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# CONCEPTUALIZING PASSIVE TRUST: THE CASE OF SMART GLASSES IN HEALTHCARE

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## Abstract

*In recent years the digitisation of healthcare has been moving forward. Emerging technologies, such as smart glasses, are being tested for allowing healthcare workers information access at the point of care, while being able to work hands-free. Yet it remains unclear how the use of smart glasses will affect the trust relationship between patients and caregivers. The patient is not an active user of the smart glasses but is nevertheless dependent on outcomes influenced by the smart glasses. The patient, therefore, becomes a passive trustor of this technology. Building upon existing trust research literature, we present a research model and extend it by interviewing 20 patients about their experiences with caregivers and their perceptions regarding the use of smart glasses in healthcare. We find that communication with patients is a key driver of passive trust in technology and trust in caregivers. This research contributes to a better understanding of the trust relationship between patients and caregivers and provides insights into the construct of passive trust in technology. In order to extend the qualitative data analysis, future research should investigate the extent of the acceptance of smart glasses by patients within healthcare facilities.*

*Keywords: Smart Glasses, Passive Trust, Healthcare.*

# 1 Introduction

As more and more time in healthcare is being spent on administrative tasks, there is less time for direct patient care tasks (Seto, Inoue and Tsumura, 2014; Vollmer, Prokosch and Bürkle, 2014). The spread and use of technology is rapidly increasing in the healthcare sector. From documentation, through operations support, to patient monitoring, the reach and support of information technology is growing (Brickel, Montague and Winchester, 2012). IT systems to support information logistics and communication are already in use in many hospitals (Ammenwerth et al., 2011). The implementation of hospital information systems (IS) promises benefits for hospitals, doctors and patients (Venkatesh, Zhang and Sykes, 2011; Wüller et al., 2018). Yet providing information access for service processes at the point of care (POC) remains a promising endeavour to improve outcomes and reduce administrative burdens (van Rooij and Marsh, 2016).

In recent decades, various portable devices have been developed for a variety of purposes and applications (Sultan, 2015). Wearable hands-free systems like Augmented Reality (AR) smart glasses, the Microsoft HoloLens for example, are a promising new development that may have the potential to transform healthcare processes and health management in general (Klinker et al., 2018). These AR smart glasses augment reality with virtual information (Azuma, 1997) and have the potential to complement or enhance service processes and workflows at the POC, while working hands-free (Huck-Fries et al., 2017; Klinker, Fries, Wiesche and Krcmar, 2017; Klinker, Wiesche and Krcmar, 2019).

On the other hand, smart glasses might also have negative side effects in terms of patient trust. Patient-doctor communication is the backbone of the primary care visit, since it influences patient trust (Asan, Tyszka and Fletcher, 2015). Patient trust can, in turn, influence patient satisfaction (Chang, Chen and Lan, 2013), opt-in intentions (Angst and Agarwal, 2009), adherence to treatment and clinical outcomes for patients. Smart glasses may disturb, disrupt, alter (Due, 2015), or impair social interaction (Jacquemard et al., 2014) and thus, may call for a new social etiquette (Due, 2014).

Existing trust research has dealt with trust in humans and trust in technology as separate topics. Moreover, IS research on trust in technology has always assumed a perspective where the trustor is an active user of a technology. However, in this case the patient becomes a passive trustor of the technology, while the healthcare worker is the active user of the technology. The experience for the patient who faces technology used in their treatment is called passive trust in the present work. So far, this type of trust has not been much studied in the literature. Xu et al. differentiate between active and passive users in socio-technical systems (Xu, Le, Deitermann and Montague, 2014; Lee, Montague and Xu, 2015). Montague, Kleiner, and Winchester deal with patients' trust in medical technologies (Montague, Kleiner and Winchester, 2009). In research about medical technologies, researchers have pointed out that trust in technology in the medical field differs from trust in technology in other areas (Montague et al., 2009).

This leads us to our research question: *How do technological enhancements of humans affect trusting beliefs within their social environment*?

