H1 to H7. Each hypothesis assumes significant effects arising from the variation of the avatar design on the chosen marketing outcome factor.

#### **4.5.3.1 Informativeness**

The following descriptive statistics give an overview of the collected data for the construct (see Table 4-11). The scale ranged from 1 (“completely false”) to 5 (“completely true”), with 5 indicating the highest possible informativeness.

*Table 4-11: Descriptive statistics for informativeness*

<i>Parameter</i>	<i>Values</i>			
	<i>Whole sample</i>	<i>Highly individualised</i>	<i>Model</i>	<i>Abstract</i>
<i>M</i>	4.06	4	4.12	4.06
<i>min - max</i>	1.75-5	3-4.75	2-5	1.75-5
<i>SD</i>	0.70	0.53	0.72	0.85

All the mean values are close to “4”, which is the second highest score, representing “mostly true”, for the statements under consideration. Furthermore, the standard deviation is relatively high for the given range of the scale. Consequently, the ANOVA analysis did not yield a significant result ( $F(2,56) = 0.134$ ,  $p = .875$ ) (see Table 4-12 below).

*Table 4-12: ANOVA output for informativeness*

	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Between Groups</i>	0.137	2	0.068	0.134	0.875
<i>Within Groups</i>	28.530	56	0.509		
<i>Total</i>	28.667	58			

Therefore, hypothesis H1, positing that informativeness would vary between the different avatar design groups (see section 2.7.2), must be rejected.

#### **4.5.3.2 Telepresence**

The following descriptive statistics give an overview of the collected data for the construct (see Table 4-13). The scale ranged from 1 (“completely false”) to 5 (“completely true”), with 5 indicating the highest possible perceived telepresence.

*Table 4-13: Descriptive statistics for telepresence*

<i>Parameter</i>	<i>Values</i>			
	<i>Whole sample</i>	<i>Highly individualised</i>	<i>Model</i>	<i>Abstract</i>
<i>M</i>	2.98	3.05	2.93	2.95
<i>min - max</i>	1.2-4.6	2.4-4	1.6-4	1.2-4.6
<i>SD</i>	0.62	0.43	0.6	0.8

All the mean values are close to “3”, which is the middle score, representing “partly false and partly true”, for the statements under consideration. Furthermore, the standard deviation is relatively high. Consequently, the ANOVA analysis did not yield a significant result ( $F(2,56) = 0.213$ ,  $p = .809$ ).

Therefore, hypothesis H2, assuming that telepresence would vary systematically between different avatar designs (see section 2.7.3), must be rejected.

### 4.5.3.3 Shopping enjoyment

The following descriptive statistics give an overview of the collected data for the investigated construct (see Table 4-14). The scale ranged from 1 (“completely false”) to 5 (“completely true”), with 5 indicating the highest possible shopping enjoyment.

Table 4-14: Descriptive statistics for shopping enjoyment

<i>Parameter</i>	<i>Values</i>			
	<i>Whole sample</i>	<i>Highly individualised</i>	<i>Model</i>	<i>Abstract</i>
<i>M</i>	4.25	4.3	4.18	4.27
<i>min - max</i>	3.17-5	3.3-5	3.17-5	3.3-5
<i>SD</i>	0.51	0.5	0.58	0.47

All the mean values are close to “4.25”, which is somewhat higher than the second highest score, the latter representing “mostly true”, for the statements under consideration. Moreover, the remaining descriptive statistical values do not differ significantly and the standard deviation is relatively high. So, the ANOVA analysis did not yield a significant result ( $F(2,56) = 0.299, p = .743$ ).

Therefore, hypothesis H3, assuming that shopping enjoyment varies systematically between different avatar designs (see section 2.7.4), must be rejected.

### 4.5.3.4 Decision support satisfaction

The following descriptive statistics give an overview of the collected data for the investigated construct (see Table 4-15). The scale ranged from 1 (“completely false”) to 5 (“completely true”), with 5 indicating the best possible “decision support satisfaction”.

Table 4-15: Descriptive statistics for decision support satisfaction

<i>Parameter</i>	<i>Values</i>			
	<i>Whole sample</i>	<i>Highly individualised</i>	<i>Model</i>	<i>Abstract</i>
<i>M</i>	4.16	4.23	4.16	4.1
<i>min - max</i>	2.67-5	3-5	3-5	2.67-5
<i>SD</i>	0.53	0.52	0.5	0.58

All the mean values are slightly higher than “4”, the latter representing “mostly true”, for the statements under consideration. Moreover, the remaining descriptive

statistical values are comparable and the standard deviation is relatively high. Consequently, the ANOVA analysis did not yield a significant result ( $F(2,56) = 0.31$ ,  $p = .734$ ).

Therefore, hypothesis H4, positing that “decision support satisfaction” varies between different avatar designs (see section 2.7.5), must be rejected.

#### 4.5.3.5 Purchase intention

Note that “purchase intention” is considered in the quantitative analysis despite the deficient test value for the reliability of the respective questionnaire scale that was identified for the collected data of this study (see section 4.5.1) for completeness and care is required in any interpretation.

The following descriptive statistics give an overview of the collected data for the investigated construct (see Table 4-16). The scale ranged from 1 (“very unlikely”) to 5 (“very likely”), with 5 indicating the highest possible “purchase intention”.

*Table 4-16: Descriptive statistics for purchase intention*

<i>Parameter</i>	<i>Values</i>			
	<i>Whole sample</i>	<i>Highly individualised</i>	<i>Model</i>	<i>Abstract</i>
<i>M</i>	4.04	4.17	3.98	3.97
<i>min - max</i>	2.33-5	3-5	2.67-5	2.33-5
<i>SD</i>	0.56	0.5	0.57	0.61

All the mean values are about “4”, the latter representing “likely”, for the statements under consideration. Moreover, the remaining descriptive statistical values are comparable and the standard deviation is relatively high. Consequently, the ANOVA analysis did not yield a significant result ( $F(2,56) = 0.775$ ,  $p = .466$ ).

Therefore, hypothesis H5, positing that “purchase intention” varies between different avatar designs (see section 2.7.6), must be rejected.

#### 4.5.3.6 Attitude towards the website

The following descriptive statistics give an overview of the collected data for the investigated construct (see Table 4-17). The scale ranged from 1 (“completely false”) to 5 (“completely true”) for five of the six items, and from 1 (“one of the worst”) to 5 (“one of the best”) for the sixth item “Compared with the presentation of garments in

other online shops, I would rate this one as: ... ”. In summary, a score of 5 indicated the best possible favourable “attitude towards the website”.

*Table 4-17: Descriptive statistics for attitude towards the website*

<i>Parameter</i>	<i>Values</i>			
	<i>Whole sample</i>	<i>Highly individualised</i>	<i>Model</i>	<i>Abstract</i>
<i>M</i>	4.03	4.13	3.92	4.04
<i>min - max</i>	2.33-5	2.83-5	2.83-5	2.33-5
<i>SD</i>	0.59	0.55	0.57	0.64

All the mean values are about “4”, the latter representing “mostly true”, for the statements under consideration. Moreover, the remaining descriptive statistical values do not differ significantly and the standard deviation is relatively high. Consequently, the ANOVA analysis did not yield a significant result ( $F(2,56) = 0.587, p = .560$ ).

Therefore, hypothesis H6, positing that “attitude towards the website” varies between different avatar designs (see section 2.7.7), has to be rejected.

#### **4.5.3.7 Perceived risk of purchase**

The following descriptive statistics give an overview of the collected data for the investigated construct (see Table 4-18). The scale ranged from 1 (“very unlikely”) to 5 (“very likely”), with 1 indicating the lowest possible perceived risk.

*Table 4-18: Descriptive statistics for perceived risk of purchase*

<i>Parameter</i>	<i>Values</i>			
	<i>Whole sample</i>	<i>Highly individualised</i>	<i>Model</i>	<i>Abstract</i>
<i>M</i>	2.21	2.12	2.29	2.24
<i>min - max</i>	1-3.24	1.41-3.06	1.29-3.12	1-3.24
<i>SD</i>	0.45	0.43	0.43	0.49

All the mean values are somewhat higher than “2”, the latter representing “unlikely”, for the statements under consideration. Moreover, the remaining descriptive statistic values are comparable and the standard deviation is relatively high. Consequently, the ANOVA analysis did not yield a significant result ( $F(2,56) = 0.773, p = .467$ ).

Therefore, hypothesis H7, positing that “perceived risk of purchase” would vary between different avatar designs (see section 2.7.8), has to be rejected.

#### **4.5.3.8 Inclusion of “avatar similarity to self”, “appearance orientation” and “shopping orientation” as co-variates**

Including “avatar similarity to self” as a co-variate into the above ANOVA calculations (ANCOVA method), for those factors where the prerequisites were satisfied, also did not yield significant results. The prerequisites of ANCOVA (Eschweiler et al., 2007) were met for several of the independent variables:

- Co-variates, here “avatar similarity to self”, may not be influenced by the experimental conditions (Diehl, 1983). This was confirmed, as shown with ANOVA analysis in the next section (see section 4.5.4).
- Co-variates have to correlate with the dependent variable, which was the case for informativeness, “attitude towards the website”, “shopping enjoyment” and telepresence (compare also section 4.5.5).
- Co-variates and the independent variable may not exhibit an interaction effect on the dependent variable. This was successfully tested with multiple regression analysis.

In addition, considering the extraneous variables “appearance orientation” and “shopping orientation” as co-variates did not lead to significant results.

The prerequisite of ANCOVA were fulfilled as follows:

- “Appearance orientation” and “shopping orientation” were not influenced by the experimental conditions. They were even raised previous to the stimuli phase.
- Co-variates correlated with the dependent variables, in the case of “attitude towards the website”, “decision support satisfaction”, “telepresence”, “perceived risk of purchase” and “purchase intention” (for “appearance orientation”) and “shopping enjoyment” (for “shopping orientation”).
- Co-variates and the independent variable did not exhibit an interaction effect on the dependent variable, as successfully tested with multiple regression analysis.

#### 4.5.4 Effects of factor avatar design on “avatar similarity to self”

The following descriptive statistics give an overview of the collected data for the investigated construct (see Table 4-19). The scale ranged from 1 (“not at all”) to 5 (“very much”), with 5 indicating the highest possible “avatar similarity to self”.

Table 4-19: Descriptive statistics for avatar similarity to self

<i>Parameter</i>	<i>Values</i>			
	<i>Whole sample</i>	<i>Highly individualised</i>	<i>Model</i>	<i>Abstract</i>
<i>M</i>	2.86	2.81	2.71	3.05
<i>min - max</i>	1.25-5	1.25-4.5	1.5-4.25	1.5-5
<i>SD</i>	0.86	0.81	0.82	0.94

All the mean values are near “2.9”, the latter representing “moderately”, for the statements under consideration. Moreover, the remaining descriptive statistic values are comparable and the standard deviation is relatively high. Consequently, the ANOVA analysis did not yield a significant result ( $F(2,56) = 0.807, p = .451$ ).

Therefore, hypothesis H8, positing that “avatar similarity to self” varies between different avatar designs (see section 2.7.9), must be rejected.

#### 4.5.5 Effects of factor “avatar similarity to self” on marketing outcome factors

Possible effects of “avatar similarity to self” on the above marketing outcome factors were analysed with simple linear, univariate regression analysis. “Avatar similarity to self” was selected as the independent variable. As all the variables in this subsection of the research model comprise interval data, regression analysis was the method of choice (Backhaus et al., 2011).

The regression analyses for each of the regressor variables listed in the following table revealed that “avatar similarity to self” predicts a significant part of their variance.

The interpretation for these separate regression models is:

- 16.2 % ( $R^2 = .162$ ) of the variance of the informativeness values is due to the linear relation to “avatar similarity to self”;
- For telepresence it is 13.8 %;
- For “shopping enjoyment” it is 13.8 %;
- For “attitude towards the website” it is 16.9 %.

Table 4-20: Regression statistics for (i) informativeness, (ii) attitude towards the website, (iii) shopping enjoyment and (iv) telepresence as dependent variable, with “avatar similarity to self” as independent variable

Regressor variables	Statistics
Informativeness	<ul style="list-style-type: none"> <li>• Global quality criteria: <math>R^2 = .162</math>, <math>F(1,57) = 11.014</math>, <math>p = .002</math></li> <li>• Regression coefficient: <math>\beta = .402</math>, <math>t(57) = 3.319</math>, <math>p &lt; .001</math></li> </ul>
Telepresence	<ul style="list-style-type: none"> <li>• Global quality criteria: <math>R^2 = .138</math>, <math>F(1,57) = 9.154</math>, <math>p = .004</math></li> <li>• Regression coefficient: <math>\beta = .372</math>, <math>t(57) = 8.258</math>, <math>p &lt; .001</math></li> </ul>
Shopping enjoyment	<ul style="list-style-type: none"> <li>• Global quality criteria: <math>R^2 = .138</math>, <math>F(1,57) = 9.145</math>, <math>p = .004</math></li> <li>• Regression coefficient: <math>\beta = .372</math>, <math>t(57) = 16,447</math>, <math>p &lt; .001</math></li> </ul>
Attitude towards the website	<ul style="list-style-type: none"> <li>• Global quality criteria: <math>R^2 = .169</math>, <math>F(1,57) = 11.592</math>, <math>p = .001</math></li> <li>• Regression coefficient: <math>\beta = .411</math>, <math>t(57) = 13.089</math>, <math>p &lt; .001</math></li> </ul>

In contrast, in the collected data, “avatar similarity to self” does not predict “decision support satisfaction”, “perceived risk of purchase” or “purchase intention”.

Therefore, hypothesis H9, suggesting that “avatar similarity to self” is positively related to the marketing outcome factors (see section 2.7.9) is supported for the four marketing outcome factors informativeness, telepresence, “shopping enjoyment” and “attitude towards the website”, each separately.

When extending the regression model with “appearance orientation” as a further independent variable, a higher coefficient of determination was achieved for two of these dependant variables, see the following table.

The interpretations for these two separate regression models are that “avatar similarity to self” and “appearance orientation” together, and with similar contribution, predict:

- 30 % of telepresence;
- 30 % of attitude towards the website.



Table 4-21: Regression statistics for (i) telepresence and (ii) attitude towards the website as dependent variable, with “avatar similarity to self” and “appearance orientation” as independent variables

<i>Regressor variables</i>	<i>Statistics</i>
Telepresence	<ul style="list-style-type: none"> <li>• Global quality criteria: <math>R^2 = .299</math>, <math>F(2,56) = 11.931</math>, <math>p &lt; .001</math></li> <li>• Regression coefficient “avatar similarity to self”: <math>\beta = .373</math>, <math>t(56) = 3.329</math>, <math>p = .002</math></li> <li>• Regression coefficient “appearance orientation”: <math>\beta = .401</math>, <math>t(56) = 3.579</math>, <math>p = .001</math></li> </ul>
Attitude towards the website	<ul style="list-style-type: none"> <li>• Global quality criteria: <math>R^2 = .290</math>, <math>F(2,56) = 11.446</math>, <math>p &lt; .001</math></li> <li>• Regression coefficient “avatar similarity to self”: <math>\beta = .412</math>, <math>t(56) = 3.655</math>, <math>p = .001</math></li> <li>• Regression coefficient “appearance orientation”: <math>\beta = .348</math>, <math>t(56) = 3.092</math>, <math>p = .003</math></li> </ul>

The check of the assumptions for these regression analyses did not reveal any violations:

- Linearity, i.e., linear relationships between the independent and dependent variables was assessed visually with scatter plots.
- Multivariate normality, i.e., normal distribution of all included variables was verified with residuals statistics, and deemed acceptable.
- Unbiasedness of error terms (residuals), i.e., no or little correlation between independent variables and error terms, was assessed visually with scatter plots.
- Homoscedasticity, i.e., homogeneity of variance of error terms along the regression was assessed visually with scatter plots.

#### **4.5.6 Effects of marketing outcome factors on purchase intention**

From the investigated marketing outcome factors, “purchase intention” is conceptually the closest to “actual” purchase. The literature states that the other marketing outcome factors considered in this study positively affect “purchase intention”, see section 2.7.6.

However, an insufficient reliability for the questionnaire scale on “purchase intention” used in this study was identified for the collected data (see section 4.5.1). Therefore, this quantitative analysis does not place the same significance on

“purchase intention” as the other marketing outcome factors in the collected data, rather it relies solely on the literature.

#### 4.5.7 Assessment of avatar characteristics

The following descriptive statistics give an overview of the evaluation of the participants of various characteristics of the appearance of the avatar (see Table 4-22).

Table 4-22: Descriptive statistics for evaluations of various avatar characteristics

Variable	Parameter	Values			
		Whole sample	Highly individualised	Model	Abstract
Body measures	<i>M</i>	2.12	2.15	2.11	2.1
	<i>min – max</i>	1-4	1-4	1-4	1-4
	<i>SD</i>	0.811	0.67	0.81	0.97
Body shape	<i>M</i>	2.25	2.4	2.11	2.25
	<i>min – max</i>	1-5	1-4	1-4	1-5
	<i>SD</i>	0.939	0.88	0.81	1.12
Posture	<i>M</i>	2.98	3.1	3.05	2.8
	<i>min – max</i>	1-5	1-5	1-5	1-5
	<i>SD</i>	1.182	0.97	1.18	1.4
Face	<i>M</i>	3.09	2.9	3.32	3.05
	<i>min – max</i>	1-5	1-5	2-5	2-5
	<i>SD</i>	1.081	0.97	1.25	1.03
Hair	<i>M</i>	3.84	3.4	3.68	4.47
	<i>min – max</i>	1-5	1-5	2-5	2-5
	<i>SD</i>	1.182	1.19	1.2	0.91
Head as a whole	<i>M</i>	3.25	2.95	3.26	3.55
	<i>min – max</i>	1-5	1-5	1-5	2-5
	<i>SD</i>	1.123	1	1.2	1.15
Skin colour	<i>M</i>	2.90	1.95	2.42	4.3
	<i>min – max</i>	1-5	1-4	1-4	2-5
	<i>SD</i>	1.423	0.83	1.02	1.13
Appearance as a whole	<i>M</i>	2.68	2.65	2.63	2.75
	<i>min – max</i>	1-5	2-4	1-5	1-5
	<i>SD</i>	.840	0.59	0.9	1.0

The question posed was “How do you like the following aspects of the appearance of your personal avatar?” Answer options ranged from 1 (“very good”) to 5 (“not satisfactory”), with 1 indicating the most positive rating (see also Appendix 5). The rating steps corresponded to school grades as experienced by the participants.

#### **4.5.7.1 Body measures**

The mean values for body measures are somewhat similar, all being slightly higher than “2”, representing “good”. Furthermore, the remaining descriptive statistical values are comparable and the standard deviation is relatively high. It would appear that the closeness of the body measures to the actual person, that was a feature of all the avatars, was successful, and was a consistent result between the groups.

#### **4.5.7.2 Body shape**

In contrast, body shape received slightly worse mean values with a little more variation between groups. However, an ANOVA revealed that these differences are not significant ( $F(2,56) = 0.471, p = .627$ ). Overall, the representation of the body shape of each participant would appear to have been successful, despite it being made solely from the body measures rather than explicitly adjusted for individual participants.

#### **4.5.7.3 Posture**

The mean values for posture were approximately “3”, the latter representing “satisfactory”, with the remaining descriptive statistical values being comparable. The avatars were available in one static posture that was the same for each group. Although not scoring as well as other characteristics, posture was not evaluated negatively on average.

#### **4.5.7.4 Face**

The face was specifically designed to be different between the groups (see Figure 3-6, p. 77): the highly individualised avatars were intended to imitate the face of the user as best possible; the model avatars possessed the face of a typical fashion model; the abstract avatar featured a face that was somewhat simplified in shape and without colouring. It would therefore be expected that the parameter would exhibit significant difference, but this was not the case. Rather, the mean value for each of the groups was close to “3”, representing a satisfactory rating and ANOVA did not yield significant differences between avatar groups ( $F(2,56) = 0.728, p = .488$ ). This

is in contrast to expectation, where the highly individualised avatar would be expected to receive a more positive rating. However, the mean value for the group with highly individualised avatars was slightly lower (which constitutes a more positive rating) than that of the two other groups.

#### **4.5.7.5 Hair**

The hair was specifically designed to be different between the groups: the highly individualised avatar was intended to imitate the hair of the user as best possible; the model avatar had a classical, neutral hairstyle; the abstract avatar did not possess a specific hairstyle, or, possibly, one could interpret it as short hair. Not surprising the latter avatar group received a poor average rating of nearly 5 ( $M = 4.47$ ). Ratings for the other two groups were better, but also on the lower half of the scale (highly individualised avatar:  $M = 3.4$ ; model avatar:  $M = 3.68$ ). An ANOVA on these scores yielded significant variation between the conditions ( $F(2,56) = 4.863$ ,  $p = .011$ ). Post-hoc Tukey tests showed that the highly individualised avatar group differed significantly at  $p = .010$  from the abstract avatar group, whilst the model avatar condition yielded significant variation in relation to the abstract avatar group only at  $p = .081$  (falling short of the chosen significance level  $\alpha$  of  $.05$ ). The variance between highly individualised avatar and model avatar group was not significant. The expectation would be for a more positive rating for the highly individualised avatar. However, the mean value for the group with the highly individualised avatars was lower (constituting a more positive rating) than that of the model group.

#### **4.5.7.6 Head**

Results for the head as a whole followed closely the separate results of face and hair and are not discussed in detail.

#### **4.5.7.7 Skin colour**

For skin colour, the highly individualised avatar yielded the best average rating of the three groups, namely “good” ( $M = 1.95$ ); the skin colour of the model avatar was rated considerably lower ( $M = 2.42$ ). The abstract avatar group received a poor average rating ( $M = 4.3$ ) for its uniform, light grey colouring. ANOVA analysis confirmed these differences to be significant ( $F(2,56) = 30.925$ ,  $p = .000$ ). Post-hoc Tukey tests showed that the highly individualised and the model avatar group each

differed significantly at  $p = .000$  from the abstract avatar group, but not between each other.

#### **4.5.7.8 Appearance as a whole**

Appearance as a whole gave a similar result for all conditions, yielding a mid-range value near to “satisfactory”. Furthermore, the remaining descriptive statistical values are comparable and the standard deviation is relatively high, showing no statistical difference between the conditions.

#### **4.5.8 Assessment of desired and optional characteristics**

The following descriptive statistics give an overview of the participants’ evaluation of:

- i. Desired characteristics of a personal avatar, including importance or rejection of imitation of different characteristics of one’s body and appearance by the personal avatar (“How important is it for you then that your avatar represents or does not represent the following characteristics of your body and appearance?”);
- ii. Importance or rejection of specific optional characteristics and functionalities of the personal avatar (“How important is it for you that your avatar features the following characteristics and functionalities?”).

Answer options were:

- 1 (“undesired”),
- 2 (“irrelevant”),
- 3 (“nice to have”) and
- 4 (“essential”), with 4 indicating the highest rating.

The scale had to be interpreted as ordinal, as equally-sized intervals between the different ranks could not be assumed. Five of the items differentiated between an “approximated representation” and an “exact, detailed representation”. Table 4-23 gives the results and ranks the desired and optional characteristics.

Six of the question items yielded the highest value for their central tendency, namely a median value of 4 (“essential”). The majority of items gained a median value of 3 (“nice to have”). Only one item received a 2 (“irrelevant”). Therefore, “on average” none of the questioned items was rated “undesired”. However, as the minimum

values show (see “min - max”), some characteristics or functionalities were undesired by some of the participants.

