



# Antecedents to the adoption of augmented reality smart glasses: A closer look at privacy risks

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## ABSTRACT

Numerous research studies and corporate press releases highlight the potential of a new form of wearable device appearing on the technology landscape: augmented reality smart glasses (ARSGs), i.e., digital eyeglasses that integrate virtual information into the user's field of vision. Yet research knows very little about this nascent technology. Therefore, the authors develop and empirically test a theoretical model to assess ARSG usage. Core findings are that expected utilitarian, hedonic, and symbolic benefits drive consumers' reactions to ARSGs. The results also show that the extent to which ARSGs threaten other people's, but not one's own, privacy can strongly influence users' decision making. A qualitative second study identifies multiple explanations for this surprising privacy finding. Theoretical and managerial implications conclude.

## 1. Introduction

Glasses-like devices, introduced or announced by Samsung, Facebook, [Amazon.com](http://Amazon.com), Magic Leap, EverySight, Microsoft, and other companies in recent years, offer augmented reality (AR) technology integrating virtual and physical information into a user's field of vision. These augmented reality smart glasses (ARSGs) offer tremendous application opportunities in areas of marketing, entertainment, logistics, manufacturing, health care, and others (Eisenmann, Barley, & Kind, 2014; Rauschnabel, 2018; Scholz & Duffy, 2018). A recent Goldman Sachs (2016, p. 4) study concludes that “as the technology advances, price points decline, and an entire new marketplace of applications (both business and consumer) hits the market, we believe VR [virtual reality]/AR has the potential to spawn a multibillion-dollar industry, and possibly be as game-changing as the advent of the PC.” Recently, many companies have already adopted the use of ARSGs, such as in product engineering, employee coaching, warehousing and logistics, or in medical applications. Microsoft launched its AR-based HoloLens, and various firms have invested in this technology (Microsoft, 2016). In contrast, Google Glass is an example that has had less market success (Haque, 2015). AR-device manufacturers and app developers therefore might benefit from deeper insights into the factors that explain consumers' reactions to ARSGs. In particular: Which factors determine consumers' adoption of ARSGs? Extant literature provides only limited answers to this question.

While the managerial importance of this inquiry is high, ARSGs are also theoretically noteworthy. First, they are worn like regular spectacles, so fashion-related factors might be relevant determinants in explaining consumer acceptance (Haque, 2015). Established media and technology adoption theories, however, typically do not include such variables.

Second, ARSGs' AR component breaks the boundaries between reality and “virtuality” (Craig, 2013). Except for a few current mobile applications of AR (e.g., Pokémon Go), this boundary crossing is novel to most consumers. However, the potential of how AR can dramatically change business and marketing has been discussed in managerial (e.g., Javornik, 2016a, b) and academic outlets (Scholz & Smith, 2016) alike. With but a few exceptions (e.g., Javornik, 2016a; Pantano et al., 2017; Scholz & Duffy, 2018), the theoretical understanding of how people react to these technological developments remains scarce.

Third, various sensors (e.g., cameras) are employed to integrate and process virtual information with real-world information, so privacy concerns with the use of ARSGs arise (Eisenmann et al., 2014). Prior research has widely replicated the finding that people react negatively to technologies that collect too much personal information about them (Debatin et al., 2009); however, ARSGs can also threaten the privacy of *other people* (Haque, 2015).

These boundary-crossing characteristics mean that ARSGs differ from other technologies, and as such, existing theoretical models may not appropriately explain consumers' reactions to ARSGs. Therefore,

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considering the unique and nascent nature of ARSGs, this research aims to investigate their expected benefits and perceived risks from the view of consumers. Building on the literature on technology acceptance, privacy risks, and uses and gratifications theory (U&GT), we develop a model to tackle the following research question: “Which factors drive the adoption of ARSGs?” (RQ1). While Study 1 confirms the proposed benefits, some unexpected findings with regards to privacy risks remain. Therefore, we conducted a second study to investigate the theoretical mechanisms of these unexpected findings in more detail. Thus, RQ2 is: “Why do (or don't) people care about their own vs. other people's privacy?”

## 2. Literature review and theory

With the rise of smart mobile technologies, an “always and everywhere” online mentality has become ubiquitous. Many of these new devices offer a user the opportunity to install Internet-based apps. Smart technologies in consumer markets began with handheld devices such as personal digital assistants. The breakthrough of smart devices was the Apple iPhone in 2007 (smartphone), followed by tablets (e.g., iPads) in 2010. With the advent of smartwatches (e.g., Apple Watch), smart devices became wearable (Chuah et al., 2016). Recently, several manufacturers have launched a new generation of smart devices: ARSGs, i.e., glasses-like smart devices that integrate virtual information in a user's field. Microsoft HoloLens and ODG R-7 are examples of existing ARSGs.