While this research question is rather broad and probably exceeds the scope of one study, we intend to tackle it by conducting exploratory work in the healthcare sector. So far, we have already conducted several interviews with individuals about their experiences in healthcare facilities using the critical incident technique (CIT). Building upon insights from these interviews, we propose a research agenda for future work on this topic. In the following section we provide a brief overview of existing trust research and how it relates to our topic.

# 2 Background

There are many relationships of trust. Trust research can be split into trust (1) between people or between groups, (2) between people and organisations, (3) between organisations, and (4) between people and technology (Söllner, Benbasat, et al., 2016). In general, trust is defined as a latent variable made up of different dimensions (Bühner, 2011). Confidence plays an important role in decision-

making (Gefen, 2000), including, for example, consumer buying intentions (Oliveira, Alhinho, Rita and Dhillon, 2017) or the decision to use a technology (Lee and See, 2004) and is a key factor in social behaviour (Gefen, 2000). In this work we define trust according to Mayer, Davis, and Schoorman (Mayer, Davis and Schoorman, 1995) as follows:

'Trust is the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party' (Mayer et al., 1995).

## 2.1 Active Trust in Technology

Similar to trust in people, trustors value the ability of a technology to perform defined tasks (McKnight, Carter, Thatcher and Clay, 2011). The decision to use a technology is therefore influenced by the perceived properties of the technology (Moore and Benbasat, 1991). The dimension's ability, integrity and benevolence have been translated from the human domain into the technological context. While ability in interpersonal confidence describes the competences and attributes of a person to fulfil a promise in a particular context, in the technological context the functionality of a technology is evaluated. Users estimate the extent to which a technology has certain functions available to perform a particular task. Integrity reflects the extent to which the technology acts consistently, reliably and according to accepted principles. In the technological context, integrity is replaced by reliability. It evaluates the consistency of all functions. Despite the lack of free will of a technology, this can be faulty (McKnight et al., 2011). Technology follows pre-engineered algorithms or logic. The transfer of benevolence into the technological context is, thus, not permissible, since no adequate comparison can be made with human decision-making (Söllner, Hoffmann, Hoffmann and Leimeister, 2011). Despite the lack of a mortal body, users assess how appropriate, effective and fast the built-in help function of a technology works in providing useful advice. Helpfulness is the third dimension of trust in technology (McKnight et al., 2011).

## 2.2 Passive Trust in Technology

According to Montague and Xu, a passive user is defined as an individual with limited control over the technologies and IT artefacts used in a system (Xu and Montague, 2012). Nevertheless, passive users are directly affected by the results and the outcome of technology use. A passive user can observe the actions and interactions of the active user with the technology and use these perceptions to assess the functionality and reliability of a technology. Inbar and Tractinsky refer to passive users as random or casual users of a system (Inbar and Tractinsky, 2009). They define the passive user as the co-user of a system that has interests in the data that comes from interactions. In addition, the passive user is influenced by the technology and the active user. A communication of the passive user with the system is only conditionally possible, or is moderated by the active user (Inbar and Tractinsky, 2009). The limited influence of the passive user inherent in an inability to control the system, can lead to insecurity and anxiety in the interaction (Inbar and Tractinsky, 2009). Although passive trust has been mentioned in various contexts, little empirical research on this topic can be found. Moreover, passive trust has not been integrated with and delimited by existing trust research.

Very little IS research has focused on the passive user perspective. This finding is supported by Söllner et al., who find that IS research on trust has mainly focused on the trust relationship between the user and the information system itself, largely neglecting that other targets of trust might also drive IS use from a user's point of view (Söllner, Hoffmann and Leimeister, 2016). For instance, in their research they found trust in the provider to be as important as trust in the IS itself. Furthermore, McKnight et al. found that users' institution-based trust in the Internet and their trust in a specific web vendor need to be in place before they are willing to conduct business with a specific vendor via the Internet (McKnight, Choudhury and Kacmar, 2002). Angst and Agarwal assessed whether patients could be persuaded to change their attitudes and opt-in behavioural intentions towards electronic health records (EHR) (Angst and Agarwal, 2009). They found that an individual's concerns for information privacy (CFIP) interacts with argument framing and both affect attitudes towards the use of

EHRs. Furthermore, their results suggest that attitudes towards EHR use and CFIP directly influence opt-in behavioural intentions