*Table 4-23: Desired characteristics and optional characteristics and functionalities of a personal avatar, ordered by median value (descending) and then by interquartile range (IQR)*

<i>Variable</i>	<i>Mdn</i>	<i>min - max</i>	<i>IQR*</i>
My clothing size	4	1-4	0
My body measures, e.g., body height or breast girth – approximated representation	4	1-4	0
My body measures, e.g., body height or breast girth – exact, detailed representation	4	1-4	1
My body shape, muscle mass, body fat – approximated representation	4	1-4	1
My skin colour	4	2-4	1
My hair colour	4	2-4	1
Optionally vary the above-named characteristics, e.g. different hairstyle, sun-tanned skin instead of winterly pale skin	3	1-4	0
My body shape, muscle mass, body fat – exact, detailed representation	3	1-4	1
My posture, e.g., hollow back, tilting – approximated representation	3	1-4	1
My posture, e.g., hollow back, tilting – exact, detailed representation	3	1-4	1
My face – approximated representation, e.g., face shape	3	2-4	1
My face – exact, detailed representation	3	1-4	1
My hairstyle – approximated representation	3	2-4	1
My hairstyle – exact, detailed representation	3	1-4	1
My eye colour	3	1-4	1
Optionally vary the posture, e.g., arms stretched forward, sitting, holding a dynamic pose	3	2-4	1
Optionally show different emotions, e.g., smiling, neutral, serious	2	1-4	1
<i>* interquartile range (IQR)</i>			

Additionally, the five items that differentiate between (i) an approximate representation and (ii) an exact, detailed representation, were tested for a significant

difference between (i) and (ii). The non-parametric Wilcoxon Signed Ranks Test was appropriate for that purpose. It has no prerequisites concerning the data. For each of the following items a significant difference was identified, whereas none was found for body measures:

- Body shape:  
Z = 2.953, p = .003, r = 0.402
- Posture:  
Z = 3.906, p < .001, r = 0.532
- Face:  
Z = 4.259, p < .001, r = 0.580
- Hairstyle:  
Z = 4.746, p < .001, r = 0.646

In each case, the approximate representation exhibited higher values and the effect size (r) is large (Cohen, 1992).

Potential differences between the avatar groups were not of interest here, as the questions did not refer to the personal avatar of the experiment, but to an imaginable personal avatar for a VTO in general. So, the participants had to imagine and evaluate what they would prefer or need, rather than assess what was actually already offered by the test system.

#### **4.5.9 Effects of appearance orientation and shopping orientation on marketing outcome factors**

Possible effects of appearance orientation and shopping orientation on the marketing outcome factors were analysed with simple linear, univariate regression analysis, as part of secondary analysis.

In cases, where less than 10 % ( $R^2 < 0.1$ ) of the variation of the dependent variable is explained with a specific regression model, it was considered practically irrelevant and is thus not reported. With appearance orientation, this was the case for “perceived risk”, “purchase intention” and “decision support satisfaction”. For shopping orientation, it was shopping enjoyment that did not exceed this threshold.

Table 4-24: Regression statistics for (i) telepresence and (ii) attitude towards the website as dependent variable, with appearance orientation as independent variable

<i>Regressor variables</i>	<i>Statistics</i>
Telepresence	<ul style="list-style-type: none"> <li>• Global quality criteria: <math>R^2 = .160</math>, <math>F(1,57) = 10.860</math>, <math>p = .002</math></li> <li>• Regression coefficient: <math>\beta = .400</math>, <math>t(57) = 3.295</math>, <math>p = .002</math></li> </ul>
Attitude towards the website	<ul style="list-style-type: none"> <li>• Global quality criteria: <math>R^2 = .121</math>, <math>F(1,57) = 7.831</math>, <math>p = .007</math></li> <li>• Regression coefficient: <math>\beta = .348</math>, <math>t(57) = 2.798</math>, <math>p = .007</math></li> </ul>

The interpretations for these two separate simple regression models are that “appearance orientation” predicts:

- 16 % of telepresence;
- 12 % of attitude towards the website.

These results were to be expected given the findings in section 4.5.5, Table 4-21, where the regression models with telepresence and “attitude towards the website” as dependent variable and “avatar similarity to self” as independent variable were successfully extended with “appearance orientation” as another independent variable.

The check of the assumptions for these regression analyses did not reveal any violations.

#### **4.5.10 Post-hoc calculations**

In order to provide guidance to similar future studies, a post-hoc sample size calculation was executed, taking “decision support satisfaction” as an exemplary factor. The potential sample size was determined using sample size calculation based on statistical power calculation with the software G\*Power 3.1 (Faul et al., 2007). Standard values of .05 for level of significance  $\alpha$ , and .80 for statistical power  $(1-\beta)$  were chosen. G\*Power gives an effect size  $f$  of 0.101 based on the achieved mean values between groups for “decision support satisfaction” (see Table 4-15, p. 119), with a corresponding total sample size  $n$  of 948 or 316 per group.

With the sample size actually chosen for this study, it was not possible to detect a significant effect from this small size. However, such a small effect had been



considered as unproductive for the research questions of this study (see section 3.4.2).

## **4.6 Qualitative results**

The qualitative analysis followed the recommended steps of thematic analysis as described in section 3.7.2:

1. The researcher familiarised with the data, by reading and rereading carefully, and noted the first ideas for coding.
2. Initial codes were generated, on the one hand based on a pre-defined list of themes that were derived from the literature and the foundations of the quantitative part of the study. On the other hand, new themes with subordinate codes were allowed to emerge from the data. The resulting code book was compiled in the English language, although the transcribed interviews were in German.
3. The code book was searched for themes, themes were reviewed, and themes were finally defined and named (steps 3 to 5, as described in section 3.7.2).

The final map of themes is summarised in Table 4-25 (p. 137).

As detailed in section 3.7.2, of the 59 available interviews, 30 were analysed, due to data saturation: during thematic analysis, no further themes were emerging with continued analysis. The cases to analyse were selected on a statistical basis. They represented the upper end (mean values of 5 to 3.5) and the lower end (2.5 to 1.25) of the range of values on the “avatar similarity to self” scale (see section 2.7.9), and, at the same time, considered equally each avatar group in the analysed sub-sample (i.e., 10 participants per avatar group of the experiment).

The specific interview questions are included as Appendix 6.

Following Creswell’s (2014) recommended procedure for the interpretation of an explanatory sequential design, the integration of the quantitative and qualitative results is described in the following chapter (see chapter 5). In addition to the separate reporting of the quantitative and the qualitative results, that chapter contains a third form of interpretation and discussion about how the qualitative findings help to expand or explain the quantitative results.

#### **4.6.1 Validity and reliability**

The researcher was aware that variation in his interaction with the participants could hardly be avoided, particularly as the interview was semi-structured and evolved individually in each case. This might have influenced consistency and objectivity, thus reliability (Oates, 2006). The researcher tried to avoid such bias as much as possible. The qualitative data did not reveal any issues regarding this aspect.

The gap between the age of the participants and the researcher (aged in his late thirties) was not considered problematic, as the difference in age is rather small (Oates, 2006). Also, the researcher, as a university employee with frequent contact with students and as a PhD student himself, still felt rather close to the living environment and realm of experiences of the student participants. Therefore, the researcher is convinced of having been eligible to conduct a thorough qualitative study.

The researcher is not aware of giving any information about himself to the interviewees that might have affected the outcomes. Also, such confounding effects were not obvious from the data.

#### **4.6.2 Potential effects of the experimental situation**

The interviews also covered potentially confounding factors that are difficult to ask in detail with a questionnaire due to their diversity and complexity.

##### **4.6.2.1 Experience concerning personal avatars and virtual try-ons**

22 of the 30 participants reported previous experiences with avatars. Most of them named computer games as the source of their experience. The popular life simulation game “The Sims” (Electronic Arts, Inc., n.d.) was mentioned very often, though only a few of the participants said that they still played the game. The remainder recalled their use of older versions of the game. “The Sims” allows the player to configure anthropomorphic avatars with a remarkable level of detail, going as far as, for example, customizing the form of the cheekbones. Nevertheless, none of the participants commented that the virtual humans of “The Sims” were equivalent alternatives compared to the personal avatars of this study.

Only 9 persons reported previous experiences with VTO. This was limited to videos with fashion models wearing the garments on offer, or simple photo mix-and-match of predefined fashion models and clothing (compare section 2.5.4). These were rated

as not being very helpful, for example, “All beautiful. Unrealistic. 34.”. “34” is a specific, small clothing size in the German garment size system for women’s dresses and suits that corresponds to a size “8” in the UK. It is a typical clothing size of a fashion model. None of the participants reported experience of the My Virtual Model technology (My Virtual Model Inc., n.d.) that was the most popular VTO solution in the market at the time of the experiment (and until now), or any other comparable application.

None of these experiences appeared to be of significant relevance for the participants’ evaluation of the experimental system used here. These were obviously too distant from this VTO concept and its personal avatars. This became apparent from the fact that virtually all the participants commented on its outstanding value for the online shopping of clothing. None of them was able to evaluate it based on a comparable experience.

#### **4.6.2.2 Assessment of garments offered**

Naturally, it was uncertain if the product assortment that was available in the experimental system of this study would meet the taste of the participants. Previous to the tests, it had been pilot tested and discussed with three female colleagues of the researcher in order to ensure that it was adequate.

Only one participant required a smaller clothing size than was actually available, and two other stated that they did not like and would not buy anything. Several said that they would have preferred a larger assortment and different types of clothing and that it was difficult for them to find something they liked. However, the vast majority of the participants commented that they had identified at least one or two pieces that they would order in reality, in view of the given scenario and assortment. Of course, they could act on the assumption that the typical conditions of online shopping of clothing also applied here, namely free shipping and returns.

Therefore, the experiment can be judged as having been rather realistic in this aspect. This also militates in favour of the validity of the measurement of the investigated marketing outcomes, though the variable “purchase intention” must be interpreted with particular caution (see section 4.5.1).

#### **4.6.2.3 Test system deficiencies, experimental procedure and personal information**

At the end of the interview the participants were asked if the deficiencies of the experimental system, due to its prototypic nature, had influenced their answers in the questionnaire or in the interview. All of them stated that this was not the case and that they managed successfully to act on the assumption of a mature system.

Also, none of the participants reported about any significant unpleasant experience from the test procedures, especially the photo and measurement session. This could have been the case as body measures and clothing are a sensitive topic for women and people in general (see also section 2.5.1). Several of the participants even complimented how pleasant the measurement taking had been conducted by the female test assistants (“I found this very enjoyable.”). Also, all of the participants negated any bias in their statements due to the fact that such personal information had been taken and used for the study.

#### **4.6.3 Overview of themes**

From the analysis of the interviews, five main thematic groups emerged:

1. Evaluation of personal avatar,
2. Physical similarity to self and identification,
3. Functionality of VTO with personal avatar,
4. Realism of presentation of clothing,
5. Value of VTO with personal avatar.

As would be expected, the themes that emerged were partly as identified a-priori from the literature, as the interview was structured to elaborate these topics. Indeed, the interview outcomes confirmed their significance. In addition, several sub-topics did emerge. Table 4-25 lists the thematic groups and the sub-topics that were identified. They are presented in detail in subsequent sections.

Table 4-25: Thematic groups and sub-topics

<i>Name of thematic group or sub-topic</i>
<b>1. Evaluation of personal avatar</b>
Degree of imitation and realism
Body measures and body shape
Face
Hair
Skin
Posture
Identification with personal avatar
<b>2. Physical similarity to self and avatar identification</b>
Importance of visual similarity to self
Importance of identification
Body measures and body shape
Face
Hair
Skin
Type of woman
Avatar creation
<b>3. Functionality of VTO with personal avatar</b>
View navigation
Visualisation of fit
Completion of outfit
Interaction with clothing
Appearance variation
<b>4. Realism of presentation of clothing</b>
<b>5. Benefits of VTO with personal avatar</b>
Appraise individual fit
Appraise individual visual appearance
Fit and visual appearance combined
Influence on purchase intention
Utilitarian, task-focused value
Recreational, experiential value
Concerns

Overall, the comments of the participants can be collated roughly into the three categories;

- Praise (positive evaluation),
- Criticism (negative evaluation) and
- Suggestions for improvement.

The naming of the themes does not differentiate between these categories as the researcher is of the opinion that this would not be helpful: the experimental system was intended as an aid to elicit attitudes and suggestions from the participants. The aim was not to advance this system, but to determine and detail requirements for comparable systems in general.

Using the results of this research as input for the development of an arbitrary, existing or new VTO application (or the like) would in any case mean to investigate and compare: what is already given, available or implemented; and what needs to be improved and incorporated? Therefore, for this analysis, the subject of a theme was of interest, not its classification in relation to the experimental system applied in this study.

Nevertheless, where relevant, statements are considered with respect to the avatar group to which the participant was assigned, in order to be able to interpret them meaningfully.

The statements cited in English in the following sections have been translated as closely as possible to the original German, although language style has been smoothed.

#### **4.6.4 Evaluation of personal avatar**

This thematic group collates the comments relating to the specific personal avatar that the participants experienced during the test. As the study used three different basic types of avatar for the experimental conditions, the interview results naturally reflect this variation. In the following, the comments of the interviewees are therefore marked with the avatar group from which they originate. The avatar types are abbreviated as: “A<sub>HI</sub>” for the highly individualised avatar, “A<sub>M</sub>” for the model avatar and “A<sub>A</sub>” for the abstract avatar. Where helpful, this is also done in subsequent sections.

#### **4.6.4.1 Degree of imitation and realism**

Positive evaluations of the degree of imitation and realism were mainly expressed by participants of the highly individualised avatar group:

- "... because the person is close to reality and is similar to oneself ...” (A<sub>HI</sub>) or
- “It corresponds to my type. However, it is not one hundred percent me.” (A<sub>HI</sub>).

However, the model avatars and the abstract avatars also received some positive feedback:

- “... I find the presentation quite true-to-life. ... it looks very human ...” (A<sub>M</sub>),
- “It enables me to decide at least based on my own type.” (A<sub>M</sub>),
- “I thought, yes, it fits. ... I find her quite good.” (A<sub>A</sub>).

However, each avatar group also received an equal number of negative statements, for example,

- “It is never a photo, it is never the real person.” (A<sub>HI</sub>),
- “It doesn’t coincide with my type. I can’t say why. Maybe, I see myself somewhat differently.” (A<sub>HI</sub>),
- “It is too ‘far away’ for me.” (A<sub>M</sub>) and
- “This looks very, very virtual. It is somehow strange.” (A<sub>A</sub>).

Participants, independent of the avatar group, refused to accept the idea of an idealised representation, for example, slenderizing, as this would reduce the main benefit of the VTO, which is to be as reliable as possible an imitation of a real try-on.

#### **4.6.4.2 Body measures and body shape**

The depiction of body measures and body shape received many positive comments from a significant proportion of the participants (24 of 30), across the three avatar groups. Comments included

- “With respect to clothing size, this worked well; these are also my sizes.” (A<sub>HI</sub>),
- “Concerning the body, I quite liked it, with the measures and so on.” (A<sub>M</sub>),
- “The body measures were adjusted well.” (A<sub>A</sub>).

It must be noted that all the avatars, independent of the avatar group, were adjusted in the same manner regarding body measurements and therefore retained the individual body measurements of their owner (see section 3.5.3.2).

At the same time, a number of participants (11) made criticisms on this aspect, mainly because they did not like specific parts of the body:

- “She looks a little wider than me.” (A<sub>M</sub>), or
- “... the circumference matches, but not the proportions.” (A<sub>A</sub>).

Again comments were not specific to any one avatar group.

Others recommended that more body measures should be included:

“More measures should be added because it is not possible to depict the body exactly based only on chest girth and hip size.” (A<sub>HI</sub>).

#### **4.6.4.3 Face**

Concerning the face, slightly more made negative comments than positive. Furthermore, participants making negative comments predominantly belonged to the highly individualised avatar group (7 of 12), whereas only four (4) criticised the face of their model avatar and only one in the abstract model group:

- A<sub>HI</sub>:
  - “He has a rather round face and mine is somewhat longer.”;
  - “Looks kind of weird.”;
  - “It is this unnatural appearance.”;
  - “Doesn’t look like me neither, I find.”;
  - “The eyes have scared me a little bit.”
- A<sub>M</sub>:
  - “I find the face is strange.”;
  - “It’s irritating that the head looks so different.”
- A<sub>A</sub>: “I thought I would maybe see the face, in a human form.”

Positive statements concerned both the highly individualised avatars and the abstract avatars alike, for example,

- “I find, I would say, it is a good picture of me, yes. It’s very good.” (A<sub>HI</sub>) and
- “I like the face. I find it rather detailed.” (A<sub>A</sub>).



It is also remarkable that several participants (mainly from the abstract group) emphasised their preference for a standard face, for example,

- “I find it quite good that this is a standard face and not somehow me” (A<sub>A</sub>) and
- “It would be enough like this, such a standard face.” (A<sub>A</sub>)

#### **4.6.4.4 Hair**

The majority of the participants (21 of 30) criticised the hair of their avatar, across all avatar groups. Concerning the abstract avatar, several interviewees stated that they believed the avatar did not possess any hair at all. In fact, the abstract avatar featured a hairstyle with short hair that fitted tightly to the head (see Figure 3-6, p. 77). Apparently, this was not obvious to these participants.

Similarly, many participants of the model avatar group did not like the hairstyle of their avatar, often because they would have preferred a hairstyle with longer hair worn loosely and not bound together. For several members of the highly individualised avatar group, the hair did not meet their expectations concerning imitation of their real hairstyle and hair colour. The absence of their real hair colour was also an issue for many participants in the other two groups.

Many participants would have liked to have seen how the clothing would look combined with longer hair: “The hair not tied back, but worn loosely, for a complete picture.” (A<sub>A</sub>). However, technical reasons of the VTO system made it important that overlap between hair and clothing was avoided as much as possible. This issue was controlled at the photo session by asking participants to tie their long hair back, if possible and if not unfamiliar to them. Another reason for this measure was to avoid the need for hairstyles (for the highly individualised avatars) that were very difficult to model realistically in 3D, for example, hair covering the face or the ears, curls, or long hair resting on the shoulders.

Only a few participants were happy with the hair of their avatar, for example, “They are completely satisfactory like this, also with this colour.” (A<sub>HI</sub>)

#### **4.6.4.5 Skin**

Of the 30 participants, 10 made negative comments on the skin of their avatar, whereas only 6 were positive. Almost all negative comments were criticisms of the pale or missing colour of the abstract avatar, for example,

- “Because it doesn’t go well together with colours.” and
- “I would prefer, if she had my skin colour, ... I envisioned it to be more colourful, I think. ... Not so neutral.” (A<sub>A</sub>).

For a small number this was no problem, with the majority of positive comments about skin made on the highly individualised avatars, for example, “... the skin colour, it is so real, because one is looking like this.” (A<sub>HI</sub>)

#### **4.6.4.6 Posture**

There were nearly equal numbers of positive and negative comments on the posture of the avatars. All the avatars featured the same static, fixed body posture, namely with the left leg lifted slightly, as if about to make a small step forward, and with a natural asymmetric posture of the upper body including the arms (see Figure 3-6, p. 77). Several of the participants would have preferred a different posture, for example, standing on both feet. Others praised the rather natural, dynamic and relaxed position for being realistic and helpful for the appraisal of the garments.

#### **4.6.4.7 Identification with personal avatar**

Fewer than half of the participants gave information on this aspect. The majority of these participants (8), across all three avatar groups, said that they could not identify with their avatar (3 affirmed it, 1 was undecided).

Typical comments were:

- The avatar was felt to be a puppet or wooden:
  - “Because I have the feeling to dress a puppet that has my measures. But, not, somehow that this is me. And, I can hardly say, if I would like the clothing, when I wear it. Because it is not me.” (A<sub>A</sub>);
  - “The avatar would be wooden for me, even if she looked exactly like me. No personality, nothing that can reflect me, my character, my nature.” (A<sub>A</sub>)
- The artificiality of the avatar:
  - “It is somewhat similar, but anyway somehow strange, very computer-like.” (A<sub>HI</sub>)
- The missing individual face:
  - “I can’t identify directly with it, because the face plays a significant role in this.” (A<sub>M</sub>)

The few participants that identified with their avatar talked about

- An overall positive impression:  
“I like her. I don’t know if the face matches reality, but, definitely, it looks friendly. Gives a good impression. I think, I can identify with it.” (A<sub>HI</sub>) and
- Gradual improvements from the usage experience:  
“The more I worked with it, the better it became. The more I identified with it.” (A<sub>M</sub>).

#### **4.6.5 Physical similarity to self and avatar identification**

This thematic group covers two aspects:

- Physical similarity to self refers to the perceived similarity between the physical appearance of the avatar and that of the user.
- Avatar identification refers to the cognitive connection that the user of an avatar may have with her virtual counterpart, in terms of the person regarding her avatar as another, substitute self in the virtual world, with a personality like a human or with comparable illusion (Suh et al., 2011).

In contrast, the construct “avatar similarity to self”, as measured in the quantitative part of this study, formed a combination of both aspects (see section 2.7.9).

Compared to section 4.6.4, the following sections focus on the expectations, requirements and suggestions of the interviewees, largely independent of the personal avatar used in this study.

##### **4.6.5.1 Importance of physical similarity to self**

Around half of the participants commented on this aspect. Twelve (12) participants spoke of the importance of physical similarity to self, whereas five (5) regarded this aspect with restraint.

The majority of these participants wanted a true likeness with great detail in their avatar:

- “I would say as true to the detail as possible, if feasible.”;
- “The skin colour, the body posture, the body measurements and the face. In order to recognise oneself in the avatar.”;
- “If I could choose, I would like to have an avatar that mirrors me to a hair.”

The few interviewees that did not specify the importance of physical similarity to self, concentrated on unpleasant feelings, missing benefit and a desired limitation of level of detail:

- “Only measures ... face or the like is scary for me, I don’t want to do that.”,
- “I don’t think that I would need it photo-realistically, that it looks like in reality.”,
- “This is already quite detailed. It is more than required. The cheek bones here ...”,
- “I find mere hints to be enough. ... If you see it exactly, to a hair, how you are, it is somewhat demotivating ... It doesn’t need to be totally detailed.”

#### **4.6.5.2 Importance of identification**

Only a subset of the participants made comments on this aspect. There were slightly more participants that emphasised the importance of identification, compared to those that rejected it (8 versus 6).

The group that preferred identification explained that identification is required as it supports the imagination of the product usage:

- “Because I have the feeling to dress a puppet that has my measures. But not somehow that this is me. And, I can hardly say, if I would like the clothing, when I wear it. Because it is not me.”,
- “I am probably quite personal in these things. I like it, if I can identify with it, and I think, I can better envision the clothing.”

Another argument was: “If I can identify well with the avatar, then I have a stronger belief in what really suits me.”

The arguments of those who rejected the importance of identification concentrated on the utilitarian benefits of the VTO:

- “It is not necessary for me to identify with it.”,
- “No, for me, it’s not about saying ‘Oh that’s me’. For me it’s about evaluating if I like the colour and so on.”,
- “I would use it solely for try-on, not for identification with it, because it is not me in person, it is just a depiction for try-on.”

#### **4.6.5.3 Body measures and body shape**

Nearly all of the participants (27) confirmed the high importance of the individualisation of the avatar concerning body measures and body shape. There were no negative comments and participants placed this above all other aspects of the characteristics of the personal avatar: “I would summarise body measures and body form into one category. And it has highest priority.”

Suggestions were given that more body measures should be included in order to create an even more accurate representation, which further emphasises this aspect (see also section 4.6.4.2).

#### **4.6.5.4 Face**

There was clear opinion on the low importance of the individualisation of the face. A significant majority voted for it (18 participants), whereas only 8 considered importance to be high. Several participants were undecided, had certain concerns or fell into a somewhat medium category.

Typical comments for those that considered the importance of the face to be low were:

- “I also find the face quite true in detail, but it is not so important for shopping.”  
(A<sub>HI</sub>)
- “I personally find that it is not so important to have my face on it, because it’s more about the fit, of the dress.”
- “A photo is always just a snapshot. And sometimes it is probably better not to see the face there. You can concentrate more on the figure, as well.”
- “Because I didn’t look at the face, because when I pick garments, they don’t need to fit to my face, but to my figure.”

Characteristic comments of those favouring high individualisation of the face contained arguments about a more realistic overall depiction, about its general importance for the forming of first impressions of human beings, and about identification:

- “Because it looks much more realistic.”
- “But for the overall impression, how it matches me, I think, the face plays a significant role.”

- “Yes, the face is one of the most important points, I think, because it is the first thing you see.”
- “It is important for identification.”

The third category of comments expressed medium importance and sufficiency of basic characteristics:

- “It would be perfect, if the face also worked well, but it’s not a must.”
- “Maybe, the main features would be nice. To be able to choose a round or edged face, the basic form.”
- “You said the type must be a match. This means it doesn’t need to be exactly your face, but the type of it?  
– Correct.”

In addition, a significant number of participants (6) commented that eye colour should be a requirement.

#### **4.6.5.5 Hair**

The importance of the individualisation of the hair was rated high by a majority of participants (11), whilst a significant number (6) made comments that indicate a medium evaluation. Only a few assessed it as being low.