### 2.1. Overview of prior research

As discussed, ARSGs are interesting for two reasons: First, the AR component among ARSGs is a recently established research domain. However, AR is much more realistic among ARSGs than among other mobile or stationary devices, indicating that looking at AR research alone is not sufficient to explain ARSG adoption. Second, ARSGs are a specific form of smart wearable devices. An increasing number of studies have investigated acceptance of numerous wearable technologies, which reflect a second novel research stream (see Kalantari, 2017 for a review). This study is one of the first to combine these research streams.

In recent years, AR has received increased attention in business publications in which applications, benefits and practical success stories have been shared (e.g., Javornik, 2016a, b). Therefore, it is not surprising that scholars from various disciplines have studied user acceptance of AR. Scholars from business disciplines have discussed both the managerial relevance and behavioral aspects of AR. For example, Javornik (2016a, b) found that a good augmentation leads to a ‘flow’ experience, which subsequently drives consumers' reactions. Likewise, Jung, Chung and Leue (2015) show that theme park users' satisfaction with AR apps is influenced by the quality of the AR content, the system as a whole, and the degree to which the AR information is personalized.

The second relevant stream of research investigates the acceptance of smart wearable devices, where most of them (e.g. fitness trackers, smartwatches, etc.) do not contain AR components. Chuah et al. (2016), for instance, investigated the acceptance of smartwatches using TAM and found that people tended to categorize them as fashion, technology, or both (‘fashnology’) and made judgments based on the visibility of the device and its usefulness. Yang et al. (2016) focused on wearable devices in general and not on a particular form of device. They found that several established technology acceptance factors such as usefulness, enjoyment, image and financial risk impacted consumers' evaluations of their devices. Surprisingly, consumer research incorporating risk factors, especially privacy, in the context of AR is scarce.

Finally, scant research exists on the adoption of ARSGs. A few exceptions include studies from Rauschnabel, Brem, and Ivens (2015), tom Dieck & Jung (2015) or Rauschnabel (2018) who explored the

adoption intention of ARSGs. They showed that numerous benefits and social norms are positively associated with adoption intention. Weiz, Anand, and Ernst (2016) found that usefulness and social norms influenced actual use of Google Glass, and Eisenmann et al.'s (2014) case study on Google Glass discussed various technological and social factors, as well as business applications. Finally, Rauschnabel and Ro (2016) investigated the relationship between Google's reputation in handling user data and consumers' reactions to Google Glass. Surprisingly, they found no significance, raising questions about the relevance of privacy concerns to ARSGs adopters.

A lack of knowledge on privacy issues for ARSGs is not the only gap in the extant literature as various other antecedents have received little, if any, attention. For example, how the wearing of ARSGs affects a user's (ideal) appearance remains an under-researched area. In this investigation, we draw from two theoretical lenses to better understand ARSGs adoption: (1) U&GT research, as consumers' needs and motives drive their reactions towards media and technology, and thus, also explain their reactions to ARSGs; and (2) privacy research, as ARSGs may threaten the privacy of both the user and others.

### 2.2. Benefits in the context of ARSGs

U&GT provides an additional theoretical lens to understand the motivational aspects of ARSGs adoption/usage. Espoused by communications scholars, U&GT was originally applied to address how and why people accept new forms of media but has grown in prevalence among scholars (e.g., Eighmey & McCord, 1998). U&GT is a theoretical motivational paradigm (Katz, 1959) that addresses individuals' motivations to adopt a particular technology (Ruggiero, 2000), as potential users seek different gratifications from various technologies (Sheldon, 2008).

U&GT scholars have developed various categories of individual needs or gratifications (Baldus, Voorhees, & Calantone, 2015) including utilitarian (gaining of benefits, information), hedonic (diversion, release from problems and stress, entertainment), and symbolic (social advantage, connection, self-expression). In general, U&GT addresses motivational drivers for media use, determinants that affect these drivers, and consequences from technology- and media-related behaviors (Sheldon, 2008). In addition, U&GT is a robust theory that can be adjusted to various contexts and integrated with other theories (Nysveen, Pedersen, & Thorbjørnsen, 2005; Rauschnabel, 2018).

### 2.3. Privacy research

The development of information technology can pose threats to individual privacy (Collier, 1995). According to Collier (1995, p. 41), “[Privacy concerns are] about the perceived threat to our individual privacy owing to the staggering and increasing power of information-processing technology to collect vast amounts of information about us...outside our knowledge, let alone our control.” As technologies become increasingly personal, ubiquitous, and pervasive, privacy concerns will grow in importance. Accordingly, many scholars define privacy concerns as general concerns that reflect a user's inherent worries about the potential loss of personal information from using a target technology (Malhotra, Kim, & Agarwal, 2004). Privacy concerns affect the perceived trustworthiness of the technology and create a psychological barrier of risk, which involves uncertainty and vulnerability (Barney & Hansen, 1994), and therefore affect individuals' willingness to adopt a new technology (Connolly & Bannister, 2007).

Centering on personal privacy, however, leaves a gap in the social context of new technology users. For example, users of social network sites often post information about people they know without asking their permission (Nissenbaum, 2010). This development demonstrates that in a technology-enabled and connected world, the flow of

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