Transferred to the medical context, patients are passive users of medical technologies, while physicians and nurses are active users. Passive trust in technology is introduced as a new construct for measuring the trust in technology of a passive user. Trust in the caregiver or physician is a prerequisite for positive patient outcomes and a key factor in determining patient satisfaction and safety (Mosad, 2015). Chang, Chen, and Lan (Chang et al., 2013) highlight the influence of trust in interpersonal interactions in the service sector. Likewise, quality care can only be achieved through a good caregiver-patient relationship (Strandås and Bondas, 2018). The conceptualisation of trust in the relationship is characterised mainly by the power imbalance between the patient and the caregiver, which increases the vulnerability and dependence of the trustor, i.e. the patient (Dinç and Gastmans, 2013). Previous studies usually dealt with only one perspective, and seldom considered the patient's side and the caregiver's side alike (Strandås and Bondas, 2018). Pearson and Raeke (Pearson and Raeke, 2000) examine patient confidence in physicians, citing ability, compassion, confidentiality, reliability and communication as the key drivers. Communication (Asan, Tyszka and Fletcher, 2016) and getting to know the patient (Strandås and Bondas, 2018) are often considered the key factors for trust relationships in the medical context.

Trust also plays a critical role in determining which technologies and applications are implemented and used in patient-centred care (Ezezika, 2015). On the other hand, the use of technology can limit or alter the communication between medical staff and patients, which in turn affects the relationship of trust. The sometimes negative effects of using electronic medical records in communication have already been investigated (Street et al., 2014).

# 3 Initial Exploration

Data was collected in 20 semi-structured interviews with former patients of the German healthcare system between June and August 2018. Twenty people were selected for interview who had personal experience as a patient in a hospital or doctor's office. Of the participants (N = 11) 55% were female. The average age was 42.5 years (SD = 19.86). All respondents were asked to rate their computer skills at the beginning of the interview, and to assess their experience with AR and smart glasses. A scale from 0 (no experience/knowledge) to 4 (comprehensive experience/knowledge) was used. On average, participants have computer experience of 19 years (SD = 5.68) and rate their computer literacy at 2.45 (SD = 1.05). Experience with AR averaged 0.3 across all participants (SD = 0.57), while smart glasses experience averaged 0.64 (SD = 0.73). The participants had the following academic degrees: intermediate (N = 2), high school (N = 3), bachelor (N = 3), master or equivalent (N = 11), doctorate (N = 1). The technique affinity rating on the above-mentioned scale averaged 2.45 (SD = 0.76) across the sample.

All interviews were logically divided into two sections. The focus of the first part of the interviews was to explore the construct of passive trust and to build up knowledge about possible factors and dimensions of the construct in order to refine the research model.

In order to assess the first part of the interview from which we wanted to gain insights into the patient-caregiver relationship, we used the Critical Incident Technique (CIT). CIT has been increasingly used in recent years for research in healthcare (Bradbury-Jones and Tranter, 2008). The role of the caregiver, as well as the perspective of patients and interactions between caregivers, doctors and patients can be successfully understood and described by the CIT (Schluter, Seaton and Chaboyer, 2007). The method is particularly suitable for researching little-known constructs and gives first indications of influencing factors and possible dimensions (Butterfield, Borgen, Amundson and Maglio, 2005). For our study, we adapted the semi-structured interview guides proposed by Norman et al. and Rous and McCormick to our context (Norman, Redfern, Tomalin and Oliver, 1992; Rous and McCormick, 2006).

The aim of the second part of the interview was to gain insights into the patient perspective regarding caregivers using smart glasses. Interviewees were presented with four pictures of caregivers wearing smart glasses. They were given the following hypothetical scenario:

*Imagine that you had a serious operation on your hand and you now have a wound that needs to heal. You are lying in hospital for a few weeks. A nurse comes into your room every day with a pair of smart glasses. With the help of the glasses, the nurse measures the size of the wound and takes photos from different angles to document the wound.*

# 4 Preliminary Results

All interviews were subjected to a qualitative analysis according to a grounded theory approach (Corbin and Strauss, 1990). A hierarchical code schema was developed. During coding, newly introduced codes were iteratively compared to existing codes, to identify similarities or differences and to ensure consistency in coding. Similar codes were grouped into subcategories. In the following we will report our main results. The number of times a topic was mentioned is indicated by the variable k.