Typical statements strongly supporting the importance were:

- “The face need not be exactly similar to my real face, but the hair colour, and roughly the hairstyle; I find this very important.” and
- “The hair is important for identification, for me.”

Comments from those assigning medium rating included:

- “Maybe hair colour not so much, if it is blond, this would possibly be enough for me.” and
- “And the hairstyle, mid-length, no extravagances required, but at least, mid-length hair like mine.”

There were equally high numbers of comments on hairstyle and hair colour (16/15) describing the requirements that interviewees had for these aspects. The motivation for hair colour related mainly to need to match the colour between hair and clothing, for example:

- “... in order to see how, for example, blond hair looks together with a red dress. This makes a difference.” or
- “It may not match with my hair colour somehow; therefore, it is very important that the avatar is similar to oneself in this aspect.”

The rationale concerning hairstyle is similar (“I would have liked to see how the hair, worn loosely, goes together with the top or the dress.”). Many participants suggested a choice of different pre-defined hairstyles and variants of how the hair is worn, for example, bound together or loose, combed back, etc.

#### **4.6.5.6 Skin**

The majority of the interviewees (19) found it very important to represent the individual skin (colour). They explained, this was essential to judge the harmony of colours of an outfit in relation to one’s own body. In contrast, a few participants were of the opinion that it would be sufficient to have a choice of basic skin colours.

#### **4.6.5.7 Type of woman**

Although only a few participants talked explicitly about the topic of the type of woman, it constitutes a rather interesting aspect. The topic arose indirectly in several other evaluations and references were identified in the qualitative data, typically as statements that contain the word “type”.

Examples included:

- “What is most important?  
– The type. ... Simply the basics.”,
- “It doesn’t need to be exactly my face. It should be the type. That’s important for me.”

#### **4.6.5.8 Avatar creation**

Only a few participants raised the topic avatar creation, which relates to the way in which the users are provided with options to configure their personal avatar by themselves:

- “That you can build together something by yourself”,
- “What I could imagine as being nice would be building blocks and one could tinker a little bit
  - You would do that? Even if it is a little bit laborious?
  - Yes, I think so. For it would be fun.”

#### **4.6.6 Functionality of VTO with personal avatar**

The value or benefit of a VTO with personal avatar is also influenced by the level of interactive functionality that is available. The themes presented here relate both to the features experienced on the experimental VTO system used for this study and suggestions for further options.

##### **4.6.6.1 View navigation**

The user interface to control the view of the avatar (see Figure 3-3, p. 74) includes a turn function, a zoom function and detail views.

These functions received almost only positive comments. Nearly all participants praised the benefits of the turn function, followed by the zoom function (commented by 17 participants) and the detail views (8). It is notable that interviewees emphasised the benefits of the stepless turning that does not restrict them to predefined viewing angles. Pre-defined views or photos are sometimes encountered with distrust by online shoppers; see also section 4.6.7, speculating that there could be manipulation of the presentation. The view navigation implemented in the test system allowed the participants to inspect every arbitrary detail (“I find it good that I can take a close look.”).

##### **4.6.6.2 Completion of outfit**

10 participants emphasised the advantage of the VTO system in being able to combine clothing by dressing the avatar with several pieces of clothing. This allows the user to appraise the look of combinations of garments:

- “Because one sees what can be combined”,



- “I can see, if T-shirt and trousers, or skirt and T-shirt fit together well.”.

Conventional online shops do not offer this feature.

Furthermore, many interviewees suggested to include shoes (16 participants) and accessories (10), not necessarily for sale, but in order to create a complete outfit (“To be able to see directly, if it fits together, if I like it, also in combination.”). This would support their imagination of the real clothing (“I sometimes try how it looks with shoes, for example, how a pair of trousers drops over particular shoes or the like.”). Also, “it makes a difference if one is barefooted, wears ballerinas or high heels. It gives a completely different impression.”

#### **4.6.6.3 Visualisation of fit**

A function to evaluate clothing fit was also available. It visualised the internal tensions of the cloth as well as the distance between the body and the cloth for the different parts of a garment in terms of a heat map (see Figure 3-5, p. 76). In this way, participants could obtain a further impression, in addition to the realistically rendered view, about areas where a specific clothing item fitted more loosely or more tightly.

This function was valued by many participants (23):

- “If I want to clarify issues, especially with the waist line of blouses, I find this helpful”,
- “It’s to some extent even better, because in the shop, in the mirror, you can’t see this very well.”

For a few participants this was only nice to have, as they were convinced they were able to imagine these aspects using the standard view. In contrast, others felt unable to interpret this information usefully.

#### **4.6.6.4 Appearance variation**

Appearance variation relates to the options that could be made available to the users to allow for individual adaptations of the appearance of their avatars. The comments on this sub-topic may have been stimulated by the main questionnaire (see Appendix 5) that asked about functions to “optionally vary the above-named characteristics, e.g. different hairstyle, sun-tanned skin instead of winter pale skin”.

In general participants made suggestions concerning hair (7) and a few also concerning skin colour:

- “I would like to choose between two hairstyles or so, maybe a pigtail and worn loosely”,
- “... for a complete appearance.”,
- “To be able to choose between short and long hair would be enough for me.”

#### **4.6.6.5 Interaction with clothing**

The VTO system employed in this study presented the clothing in one static position to the users. A direct interaction with the garments in order to alter, for example, the drape was not foreseen. However, in the interviews two sub-topics occurred that are subsumed under the theme interaction with clothing, namely:

- Variation of posture and body movements, and
- Adjusting drape and putting clothing in place.

Comments on the first of the two sub-topics may have been inspired by the main questionnaire that asked how important it would be to “optionally vary the posture, e.g. arms stretched forward, sitting, holding a dynamic pose” (see Appendix 5). Almost every participant made a positive comment on this. Many would like to see how the clothing would look and fit if, alternatively, the avatar was sitting, if the arms were stretched upward or if it was standing in other positions. Interviewees also asked for dynamic movements, requiring an animated representation.

The ability to adjust the drape of garments and to put clothing into place was another option suggested by a few participants. This idea obviously results from the practice that people often re-arrange garments on their body, as part of the act of getting dressed and when they get out of place later. Also, there are options how to wear a specific garment, for example, rolling up one’s shirt sleeves (“Fiddling with the clothing ... that is something quite common.”).

#### **4.6.7 Realism of presentation of clothing**

The number of participants that expressed negative comments about the realism of the depiction of garments was higher than those expressing a positive comment (16 versus 11 respectively). The lack of photo-realism was criticised (e.g., “It looks too much like computer-generated for me. The clothing will look differently in reality;

the photos used in other stores are more realistic.”). Also difficulties to imagine the real clothing were voiced:

- “For me it is a virtual dress, and I don’t know how I can imagine how this will look like, if I get it sent to my home.”,
- “I could envision the skirt quite well, for example, also the top; but I had greater difficulty with the dress. I can’t generalise.”.

Also, there were doubts about the realism of the depiction of colour and material (e.g., “You can’t see the texture of the clothing well.”).

Positive comments were:

- “You get an idea of it.”,
- “I can imagine it quite well.”,
- “It doesn’t make a big difference for me if it is computer-generated or total photo-quality. As long as the colours are reasonably correct.”

People seem to distrust photos of clothing in online shopping, for example:

- “So, you can’t rely on photos?  
– No, not completely.”,
- “Photos are often manipulated.”,
- “I imagine that folds are retouched or cloth is specially arranged.”.

A VTO system as used in this study was considered not to allow such manipulations.

#### **4.6.8 Benefits of VTO with personal avatar**

This thematic group covers the aspects that participants commented as being beneficial for them when using a VTO with personal avatar and focuses on the individualised information provided by the VTO. Some positive comments related to general aspects of the individualised information such as:

- “It’s more honest, what can be good or bad.”,
- “It is really very individual, and I liked this very much.” (AM).

However, many comments could be categorised into a number of sub-topics, which are discussed in the following sections.

#### **4.6.8.1 Appraise individual fit**

This sub-theme received many comments from nearly all the participants. Typical examples are:

- “I like the concept, because I normally have to send back half of the products, because they are too small, or don’t fit me, because they are too big. I believe that it would help to select garments in a well-directed manner.”
- “That one can see, what fits oneself, if it is tight-fitting or wide, if the size is fitting, concerning the length.”
- “That I have an avatar that looks at least almost like me, regarding body measures. It doesn’t help me to look at a person of 1.75 meters and dress size 36. This doesn’t help given my body height of only 1.60. Even if I would be a 36, it wouldn’t come close.” (A<sub>A</sub>)
- “In this case, with my avatar, it’s only about correct fit.” (A<sub>A</sub>)
- “Especially, to see the true cut of a trousers or the like. Because, often, you can’t see this on a picture: Is it really so narrow or is it wider?”

#### **4.6.8.2 Appraise individual visual appearance**

Visual appearance represents aspects other than correct fit. It mainly relates to colours and style; where style is closely linked to the type of woman, hairstyle and colours of hair and skin and so forth. In contrast to the previous sub-topic, this was mentioned by approximately half of the participants and received many fewer comments, however the numbers are significant (15 participants, 22 comments). Typical comments were:

- “Because you can envision it better, for example, skin or hair colour, how will it look together with the colour. ... You can see if the colour suits you.” (A<sub>HI</sub>)
- “If hair colour would be appropriate, maybe the hairstyle too, then one could really say if it suits or not.” (A<sub>M</sub>)

#### **4.6.8.3 Fit and visual appearance combined**

A significant number of participants (11) made comments that could not be assigned clearly to either of the previous sub-topics, but related to a combined notion of fit and visual appearance, for example:

- “So that I can imagine better how it looks on me.”

- “To gain a better impression of the piece of clothing, generally, but also individually for oneself.”
- “I think it is very useful. My personal experience is, things look beautiful on pictures and fashion models on the Internet. When trying them on at home you think, no, it doesn’t suit me at all. Neither style, nor correct fit. Therefore, I think it would be really good to have my virtual body in the computer and to try out things in advance.”
- “I find it interesting to try out colours, together with fit checking, to experiment with different clothing sizes and to check what works best.”

There were also a number of negative comments that relate to the lack of informative value or that indicate the importance of colours (and hair):

- “The fit checking is good, but it is not so significant, concerning my imagination how it could be in reality.” (A<sub>HI</sub>)
- “I can’t see if it suits me or not.” (A<sub>M</sub>)
- “I can’t say anything on the colour, because skin colour is lacking, hairstyle as well, such things.” (A<sub>A</sub>)

#### **4.6.8.4 Influence on purchase intention**

All interviewees, without exception, confirmed that the VTO with personal avatar would help them with their purchase decisions. Benefits given were typically about:

- Increased benefits of online shopping, for example:
  - “This would be a reason to order clothing over the Internet.”
- Decreased need to order (and send back) different variants in size and style:
  - “So, you would order fewer variants?
    - Yes.”,
  - “I think it would have a large effect. The sheer fact that I would order a smaller number of pieces.”
- Decision support:
  - “I would be able to decide better, what to order, compared to elsewhere.”,
  - “I think it influences decisions, as you can see directly, if it doesn’t fit at all.”

- Increased confidence to try out unfamiliar clothing:  
“Simply because, garments that I would not buy and just skip, because I would think ‘Hmm, no, this will look stupid on me’, I can see them here and maybe I would like them and go for them.”

#### **4.6.8.5 Utilitarian, task-focused value versus recreational, experiential value**

The interview outline contained a question on the utilitarian or task-focused value of the VTO with personal avatar, together with a question on the recreational or experiential side. Nearly all the participants made positive comments on both aspects, often emphasising that it supports both:

“First, I thought, it is only a task-oriented matter. But I can well imagine to turn it into a recreational application.”.

Concerning recreational or experiential value, many interviewees commented on:

- The fun aspect of the system:  
“It’s nice, the try-on, it makes it fun.”,
- Its suitability to search around:
  - “... to try out a lot of pieces.”,
  - “... to try what could be combined.”,
- Its usefulness for experimentation:  
“You can experiment with clothing sizes, with colours, with different styles of clothing, and look what is more suitable for the occasion.”, or, again,
- The trial of unfamiliar garments:  
“... rather give edgy or crazy outfits a chance.”.
- For some it was like a game:
  - “I wouldn’t need to play computer games or the like any more. I would sit there and try on all the pieces.”,
  - “... it would be a gimmick, I would try on stuff, just for fun.”.

Interviewees demonstrated the utilitarian or task-focused value commenting on the following aspects:

- Appraisal of individual fit and visual appearance (see also sections 4.6.8.1, 4.6.8.2 and 4.6.8.3):  
“It makes it easier for me to learn about what would suit me, how it will look

like. I wouldn't need to order so many needless pieces that I have to return anyhow, because they look stupid. It makes it easier.”

- Comfort and facilitation:
  - “The avatar tries on everything without protest, in contrast to myself. It is definitely very comfortable.”,
  - “Personally for me, it means much less stress, as I find trying on garments in department stores is very exhausting.”
- Minimisation of risk:
  - “The risk is minimised that clothing doesn't fit me at all, or that a T-shirt, say, reaches underneath the knees.”,
  - “The avatar helps with decisions about more important, urgently needed pieces.”
- Effect of increasing usage experience:

“You will get used to it, and then you will probably look with greater focus.”

#### **4.6.8.6 Concerns**

The interview data also revealed some concerns. Several participants expressed doubts concerning the realism and the reliability of the depiction of the clothing:

- “I still don't know, how it will look in reality.”,
- “But I think, it would still look different when I really wear it.”,
- “Colours always look different in the computer.”.

Also, essential shortcomings were mentioned to still exist (“You can't feel the material.”).

A possible demotivating effect was described by a few interviewees:

- “I could well imagine that some women would be unable to cope with this information, in this honest form.”,
- “I still find it demotivating. ... But that's a personal issue, isn't it? If you want to go shopping true to detail, then you have to accept this.”

Finally, a significant number of participants (7) talked about privacy concerns and about being reluctant to disclose some of the personal information involved in the VTO with personal avatar:

- “I would try on stuff, and then I would be afraid someone could see this.”,

- “Because the anonymity of the Web is essential for me.”

#### **4.6.9 Consumer characteristics**

Apart from the themes presented in the previous sections, the interviews also revealed some aspects related to consumer characteristics.

##### **4.6.9.1 Body image**

There were no direct questions relating to this aspect nor was there any attempt to elicit statements indirectly. Nevertheless, a few interesting comments emerged:

- Awareness of own deficits:
  - “I would need to do specific things, and then this would maybe look differently. I am very realistic in that point.
    - So, you have no problems with it?
    - I don’t have a problem with it. I know I should.”,
  - “I thought, OK, I look like that. It was not negative, but it is this foolish idea in our mind, being slender. But I thought, this is appropriate.”
- Unpleasant feelings, self-doubts:
  - “As I saw her, ... it was somehow displeasing. Thinking, if you really look like this, if others perceive you the same way ... for me this looks large. I felt self-doubts.”

##### **4.6.9.2 Shopping orientation**

The participants were asked about their shopping orientation when shopping online. This factor was also included in the quantitative part of the study (see section 3.6.1) as independent variable. The questionnaire produced a value on a continuum between task-oriented and recreational shopping orientation.

From the interview data it became clear that a significant number of the participants could not classify their shopping orientation unambiguously on such a scale:

- “I think, it depends.”,
- “I think I am focussed first and then I see different stuff and start to search around.”,
- “You said you are sometimes goal-oriented and sometimes you rummage.
  - Yes.”



Concerns on the usefulness of the scale were therefore indicated and shopping orientation was interpreted with care in this study.

In the next chapter, the findings of this chapter will be discussed, and the results will be linked with the literature reviewed in chapter 2.

## **5 Discussion**

This chapter discusses and merges the quantitative and qualitative results of this study and relates them to the research objectives specified at the beginning of the thesis.

First, the various outcomes with direct relation to marketing outcomes are discussed. Then, avatar characteristics are assessed based on quantitative and qualitative results. Functionality and benefits of the VTO with personal avatar are two further reviewed topics of this chapter that are of relevance for the research questions. Finally, the limitations of this study are considered.

### **5.1 Evaluation of avatar design**

The design options for personal avatars are almost endless, as indicated in section 2.6.1. On the one hand, there is the range of aspects of the appearance of an individual person that an avatar can imitate or ignore, for example, body measures, face and hair and so forth. On the other hand, there are the numerous design alternatives regarding level of detail, graphical styles or stylised design, approximation or idealisation, animation, or even variations of these aspects within one and the same avatar.

For the experimental part of this study, where participants were presented with specific avatars, it was inevitable that only an incomplete subset of design variations could be investigated. First of all, this research focused exclusively on static visual aspects, similar to the majority of the existing work on the topic (e.g., Calhoun et al., 2010; Merle et al., 2009; Suh et al., 2011). Second, a specific design had to be selected for each of the three avatar types constituting the three experimental conditions of the study, i.e., highly individualised avatar, model avatar and abstract avatar (see section 2.8). These variants were selected and designed to cover a broad spectrum of fundamental categories of visual appearance, but naturally could only represent a limited number of the possible options.

It must also be noted that all the avatars retained the individual body measures of their users, so that variation in this respect was avoided. This guaranteed an accurate and comparable individual depiction of the clothing products for each participant, satisfying the goal not to vary this factor between participants.

However, despite any limitations, the questionnaires and the interviews allowed arbitrary aspects of avatar design to be evaluated and discussed. Indeed, the qualitative results showed that the participants did reflect on avatar design options beyond what was presented as part of the experiment.

## **5.2 Effects of avatar design on marketing outcome factors**

An unexpected result was that each of the hypotheses that proposed there would be significant variation of the considered marketing factors between the three avatar groups had to be rejected (see section 4.5.3). Specifically, for the data collected in this study, the quantitative analysis showed:

- Informativeness did not vary between the different avatar designs.
- Telepresence did not vary between the different avatar designs.
- “Shopping enjoyment” did not vary between the different avatar designs.
- “Decision support satisfaction” did not vary between the different avatar designs.
- “Attitude towards the website” did not vary between the different avatar designs.
- “Perceived risk of purchase” did not vary between the different avatar designs.
- “Purchase intention” did not vary between the different avatar designs (however, please note the problematic reliability of the measuring of “purchase intention”, see section 4.5.1).

Therefore, for the data collected with this study, it can be deduced that avatar design, when considered as sole factor, does not have a direct effect on the investigated marketing outcome factors.

These results have to be interpreted considering the following surrounding conditions:

- Imitation of body measures and body shape did not vary between groups as it was implemented identically for all the avatars.
- The effect size assumed for the purpose of calculation of the required sample size was large, according to Cohen’s rule of thumb (Cohen, 1988), as explained in section 3.4.2. Therefore, effects of a smaller size could hardly be detected. They may exist, but when designing the study, they were considered as

unproductive for the given practical background of this research. Post-hoc calculations show (see section 4.5.10) that a considerably larger sample size of 948 in total or 316 per group would have been required to identify a significant effect. This hypothetical sample size also exceeds comparable research (Merle et al., 2012; Suh et al., 2011).

Two interpretations of these outcomes are possible, though both are not evidenced by the data:

- Avatar design (other than body measures and body shape) has no effect on the investigated marketing outcome factors in the given context, i.e., a VTO in online shopping of real clothing.
- Avatar design may have effects of a size that could not be detected with this study.

Although avatar design is a rather heterogeneous topic, see section 5.1, analysis of the different characteristics constituting avatar design can provide distinct insight. For example, one possible explanation of the aforementioned results may be that the imitation of body measures and body shape has such significance for VTO users in online shopping that this outweighs any other aspects of avatar design. In the case of this study, this would include those aspects that were varied between the groups, namely face, hair and colour. Section 5.6 discusses these separate avatar characteristics in more detail.

In a related experiment by Merle et al. (2012), participants belonging to one of three conditions were asked for the perceived level of personalisation concerning their personal avatar (see section 2.6.2 for details of that study). Two of the four conditions used avatar types that likewise imitated body measures, as in this study. The face was individualised in only one of these two groups. When analysing their collected data, the researchers decided to put the two groups together as no significant variance between these groups for perceived level of personalisation was identified. In this respect, the results reported here seem to agree with that study, as no significant difference between avatars with different designs, apart from imitation of body measures, was identified.

Moreover, most of the investigated marketing factors achieved good ratings on average, each around the second-best step on the applied 5-point rating scale, except for telepresence, which was only rated as moderate. This indicates the considerable benefits that the VTO with personal avatar provides to consumers. However, the significantly lower rating of telepresence seems to illustrate that a VTO, naturally, can still not reproduce the experience of a real try-on and inspection of the real clothing: Important sensory information is missing, for example, customers are not able to touch the material and feel the clothing on their skin.

### **5.3 Effects of avatar design on “avatar similarity to self”**

Prior to the experiment it was assumed that the factor “avatar similarity to self” would vary systematically between the three experimental conditions. This hypothesis must also be rejected (see section 4.5.4). Again, this outcome was somewhat surprising, given the objectively rather significant differences in avatar design between the three groups. Once more, for the interpretation, the unvaried imitation of body measures and body shape and the large effect size assumed for sample size calculation have to be considered (compare the previous section 5.2).

As one attempt to explain this outcome, the quality of the highly individualised avatars may be questioned. It is the case that differences in quality may arise dependent on the ability of the 3D modeller and the manual effort invested; and some of the highly individualised personal avatars were better than others, i.e., they seemed to be a more accurate representation of their user. Comparable work has reported similar difficulties, especially for the face (Suh et al., 2011).

However, an objective evaluation of the quality of such a personal avatar, that is also seen the same way by the imitated person, seems to be hardly possible anyhow. Evaluating a portrait of a specific other person is a rather subjective undertaking, all the more when this person is not a well-known, related party. Moreover, it is hardly predictable if individuals themselves like their portrayal, independently of how objectively correct it may be; compare, for example, the often contrasting opinions on the quality of photos of individual persons. This is because body image is a very subjective perception (see section 2.5.1). Therefore, rather inevitably, this research, in line with other comparable work (Merle et al., 2012; Suh et al., 2011) refrained

from constructing an objective evaluation of the highly individualised avatars, but relied on the opinions of the users about their avatars.

The mean values for “avatar similarity to self” were likewise almost “3” in all groups, representing “moderately”, which is the middle rank. This constitutes a quite low value, especially for the highly individualised avatar. The standard deviation of nearly one (1), representing a full rating step for the employed 5-point scale, is rather high, and implies that many participants delivered significantly better or worse ratings for the similarity of their avatar.

A potential reason for these results is that many participants identified at least one or two issues with the appearance of their avatar, for example, an improper shape of a specific body part, while many different details were well liked. This was observable from the interviews. Also, it seemed that participants brought along certain expectations on how their personal avatar would look like. Maybe, these were met only partially by the avatar. However, care had been taken that the information provided to the participants prior to the experiment, from the recruiting and from the measurement and photo taking, had been as sparse as possible in order to avoid these issues. It may be possible that taking the photos made some participants expect avatars that would resemble them more than the model and the abstract avatars did.

Similar research has gained comparably low values: Merle et al. (2012) received a mean value for perceived self-congruity of their highly individualised avatar that was even below the middle rank of their scale. Suh et al. (2011) differentiated between facial and body similarity and, on a 7-point scale, determined a mean value slightly above the middle rank for their high face similarity group, and, less surprisingly, 1.5 steps above the middle rank for their high body similarity group (see section 2.6.2 for more details on that research).

#### **5.4 Effects of “avatar similarity to self” on marketing outcomes**

The hypothesis that “avatar similarity to self” is positively related to the investigated marketing outcome factors was partly supported by the data collected in this study: “avatar similarity to self” partly explained the variance of the factors informativeness, telepresence, “shopping enjoyment” and “attitude towards the website” – the greater the perceived avatar similarity, the higher the respective marketing outcome factor. However, in contrast, in the collected data, “avatar

similarity to self” did not predict “decision support satisfaction”, “perceived risk of purchase” and “purchase intention”.

The identified relations were demonstrated with separate regression models for each of these factors. The linear relation to “avatar similarity to self” accounted for 14 to 17 % of the variance of the separate factors, which seem to constitute small values. Low values for coefficients of determination in regression models are common, when several potential factors have not been considered, be it knowingly or not (Schloderer, Ringle, & Sarstedt, 2011). This is the case with the experimental study at hand: As avatar design is in the focus of this research, the investigation was restricted to this factor.

At the same time, the questionnaire consistently referred to “try-on with personal avatar ...”, for example, “If I were actually shopping for clothing online, this try-on with personal avatar would let me easily visualise what the actual garment is like.” This was because it was assumed that the participants would not be able to answer meaningfully if being asked for the separate contribution of only the personal avatar within the VTO (for instance “... the individualisation of the avatar ...”). The personal avatar forms an integral part of the VTO and is essential for its utility. Therefore, it must be assumed that participants would anyhow have considered the VTO in its entirety when assessing the marketing outcome factors, instead of referring solely to their avatar. Apart from their avatar, they probably have included in their evaluation the realism of the presentation of the clothing and related possible uncertainties on the quality of the real clothing, missing sensory information (e.g., not being able to touch the material), the functionality of the VTO and its usability, etc. These aspects were, consciously, not integrated in the research model of this study. However, they may account for significant parts of the unexplained variation in the aforementioned regression models. Another possible source of variation in marketing outcomes are consumer characteristics; this study considered the factors “appearance orientation” and “shopping orientation” (see below).

In the comparable work of Suh et al. (2011) an even lower value of the coefficient of determination of 0.12 was achieved for “perceived diagnosticity”. This construct can be considered as being connatural to informativeness and telepresence.

The identified values for the coefficients of determination in the above regression models are therefore regarded as expedient for this study. If in practice a given VTO application of an online clothing shop is implemented in such a way that it delivers a reliable try-on and true to detail imagery of the real products, from the point of view and experience of the consumers, then it seems worthwhile to try to maximise the perceived “avatar similarity to self”.

This result corresponds to the conclusion of Merle et al. (2012) that the perceived resemblance between the consumers and their avatars should be maximised in order to increase the positive impact of VTO on marketing outcomes. However, these authors did not derive specific recommendations for personal avatar design from their experimental study (see section 2.6.2).

This study also collected data on the two factors “appearance orientation” and “shopping orientation” that both constitute individual characteristics of consumers (see section 2.7.10). When extending the above separate regression models with “appearance orientation” as a further independent variable, higher coefficients of determination were achieved for telepresence and “attitude towards the website” (see section 4.5.5). “Avatar similarity to self” and “appearance orientation” together and with similar contribution accounted for 30 % of the variation of “telepresence” and of “attitude towards the website”.

In this study, the construct telepresence represents the realism of the try-on as simulated by the VTO as well as the quality of information about the real clothing delivered with the VTO feature (see section 2.7.3). The higher the “appearance orientation” of a participant (and the greater the perceived “avatar similarity to self”), the higher was the amount of telepresence. The obvious interpretation would be: Consumers that pay more attention to their appearance and are more centred on appearance in their thoughts and behaviour perceive the product information conveyed by the VTO with personal avatar to be more beneficial and relevant for their product appraisal, as expressed in the telepresence construct, compared to other consumers. It seems that high “appearance orientation” implies information needs that are served well by the VTO with personal avatar. This relation is less relevant for persons with lower “appearance orientation”.



The relation between “appearance orientation” and “attitude towards the website” turned out to be rather comparable to the former case of telepresence. Also, the rationale assumed for telepresence appears to apply here: The described advantages of the VTO with personal avatar perceived by persons with high “appearance orientation” may also influence positively their “attitude towards the website”.

“Appearance orientation”, together with “avatar similarity to self” did not contribute to the explanation of the variance of the factors “informativeness” and “shopping enjoyment”. This consumer characteristic seems to be irrelevant in both cases and, thus, not suitable to categorise the user population. Also, integration of the factor “shopping orientation”, in place of “appearance orientation”, into the above regression models was not successful.

Having identified “avatar similarity to self” as being independent of the experimental conditions, i.e., variation of avatar design, the factor lent itself to be included as an independent co-variate (see section 4.5.3.8). The purpose was to test if the proven effect of “avatar similarity to self” on the respective marketing outcomes masked the hypothesised influence of avatar design on the marketing outcomes. This could be done for informativeness, “attitude towards the website”, “shopping enjoyment” and telepresence, as these correlated with “avatar similarity to self”. Again, no significant effect could be identified, which further supports the above result (see section 5.2) that the investigated avatar design variation did not have a systematic, direct effect on the included marketing outcome factors.

## **5.5 Factors for purchase intention**

The influence of the investigated marketing outcome factors on purchase intention was of secondary importance for this research. These factors were not controlled as independent variables. However, test results may have indicated the realism of the simulation of a real shopping scenario in this experimental study. As stated in section 4.5.6, from the investigated range of marketing outcome factors, “purchase intention” is conceptually the closest to “actual” purchase that could be measured. The positive effect of the other included marketing outcome factors on “purchase intention” is described in the literature (see section 2.7). However, because of the insufficient reliability of the questionnaire scale on “purchase intention” for the data collected in this study (see section 4.5.1), the relation between the other marketing

outcome factors and “purchase intention” was not tested. Instead, it was relied solely on the literature.

One reason that the questionnaire scale on “purchase intention” did not work as expected in this study, might be the question item “How likely would it be that you ... now buy one or more of the garment items you just viewed in this shop?”. Omitting it would have resulted in an improved (though still not acceptable) reliability. The item might have referred too strongly to a real shopping scenario that was not present in this study. However, much of the comparable published research has included “purchase intention”, though without indicating similar issues.

Also, rather naturally, actual purchase intention might depend primarily on the specific products offered. However, the vast majority of the participants admitted to have found at least one or two garments that they would order in reality, in view of the given scenario (see section 4.6.2.2). Therefore, the product assortment can be considered not to have confounded purchase intention.

“Purchase intention” received high mean values for all the groups, namely about “4” (representing “likely”, the second highest possible score). This result, allowing for any deficiencies, can be interpreted as an indicator of the good quality of the experimental simulation, despite its inherent artificiality.

Furthermore, the qualitative results show that the participants are convinced that the VTO with personal avatar would help them with their purchase decisions (see section 5.9). Indeed, actual purchase intention might depend primarily on the specific products available in a shop. The more suitable the personal avatar to help a customer with their product appraisal, the more obvious it may become that a piece of clothing is not preferred and so is rejected by the customer. Conversely, a customer may become convinced with the help of the personal avatar that a product suits well and has a good fit. In the latter case, the same personal avatar would contribute to increase purchase intention.

## **5.6 Assessment of avatar characteristics**

The different characteristics and body parts of the avatars were evaluated by the participants both as part of the questionnaire (see sections 4.5.7 and 4.5.8) and in the interview (sections 4.6.4 and 4.6.5). Whilst the participants evaluated the specific

personal avatar provided to them in this study, they expressed expectations, requirements and suggestions largely independent of this personal avatar. This section integrates these various results by discussing them together as appropriate. The order in which the different aspects are presented reflects their importance for the participants.

### **5.6.1 Body measures and body shape**

For the question on the preference of this aspect of the avatar, the closeness of the body measures to the actual person received nearly identical high mean values (approx. “2”, i.e., “good”) for all the groups (see Table 4-22, p. 126). These means were the highest achieved for all the characteristics evaluated (except for the skin colour for the highly individualised avatar that was slightly higher). The conformity between the groups had to be expected, as all the avatars retained the individual body measures of their users, so that variation in this respect was avoided.

The same applies for body shape, although with slightly worse mean values and with a little more (though statistically not significant) variation between groups. This can be explained by the fact that the body shape of all the avatars was basically identical, i.e. there was no individualisation of the shape in the sense of adjusting muscle mass, body fat, posture, or otherwise (see section 3.5.3.2).

In contrast, in reality any two persons with the same measures may exhibit visual differences in these shape-related attributes. Thus, a little less positive evaluation of the given body shapes compared to body measures seems reasonable. Nevertheless, the representation of the body shapes of the participants would appear to have been successful.

The quantitative results on the desired characteristics of the personal avatar (see section 4.5.8) show that the vast majority of the participants considered the body measures as being “essential”, so that this aspect proved to be of utmost importance. Indeed, the approximated representation of body measures and the clothing size share the top rank of the ordered list of desired characteristics (see Table 4-23, p. 130). The exact, detailed representation of body measures was ranked second, although the difference to the approximated representation was not statistically significant.

The high ranking of the clothing size in this list should be interpreted as indicating that customers naturally desire their avatar to have their clothing size, whilst at the same time prefer to have a truer to detail, more individualised avatar, i.e., depicting the real body measures. This became apparent also from the qualitative data, where participants emphasised the importance of the exact body measures (see sections 4.6.4.2 and 4.6.5.3) and of detailed physical similarity to self in general (see section 4.6.4.1). They even suggested that more body measures should be included in order to adjust more parts of the body individually.

At first glance, the latter seems somewhat contradictory compared to the preference of an approximated over an exact, detailed representation. However, two aspects have to be differentiated here:

- The need to imitate certain overall aspects, such as the specific length of the legs, rather than ignoring them by using a standard;
- Compared to attention to detail or exactness of the depiction within these aspects.

Whilst a preference for consideration of more aspects can be identified from the results, there was also evidence that many participants were somewhat restrained concerning an overly revealing representation. However, it is clear that quite different preferences exist between the participants concerning a very true to detail versus an approximated depiction of their real appearance, although there was consensus that their avatar should be sufficiently accurate for a reliable try-on.

It should be noted that many participants commented critically on the closeness to reality of specific details of the representation of their body measures and body shapes in their avatar (see sections 4.6.4.2). It can be concluded that the closer the representation of specific personal aspects is made to reality, in this case the body measures, the more critical can be the appraisal of these attributes by users. This agrees with published work; for example Lutchyn et al. (2009) describe corresponding disadvantages of overly individualised avatars (see section 2.6.3).

### **5.6.2 Skin colour**

The skin colour of the highly individualised avatars gained the highest mean rating by participants out of the three avatar designs (approx. “2”). The skin colour of the

model avatars was rated considerably lower on average, although the difference from the highly individualised avatars was not statistically significant. In contrast, the mean rating for the abstract group was poor (worse than “4”, i.e., “fair/pass”; see Table 4-22, p. 126) and the difference to each of the two other groups was significant. Numerous negative comments from members of the abstract group revealed that they would have preferred a less neutral, more realistic or even individually coloured avatar (see section 4.6.4.5).

Moreover, the results on the desired characteristics of the personal avatar (see section 4.5.8) show the utmost importance of the imitation of the individual skin colour. It might be the case that many participants of the model avatar group perceived the skin colour of their avatar as satisfactorily similar to theirs. This would explain why its rating was quite good, even though the skin colour was not explicitly individualised to the participants of this group.

Consistent with these results, the interview data showed that the majority of the interviewees found it very important to have their individual skin (colour) represented (see section 4.6.5.6). They asserted that this was essential to judge the harmony of colours of an outfit in relation to one’s own body. A few participants suggested the less individual approach to offer a choice of basic skin colours.

### **5.6.3 Hair**

The avatars of the abstract group received a poor average rating for the depiction of their hair. This is unsurprising as the hair was not specific for colour or style. Indeed, the interviews showed that many participants of this group did not even notice the hair (see section 4.6.4.4). The values for the other two groups were much better (statistically significant difference to the abstract group for each), though only gained a middle rank score between “moderate” and “fair/pass” (see Table 4-22, p. 126).

Higher ratings had been expected, especially for the highly individualised avatar; the high standard deviation shows that there were at least a few participants that liked the hair of their avatar. However, for the majority of the participants the hair did not meet their expectations concerning imitation of their actual hairstyle or hair colour. This shows that there are difficulties to model and render convincing individualised hair from photo snapshots. Indeed, the quality of the hair of the highly individualised

avatars concerning closeness to reality and imitation of the real hair of the users can be put into question, as already discussed in section 5.3.

However, causes might not only be technical in nature, but may also lie in the preferences of the consumers for how the hair is worn. These could not be covered in the single depiction of the avatar. Long hair especially can be worn in different styles and, as the interview data showed, women like to try out different arrangements of their long hair when trying on clothing. Also, hair length constantly changes.

Consequently, also the model avatars received much criticism for hair. In contrast to the model and the abstract avatars, which had relatively short hair, most of the women in the sample had long hair. Therefore, any positive comments might have been mostly due to the situation where the model avatar met the current preference of the participant.

In contrast to the question on the general characteristics of hair, there were specific questions relating to desired characteristics of the personal avatar (see section 4.5.8) regarding hair colour and hairstyle. Hair colour had a rating as high as skin colour, whereas hairstyle scored significantly worse (see Table 4-23, p. 130), namely as “nice to have”. Also, a significant difference was identified for hairstyle between the approximated representation and the exact, detailed representation, with the latter scoring lower.

Again, similar to the skin (see section 5.6.2), hair colour seemed to be of high importance to the participants, and greater than hairstyle. This outcome is also supported by the interview data. Similar to the skin aspect, participants suggested offering a choice of colours, different pre-defined hairstyles and variants of how the hair can be worn (see section 4.6.5.5).

Overall, hair seems to be an aspect of high or at least medium importance for most women, with greatest relevance when considering a complete outfit. It therefore should be represented appropriately in a personal avatar. Highest priority should be placed on colour, followed by length and style.

#### **5.6.4 Face**

The face was specifically designed to be different between the groups (see Figure 3-6, p. 77), and therefore the rather small difference obtained for mean values on this

aspect is somewhat unexpected (all around “3”, i.e., “satisfactory”, see Table 4-22, p. 126). The highly individualised avatar would have been expected to receive a more positive rating. However, this outcome agrees with the results published by Merle et al. (2012), who also did not receive significantly better evaluations for avatars with individualised faces compared to otherwise similarly individualised avatars (see section 5.2).

Participants making negative comments on the face of their avatar predominantly belonged to the highly individualised avatar group (see section 4.6.4.3). Some of these statements can be ascribed to “uncanny valley” effects, predominantly concentrating on the face (which is typical for this phenomenon): “Looks kind of weird.”, “... unnatural appearance.”, “The eyes have scared me a little bit.”, “... face is strange”. As with the hair, this demonstrates the difficulties faced to model and render a convincing and comfortable, familiar (“non-eerie”) individualised face from photo snapshots. Therefore, the quality of the faces of the highly individualised avatars regards closeness to reality and imitation of the actual face of the user may have been problematic, as already discussed in section 5.3.

Causes might not only be technical in nature. It might have been the case that the participants would have liked to have seen the portrait photos taken for the experiment in advance, as people are usually quite critical of photos of themselves and may have prejudged, and this could have introduced issues even with the source material for the highly individualised faces. However, this factor was not investigated.

Concerning the desired characteristics of the personal avatar, the individualisation of the face scored a medium rank in the priority list (see Table 4-23, p. 130), with a median of “3” classifying it as a nice-to-have feature. There was a significant difference between the approximated representation and the exact, detailed representation, with the “approximated representation” scoring higher.

Concerning the importance of the individualisation of the face, the interviews showed that a clear majority rated it as being low or medium importance (see section 4.6.5.4). These results agree with the work of Suh et al. (2011) that indicate the lower importance of face similarity compared to body similarity. Those participants that expressed medium importance asked for imitation of the main features of the face

and specifically the depiction of the type of the face. Also, the idea of a standard face as featured by the model avatar and the abstract avatar was evaluated positively by some participants.

Some interviewees suggested that the eye colour could be individualised, which further indicates the significance of colour. However, individualised eye colour only scored a medium rank in the priority list as a desired characteristic of the personal avatar (see Table 4-23, p. 130), with a median of “3” classifying it as a nice-to-have feature.

Overall, from these results, it seems advisable not to try to provide highly individualised faces, but to offer a range of standard faces that represent different types of faces, or to allow for some basic customisation, such as elementary face shapes and eye colour. In this way, the risk of low acceptance that highly individualised faces seem to have due to shortcomings perceived by their users, that may in part be due to the still not fully understood and therefore hard to control “uncanny valley” effects, may be reduced.

### **5.6.5 Posture**

The aspect and term posture comprised two separate components in this study; representing both

- The pose that a person strikes for a specific purpose and
- Durable postural characteristics, for example, hollow-back or tilting.

Without specifically addressing this distinction, the posture of all the avatars scored “satisfactory”, i.e., the middle rank (see Table 4-22, p. 126).

Concerning the desired characteristics of the personal avatar, where posture referred to the postural characteristics, it received a medium rank in the priority list (see Table 4-23, p. 130), classifying the individual posture as a “nice to have” feature. A significant difference was identified between the approximated representation and the exact, detailed representation, with the latter scoring as less desired.

The interview data produced an equal picture between positive and negative comments. In referring to posture in the sense of pose, some liked the pose that all the avatars featured, whereas others would have preferred a different one (see section 4.6.4.6). Therefore, a recommendation would be to offer different poses. This



supports the suggestion in section 5.8.5, where pose is discussed as a means to interact with the clothing.

### **5.6.6 Required accuracy**

The topic of accuracy of imitation of specific aspects of individuals by their avatar was raised in several of the previous sections and is further discussed as a result of the perceived significance.

From the five aspects relating to the desired and optional characteristics of a personal avatar, on which participants were asked to differentiate between an approximate representation and an exact, detailed representation, body shape, hairstyle, face and posture showed a significant difference (see section 4.5.8). Only body measures did not exhibit such a difference.

In addition, the topic of type (of woman) emerged several times in different contexts. It was related to the concept of an approximate representation, rather than detailed representation of characteristics of the users. This provides evidence that omitting detail, “smoothing” small and irrelevant individualities, and focussing on essential aspects might be a preferred strategy for the type of avatars investigated in this study.

The concept of idealisation, for example, slenderizing, is a related topic. It was rejected by participants in view of the fact that it would reduce the main benefit of the VTO, which is to be as reliable as possible an imitation of a real try-on.

### **5.6.7 Summary**

Participants also rated their liking of “appearance as a whole”. Results were as expected, as it more or less reproduced the ratings of the separate components body measures, hair, face etc. This consistency may be interpreted as supporting the reliability of the different results.

#### **5.6.7.1 Avatar types investigated**

Concerning the assessment of avatar characteristics, in the form of the evaluation of the specific personal avatars provided in this study, the following can be recapped:

- All three were equally successful concerning body measures and body shape.
- The highly individualised avatars did not show significant advantages over the model avatars. Face imitation did not prove to be an advantage.

- The abstract avatars were problematic especially concerning skin colour, hair colour and hairstyle.

In summary, no one design was deemed optimal, rather basic design recommendations could be derived. As an experiment, having avatar variation helped participants to consider a broad range of aspects of avatar design.

Also, a dilemma appeared. Whereas the highly individualised avatars were often inspected very critically, with individuals looking for difference in details and comparing them to their respective body image, the model avatars and the abstract avatars were criticised for lack of similarity. Understanding a balance between these opposites seems to be required.

#### **5.6.7.2 Individual body measures and body shape**

The paramount significance of the imitation of individual body measures and, similarly, body shape matches with the utmost importance of the appraisal of correct fit given by the participants. For the majority of the subjects, the avatars seemed to be quite convincing concerning this aspect, independent of the remaining aspects of the avatar design.

It should be noted that the experimental procedure of having assistants taking the measurements may have had a positive influence on this evaluation, by increasing the trust that the participants placed on this particular aspect of their avatar. The suggestion to include more body measures can be interpreted as further evidence of the perceived adequacy of the personal avatar for product appraisal related to body measures and body shape.

It is conceivable that this aspect has mitigated the identified shortcomings of the different avatar designs, and has removed some of the differences that would have been expected between them. This may be seen equally from the responses in the qualitative analysis and that participants most liked the two related aspects “body measures” and “body shape” of their avatar, with these variables also showing the strongest correlation with “avatar similarity to self” from all aspects. Therefore, “body measures” and “body shape” may be interpreted as the strongest influencing factor for “avatar similarity to self” for a VTO with personal avatar.

### **5.6.7.3 Individual visual appearance**

In the interviews, ability to check fit and appraisal of the overall visual appearance of the look of a garment emerged as separate topics: Participants distinguished between the benefits that the VTO with personal avatar provides in both of these areas (see section 5.9). However, as expected, the look of a piece of clothing was described as being dependent on the colouring (colours, patterns, material) as well as the cut, i.e., the form. How the cut or form of a specific garment suits an individual is in turn strongly influenced by the body measures and body shape of that person.

So, again, body measures and body shape were proven significant. However, there was also strong evidence that colours play an important role for consumers. They were commented as being essential for the appraisal of the look of garments in relation to the individual. Therefore, imitating the colours that essentially define the visual appearance of a consumer (skin and hair colour) should have next priority after body measures and shape.

## **5.7 Physical “avatar similarity to self” and avatar identification**

“Avatar similarity to self” and avatar identification are two related concepts that have been investigated separately in comparable work (Garnier & Poncin, 2013b; Suh et al., 2011), as well as integrated in one construct (Merle et al., 2012). The construct used in the quantitative part of this study, namely “avatar homophily” by Nowak et al. (2008), also combines both aspects.

As discussed in section 5.3, rather unexpectedly, ratings on “avatar similarity to self” were only moderate, and comparable for all the three avatar groups; a better result had been expected, especially for the highly individualised avatar. The relatively low values in the questionnaire seem to be due to the issues that many participants identified for the appearance of their avatar (see section 5.3). It may also be the case that the identification component included in the construct has affected negatively the outcome on this aspect, as identification seems to exhibit higher requirements on the avatar appearance than the purely utilitarian purposes of the VTO (see below).

The qualitative part of this study yielded further insight on the importance of both aspects for consumers (see sections 4.6.5.1 and 4.6.5.2), though it must be noted that only a subset of the participants commented directly on these aspects. From these

comments it was observed that participants predominantly found physical similarity to self quite important.

Overall, from the results of this study, it appears that avatar identification is less important than the physical similarity to self for a task-based application like a VTO with personal avatar.

### **5.7.1 Physical “avatar similarity to self”**

In general, most of the participants were asking for greater detail in their avatar, even if the range of suggestions was somewhat ambiguous. It seems that, if the option was available, most participants would prefer to have a very true to detail personal avatar and if it would be implemented with high quality then they would like to try or use it. However, their attitude towards the resulting personal avatar can only be speculated.

In contrast, participants that were cautious about a very detailed imitation of themselves voiced specific reasons, namely to avoid unpleasant feelings, for example, becoming demotivated by evident discrepancies with their own body image (see section 4.6.9.1), and missing benefits. The latter corresponds to findings already discussed above.

Furthermore, “avatar similarity to self” seems to be an individual perception, with people having different key aspects where they require individualisation of the avatar and on which they then concentrate. Participants that had fewer issues with the correct fit of garments seemed to focus more on the colour and look of outfits. For them, the respective avatar characteristics may have higher priority. In contrast, participants that often struggle with correct fit appeared to look more strongly on size and fit information.

The results about required accuracy (as explained in section 5.6.6) showed a preference for an approximate representation of the aspects body shape, hairstyle, face and posture. It can be concluded that physical “avatar similarity to self” is important, mainly for the sake of a useful VTO, but that, as long as this requirement is fulfilled (mainly by exact body measures, shape and skin colour), unnecessary details should be omitted.

### **5.7.2 Avatar identification**

Similarly, the range of opinions on importance of identification is nearly balanced between preference and caution. Some of the participants that commented on the topic explained that successful identification with the personal avatar supports the product appraisal. It was argued that the product use can be better envisioned and that the VTO result is more trustworthy. The arguments of those who rejected the importance of identification concentrated on the utilitarian benefits of the VTO, i.e., evaluating fit and look that are present independently of a possible identification. Also, comments indicated that identification requires that more aspects of the avatar imitate the real appearance of the user, for example, hair and face. However, striving for high-level individualisation for the sake of identification, with imitation of more and more details, would further risk facing the same issues. Moreover, if not commenting on the importance of avatar identification is interpreted as attaching little value to its significance then a clear majority of participants appeared to judge avatar identification as being unnecessary or subordinate.

## **5.8 Functionality of VTO with personal avatar**

The results on functionality of VTO originate mainly from the qualitative part of this study. They are relevant for the research questions on avatar design as the value or benefit of a VTO with personal avatar is also influenced by the level of interactive functionality that is available. The following insights relate both to the features experienced in the experimental VTO system used for this study and to suggestions given by the participants for further options.

### **5.8.1 View navigation**

The positive evaluation of the different functionalities for adjusting the view of the dressed personal avatar (see section 4.6.6.1) illustrates the following:

- To present the VTO with personal avatar in 3D is essential:

If appropriate 3D navigation is implemented, it does not restrict the consumers to predefined viewing angles, but lets them choose individually how they want to look at the clothing and which parts of the clothing they want to inspect in detail. Participants especially valued these options; describing them as far better than the typical predefined photos and viewing angles for product appraisal. This agrees with the existing research that has demonstrated

advantages of three-dimensional images over conventional 2D imagery (Choi & Taylor, 2014; Li et al., 2002; Schlosser, 2003).