## 4.1 Interviews with Critical Incident Technique

All positive technology perceptions experienced by patients mentioned during their visits to healthcare facilities can be assigned to the categories ‘interest’ (k = 3), ‘reliability’ (k = 5) and ‘functionality’ (k = 7). The subcategory ‘interest’ suggests that personal involvement and curiosity regarding the functions and characteristics of a technology positively influences passive trust in technology. This indicates that the constructs of reliability and functionality that we have transferred from the active trust context also apply in the passive trust context.

The negative technology perceptions can be divided into the subcategories of ‘technology properties’ (k = 10) and ‘functionality’ (k = 1). Among technology properties, statements about the size, volume and age of a technology and other confounding factors are summarised. Patients rated technologies as negative in part because of their underlying mechanisms. For example, x-rays are considered a negative medical technology because many consider the technology dangerous and unhealthy. Due to the frequency of the statements, it can be assumed that not only the functionality of a technology, but also its external characteristics affect patients in their perception and thus impact their trust. When designing and introducing such technologies, care should be taken to explain unpleasant characteristics in order to avoid patient insecurity.

In addition to technology perceptions, the interviews were examined for positive and negative personal influences. Positive influences of persons were subdivided into the categories ‘caring’ (k = 8), ‘information and communication’ (k = 18) and ‘professionalism’ (k = 9). The negative influences were divided in the categories ‘missing control’ (k = 12), ‘information and communication’ (k = 16) and ‘motivation and motives’ (k = 6).

Benevolence, as a positive influence, encompasses all the situations described, in which caregivers showed compassion and patience for the well-being of a patient. The results confirm that benevolence, as an important dimension of personal trust, also plays an important role in the trust relationship between patients and caregivers. The relationship with the medical staff is especially important for the patients. Illness and pain induce feelings of insecurity and anxiety in the patient, so, especially in these moments, the care of another person is of particular importance.

Information and communication are perceived to be both positive and negative. Positive statements imply that malaise and anxiety can be reduced through explanations and education. Communication with the medical staff have positively influenced a situation in many cases. Explanations that positively influence a patient-caregiver relationship are often described by their level of detail. The temporal component also plays a role here. Patients want to be informed as soon as possible about treatments, diagnoses and their state of health. Negative statements in this category almost exclusively refer to the lack of information and education. Patients describe uncertainty and anger about being poorly informed or uninformed about treatments and diagnoses. In addition, respondents attach great im-

portance to receive the reasoning for medical advice. Patients have very little influence on their own destiny. They rely completely on doctors and nurses and their ability to heal them. Knowing what is being done, for what purpose it is done and how it is done, at least gives the patient some degree of control over the situation. From the interviews, it is clear that communication and information are the basis of a good patient-nurse relationship.

Among the positive influences is the subcategory of professionalism. The statements show that patients consider a competent caregiver 'professional'. A clean and quick execution of activities is perceived positively by patients and increases their confidence in the caregiver. When mistakes happen or important checks are forgotten, trust in medical personnel decreases. When patients question the motivation and motives of medical staff, it negatively affects their trust in that person. A person who puts personal profit before the well-being of the patient is perceived as incompetent and the trust decreases.

### 4.2 Patient Feedback on the Hypothetical Smart Glass Scenario

Patients offered many positive views on the use of smart glasses in healthcare. For the positive assessments the categories were 'cooperation' (k = 1), 'avoidance of mistakes' (k = 8), 'general improvements' (k = 22), 'suitability for the use case' (k = 11), 'innovation and progress' (k = 10), 'Efficiency and time savings' (k = 11) and 'work relief' (k = 6) were formed.

Without much knowledge of smart glasses or the specific application, patients mentioned many advantages of integrating smart glasses into patient-related care. The interviewed patients rated the application as very innovative and progressive, and suitable for the application of medical documentation. The subjects were mostly interested and amazed by the technical possibilities. Patients thought that the application has the potential for improving the process. One person noted the possibility of improved collaboration and communication among medical staff. Many respondents see the use of smart glasses as having the advantage of avoiding errors through a regulated documentation process. Many interviewees were generally very positive about technical progress in the medical field.