- The intensity with which most participants used these features during the experiment, as well as their respective comments, show that they valued and trusted the product information provided by the VTO with personal avatar.

### **5.8.2 Completion of outfit**

Completion of the outfit (see section 4.6.6.2) provides the ability for the VTO to be used to appraise not only one piece of clothing at a time, i.e., one after the other and each separately, but to create a complete outfit. Its benefit was identified by participants and was the further support for the evaluation, namely if a combination of products is suitable for the shopper, for example, if they match the existing wardrobe of the consumer. To increase functionality, it was suggested that shoes and accessories (not necessarily for sale) should be included, as they may be required to complete an outfit. In addition, wearing shoes or not can have an effect on the fit of garments, for example, for the length of trousers, or in the case of shoes with higher heels on the body pose (if represented accordingly by the VTO with personal avatar).

### **5.8.3 Visualisation of fit**

The VTO feature that provided the special visualisation of the fit of a garment (see section 4.6.6.3) was valued by the majority of the participants included in the qualitative analysis. It must be noted that it was clear from a usability-centred point of view, independent of the results of this study, that the implementation of the fit visualisation option available in the experimental system (see Figure 3-5, p. 76) could be improved. For example, a more condensed presentation of the fit information that would make it easier for participants to understand the provided information would be recommended. However, only a small number of participants felt unable to interpret this information. For those that found it helpful it has probably increased the trust in the VTO system to provide reliable fit information.

### **5.8.4 Appearance variation**

Functionality for variation of appearance relates to the options that could be made available to the users to allow for individual adaptations of the appearance of their avatars. In contrast, in the experiment of this study participants were not able to alter the appearance of their avatars. The comments on this topic (see section 4.6.6.4) may

have been stimulated by the main questionnaire (see Appendix 5) that asked about functions to “optionally vary the above-named characteristics, e.g. different hairstyle, sun-tanned skin instead of winter pale skin”. This question on the general ability to vary appearance received a medium rank in the priority list of “desired characteristics and optional characteristics and functionalities of a personal avatar” (see Table 4-23, p. 130), classifying it as a “nice to have” feature.

As discussed in section 5.6, offering a limited range of pre-defined variants for aspects of the personal avatar, rather than trying to imitate every possible detail of the user, appears to be an adequate solution (except for body measures and shape that must be very accurate). This would also allow users to change these aspects at will. However, participants did not feel the need to have such options, at least for most of the aspects of a personal avatar. Unfortunately, the rating question did not allow participants to differentiate between which aspects they would have desired to be variable. However, from the interviews it became apparent that participants would like to vary how their hair is worn during the VTO, in order to check how well different styles blend with the overall outfit.

As presented in section 4.6.5.8 only very few participants raised the related topic of avatar creation, which represents the comprehensive configuration or building of an avatar (see also section 2.6.5) compared to variation of appearance. Such a creation process was omitted in this work in order to strictly control the appearance of the avatar stimuli and to ensure comparable stimuli within the avatar groups. Obviously, participants did not feel the need to act as maker of their avatar. A potential risk for task-oriented commercial contexts, as identified by Garnier and Poncin (2013a), is that credibility could be diminished if playful aspects of avatar creation are exaggerated as compared to the utilitarian side. The results of this study show that avatar creation options of the extent discussed here are not required for the users and that, therefore, the named risks can easily be avoided.

### **5.8.5 Interaction with clothing**

The topic appeared in this study (see section 4.6.6.5) under the aspects of variation of posture and body movement, as well as “adjusting drape” and “putting clothing in place”.

Again, the main questionnaire may have inspired comments by asking how important it would be to “optionally vary the posture, e.g. arms stretched forward, sitting, holding a dynamic pose” (see Appendix 5). This question showed a medium rank in the priority list of “desired characteristics and optional characteristics and functionalities of a personal avatar” (see Table 4-23, p. 130), classifying it as a “nice to have” feature. However, in the interviews, almost every participant made a positive comment on this, expressing the desire to check the fit and see the clothing for different poses of the avatar and even in motion.

Adjusting the drape of garments and putting clothing into place as well as trying out different variants of how to wear a specific garment were other options suggested. Such activities are typical for how people interact with clothing in reality. Therefore, overall, these results can be interpreted as evidence on how convincing participants found the individual product information presented by the VTO with personal avatar. They seemed to have considerable confidence in the abilities of the VTO technology and credibility of the information it provides.

## **5.9 Benefits of VTO with personal avatar**

Considering the value or benefits that consumers attribute to the VTO with personal avatar was one approach of this study to elicit insight on effective avatar design. The following aspects were covered in both the quantitative and the qualitative part of the study:

- Appraisal of the individual fit of clothing
- Appraisal of the individual personal look of clothing
- Decision support
- Recreational, experiential benefits
- Utilitarian, task-focused benefits
- Privacy

### **5.9.1 Appraisal of the individual fit of clothing**

The most significant benefit expressed by the participants in the interviews was the usefulness of the VTO with personal avatar for the appraisal of the individual fit of the clothing (see section 4.6.8.1, and also section 5.6.7.2). This can also be interpreted from the good mean values achieved across all avatar groups for



informativeness, “decision support satisfaction” and “perceived risk of purchase”. The VTO, no matter which type of personal avatar was used, was judged to be useful in this respect, showing that the imitation of body measures and body shape should have highest priority.

### **5.9.2 Appraisal of the individual personal look of clothing**

Visual appearance represents aspects other than correct fit and mainly relates to colours and style, with style being closely linked to the type of woman, hairstyle and hair colour, and skin colour. Looking at the qualitative data, the benefits of the VTO with personal avatar concerning the appraisal of the individual visual appearance proved to be slightly less significant than the aspect of appraisal of the individual correct fit (see section 4.6.8.2, and also section 5.6.7.3). Again, this type of benefit has likely been reflected by the ratings on informativeness, “decision support satisfaction” and “perceived risk of purchase”. Possible reasons for expected, but absent differences on these factors between groups have already been discussed in section 5.2. However, from the interview comments it is clear that the model and the abstract avatars were less suitable for that purpose because they do not imitate the individual hairstyle and colours, especially of skin and hair, of the users.

The look of a piece of clothing was described by participants as being dependent on the colour and the cut (see section 5.6.7.3). In turn, body measures and body shape strongly influence how the cut of a specific garment matches an individual. So, both aspects, namely appraisal of the individual correct fit and the individual visual appearance work together and influence the personal look of a garment when worn by an individual. The benefits of this combination were also reflected in the results for the VTO with personal avatar (see section 4.6.8.3).

The usefulness of a VTO with personal avatar also depends on the characteristics of the product, as comments from the participants have indicated. For some types of garments, correct fit is critical, whereas the overall look is unimportant, because consumers can easily imagine it from experience. An example would be garments such as “basic clothing”, for example, unicolour T-shirts. In this case, body measures and shape would matter and colours would be secondary. Conversely, for other types of garments, fit may be unimportant but colours and patterns may be critical. For some garments, both fit and colours may be essential. Clothing shops could decide,

based on their range of garments, where the focus of their VTO with personal avatar should be placed.

It must be noted that there were also participants that emphasised that the individual product information provided by the VTO with personal avatar failed to support sufficiently the imagination of how the product would look like in reality. The realism of the presentation of clothing was criticised by many participants (see section 4.6.7), namely the overall computer-generated look and the lack of photo-realism of colours and material, as well as the resulting expected differences to the real clothing. Interestingly, other participants emphasised the contrary, stating that they did not have problems to envisage the real clothing.

People seem to distrust photos of clothing in online shopping, having the possibility of manipulation of the garments in mind. In contrast, the VTO with personal avatar engendered much more trust in this respect.

The experimental online shop used in this study did not include photos of the real products, as described in section 3.5.3.3. In a real setting, the product photos typically available could probably rectify the above issues, given that virtual imagery and photos of the real product go well together.

### **5.9.3 Decision support**

All interviewees, without exception, confirmed that the VTO with personal avatar would help them with their purchase decisions. This corresponds to the high mean values achieved across all avatar groups for the marketing outcome “purchase intention” (however, please note the reliability issue of the respective questionnaire scale, see section 4.5.1). Benefits specified were typically about making online shopping more attractive, decreasing the need to order (and send back) different variants of garments in size and style, decision support (also reflected in the marketing outcome “decision support satisfaction”) and increased confidence to try out unfamiliar clothing. This corresponds to the literature on the VTO concept (see section 2.6.2). These results seem not to imply specific recommendations for avatar design.

### **5.9.4 Recreational, experiential benefits**

A common notion in the literature on retailing is the differentiation between utilitarian, task-focused and recreational, experiential purposes and attitudes.

Shoppers can have a specific shopping orientation when going shopping (see section 3.6.1) and shopping facilities can include specific measures intended to meet the different requirements of these directions.

Nearly all the participants expressed their opinion that the VTO with personal avatar supports both aspects (see section 4.6.8.5). Concerning the benefits related to the recreational or experiential side, participants named:

- The fun aspect of the system;
- Its suitability to search around;
- Its usefulness for experimentation; and
- Ability to trial unfamiliar garments.

This corresponds to the high mean values achieved on shopping enjoyment, independent of the avatar group (see section 4.5.3.3).

#### **5.9.5 Utilitarian, task-focused benefits**

The utilitarian or task-focused benefits emphasised by participants centred on:

- Appraisal of individual fit and visual appearance,
- Comfort and facilitation and
- Minimisation of risk.

These aspects have been discussed above.

Overall, the participants expressed a stronger focus on the utilitarian or task-focused benefits of the VTO with personal avatar, accompanied by a concentration on the product appraisal: aspects of the avatar design were evaluated in relation to their benefit for supporting an individualised provision of product information.

If at all, there was only rare evidence that the personal avatar in the VTO could become an end in itself in the investigated application domain and distract consumers from the product, as described, for example, by Nah, Eschenbrenner, and DeWester (2011) in a similar context. However, the design of avatars and of the related functionality, for example, for avatar creation by users, should keep this risk in mind and avoid exaggeration of playful aspects as compared to the utilitarian side.

### **5.9.6 Privacy**

The interview data also revealed some concerns about privacy and about being reluctant to disclose some of the personal information involved in the VTO with personal avatar (see section 4.6.8.6). This aspect speaks in favour of a personal avatar similar to the model or the abstract avatar type used in this study, as both are anonymous compared to the highly individualised alternative.

## **5.10 Limitations**

The following limitations of this study are acknowledged.

### **5.10.1 Scope of the study and generalisability**

#### **5.10.1.1 Application domain**

As explained in section 2.4, research on avatars in e-commerce must pay close attention to the characteristics of the specific application context, as these might affect or be affected by the use of an avatar (Suh et al., 2011; Zagel & Süßmuth, 2013). As a result, the outcomes of this study are not necessarily transferable to other application domains within online shopping. Clothing is a unique type of product that fulfils so many purposes at the same time unlike many other products. Clothing can help define the identity of a person and becomes part of their body image (see section 2.5.1). Even for other “body-related” types of products, for example, accessories such as watches or hats, it is not clear, if they entail exactly the same requirements. Greater differences can be expected for more distant contexts that are not apparel-oriented, for example, shopping for furnishing or visualisation for sport activities and for plastic surgery.

#### **5.10.1.2 Extent of validity of design recommendations**

This work proposes basic design guidelines for personal avatars for a specific application field and believes that these will assist practitioners engaged in the design of such applications. It is also recognised that the current approach to design at any one time will be influenced by the prevailing socio-cultural context. This context is subject to constant change and, insofar, this study constitutes a “snap-shot” of the current situation in Germany, or at best Western Europe. It is therefore accepted that the design recommendations in this work may become outdated depending on future developments, trends and influences.

This may include:

- Experiences with personal avatars from other application domains, for example, games or online worlds,
- Digital media culture, for example, user habits in social media,
- Data privacy.

However, most of the design recommendations consider aspects of customer requirements related to effective product appraisal and customer behaviour that are only expected to change in the long-term.

### **5.10.2 Participant selection**

The sample of participants was recruited from the student population at Fulda University in Germany, where the investigator of this study is employed as a scientific assistant. Their age was that of typical students, so that the results may not generalise to all Internet shoppers – older users that are not digital natives may not be as comfortable or be as involved with advanced technology like the VTO with personal avatar. Online shoppers with less Internet experience than the sample included in this study may find the technology too complicated and time consuming (Kim et al., 2007). These differences may influence the attitude and behaviour of consumers, but were not considered by this study.

However, although students do not precisely represent the entire population of potential users of online clothing shopping with personal avatar, these young adults have the potential to become heavy users of such online services, due to their Internet and online shopping affinity (Suh et al., 2011; Zigel & Süßmuth, 2013). The evaluations by the participants of the benefits of the VTO with personal avatar, together with their existing experiences with online shopping, suggest this as well. Therefore, external validity, though restricted to women only, was not threatened significantly.

### **5.10.3 Stimulus sampling and quality**

Although the three different types of avatar design compared in this study were chosen with care and for well-considered reasons (see section 2.8), shortcomings cannot be ruled out. The number of experimental conditions was restricted, so that more than one aspect had to be varied between each group. An alternative

arrangement of variation between avatars may have yielded different and perhaps more distinct quantitative results. In addition the quality of the highly individualised avatars can be questioned, as in section 5.3.

The choice of avatar designs appears to have worked well for the qualitative part of the study by stimulating the interviewees to reflect on the different aspects of the appearance of their avatar.

However the quantitative part was dependent on the quality of the avatar, and this work relied on the willingness of the participants to ignore obvious deficiencies, and make their judgement based on the assumption of a mature system. The participants were given clear instructions on this aspect in the introduction to the experimental system (see section 3.5.3.5) and then asked in the debriefing if any deficiencies of the prototype had influenced their answers, see Appendix 6. No significant issues were identified in this respect (see section 4.6.2.3), and it is assumed that the prototype quality is not a significant limitation of the study.

#### **5.10.4 Avatar creation**

The degree of identification with a personal avatar and its perceived similarity to self may be influenced by the extent to which participants may have contributed to the creation of their own avatar (see section 2.6.5). In this project, the only aspect of the avatar creation process for the participants was to have their measurements and photographs taken by the test assistants. However, the taking of measurements especially seemed to have influenced positively the trust that participants placed in the body measures and shape of their personal avatar.

Therefore, although the participants had little involvement with the customisation of their avatar, this was not perceived to have influenced outcome. Moreover, this aspect was carefully controlled in this study by having identical involvement for the three different avatar groups.

In addition, the gathered insights indicate that the range of options for avatar configuration should be constrained (see section 5.8.4).

#### **5.10.5 Incomplete shopping process**

The experiment did not include the complete set of steps of an online shopping transaction, but was restricted to the selection of products for later purchase. In

particular, the participants could not appraise the real products and could not determine whether the information they had gathered with the VTO and their expectations were matched by the real products. However this study was specifically designed to investigate the effect of the design of the personal avatar on the purchase decision and not to test the quality and reliability of the VTO technology to imitate the real clothing.

In practice, experience of the similarity between the virtually presented and the real clothing and repeated use of such an online shop may lead to increased confidence (or not) in the VTO technology, which may affect the perception of the technology. However this aspect may not directly impact on the effect of the different designs of avatar.

Further research could consider this factor, but would have to analyse thoroughly the complex cause and effect, for example, possible shortcomings of the product imitation not related to the personal avatar. In practise, if a VTO technology is able to reliably render the real products, then the recommendations stemming from this research should be valid.

## **6 Conclusion**

The main findings of this study are summarised in the following sections and a conclusion is provided. In addition, the contributions of this research to the state of the art and to the practice of online shopping are detailed, and possible future research avenues are discussed.

This study investigated basic design aspects of personal avatars in online shopping that are intended as graphical representations of consumers and are provided to support appraisal of articles for sale by supplying individualised product information. Similar to most of the comparable existing work, this research selected online retail of clothing as exemplary application domain.

### **6.1 Main findings**

This study pursued the following objectives:

1. To investigate which individual visual characteristics of a consumer should be imitated by a personal avatar as part of a virtual try-on (VTO) of clothing or similar application in online shopping in order to achieve positive effects on pertinent consumer reactions.
2. To investigate in what way these aspects should be presented by a personal avatar in order to achieve positive effects on pertinent consumer reactions.
3. To identify potential discrepancies between expectations or preferences of consumers on the design of personal avatars compared to actual effects on desired marketing outcomes.
4. To assess if sensing an avatar as personal image, in the sense of identification of the consumers with their avatar, has a positive effect on marketing outcomes, and to investigate which characteristics assure an avatar is sensed as personal image.
5. To derive practical basic design recommendations for personal avatars in VTO applications.
6. To derive practical basic design recommendations for VTO applications other than the personal avatar (a secondary objective).

In order to tackle these questions, a laboratory experiment was conducted that tested different exemplary avatar designs with potential users of a VTO with personal



avatar in a typical scenario of online shopping of clothing. Quantitative and qualitative data on attitudes and preferences of the participants concerning personal avatars as well as on pertinent marketing-related outcomes were collected, analysed and discussed.

Providing a VTO as part of an online shop constitutes a measure of visual marketing, whose self-evident, ultimate purpose is to support product sales, i.e., to increase turnover. In contrast, consumers want to identify products that meet their requirements; typically they do not buy until the “perceived risk of purchase” is sufficiently minimised. In the case of a VTO with personal avatar, this difference in goals between provider and customer is complemented on the part of the customer by specific aspects emerging from the avatar individualisation: the attention of online shoppers may be drawn to the flaws of their personal avatar, and product appraisal then may take a back seat or may even be affected negatively.

Therefore, this research tried to consider and integrate both the marketing outcome factors that may be influenced by the VTO with personal avatar together with the attitudes and the preferences of consumers towards their avatar. Important aspects might be missed if the direct reactions of consumers towards their avatar are ignored, as they are essential for the acceptance of this visual marketing measure by consumers, as well as providing influence on the utilitarian and experiential value that consumers perceive.

The different concrete avatar designs that were compared in this study did not generate significant differences in the investigated marketing outcome factors informativeness, telepresence, “shopping enjoyment”, “decision support satisfaction”, “attitude towards the website” and “perceived risk of purchase”. However, these marketing factors achieved high positive ratings, except telepresence, which was only moderately rated. This indicates the considerable benefits that the VTO with personal avatar provides to consumers.

Whilst the quantitative measuring of “purchase intention” was problematic, the qualitative results show that the participants are convinced that their personal avatar would help them with their purchase decisions. Rather naturally, actual purchase intention might depend primarily on the specific products offered. Indeed, the more suitable the personal avatars to support the customers in appraising the relevant

product characteristics, the more clearly it may become that a product is not preferred and so is rejected. Conversely, a customer may become persuaded with the help of the same personal avatar that a product shows good fit and is well suited, and purchase intention increases.

In spite of the, objectively, clearly visible differences between the three experimental conditions, namely highly individualised avatar versus model avatar versus abstract avatar, this variation of avatar design did not lead to significant differences in “avatar similarity to self” as perceived by the participants. “Avatar similarity to self” was rated almost “moderately” in all avatar groups. From the interview data, it appeared that many participants identified at least one or two issues with the appearance of their avatar that lowered the rating, while many different details were well liked.

However, comparable to existing work, the collected data showed that “avatar similarity to self” has a positive effect on the investigated marketing outcomes informativeness, telepresence, “shopping enjoyment” and “attitude towards the website”. For each, it explained a portion of the variance of the factor: The greater the perceived “avatar similarity to self”, the higher the respective marketing outcome factor. A corresponding relation was not found in the collected data for “decision support satisfaction” and “perceived risk of purchase”. From this, it can be stated that “avatar similarity to self” is an important predictor for certain marketing outcomes that have been shown to influence purchase behaviour.

These results about effects on the investigated marketing outcomes do not evidence an advantage of one of the tested concrete avatar designs in their entirety and therefore, cannot guide avatar design. Comparably, Merle et al. (2012) concluded that the perceived resemblance between consumers and their avatars has to be maximised, but did not suggest specific recommendations for personal avatar design.

It must be noted, that body measures and shape were not varied in the experiment of this study, in contrast to the experimental approaches in most of the similar work reported in the literature. However, both aspects proved to be of high importance for the participants in this study, as they are an essential prerequisite for a meaningful individualised appraisal of clothing.

This study identified the consumer characteristic “appearance orientation” as a further factor that, together with “avatar similarity to self”, influences marketing outcomes, namely the constructs “telepresence” and “attitude towards the website”. It seems that consumers that have the characteristics of paying more attention to their appearance and being more centred on appearance in their thoughts and behaviour, should be classed as “appearance oriented” and are observed to perceive the product information conveyed by the VTO with personal avatar to be more beneficial and relevant for their product appraisal, as expressed in the “telepresence” construct, compared to other consumers. Likewise, the described advantages of the VTO with personal avatar perceived by persons with high “appearance orientation” also appear to influence positively their “attitude towards the website”.

The collected quantitative and qualitative data on attitudes and preferences of consumers towards their avatar provided further distinct insights. Concerning the three tested avatar designs, the highly individualised avatars were often inspected quite critically, with individuals looking for details and comparing them to their own body image, whereas the model avatars and the abstract avatars were criticised for insufficient similarity.

Overall, the interviews illustrated the substantial utilitarian or task-focused benefits that the participants ascribed to a VTO with personal avatar in the form of an implementation as tested in this study. Aspects of the avatar design were mainly evaluated in relation to their benefit to support the individualised provision of product information. These benefits can also be related to marketing outcomes and to the interests of retailers. However, nearly all the participants identified a recreational or experiential side as well, namely the fun aspect of the system, its suitability to search around, its usefulness for experimentation and the trial of unfamiliar garments. These aspects meet the interests of the retailers as well.

Moreover, it appears that avatar identification is less important than physical similarity to self for a task-based application such as a VTO with personal avatar. Furthermore, avatar identification seems to impose higher requirements on the avatar appearance than the purely utilitarian purposes of the VTO. However, striving for high-level individualisation for the sake of identification, with imitation of more and

more details, would again risk facing negative reactions due to subjectively perceived shortcomings.

Generally, the requirements of consumers for their personal avatar proved to be somewhat heterogeneous, so that aggregations have to be interpreted with caution. For example, some seem to pay less attention to correct fit, because they normally experience only minor issues with this aspect. Alternatively, some expressed the desire for a very true to detail depiction of their real appearance whereas many others stated a preference for approximation.

However, the following main findings about different aspects of a personal avatar in a VTO context can be stated from this research (see also Figure 6-1).

1. Correct imitation of body measures, body shape, skin colour and hair colour is of essential importance for women.
2. Women with long hair prefer this to be shown with the real hair length and worn loosely, preferably with an option to show in different hairstyles.
3. It is sufficient to imitate the main features of the face to represent the basic type.
4. Posture in the sense of a durable individual postural characteristic of the consumer did not attract much attention in the interviews. Posture as a particular pose that a person strikes for a particular purpose is relevant as a means to interact with clothing, see below.

For the first four aspects (no. 1 in the list) an individualised imitation was classified as “essential” by mean value, and as “nice to have” for the remainder of the list. This was confirmed by the qualitative results that in addition indicated the order presented above, with decreasing priority. This list of aspects proved to be exhaustive and no further aspects of significant relevance were determined.

For the aspects body shape, hairstyle, face and posture, a preference for an approximate representation over an exact, detailed representation was identified, whilst there was no significant difference between both levels of detail for body measures. Overall, a representation of the type of woman, without omitting or ignoring the above aspects, seems to be suitable for most of the aspects, except body measures, which are essential for a reliable evaluation of correct fit.

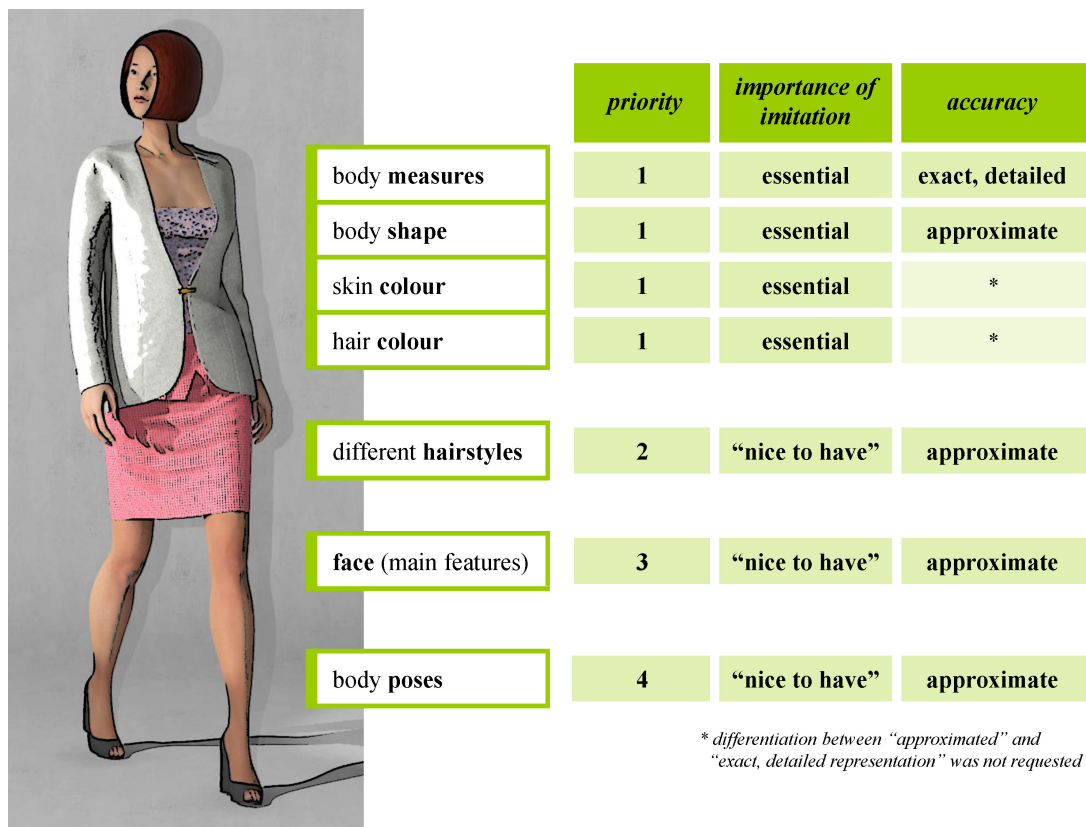


Figure 6-1: Schematic depiction of main findings about different aspects of a personal avatar in a VTO context

Consumers seem to require such a complete individualised picture in order to appraise garments as part of an overall outfit. This is because an outfit constitutes the result of the interplay of the clothing and the body, i.e., correct fit, shape, colour, hair and face. At the same time, detail can and should be omitted; small and irrelevant peculiarities should be “smoothed” and the focus should be directed on essential aspects, so that the utilitarian benefits of the VTO are not impaired. The latter may even vary between types of clothing; compare, for example, fit-critical versus less tightly fitting clothing or unicolour/achromatic versus colourful garments.

A discrepancy seems to exist between the desire for a high level of detail, as apparent from many interview comments and the likelihood that this may cause distraction from the actual purpose of the VTO with personal avatar, i.e., the appraisal of products. It seems that, if the option was available to have a personal avatar that is very true to detail in many more aspects than solely the body measures, and if it would be implemented with high quality, then many participants would like to try or use it. However, their attitude and response towards the resulting personal avatar would need to be speculated. The highly individualised avatars of this study already

received much criticism. So, rather than being a positive influence, negative effects on “attitude towards the website” would be possible, if these avatars did not fulfil the increased expectations of the consumers. Moreover, participants have also argued against an overly exact, detailed and revealing representation, specifying avoidance of unpleasant feelings and missing utilitarian benefits. Even if there is preference for consideration of more aspects, as also identifiable from the results, this could be constituted, not by ignoring them but substitution by using suitable standard forms.

The following practical basic design recommendations for personal avatars in VTO applications can be derived from this study. They are formulated in such a way that they are independent of the availability of specific technology, for example, high-quality body scanning. However, where appropriate, any differences that might arise in their implementation are addressed.

- *Represent body measures as exact as possible.*

The individual measures of the customers should be realized exactly in the personal avatar. This is an essential prerequisite to achieve a reliable simulation and a resulting convincing visual presentation of the fit of the clothing. This study yielded good results with the range of values typically used to determine the clothing size, namely body height, chest girth, waist girth, hip size and arm length. Further measures could be included to increase the accuracy of representation, such as a separate measure of torso and leg length, rather than simple body height.

- *Omit irrelevant details and “smooth” minor peculiarities in order to place the focus on essentials.*

Examples are imperfections of the skin (e.g., macules) or of the face (e.g., asymmetries, nose hump).

- *Support different types of body shape, within the boundaries of the above measures.*

A detailed body scan has the advantage that it will capture the individual body shape. Otherwise, for example, if the users are required to configure the body shape by themselves, then a selection of different types of body shape should be offered. One category could be “body fat” or “visibility of muscles”, for example, with a range of two or three levels. Another could be variants of the

shape of the lower torso: waist with broad frontal silhouette and flat belly versus more slender frontal silhouette but somewhat thicker belly (see Figure 3-7, p. 78).

- *Offer the user fine-grained adjustment of skin colour and hair colour.*  
A given system might be able to suggest the individual skin and hair colour of a customer based on a photo. Nevertheless, users should have the option to adjust these at their discretion to allow for change in appearance as might arise from make-up, sunbathing or dyeing the hair.
- *Offer the user a selection of hairstyles according to hair length.*  
The system might suggest a hairstyle based on a photo. However, users should have the option to adjust the style.
- *Offer a selection of face types and/or some basic face configuration options.*  
A detailed body scan has the advantage that it will capture the individual face shape, or the system might provide the individual face based on a photo, as in this work. Alternatively, a selection of different basic face types (for example, smooth versus harder facial features) can be offered to the user. In addition, basic individual features should be allowed to be changed, such as a choice of eye colour, or of colour of eyebrows.
- *Keep the number of configuration options to a reasonable number.*  
Users should not be overwhelmed with avatar configuration options. A small set of predefined alternatives should be offered for the different configuration options (see above) where meaningful, that may, for example, be restricted to reasonable levels of deviation from the value initially suggested by the system.

Overall basic design recommendations for VTO applications, in addition to the personal avatar that were found or confirmed by this study, are:

- *Implement as a 3D solution; 3D has benefits over 2D, assuming the usability of 3D navigation.*

A good example was created for this work, as shown in Figure 6-2.

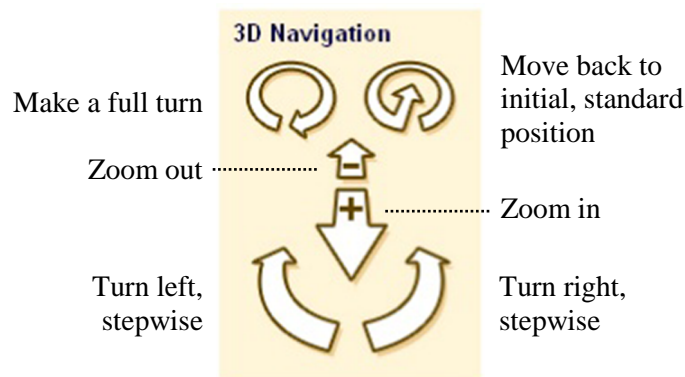


Figure 6-2: Screenshot of the 3D navigation widget of the online clothing shop used in this study

- Offer options to arrange complete outfits.  
Reasonable product combinations should be possible (shirts and trousers, etc.). Additionally, shoes and accessories should be provided to complete any outfit (not necessarily for sale).
- Provide a visualisation of fit; pay attention to facilitate easy comprehension of the presented fit information.

Figure 6-3 shows an example that constitutes an improvement of the fit visualisation used for this work (compare Figure 3-5, page 76). The blue-coloured shade is intended to represent the goodness of fit: no or light shading indicates good fit, dark shading indicates issues with fit.



Figure 6-3: Photo-realistic representation of a red dress (left) versus visualisation of fit information as heat map (right)

- Offer the user a selection of different poses as a means to interact with clothing.

For example, standing straight, stretching arms forward, remaining “frozen” in



a dynamic pose. – animated movement sequences are considered as technically not yet practical.

- *Offer the user options to adjust drape and to put clothing in place in different ways.*

For example, offer the choice to roll up sleeves of a shirt or to turn up the collar of a coat (provided as a garment-specific preconfigured option to choose from).

- *Offer the user options for hair length and style.*

For example, offer a choice between worn loosely (resting on the shoulders) or tied back (ponytail or other variants).

- *Provide product photos of the real clothing.*

## **6.2 Contributions and novelty**

The contributions of this study to the state of the art are the following:

- The benefits of striving to ever increase the degree of avatar individualisation and realism, as is seen in contemporary work, are doubtful. This study shows that there may be no significant advantage for highly individualised personal avatars in online shopping.
- Related to that, the answer to the still open question about required accuracy, that strongly influences the implementation costs of concrete applications, is added to: While perceived physical “avatar similarity to self” is important and therefore must be accomplished (mainly by exact body measures, shape, and skin and hair colour), in particular for the sake of a useful VTO, unnecessary details can and should be omitted.
- The study shows that, for a task-based application such as a VTO with personal avatar, avatar identification is less important than physical similarity to self. Whilst physical similarity represents the perceived similarity between the physical appearance of the avatar and that of the user, avatar identification refers to the cognitive connection that the user of an avatar may have with it, in terms of regarding the avatar as another, substitute self in the virtual world, with a personality like a human or with comparable illusion. Avatar identification demands more effort (technical, manual etc.) for individualisation of the avatar than the more easily tangible / controllable physical similarity to self.

- The study shows that extensive options for avatar creation are not beneficial for users in online shopping. Rather, it is better if the configuration options are kept simple and concentrate on those features that directly support the utilitarian purposes of the VTO, such as appraising an outfit in relation to individual hair style and hair colour. This avoids the situation where the playful aspects, compared to the utilitarian, become exaggerated, and that the personal avatar may become an end in itself and distract consumers from the product. In contrast, existing literature often emphasises the importance of avatar creation by the users.
- The avatar designs in this study did not generate significant differences in the investigated marketing outcome factors, informativeness, telepresence, “shopping enjoyment”, “decision support satisfaction”, “attitude towards the website” and “perceived risk of purchase”. However, the positive effects of perceived “avatar similarity to self” on marketing outcomes, as well as the benefits that the VTO with personal avatar provides to consumers, were replicated compared to existing findings, using this set of avatar designs.
- The consumer characteristic “appearance orientation” was identified as a further factor that, together with perceived “avatar similarity to self” (that was found to be independent of the investigated manipulation of avatar design in this study), positively influences marketing outcomes, namely the constructs “telepresence” and “attitude towards the website”. “Appearance orientation” implies that such consumers pay more attention to their appearance and are more centred on appearance in their thoughts and behaviour, than others that are less or not oriented towards their appearance. High “appearance orientation” seems to imply information needs that are served well by a VTO with personal avatar.

Potential users of these results are the scientific community from several domains, primarily Marketing, Information Systems, and Psychology. These groups can build on the results when framing further research (see the next section for suggested further research).

The contributions of this study to the practice of online shopping are the basic design recommendations for personal avatars and VTO or similar applications. Managers in

online retail can utilise these findings to choose or create the details of specific implementations of such applications in practice. However, this work does not claim to cover the available myriad of visual design options exhaustively, rather it provides a range of basic design principles.

Concerning novelty of the approach and of the results of this work, the following can be stated:

- Novel and more detailed insights on attitudes and preferences of consumers towards personal avatars as part of VTO applications, and their different aspects, with relation to marketing outcomes were generated. The basic design principles provide more detail than has been published to date.
- Existing work on the topic has relied on quantitative data, whereas this research includes both quantitative and qualitative data, which revealed detail and insight.
- This is the first study to the knowledge of the researcher that investigates different avatar designs without varying body measures and body shape.
- This is the first study to the knowledge of the researcher that investigates an abstract avatar design in a high-quality VTO context, as analogous to display mannequins in shop windows.

### **6.3 Future research**

The outcomes indicate areas requiring further investigation and aspects where work might generalise the findings of this research. Further research could include:

- Experiment replication with men:  
Some of the relevant differences known for men compared to women concerning fashion and clothing are less involvement (O'Cass, 2004) and less “perceived risk of purchase” in online shopping (Dennis, Hansen, & Møller Jensen, 2009). Therefore, the response of men to a VTO with personal avatar would probably differ compared to this study that concentrated on women.
- Experiment replication with different age groups:  
For example, older people that are not “digital natives” and are less experienced concerning Internet and online shopping might have different attitudes and expectations towards VTO with personal avatar.

- Returning to the field:

In order to check the results of this study, it would be meaningful to evaluate in further experiments personal avatars that are designed based on the recommendations of this study, and to contrast them, for example, with another set of highly individualised avatars. The latter could be built with even more effort to create an exact imitation of the consumer; and participants could be involved in the configuration process, i.e., they could help to identify shortcomings of their avatar prior to the experiment in order to obtain a successful high individualisation.

- Testing in real and longitudinal scenarios:

Leaving the laboratory, and testing the VTO concept with personal avatar in real scenarios as part of established online shops, with real clothing and real purchases seems promising, as well as adopting longitudinal methodologies to investigate possible effects of usage experience. Consumer reactions and marketing outcomes might change if people become accustomed to their personal avatar and if the potential effect of the current mere impressiveness of the technological innovation diminishes.

- Testing further basic designs options:

Some practitioners try to avoid issues concerning the face with workarounds like omitting the head by cropping the display window accordingly (Embodee Corp., n.d.) or lowering the gaze and bowing the head, so that the face is hardly visible (Fits.me, n.d.). It would be interesting to also investigate these design options, as they promise to avoid effort for individualisation.

- Effects of social contexts:

This study investigated the personal avatar in the private setting of a virtual try-on. Today, sharing personal imagery is omnipresent as part of the social Internet and is accepted as recreational, playful activity. This might influence requirements for personal avatars. For example, avatar identification might play a more significant role, compared to the predominantly utilitarian and task-based context regarded in this study.

- Economic, market-related considerations:

Managers of online retail require cost-benefit calculations for their decisions and future work should also try to include this aspect. Offering customers a

virtual try-on with personal avatar with a highly realistic simulation of clothing as used for this study will generate effort for the digital preparation of the clothing and for the avatar individualisation. The latter strongly depends on the chosen technical solution that may be more or less costly. Besides, product assortments are often quite large and the “life span” of fashion collections is short. These costs need to be considered against possible savings from lowered return rates.

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# Appendices

## Appendix 1: Ethical Approval Letters and Permission to Conduct Experiment

### A: Statement of ethics approval by Brunel University:

**School of Information Systems, Computing and Mathematics**  
David Gilbert, Head of School, Professor of Computing  
Jasna Kuljis, Head of Information Systems and Computing, Professor of Computing  
Tony Rawlins, Head of Mathematical Science, Professor of Mathematics



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Annette.Payne@brunel.ac.uk  
Lampros.Stergioulas@brunel.ac.uk  
Zidong.Wang@brunel.ac.uk

Date: 05 December 2011

#### STATEMENT OF ETHICS APPROVAL

**Proposer: Rainer Blum**

**Title: Effects of Visual Appearance of Virtual Humans in E-Commerce**

The school's research ethics committee has considered the proposal recently submitted by you. Acting under delegated authority, the committee is satisfied that there is no objection on ethical grounds to the proposed study. Approval is given on the understanding that you will adhere to the terms agreed with participants and to inform the committee of any change of plans in relations to the information provided in the application form.

Yours sincerely,

A handwritten signature in black ink that reads "Zidong Wang". The signature is written in a cursive style with a large, sweeping initial 'Z'.

**Professor Zidong Wang**  
**Chair of the Research Ethics Committee**  
**SISCM**

## B: Statement of ethics approval by Fulda University:

**Hochschule Fulda**  
University of Applied Sciences



Hochschule Fulda · Postfach 2254 · D-36012 Fulda

To whom it may concern

Votum der Ethik-Kommission zur Durchführung einer Studie zu den Wirkungen computergenerierter Darstellungen von Menschen  
Antrag von Rainer Blum (PhD Student), Juli 2011

Sehr geehrte Damen und Herren,

die Ethik-Kommission der Hochschule Fulda hat den fundierten Antrag zur Durchführung einer Studie mit dem Titel:

**„Effects of Visual Appearance of Virtual Humans in E-Commerce“**  
unter Leitung von Malcom Clarke, Brunel University West London und Prof. Dr. Karim Khakzar, Hochschule Fulda, geprüft und in der Sitzung am 12.10.2011 darüber beraten.

Das geplante Forschungsvorhaben wird von der Ethik-Kommission der Hochschule Fulda befürwortet. Es bestehen aus ethischer und rechtlicher Sicht keine Bedenken. Ein Problem wird jedoch in der Trennung von Einwilligungserklärung und Fragebogen gesehen. Herr Blum wird gebeten, der Ethikkommission kurz zu beschreiben, wie die beiden Bögen zeitlich und örtlich getrennt aufbewahrt werden.

Mit freundlichen Grüßen

Prof. Dr. Kathrin Kohlenberg-Müller  
- Vorsitzende der Ethik-Kommission -



Marquardstraße 35  
D-36039 Fulda

Prof. Dr. oec. troph.  
Kathrin  
Kohlenberg-Müller

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[www.hs-fulda.de](http://www.hs-fulda.de)

Fulda, 20.10.2011



## C: Permission to conduct experiment by Fulda University:

**Hochschule Fulda**  
University of Applied Sciences



**DER  
PRÄSIDENT**

*Hochschule Fulda · Postfach 2254 · D-36012 Fulda*

Brunel University  
Research Ethics Committee  
Uxbridge  
Middlesex UB8 3PH  
United Kingdom

Fulda, 28 July 2010

**Permission to conduct experiment**

Dear Sir or Madam,

hereby, Hochschule Fulda - University of Applied Sciences grants Rainer Blum permission to conduct the experiment named "Effects of Virtual Humans' Visual Appearance in E-Commerce" on its premises.

Kind regards



Prof. Dr. Karim Khakzar  
(President)

*Marquardstraße 35  
D-36039 Fulda*

*Bearbeiter:  
Rainer Blum*

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Zertifikat seit 2006  
audit familiengerechte  
hochschule

## **Appendix 2: Information Sheet**

**(English version)**

### **Research Participant Information Sheet**

Title of the study

#### **”Effects of the Visual Appearance of Virtual Humans in Online Shops”**

You are being invited to take part in an exciting research study. It is run by Rainer Blum, as part of his PhD project at Hochschule Fulda - University of Applied Sciences, Department of Applied Computer Science and in cooperation with Brunel University, United Kingdom.

Before you decide to take part it is important that you understand why the research is being done and what it involves. Please take time to read the following information. Please ask us if there is anything that is not clear or if you would like more information.

#### **1. What is the purpose of the study?**

This research project is about consumer reactions towards computer-generated graphical representations of humans, termed “avatars”. Used to support the product presentation in online shops, these avatars can be customized individually, e.g. according to the wishes of particular customers. For example, they may rather realistically imitate the visual appearance and the body measures of a person.

In this study, you will even be able to virtually try-on clothing items with your personal avatar in an online shop. The study’s purpose is to investigate which visual characteristics these avatars should exhibit in order to achieve maximum benefit for customers and shop owners.

#### **2. Do I have to take part?**

No, this study is entirely voluntary and it is up to you to decide whether or not to take part. If you do you will be asked to sign a consent form. You are still free to withdraw at any time without giving a reason and without detriment to yourself.

#### **3. What will happen to me if I take part?**

If you take part we will ask you to come to our research lab at Fulda University. Here, in order to be able to prepare your personal avatar for you, we have to make some photos of you. Also, a female assistant will help you to take some of your body measure with the help of a measuring tape, like body height, breast girth and arm length.

The actual session starts with an initial questionnaire that you fill in by yourself. Then, you will try-on several garments in an online shop. Meanwhile, an assistant will offer support in case of any problems or questions. In parallel, he will take notes of relevant reactions of you. Afterwards you will again be asked to answer a questionnaire by yourself, subsequently you will be interviewed. The duration of this session will be around 1 hour and 15 minutes and it will be audio-recorded.

#### **4. Will my details and results be kept confidential?**

Yes, all the information you provide will be kept confidential. Any personal information will be kept securely at Fulda University and anonymous information will be kept separate from it. Audio records, photos and personalised avatars will be deleted upon completion of the study. Any information that could identify you will be removed before the research is analysed, written up, or before any presentation of the results is made.

#### **5. What are the benefits of getting involved?**

There will be no direct benefit to you following your participation in this study. However, your assistance through participation will help to broaden understanding of effects of avatar design in online shopping. Results from this study serve the formulation of a doctoral thesis and will be submitted for publication as well as presented at conferences, so that they can reach an audience of professionals. In doing so, personal information will not be published.

#### **6. Will I be paid for participating in the research?**

As compensation for your time and support of the research study you will receive a cash payment of 20 €.

#### **7. Who is supervising the research?**

This study has been granted ethical approval by the Research Ethics Committees of Fulda University and of Brunel University, United Kingdom. Prof. Dr. Karim Khakzar, Fulda University and Dr Malcolm Clarke, Brunel University are the supervisors of this PhD project.

If you have any concerns or complaints regarding the ethical elements of this project please contact [siscm.srec@brunel.ac.uk](mailto:siscm.srec@brunel.ac.uk) or Dr Laurence Brooks, Brunel University, Tel. No. +44 1895 266010.

#### **Contact details for further information and registration**

Rainer Blum,

tel. +49 661/ 9640-338 or

email [Rainer.Blum@informatik.hs-fulda.de](mailto:Rainer.Blum@informatik.hs-fulda.de)



**(German version)**

## **Informationsblatt für Teilnehmer der Forschungsstudie**

### **“Wirkung von virtuellen Menschen (Avataren) in Online Shops”**

Wir laden Sie herzlich ein, an einer spannenden Forschungsstudie teilzunehmen. Sie wird von Rainer Blum im Rahmen seiner Doktorarbeit an der Hochschule Fulda, Fachbereich Angewandte Informatik in Kooperation mit der Brunel University, United Kingdom durchgeführt.

Bevor Sie sich entscheiden an der Studie teilzunehmen, sollten Sie verstehen, zu welchem Zweck sie durchgeführt wird und was sie beinhaltet. Bitte nehmen Sie sich daher Zeit, die folgenden Informationen zu lesen. Bitte fragen Sie uns, falls Unklarheiten bestehen oder Sie weitere Informationen wünschen.

#### **1. Worin besteht der Zweck der Studie?**

Diese Forschungsarbeit beschäftigt sich mit Reaktionen von Kunden auf computergenerierte Darstellungen von Menschen, so genannte “Avatare”. Eingesetzt zur Unterstützung der Produktpräsentation in Online Shops, können diese Avatare individuell angepasst werden, z.B. nach den Wünschen der einzelnen Kunden. Unter anderem können sie relativ realistisch das Aussehen und die Körpermaße einer Person wiedergeben.

In der vorliegenden Studie werden Sie mittels Ihres persönlichen Avatars sogar virtuell Kleidung in einem Online Shop anprobieren können. Der Zweck dieser Studie ist es dabei zu untersuchen, welche visuellen Eigenschaften solche Avatare aufweisen sollten, um maximalen Nutzen für Kunden und Betreiber von Online Shops zu erzielen.

#### **2. Muss ich teilnehmen?**

Nein, diese Studie ist komplett freiwillig und Sie entscheiden selbst, ob Sie teilnehmen möchten oder nicht. Wenn Sie sich dafür entscheiden, werden Sie gebeten eine Einwilligungserklärung zu unterschreiben. Auch danach steht es Ihnen jederzeit frei, von Ihrer Teilnahme an der Studie zurückzutreten oder sie abzubrechen, ohne Angabe von Gründen und ohne einen Nachteil für Sie.

#### **3. Was kommt auf mich zu, wenn ich teilnehme?**

Wenn Sie sich beteiligen, werden wir Sie bitten, in unser Forschungslabor an der Hochschule Fulda zu kommen. Hier werden wir ein paar Photoaufnahmen von Ihnen machen, um auf dieser Basis Ihren persönlichen Avatar für Sie erstellen zu können. Außerdem wird eine weibliche Mitarbeiterin Sie dabei unterstützen, mittels eines Maßbandes einige Ihrer Körpermaße zu ermitteln, wie Körperhöhe, Brustumfang und Armlänge.