In addition to the various positive reviews, some negative aspects also came up. The negative ratings can be summarised as 'scepticism, alienation and anxiety' (k = 23), 'data security and transparency' (k = 4), 'shame' (k = 5) and 'eye contact and personal attention' (k = 10).

None of the interviewees mentioned only positive or negative points. Most of the negative comments can be grouped into the category 'scepticism, alienation and anxiety'. Some of the interviewees said that they felt uncertainty or fear at the sight of a caregiver with smart glasses. Others were sceptical about smart glasses improving the quality of care, but instead leading to caregivers being put out of their jobs. A lot of comments were linked to missing eye contact. Many of the interviewed patients stated that lack of eye contact with the caregiver was the reason for their scepticism and insecurity. Two interviewees said they were worried about data storage in the new system and that they value transparency in data handling.

All patients were asked if the location of the wound would be important to them if the documentation was done with smart glasses. 25% (N = 5) of all respondents answered this question with a yes. However, three of these individuals stated that their answer had nothing to do with the documentation system. In general, the location of the wound affects feelings of shame or uncertainties.

## 5 Research Model

In the following we present our research model and explain all relevant constructs that are used in it. Figure 1 shows a depiction of our research model. In the following we will explain the constructs that are used in the model.

The opt-in intention for a new technology is defined as the general willingness of a patient to consent to the use of this technology in their treatment and care (Angst and Agarwal, 2009). This intention may indicate a patient's later acceptance or rejection of the technology (Montague, Winchester and

Kleiner, 2010). The satisfaction of a patient with the medical services received is an important indicator for hospitals and medical staff, as it is possible to draw conclusions about the quality of services. The relationship between medical staff and the patient, as well as the patient's trust in medical staff, can positively influence patient satisfaction (Chang et al., 2013). We use the constructs of satisfaction and opt-in intention as outcome variables in our research model.

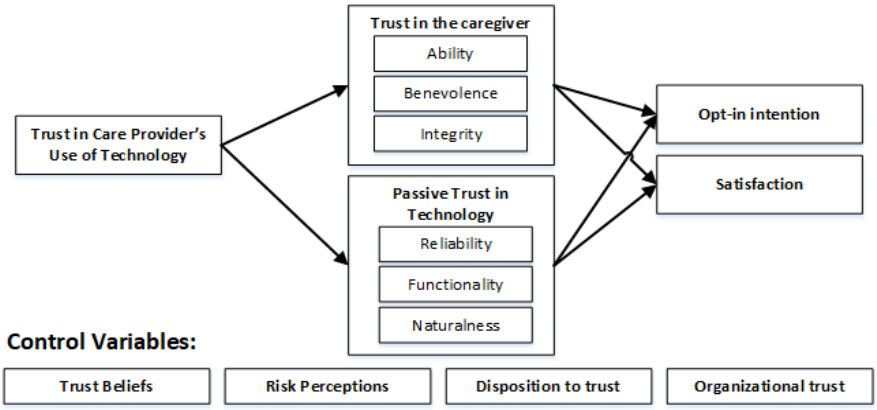


*Figure 1. Research Model*

Mayer et al. (Mayer et al., 1995) describe interpersonal trust as an assessment of the ability and attributes of another person to act as expected in a risky situation. Interpersonal trust encompasses the construct's ability, benevolence and integrity (Mayer et al., 1995). The construct ability refers to all abilities, competencies, and properties that enable an individual to exert influence in a particular domain (Mayer et al., 1995). McKnight, Choudhury, and Kacmar define the construct as the ability to do for the other person what needs to be done for them (Harrison McKnight et al., 2002). Benevolence is the evaluation of the extent to which another party, apart from one with an egocentric profit motive, acts in the interest of another (Mayer et al., 1995). Integrity refers to values and principles of another party (Mayer et al., 1995). Of particular interest here is the impact of the use of smart glasses on assessing the ability and benevolence of a caregiver by the patient. Within our research model we refer to interpersonal trust and its constructs ability, benevolence and competence as 'trust in the caregiver'.