Die eigentliche Sitzung beginnt mit einem Eingangsfragebogen, den Sie selbst ausfüllen. Anschließend werden Sie einige Kleidungsstücke in einem Online Shop virtuell anprobieren. Währenddessen wird Sie ein Mitarbeiter im Fall von

Schwierigkeiten oder Fragen unterstützen. Er wird sich auch Notizen zu relevanten Reaktionen von Ihrer Seite machen. Danach füllen Sie wiederum einen Fragebogen aus, anschließend werden Sie interviewt. Die Sitzung wird ungefähr eine Stunde und 15 Minuten dauern und sie wird als Tonaufnahme festgehalten.

#### **4. Werden meine Daten und Ergebnisse vertraulich behandelt?**

Ja, sämtliche Informationen, die Sie bereitstellen, werden vertraulich behandelt. Personenbezogene Informationen werden sicher und getrennt von anonymen Informationen an der Hochschule Fulda verwahrt. Tonaufnahmen, Photos und Ihr persönlicher Avatar werden nach Abschluss der Studie vernichtet. Jegliche Information, anhand derer Sie identifiziert werden könnten, wird entfernt, bevor diese Forschungsarbeit ausgewertet oder als Bericht ausgearbeitet oder bevor Ergebnisse präsentiert werden.

#### **5. Welcher Nutzen ergibt sich aus der Teilnahme?**

Aus Ihrer Teilnahme ergibt sich kein direkter Nutzen für Sie. Allerdings wird Ihre Unterstützung helfen, die Wirkung von Avataren im Online Shopping besser zu verstehen. Die Ergebnisse dieser Studie dienen der Erstellung einer Doktorarbeit und werden zur Veröffentlichung eingereicht und auf Konferenzen präsentiert, um das entsprechende Fachpublikum zu erreichen. Personenbezogene Informationen werden dabei nicht veröffentlicht.

#### **6. Werde ich für meine Teilnahme bezahlt?**

Als Entschädigung für Ihren Zeitaufwand und Ihre Unterstützung der Forschungsarbeit erhalten Sie eine Vergütung von 20 € in bar.

#### **7. Wer beaufsichtigt diese Forschungsarbeit?**

Diese Studie wurde hinsichtlich ethischer Aspekte seitens der Ethikkommissionen der Hochschule Fulda und der Brunel University, United Kingdom, befürwortet. Prof. Dr. Karim Khakzar, Hochschule Fulda und Dr. Malcolm Clarke, Brunel University, fungieren als Betreuer dieses Promotionsprojektes.

Sollten Sie Bedenken oder Beanstandungen bezüglich der ethischen Aspekte dieses Projektes haben, kontaktieren Sie bitte [siscm.srec@brunel.ac.uk](mailto:siscm.srec@brunel.ac.uk) oder Dr Laurence Brooks, Brunel University, United Kingdom, Tel.Nr. +44 1895 266010.

#### **Kontaktdaten für weitere Informationen und Anmeldung**

Rainer Blum

tel. +49 661/ 9640-338 oder

email [Rainer.Blum@informatik.hs-fulda.de](mailto:Rainer.Blum@informatik.hs-fulda.de)

## Appendix 3: Consent Form

(English version)

### Consent Form

concerning my participation in the study

**“Effects of the Visual Appearance of Virtual Humans in Online Shops”**

*Please tick appropriate box*

	YES	NO
Have you read the Research Participant Information Sheet?	<input type="checkbox"/>	<input type="checkbox"/>
Have you had an opportunity to ask questions and discuss this study?	<input type="checkbox"/>	<input type="checkbox"/>
Have you received satisfactory answers to all your questions?	<input type="checkbox"/>	<input type="checkbox"/>
Who have you spoken to? .....		
Do you understand that you will not be referred to by name in any report concerning the study?	<input type="checkbox"/>	<input type="checkbox"/>
Do you understand that you are free to withdraw from the study ...		
• at any time	<input type="checkbox"/>	<input type="checkbox"/>
• without having to give a reason for withdrawing?	<input type="checkbox"/>	<input type="checkbox"/>
I agree to have this session audio-recorded.	<input type="checkbox"/>	<input type="checkbox"/>
I agree to the use of non-attributable direct quotes when the study is written up or published.	<input type="checkbox"/>	<input type="checkbox"/>
Do you agree to take part in this study?	<input type="checkbox"/>	<input type="checkbox"/>

Signature of Research Participant ..... Date .....

Name in capitals .....

Witness Statement: I am satisfied that the above-named has given informed consent.

Witnessed by ..... Date .....

(German version)

## Einwilligungserklärung

bezüglich meiner Teilnahme an der Studie

“Wirkung von virtuellen Menschen (Avatare) in Online Shops ”

*Bitte Zutreffendes ankreuzen*

	<b>JA</b>	<b>NEIN</b>
<b>Haben Sie das Informationsblatt für Teilnehmer der Forschungsstudie gelesen?</b>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Hatten Sie Gelegenheit Fragen zu stellen und diese Studie zu besprechen?</b>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Haben Sie zufrieden stellende Antworten zu all Ihren Fragen erhalten?</b>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Mit wem haben Sie gesprochen? .....</b>		
<b>Haben Sie verstanden, dass Sie in den Berichten zu dieser Studie keinesfalls namentlich genannt werden?</b>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Ist Ihnen klar, dass Sie von Ihrer Teilnahme zurücktreten bzw. die Studie abbrechen können, und zwar ...</b>		
• jederzeit	<input type="checkbox"/>	<input type="checkbox"/>
• ohne einen Grund für Ihren Rücktritt angeben zu müssen?	<input type="checkbox"/>	<input type="checkbox"/>
<b>Ich bin einverstanden, dass eine Tonaufnahme der Sitzung angefertigt wird.</b>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Ich bin einverstanden, dass von mir gemachte Äußerungen in Berichten oder Veröffentlichungen zu dieser Studie direkt zitiert werden können – allerdings ohne Angabe meines Namens.</b>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Willigen Sie ein, an dieser Studie teilzunehmen?</b>	<input type="checkbox"/>	<input type="checkbox"/>

**Unterschrift des Teilnehmers .....**      **Datum .....**

**Name in Großbuchstaben .....**

Ich bestätige, dass die o.g. Person die Einwilligungserklärung abgegeben hat.

Bestätigt von ..... Datum .....

## Appendix 4: Initial Questionnaire

(English version)

### Directions

On the following pages we ask you for information and statements about different topics. Where opinions, attitudes and the like are prompted, we are interested in your personal rating. That means, there are no **right** or **wrong** answers.

Please try to answer the questions as honestly as possible. Also, be sure to answer all of the items, even if you are not certain of the best answer. The best answer is what you feel is true of yourself at this moment.

Where the response options look like as in the following example or similar, please read carefully each given statement at first and then decide how much it applies to you personally. Again, answer these questions as they are true for you **at that time**. Please tick only one box per statement.

### Sample:

*(also shows how you can revise your selection when required)*

Please decide how much the following statement applies to you personally:

“I like to go shopping.”

completely  
false

mostly false

partly false and  
partly true

mostly true

completely true

## Age, language, profession

Please enter your age: \_\_\_\_\_

Please name your German language skills:

*(please tick only one box)*

excellent, German is my first language:

excellent, German is not my first language:

Please specify your occupational activity:

current status, e.g. “student”, “employee”: \_\_\_\_\_

name of study course *and* current semester  
**or** occupational title,

e.g. “B.Sc. Digital Media (3)”, “banker”: \_\_\_\_\_

name(s) of further completed study courses  
or further considerable  
professional experience: \_\_\_\_\_

## Usage habits and experience concerning Internet

Considering your use of the Internet over the past 12 months, please answer the following:

How many hours per week do you usually spend using the Internet for private or professional purposes (email, surfing the Web, online shopping, instant messaging e.g. ICQ, social networks e.g. Facebook)?

*(please tick only one box)*

less than 5 hours

5 to 15 hours

15 to 30 hours

more than 30 hours

“I enjoy surfing the Web”

completely  
false

mostly false

partly false and  
partly true

mostly true

completely true

## Habits and experience concerning online shopping in general

In the following, please refer to online shopping of **all kinds of products** – and please disregard the purchase of services like travel booking or banking.

Please indicate the frequency of your use of the Web for the following kinds of activities (over the past 12 months):

*(please tick only one box in each row)*

	daily	one or several times a week	one to 3 times a month	one to eleven times a year	less
work/study	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
entertainment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
online shopping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Since when do you buy via the Web?

*(please tick only one box)*

since 0 to 12 months	<input type="checkbox"/>
since 1 to 2 years	<input type="checkbox"/>
since over 3 years	<input type="checkbox"/>

Considering your online shopping experience, again concerning all kinds of products and over the past 12 months, please answer the following questions:

“All in all, I am satisfied with the utility provided by the Web for shopping.”

completely false	mostly false	partly false and partly true	mostly true	completely true
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

“I enjoy shopping via the Web.”

completely false	mostly false	partly false and partly true	mostly true	completely true
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Habits and experience concerning shopping of clothing

Considering your shopping of **clothing** over the past 12 months, please answer the following questions:

Where do you pick your clothing before purchasing it?

Please specify in % (please ensure 100% in total).

shops/ stores \_\_\_\_\_ %

online shops \_\_\_\_\_ %

printed catalogues \_\_\_\_\_ %

teleshopping/ TV sales channels \_\_\_\_\_ %

other: \_\_\_\_\_ %

(when required please name)

Please indicate how often you use the following sales channels for the shopping of clothing from home:

(please tick only one box in each row)

	regularly, i.e. at least once every three months	sporadic, i.e. once or twice a year	never
online shops	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
printed catalogues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
teleshopping/ TV sales channels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

“All in all, I am satisfied with the utility provided by home shopping of clothing.”

completely false	mostly false	partly false and partly true	mostly true	completely true
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

“I enjoy shopping clothing from home.”

completely false	mostly false	partly false and partly true	mostly true	completely true
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



## Appearance orientation

Please decide how much each of the following statements applies to you personally:

	completely false	mostly false	partly false and partly true	mostly true	completely true
Before going out in public, I always notice how I look.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am careful to buy clothes that will make me look my best.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I check my appearance in a mirror whenever I can.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Before going out, I usually spend a lot of time getting ready.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It is important that I always look good.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I use very few grooming products.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am self-conscious, if my grooming isn't right.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I usually wear whatever is handy without caring how it looks.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I don't care what people think about my appearance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I take special care with my hair grooming.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I never think about my appearance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am always trying to improve my physical appearance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	completely false	mostly false	partly false and partly true	mostly true	completely true

## Shopping orientation

Please decide how much each of the following statements applies to you personally. In doing so, please think about buying clothing and similar products, i.e. such that are not convenience goods (like e.g. groceries):

	completely false	mostly false	partly false and partly true	mostly true	completely true
I often shop because I want to, not because I have to.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
When I shop, I look for what I need and rarely browse or look for anything else.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shopping can be an exciting recreational activity for me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I often go shopping just for the fun of it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I avoid shopping whenever I can.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**(German version)**

**Hinweise**

Auf den folgenden Seiten bitten wir Sie um Informationen und Aussagen zu verschiedenen Themen. Dort, wo es um Meinungen, Einstellungen u.ä. geht, interessiert uns Ihre persönliche Einschätzung. Das heißt, es gibt dabei keine **richtigen** oder **falschen** Antworten.

Bitte versuchen Sie, die Fragen so ehrlich wie möglich zu beantworten. Stellen Sie bitte auch sicher, dass Sie alle Fragen beantworten, auch wenn Sie unsicher sind, welches die passende Antwort ist. Am besten wählen Sie Ihre Antworten so, wie sie für Sie **in diesem Moment** zutreffen.

Dort, wo die Antwortmöglichkeiten wie im folgenden Beispiel oder ähnlich aussehen, lesen Sie bitte zunächst sorgfältig jede Aussage und entscheiden Sie dann, wie sehr diese auf Sie persönlich zutrifft. Noch einmal: Treffen Sie Ihre Auswahl dabei so, wie sie für Sie **in diesem Augenblick** zutrifft.

Kreuzen Sie bitte nur ein Kästchen pro Aussage an.

**Beispiel:**

*(zeigt auch, wie Sie Ihre Auswahl bei Bedarf noch ändern können)*

Bitte entscheiden Sie, wie sehr die folgende Aussage auf Sie persönlich zutrifft:

„Ich gehe gerne einkaufen.“

überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

## Alter, Sprache und Beruf

Bitte geben Sie Ihr Alter an: \_\_\_\_\_

Bitte schätzen Sie Ihre deutschen Sprachkenntnisse ein:

*(bitte nur ein Kästchen ankreuzen)*

sehr gut, Deutsch ist meine Muttersprache:

sehr gut, Deutsch ist aber nicht meine Muttersprache:

Bitte machen Sie Angaben zu Ihrer beruflichen Beschäftigung:

aktueller Status, z.B. „Studierende“, „Angestellte“: \_\_\_\_\_

Studiengangs-Bezeichnung *und* aktuelles Semester

**oder** Berufsbezeichnung,

z.B. „B.Sc. Digitale Medien (3)“, „Bankkauffrau“: \_\_\_\_\_

weitere abgeschlossene Studiengänge

oder weitere mehrjährige Berufserfahrung: \_\_\_\_\_

## Nutzungsgewohnheiten und -erfahrungen bzgl. Internet

Bitte beantworten Sie die folgenden Fragen zu Ihrer Nutzung des Internet bezogen auf die letzten 12 Monate:

Wie viele Stunden nutzen Sie das Internet pro Woche privat oder beruflich (E-Mail, im Web surfen, Online Shopping, Instant Messaging wie z.B. ICQ, soziale Netzwerke wie z.B. Facebook)?

*(bitte nur ein Kästchen ankreuzen)*

weniger als 5 Stunden

5 bis 15 Stunden

15 bis 30 Stunden

mehr als 30 Stunden

„Ich genieße es, im Web zu surfen.“

überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Gewohnheiten und Erfahrungen beim Online Shopping im Allgemeinen

Beziehen Sie sich im Folgenden bitte auf das Online Shopping von **Produkten aller Art** – und lassen Sie den Kauf von Dienstleistungen wie Reisen oder Bankgeschäfte bitte außen vor.

Bitte geben Sie an, wie häufig Sie das Web für folgende drei Aktivitäten nutzen (bezogen auf die letzten 12 Monate):

(bitte in jeder Zeile nur ein Kästchen ankreuzen)

	täglich	ein oder mehrmals pro Woche	ein oder bis zu drei Mal im Monat	ein oder bis zu 11 Mal im Jahr	weniger
Arbeit/ Studium	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unterhaltung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Online Shopping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Seit wann kaufen Sie über das Web ein?

(bitte nur ein Kästchen ankreuzen)

- seit 0 bis 12 Monaten
- seit 1 bis 2 Jahren
- seit über 3 Jahren

Bitte beziehen Sie sich bei den folgenden Fragen zu Ihren Erfahrungen zum Online Shopping wieder auf Produkte aller Art und die letzten 12 Monate:

„Im Großen und Ganzen bin ich zufrieden mit dem Nutzen, den mir das Web beim Einkaufen bietet.“

überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

„Ich genieße es, über das Web einzukaufen.“

überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Gewohnheiten und Erfahrungen beim Kauf von Bekleidung

Bitte beantworten Sie die folgenden Fragen zu Ihren Einkaufsgewohnheiten bezüglich **Bekleidung**, bezogen auf die letzten 12 Monate:

Wo suchen Sie Ihre Bekleidung aus, bevor Sie sie kaufen?

Bitte Angaben in Prozent machen (bitte auf eine Summe von 100% achten).

Geschäfte/ Kaufhäuser \_\_\_\_\_ %

Online Shops \_\_\_\_\_ %

Gedruckte Kataloge \_\_\_\_\_ %

Teleshopping/ TV Verkaufssender \_\_\_\_\_ %

andere: \_\_\_\_\_ %

(bei Bedarf bitte benennen)

Bitte machen Sie Angaben, wie häufig Sie die folgenden Angebote für den Einkauf von Bekleidung von Zuhause aus nutzen:

(bitte in jeder Zeile nur ein Kästchen ankreuzen)

	regelmäßig, d.h. mindestens einmal alle drei Monate	unregelmäßig, d.h. einmal oder zweimal im Jahr	nie
Online Shops	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gedruckte Kataloge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teleshopping/ TV Verkaufssender	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

„Im Großen und Ganzen bin ich zufrieden mit dem Nutzen, den mir das Einkaufen von Kleidung von Zuhause aus bietet.“

überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

„Ich genieße es, Bekleidung von Zuhause aus einzukaufen.“

überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Orientierung am eigenen Aussehen

Bitte entscheiden Sie, wie sehr die folgenden Aussagen auf Sie persönlich zutreffen:

	überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz
Bevor ich mich unter Menschen begeben, überprüfe ich immer mein Aussehen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich achte darauf, Kleidung zu kaufen, die mir sehr gut steht.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich prüfe mein Aussehen im Spiegel, wann immer ich kann.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bevor ich ausgehe, verbringe ich viel Zeit damit, mich zurecht zu machen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Es ist wichtig, dass ich immer gut aussehe.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich benutze sehr wenige Pflegeprodukte.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Es macht mich verlegen, wenn ich ungepflegt bin.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich ziehe mich gern bequem an, egal wie es aussieht.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Es ist mir egal, was andere Menschen über mein Aussehen denken.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich gebe mir besondere Mühe, meine Haare zu pflegen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich denke niemals über mein Aussehen nach.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich versuche ständig mein Aussehen zu verbessern.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz

## Motive und Einstellung zum Einkaufen

Bitte entscheiden Sie, wie sehr die folgenden Aussagen auf Sie persönlich zutreffen. Bitte beziehen Sie sich dabei auf den Kauf von Bekleidung und ähnliche Produkte, das heißt solche, die nicht zum täglichen, kurzfristigen Bedarf (wie z.B. Lebensmittel) zählen:

	überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz
Oft kaufe ich ein, weil ich es möchte, nicht weil ich es muss.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wenn Ich einkaufe, suche ich nach den Artikeln, die ich benötige. Ich stöbere selten oder sehe mich selten nach etwas anderem um.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Einkaufen kann für mich eine spannende und aufregende Freizeitbeschäftigung sein.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich gehe oft einkaufen nur wegen des Spaßes, den ich dabei habe.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich vermeide es einzukaufen, so oft ich kann.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



## **Appendix 5: Main Questionnaire**

**(English version)**

### **Task description**

[to be conveyed verbally]

Now, please imagine you are shopping for clothing in a real online shop.

You are looking for garments intended for private occasions that call for a rather formal clothing, for example the birthday celebration of your parents.

Please, have a look at the offer and browse the product catalogue a little bit. Try on different garments with the help of your personal avatar, in order to find out if you like them.

Make a pre-selection of four or more garments, please. Imagine that you may decide to purchase these garments later.

Put them in the basket please.

One more remark on your personal avatar:

*[depending on the group:]*

- *[Personalised avatar:]*

Its visual appearance was adapted to yours. It was designed to imitate your face, hairstyle, skin colour, hair colour and eye colour as well as your body measures as good as possible.

- *[Model avatar:]*

It was customized to your body measures.

- *[Abstract avatar:]*

It was customized to your body measures.

## Directions

The directions stated at the beginning of the test also apply to this part of the questioning:

We are interested in your personal rating; that means there are no **right** or **wrong** answers. However, please try to answer the questions as honestly as possible.

Please be sure to answer all of the items, even if you are not certain of the best answer. The best selection is what you feel is true of yourself **at this moment**.

Please read carefully each given statement at first and then decide. Please tick only one box in each case.

## Assessment of the information, that is imparted

Please decide how much each of the following statements applies to you personally:

	completely false	mostly false	partly false and partly true	mostly true	completely true
This try-on with my avatar gives me quick and easy access to large volumes of information.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Information obtained with this try-on with my avatar is useful.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have learned a lot from using this try-on with my avatar.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think the information obtained with such a try-on with personal avatar is helpful.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Attitude towards the virtual try-on with personal avatar

Please decide how much each of the following statements applies to you personally. In doing so, please disregard the currently existing deficiencies of the system.

	completely false	mostly false	partly false and partly true	mostly true	completely true
This try-on with my personal avatar would make it easy for me to build a relationship with the online retailer.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would like to visit this try-on with my personal avatar again in the future.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I'm satisfied with the service provided by this try-on with personal avatar.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel comfortable in using this try-on with my personal avatar.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel using this try-on with my personal avatar is a good way for me to spend my time.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Compared with the presentation of garments in other online shops. I would rate this one as:	one of the worst				one of the best
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Decision support satisfaction

Please decide how much each of the following statements applies to you personally:

	completely false	mostly false	partly false and partly true	mostly true	completely true
Use of this try-on with my personal avatar enables me to make better purchasing decisions.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
This try-on with my personal avatar assists me in making a decision more effectively.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use of this try-on with my personal avatar enables me to set my priorities in making the purchase decision.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Shopping enjoyment

Please decide how much each of the following statements applies to you personally:

If I were actually shopping for clothing online, this try-on with my personal avatar would create a shopping experience that would be ...	completely false	mostly false	partly false and partly true	mostly true	completely true
... appealing.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... interesting.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... not fun.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... entertaining.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... exciting.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... unenjoyable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Closeness to reality

Please decide how much each of the following statements applies to you personally:

If I were actually shopping for clothing online, this try-on with personal avatar would ...	completely false	mostly false	partly false and partly true	mostly true	completely true
... let me easily visualize what the actual garment is like.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... give me as much sensory information about the clothing as I would experience in a store.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... create a product experience similar to the one I'd have when shopping in a store.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... allow me to interact with the clothing as I would in the store.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... provide accurate sensory information about the clothing.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Perceived risk of purchase

Please imagine you were to purchase one of your favourite items out of the just selected garments from this online shop. Now, please think about the possible consequences involved and rate how likely or unlikely each of the following statements would be.

	very unlikely	unlikely	neither likely nor unlikely	likely	very likely
The colour will not be what I thought it would be.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The size will not fit me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I will want to return it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I will want to exchange it for another item.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I will like it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It will not look good on me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My friends will think I look funny when I wear it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I will not be able to match it with my current clothing.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I will not feel comfortable wearing it in public.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I will have to have altered it, i.e., lengthen or shorten the hem.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I will feel that I just threw away a lot of money.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I will feel that I just wasted time shopping via the Internet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I will not wear the item.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I will feel that I have shopped impulsively.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It will affect the way others think of me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It will be a risky purchase.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It will correspond to my personal style.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Purchase intention

Please imagine that such a try-on with personal avatar is part of real online shops by now. Then answer each of the following questions:

How likely would it be that you ...	very unlikely	unlikely	neither likely nor unlikely	likely	very likely
... now buy one or more of the garment items you just viewed in this shop?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... shop for clothing via such a try-on with personal avatar when you buy garments in the near future?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... buy clothing via such a try-on with personal avatar when you find something you like?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Avatar similarity to self

Please decide how much each of the following statements applies to you personally:

The avatar I used to try on garment items ...	not at all	a little	moderately	much	very much
... is similar to me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... is like me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... represents something in me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How much do you identify with the avatar you used to try on garment items?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Assessment of the appearance of the avatar

How do you like the following aspects of the appearance of your personal avatar?

*(the rating steps correspond to school grades)*

	not satisfactory (5)	fair/pass (4)	satisfactory (3)	good (2)	very good (1)
body measures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
body shape	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
posture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
face	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
hair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
head as a whole	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
skin colour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
appearance as a whole	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Please name and rate further aspects if required:</i>					
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



## Desired characteristics of the personal avatar

Now, please consider the following:

With the help of the virtual try-on, you may also appraise, in addition to **individual fit** and **general visual appearance** of the clothing, if the clothing looks good on you and if it corresponds to your **colour type** and **personal style**.

How important is it for you then, that your avatar represents or does not represent the following characteristics of your body and appearance?

	undesired	irrelevant	nice to have	essential
my clothing size	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
my body measures, e.g. body height or breast girth				
- approximated representation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- exact, detailed representation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
my body shape, muscle mass, body fat:				
- approximated representation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- exact, detailed representation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
my posture, e.g. hollow back, tilting:				
- approximated representation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- exact, detailed representation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
my face:				
- approximated representation, e.g. face shape	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- exact, detailed representation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
my hairstyle:				
- approximated representation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- exact, detailed representation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
my skin colour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
my hair colour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
my eye colour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Please name and rate further aspects if required:</i>				
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How important is it for you, that your avatar features the following characteristics and functionalities?

	undesired	irrelevant	nice to have	essential
optionally vary the above-named characteristics, e.g. different hairstyle, sun-tanned skin instead of winterly pale skin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
optionally vary the posture, e.g. arms stretched forward, sitting, holding a dynamic pose	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
optionally show different emotions, e.g. smiling, neutral, serious	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**(German version)**

## **Aufgabenbeschreibung**

*[wird mündlich mitgeteilt]*

Stellen Sie sich nun bitte vor, Sie kaufen in einem realen Online Shop Bekleidung ein.