Trust in a specific technology reflects confidence in a specific technology, beliefs and impressions about the beneficial features and characteristics of the technology (McKnight et al., 2011). The authors assume that users know the technology so well that they can predict how they will react under different conditions (McKnight et al., 2011). Since this research model describes the trust of patients and patients are passive users who neither control nor see the technology itself, not all of the dimensions of trust of McKnight et al. (McKnight et al., 2011) are applicable in this context. Only reliability and functionality can be assessed by patients through an observation of the active user.

The trust of patients in medical technologies is gaining importance as digitalisation in healthcare continues. Technology can change the context of human relationships and interactions and thus influence trust in the caregiver (Jarvenpaa, Shaw and Staples, 2004). Patients' impressions of how the caregiver handles the technology are thus likely to impact their trust in the caregiver and the technology (Montague et al., 2010).

Moreover, we have added several control variables to our model that are known to have an influence on trust and might have an influence in the healthcare context. These constructs are: trust beliefs (Lang, Wiesche and Krcmar, 2017), risk perceptions (Fox and Connolly, 2018), disposition to trust (McKnight, Choudhury and Kacmar, 2002) and organisational trust (Lang, Wiesche and Krcmar, 2018).

# 6 Conclusion and Future Research Agenda

The evaluation of the interviews showed that patients have mixed feelings about the use of smart glasses in delivering their care. The interviewees commented that initial eye contact is essential for

them to build trust in the caregiver. This supports results of Riedl et al. who argue that human faces help to build trust (Riedl et al., 2014). The results also show that patients want to retain as much control as possible during treatment. Extensive patient education and information on measures, diagnoses and applied technologies give the patient the feeling of being able to control the situation.

The results support the assumption that reliability and functionality are dimensions of passive trust in technology similar to research findings in the active trust literature (McKnight et al., 2011). Technology characteristics such as shape, appearance and size have also been identified as a potential dimension of passive trust in technology. It is also possible that further constructs, which are relevant to the context of passive trust, have been not been uncovered in this initial phase of our research.

The interview results also provide insights into the relationship between patient and caregiver. The qualitative analysis of the interviews confirms competence, integrity, benevolence as trust dimensions (Mayer et al., 1995) and identified communication skills as an additional dimension of trust building for caregivers. The results confirm the research model, but emphasise communication as an influencing factor more than was initially assumed.

When reflecting upon what can be learned from our results regarding technological enhancements and how they affect trusting beliefs within a social environment, we conclude that perceptions of human traits, as well as the technology, are both likely to be main factors. As positive and negative experiences mentioned by patients were mainly related to information and communication, we intend to conduct further research focused on encounters with caregivers and patients in the field. We would like to compare how smart glasses change such encounters.

We intend to use media naturalness theory as a guiding theory for our future work. Media naturalness theory builds upon the theory of evolution by Charles Darwin (Darwin, 1859) and proposes that humans have evolved using 'natural' communication and are therefore genetically optimised for certain communication traits (Kock, 2009). Natural communication encompasses facial expressions, body language, speech, synchronicity and co-location of communication partners (DeRosa, Hantula, Kock and D'Arcy, 2004). Using different smart glasses designs we intend to test the influence of facial expressions on the naturalness of the communication between caregivers and patients. Since facial expressions increase the naturalness of communications we hypothesise:

H1: Smart glasses' designs that obscure facial expressions will be perceived as less natural than face-to-face communication.

Technology interaction by the caregiver with the smart glasses could be done using voice commands or body language. Using body language like hand gestures will likely have an influence upon the naturalness of the body language of the caregiver. Moreover, voice commands will probably have an influence on the naturalness of the vocal communication (speech) between caregiver and patient. Therefore we hypothesise:

H2: Technology interaction with smart glasses that uses body language will be perceived as less natural than face-to-face communication.

H3: Technology interaction with smart glasses that uses voice commands will be perceived as less natural than face-to-face communication.

We intend to conduct a series of experiments in which we manipulate the factors described above in order to test our hypotheses.

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