Sie suchen nach Kleidungsstücken für private Anlässe, die eine eher förmliche Bekleidung erfordern, wie z.B. der runde Geburtstag Ihrer Eltern.

Schauen Sie sich bitte das Angebot an und stöbern Sie ein wenig. Probieren Sie verschiedene Kleidungsstücke mit Hilfe Ihres persönlichen Avatars an, um zu beurteilen, ob sie etwas für Sie wären.

Treffen Sie bitte eine Vorauswahl von vier oder mehr Kleidungsstücken, von denen Sie sich vorstellen können, sie später zu kaufen.

Legen Sie diese bitte in den Warenkorb.

Noch ein Hinweis zu Ihrem persönlichen Avatar:

*[je nach Gruppe:]*

- *[Personalisierter Avatar:]*  
Sein Aussehen wurde dem Ihrigen angepasst. Er wurde mit dem Ziel gestaltet, Ihr Gesicht, Ihre Frisur, die Farbe Ihrer Haut, Haare und Augen sowie Ihre Körpermaße möglichst gut wiederzugeben.
- *[Model Avatar:]*  
Er wurde entsprechend Ihrer Körpermaße angepasst.
- *[Abstrakter Avatar:]*  
Er wurde entsprechend Ihrer Körpermaße angepasst.

## Hinweise

Auch für diesen Teil der Befragung gelten wiederum die eingangs genannten Hinweise:

Uns interessiert Ihre persönliche Einschätzung, das heißt, es gibt keine **richtigen** oder **falschen** Antworten. Versuchen Sie bitte, die Fragen so ehrlich wie möglich zu beantworten.

Stellen Sie bitte sicher, dass Sie alle Fragen beantworten, auch wenn Sie unsicher sind, welche Antwort für Sie persönlich **jetzt in diesem Augenblick** zutrifft.

Lesen Sie bitte zunächst sorgfältig jede Aussage und entscheiden Sie dann. Bitte kreuzen Sie jeweils nur ein Kästchen pro Zeile an.

## Bewertung der Informationen, die vermittelt werden

Bitte entscheiden Sie, wie sehr die folgenden Aussagen auf Sie persönlich zutreffen:

	überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz
Diese Anprobe mit meinem Avatar liefert mir schnell und einfach eine große Menge an Informationen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Die Informationen, die ich mit dieser Anprobe mit meinem Avatar erhalte, sind sinnvoll.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich habe einiges erfahren, indem ich diese Anprobe mit meinem Avatar verwendet habe.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich denke, die Informationen, die ich mit einer solchen Anprobe mit persönlichem Avatar erhalte, sind hilfreich.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Einstellung zur Anprobe mit persönlichem Avatar

Bitte entscheiden Sie, wie sehr die folgenden Aussagen auf Sie persönlich zutreffen.  
Lassen Sie dabei bitte die zurzeit noch bestehenden Mängel des Systems außer Acht.

	überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz
Diese Anprobe mit meinem persönlichen Avatar würde es mir als Kunde leichtmachen, eine dauerhafte Bindung zu dem Online-Händler zu entwickeln.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich würde diese Anprobe mit meinem persönlichen Avatar in Zukunft gerne wieder aufsuchen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich bin zufrieden mit der Leistung, die diese Anprobe mit meinem persönlichen Avatar bietet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich fühle mich wohl dabei, diese Anprobe mit meinem persönlichen Avatar zu nutzen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Die Zeit, die ich mit dieser Anprobe mit meinem persönlichen Avatar verbringe, empfinde ich als gut genutzt.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Verglichen mit der Darstellung von Kleidungsstücken in anderen Online Shops würde ich diese hier einschätzen als:	eine der Schlech- testen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	eine der Besten
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Zufriedenheit bezüglich der Entscheidungshilfe

Bitte entscheiden Sie, wie sehr die folgenden Aussagen auf Sie persönlich zutreffen:

	überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz
Diese Anprobe mit meinem persönlichen Avatar ermöglicht es mir, insgesamt bessere Kaufentscheidungen zu treffen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Diese Anprobe mit meinem persönlichen Avatar unterstützt mich darin, effektiver zu entscheiden.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Diese Anprobe mit meinem persönlichen Avatar versetzt mich in die Lage, meine Prioritäten für die Kaufentscheidung festzulegen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Einkaufserlebnis

Bitte entscheiden Sie, wie sehr die folgenden Aussagen auf Sie persönlich zutreffen:

	überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz
Gesetzt, ich würde wirklich Kleidung online einkaufen, dann würde mir diese Anprobe mit meinem persönlichen Avatar ein Einkaufserlebnis bieten, das ...					
... reizvoll ist.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... interessant ist.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... keinen Spaß macht.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... unterhaltsam ist.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... alles andere als langweilig ist.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... unangenehm ist.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Realitätsnähe

Bitte entscheiden Sie, wie sehr die folgenden Aussagen auf Sie persönlich zutreffen:

Gesetzt, ich würde wirklich Kleidung online einkaufen, dann würde diese Anprobe mit meinem persönlichen Avatar ...	überhaupt nicht	eher nicht	teils/ teils	eher	voll und ganz
... es mir leicht machen, mir vorzustellen, wie das Kleidungsstück in der Realität beschaffen ist.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... mir genauso viele Sinneseindrücke zur Kleidung vermitteln, wie ich sie in einem Geschäft erleben würde.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... mich die Kleidung auf ähnliche Art und Weise erfahren und beurteilen lassen, wie ich es beim Einkauf im Geschäft tun würde.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... es mir erlauben, so mit der Kleidung umzugehen, wie ich es im Geschäft tun würde.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... realitätsnahe Sinneseindrücke zur Bekleidung liefern.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Empfundenes Risiko beim Kauf

Bitte stellen Sie sich vor, Sie sollten eines Ihrer bevorzugten Teile aus den eben ausgewählten Kleidungsstücken in diesem Shop kaufen. Bitte denken Sie nun an mögliche Konsequenzen und geben Sie für jede der folgenden Aussagen an, wie wahrscheinlich oder unwahrscheinlich sie wäre.

	sehr unwahr- scheinlich	unwahr- scheinlich	weder noch	wahr- scheinlich	sehr wahr- scheinlich
Die Farbe wird nicht so sein, wie ich sie mir vorgestellt habe.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Die Größe wird mir nicht passen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich werde es zurückgeben wollen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich werde es gegen ein anderes Kleidungsstück umtauschen wollen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Es wird mir gefallen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Es wird gut an mir aussehen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Meine Freunde werden denken, dass ich darin komisch aussehe.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Es wird nicht zu den Kleidungsstücken passen, die ich schon besitze.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich werde mich nicht wohlfühlen, es in der Öffentlichkeit zu tragen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich werde es ändern lassen müssen, z.B. kürzen oder enger machen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich werde das Gefühl haben, eine Menge Geld verschwendet zu haben.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich werde das Gefühl haben, meine Zeit beim Einkaufen im Internet verschwendet zu haben.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	sehr unwahr- scheinlich	unwahr- scheinlich	weder noch	wahr- scheinlich	sehr wahr- scheinlich

(bitte umblättern!)



	sehr unwahr- scheinlich	unwahr- scheinlich	weder noch	wahr- scheinlich	sehr wahr- scheinlich
Ich werde das Kleidungsstück nicht tragen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ich werde das Gefühl haben, dass ich zu spontan eingekauft habe.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Es wird einen Einfluss darauf haben was andere von mir denken.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Es wird ein mit Risiken behafteter Einkauf sein.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Es wird zu meinem persönlichen Stil passen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Kaufabsicht

Bitte stellen Sie sich vor, eine solche Anprobe mit persönlichem Avatar wäre inzwischen Teil von realen Online Shops. Beantworten Sie anschließend jede der folgenden Fragen:

	sehr unwahr- scheinlich	unwahr- scheinlich	weder noch	wahr- scheinlich	sehr wahr- scheinlich
Wie wahrscheinlich wäre es, dass Sie ...					
... eines oder mehrere der Kleidungsstücke, die Sie gerade betrachtet haben, jetzt hier kaufen?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... mittels einer solchen persönlichen Anprobe einkaufen, wenn Sie demnächst Kleidung kaufen?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... Kleidung mittels einer solchen persönlichen Anprobe kaufen, wenn Ihnen etwas gefällt?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Ähnlichkeit des Avatars zu einem selbst

Bitte entscheiden Sie, wie sehr die folgenden Aussagen auf Sie persönlich zutreffen:

Der Avatar aus der Anprobe ...	überhaupt nicht	ein wenig	mittelmäßig	ziemlich	sehr stark
... ähnelt mir.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... ist so wie ich.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... gibt etwas von mir wieder.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wie sehr identifizieren Sie sich mit dem Avatar aus der Anprobe?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Bewertung des Aussehens des Avatars

Wie gut finden Sie die folgenden Aspekte des Aussehens Ihres persönlichen Avatars?

*(die Stufen entsprechen Schulnoten)*

	ungenügend (5)	ausreichend (4)	befriedigend (3)	gut (2)	sehr gut (1)
Körpermaße	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Körperform	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Körperhaltung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gesicht	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Haare	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kopf als Ganzes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hautfarbe/ Farbton der Haut	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Erscheinungsbild insgesamt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Nennen und bewerten Sie bei Bedarf bitte weitere Aspekte:</i>					
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Gewünschte Eigenschaften des persönlichen Avatars

Halten Sie sich nun bitte folgendes vor Augen:

Mit Hilfe der virtuellen Anprobe können Sie, neben der **individuellen Passform** und dem **generellen Aussehen der Bekleidung**, unter Umständen auch beurteilen, ob die **Bekleidung Ihnen steht**, zu **Ihrem Farbtyp** passt und ob sie **Ihrem persönlichen Stil** entspricht.

Welche Bedeutung hat es unter dieser Maßgabe für Sie, dass Ihr Avatar die folgenden Eigenschaften Ihres Körpers und Ihres Aussehens wiedergibt oder nicht wiedergibt?

	nicht erwünscht	irrelevant	schön zu haben, aber nicht notwendig	unbedingt erforderlich
meine Kleidergröße	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
meine Körpermaße, wie z.B. Körpergröße oder Brustumfang				
- in angenäherter Darstellung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- in exakter, detaillierter Darstellung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
meine Körperform, Muskelmasse, Körperfett:				
- in angenäherter Darstellung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- in exakter, detaillierter Darstellung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
meine Haltung, z.B. Hohlkreuz, Schiefstellungen:				
- in angenäherter Darstellung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- in exakter, detaillierter Darstellung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
mein Gesicht:				
- in angenäherter Darstellung, z.B. Gesichtsform	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- in exakter, detaillierter Darstellung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
meine Haarfrisur:				
- in angenäherter Darstellung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- in exakter, detaillierter Darstellung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	nicht erwünscht	irrelevant	schön zu haben, aber nicht notwendig	unbedingt erforderlich

(bitte umblättern!)

	nicht erwünscht	irrelevant	schön zu haben, aber nicht notwendig	unbedingt erforderlich
meine Hautfarbe/ Farbton der Haut	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
meine Haarfarbe	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
meine Augenfarbe	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Nennen und bewerten Sie bei Bedarf bitte weitere Aspekte:</i>				
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Welche Bedeutung hat es für Sie, dass Ihr Avatar die folgenden Eigenschaften und Funktionen bietet?

	nicht erwünscht	irrelevant	schön zu haben, aber nicht notwendig	unbedingt erforderlich
wahlweise die oben genannten Eigenschaften variieren, z.B. andere Haarfrisur, sonnengebräunte statt winterlich blasse Haut	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
wahlweise die Körperhaltung variieren, z.B. Arme nach vorne gestreckt, sitzend, in einer Bewegung verharrend	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
wahlweise unterschiedliche Emotionen darstellen, z.B. lächelnd, neutral, ernst	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## **Appendix 6: Interview Guide**

### **(English version)**

#### **Experience concerning personal avatars and virtual try-ons**

- Do you already have experience with avatars?  
Yes:  No.
- [If „Yes”] Of which kind and in which context?
- Do you already have experience with virtual try-on applications?  
Yes:  No.
- [If „Yes”] Of which kind and in which context?

#### **Attitude towards (specific) characteristics of the personal avatar**

- If you think back, what did you feel when you viewed your avatar for the first time?
- Have your feelings towards your avatar changed in the course of the test?
- What did irritate you or what does irritate you the most of your personal avatar and why?
- What of your personal avatar stands out positively in your opinion and why?

#### **Utility of the personal avatar and virtual try-on**

- Now, please reflect once again on the utility of the virtual try-on with your personal avatar!
- What purpose does the virtual try-on serve for you?
- What purpose does the avatar serve for you in the process?
- Which advantages would you emphasize especially?
- Which functionalities are the most important ones for you?  
Please name three at minimum – or more!
- What further functionalities should be provided from your point of view?  
Is there something additional or is everything already covered?

- Now, please compare this virtual try-on with your personal avatar with other clothing shops on the Internet that you know!  
In comparison, where do you see advantages or disadvantages for yourself?
- How do you usually proceed when shopping online for clothing?
- In what way does the virtual try-on with personal avatar meet your shopping habits, here?
- Do you think that an individually adapted avatar – of that type you used in this test – can influence your purchase decision?  
Please explain, why or why not!
- [If „Maybe” or “No”] What is missing?

#### **Assessment of garments offered; explanation of selection made**

- What is your general opinion about the offered assortment of garments?
- Please explain why you chose these items!

#### **Recognition of oneself in the personal avatar, identification with the personal avatar**

- To what extent is it important for you, that you recognize yourself in the avatar respectively that you identify with it?
- Please explain why!
- Please try to explain what characteristics an avatar must have, in order that you recognize yourself respectively that you identify with it!  
Please address the most important characteristics!

#### **Desired characteristics of the personal avatar**

- Please imagine, that you could design your personal avatar for the online shopping of clothing completely according to your own ideas.  
The questionnaire already covered a range of possible characteristics and variations.
- What further ideas for the design can you think of, given that they are reasonable for you?
- Which of those would you emphasize as especially important and decisive for yourself?

### **Transfer to other products and to other context**

- In this test you have used the virtual try-on with your personal avatar to buy clothing.
- For what other kinds of products could such a personalised avatar be useful for yourself when shopping online?
- For what other purposes, apart from online shopping, could you imagine, to use this personal avatar?

### **[Responding to salient reactions]**

[as far as not done yet]

### **Debriefing**

- Did the deficiencies of the prototype influence your answers?
- Did you find anything unpleasant?
- In this test also personal information has been touched and used.
- What do you think:  
Have you therefore been self-conscious concerning some of your statements?  
Did therefore some of your statements turn out to be different compared to the case, that no personal information had been involved?
- [If „Yes“] Please estimate: How big is the portion of your answers, for which this is the case?
- Do you have any other comments on the course of this test?
- How interesting do you find the topic of this study?
- Do you have any further questions concerning this study?
- Thank you very much for participating in this study.
- You have helped us a lot with your answers.

**(German version)**

**Erfahrungen mit persönlichen Avataren und Virtuellen Anproben**

- Haben Sie bereits Erfahrungen mit Avataren?  
Ja.  Nein.
- [Falls „Ja“] Welcher Art und in welchem Zusammenhang?
- Haben Sie bereits Erfahrungen mit Virtuellen Anproben?  
Ja.  Nein.
- [Falls „Ja“] Welcher Art und in welchem Zusammenhang?

**Einstellung zu (einzelnen) Eigenschaften des persönlichen Avatars**

- Wenn Sie zurückdenken, was empfanden Sie als Sie Ihren Avatar zum ersten Mal betrachtet haben?
- Haben sich Ihre Empfindungen gegenüber Ihrem Avatar im Verlauf des Tests geändert?
- Was irritiert oder irritierte Sie am meisten an Ihrem persönlichen Avatar und warum?
- Was ist Ihnen positiv an Ihrem persönlichen Avatar aufgefallen und warum?

**Nutzen des persönlichen Avatars und der Virtuellen Anprobe**

- Denken Sie nun bitte noch einmal über den Nutzen der virtuellen Anprobe mit Ihrem persönlichen Avatar nach!
- Welchen Zweck erfüllt die virtuelle Anprobe für Sie?
- Welchen Zweck erfüllt dabei der Avatar für Sie?
- Welche Vorteile würden Sie besonders herausheben?
- Welche Funktionen sind aus Ihrer Sicht die wichtigsten?  
Nennen Sie bitte mindestens drei – oder mehr!
- Welche weiteren Funktionen sollten aus Ihrer Sicht geboten werden?  
Gibt es etwas Zusätzliches oder wird bereits alles abgedeckt?



- Vergleichen Sie diese virtuelle Anprobe mit Ihrem persönlichem Avatar nun bitte mit anderen Bekleidungshops im Internet, die Sie kennen!  
Worin sehen Sie im Vergleich Vor- oder Nachteile für sich?
- Wie gehen Sie für gewöhnlich beim Kleidungskauf im Internet vor?
- Inwiefern kommt die Anprobe mit persönlichem Avatar dabei Ihren Einkaufsgewohnheiten entgegen?
- Denken Sie, dass ein für Sie individuell angepasster Avatar – in der Art wie Sie ihn in diesem Test verwendet haben – Ihre Kaufentscheidung beeinflussen kann?  
Bitte erklären Sie warum oder warum nicht!
- [Falls „Vielleicht“ oder „Nein“] Was fehlt?

### **Bewertung der angebotenen Kleidungsstücke; Erläuterung der vorgenommenen Auswahl**

- Was sagen Sie generell zur angebotenen Auswahl an Kleidungsstücken?
- Bitte erklären Sie, warum Sie diese Kleidungsstücke ausgewählt haben!

### **Sich im persönlichen Avatar wiedererkennen, sich mit ihm identifizieren**

- Inwiefern ist es für Sie wichtig, dass Sie sich bei der virtuellen Anprobe in Ihrem Avatar wiedererkennen bzw. sich mit ihm identifizieren?
- Bitte erklären Sie warum!
- Bitte versuchen Sie zu erklären, welche Eigenschaften ein Avatar haben muss, damit Sie sich wiedererkennen bzw. damit Sie sich mit Ihrem Avatar identifizieren können!  
Bitte gehen Sie auf die wichtigsten Eigenschaften ein!

### **Gewünschte Eigenschaften des persönlichen Avatars**

- Stellen Sie sich bitte vor, Sie könnten Ihren persönlichen Avatar für den Online-Einkauf von Bekleidung völlig nach Ihren eigenen Vorstellungen gestalten.  
Im Fragebogen wurden bereits einige mögliche Eigenschaften und Variationen behandelt.
- Welche weiteren, für Sie sinnvollen Gestaltungsideen fallen Ihnen ein?
- Was davon würden Sie als besonders wichtig und entscheidend für Sie hervorheben?

## **Übertragung auf andere Produkte und andere Situationen**

- In diesem Test haben Sie die virtuelle Anprobe mit Ihrem persönlichen Avatar dazu verwendet, Bekleidung zu kaufen.
- Für welche anderen Produkte könnte ein solcher persönlicher Avatar beim Online Shopping für Sie von Nutzen sein?
- Für welche anderen Zwecke, abgesehen vom Online Shopping, könnten Sie sich vorstellen, diesen persönlichen Avatar zu nutzen?

### **[Auf hervorstechende Reaktionen eingehen]**

[sofern noch nicht geschehen]

## **Debriefing**

- Wurden Ihre Antworten von den Mängeln des Systems beeinflusst?
- Fanden Sie irgendetwas unangenehm?
- Im Rahmen dieses Tests wurden auch persönliche Informationen berührt und verwendet.
- Was denken Sie:  
Wurden Sie dadurch möglicherweise bei einigen Ihrer Angaben „gehemmt“?  
Sind dadurch möglicherweise einige Ihrer Angaben anders ausgefallen, als wenn keine persönlichen Informationen im Spiel gewesen wären?
- [Falls „Ja“] Was schätzen Sie: Wie groß ist der Anteil Ihrer Angaben, für den dies der Fall ist?
- Haben Sie weitere Anmerkungen zum Ablauf dieses Tests?
- Wie interessant finden Sie das Thema der Studie?
- Haben Sie noch Fragen zu dieser Studie?
- Vielen Dank für Ihre Teilnahme.
- Sie haben uns mit Ihren Antworten sehr geholfen.

## Appendix 7: Relevant publication list of the author

- Bomsdorf, B., Blum, R., & Künkel, D. (2015). Towards ProGesture, a Tool Supporting Early Prototyping of 3D-Gesture Interaction. *International Journal of People-Oriented Programming*, 4(2), 54–70. doi:10.4018/IJPOP.2015070103
- Blum, R. (2015). Virtual Twins for Online Clothing Shoppers. In S. Diefenbach, N. Henze, & M. Pielot (Eds.), *Mensch und Computer 2015 – Proceedings* (pp. 387–390). Berlin: de Gruyter Oldenbourg.
- Bomsdorf, B., & Blum, R. (2014). Early Prototyping of 3D-Gesture Interaction within the Presentation-Gesture-Dialog Design Space. In M. Kurosu (Ed.): *Vol. 8511. Lecture Notes in Computer Science, Human-Computer Interaction. Advanced Interaction Modalities and Techniques. Proceedings of HCI Intl. 2014* (pp. 12–23). Cham: Springer. doi:10.1007/978-3-319-07230-2\_2
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- Rupprecht, D., Blum, R., & Bomsdorf, B. (2012). Evaluation von Freihandgesten im Kontext einer virtuellen Anprobe. In H. Reiterer & O. Deussen (Eds.), *Mensch & Computer 2012. 12. fachübergreifende Konferenz für interaktive und kooperative Medien. interaktiv informiert - allgegenwärtig und allumfassend!?* (pp. 373–376). München: Oldenbourg.

- Blum, R., & Clarke, M. (2011). Evaluating Effects of Visual Appearance of Virtual Humans in E-Commerce. In K. Blashki (Ed.), *Proceedings of the IADIS Intl. Conference on Interfaces and Human Computer Interaction*. (pp. 365–368)
- Rupprecht, D., Hesse, S., & Blum, R. (2011). Automatic Face Feature Points Extraction. In V. Duffy (Ed.), *Lecture Notes in Computer Science. Digital Human Modeling* (Vol. 6777, pp. 186–194). Berlin, Heidelberg: Springer. doi:10.1007/978-3-642-21799-9\_21
- Blum, R., Bomsdorf, B., Khakzar, K., & Rupprecht, D. (2010). Virtuelle Anprobe im Internet. In J. Ziegler (Ed.), *Mensch & Computer 2010. 10. fachübergreifende Konferenz für interaktive und kooperative Medien. Interaktive Kulturen..* München: Oldenbourg.
- Blum, R., Bomsdorf, B., & Rupprecht, D. (2010). UX and Usability Criteria - Insights from a Case Study. In K. Blashki (Ed.), *Proceedings of the IADIS International Conference on Interfaces and Human Computer Interaction*.
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- Khakzar, K., George, J., & Blum, R. (2009). Adaptive User Interfaces for the Clothing Retail. In J. Jacko (Ed.), *Lecture Notes in Computer Science. Human-Computer Interaction. Ambient, Ubiquitous and Intelligent Interaction* (Vol. 5612, pp. 314–319). Berlin, Heidelberg: Springer. doi:10.1007/978-3-642-02580-8\_34
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## **Appendix 8: Publications resulting from this work**

- Blum, R. (2015). Virtual Twins for Online Clothing Shoppers. In S. Diefenbach, N. Henze, & M. Pielot (Eds.), *Mensch und Computer 2015 – Proceedings* (pp. 387–390). Berlin: de Gruyter Oldenbourg.
- Blum, R., & Clarke, M. (2011). Evaluating Effects of Visual Appearance of Virtual Humans in E-Commerce. In K. Blashki (Ed.), *Proceedings of the IADIS International Conference on Interfaces and Human Computer Interaction* (pp. 365–368).