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Who will buy smart glasses? Empirical results of two pre-market-entry studies on the role of personality in individual awareness and intended adoption of Google Glass wearables

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ABSTRACT

Recent market studies reveal that augmented reality (AR) devices, such as smart glasses, will substantially influence the media landscape. Yet, little is known about the intended adoption of smart glasses, particularly: Who are the early adopters of such wearables? We contribute to the growing body of research that investigates the role of personality in predicting media usage by analyzing smart glasses, such as Google Glass or Microsoft Hololens. First, we integrate AR devices into the current evolution of media and technologies. Then, we draw on the Big Five Model of human personality and present the results from two studies that investigate the direct and moderating effects of human personality on the awareness and innovation adoption of smart glasses. Our results show that open and emotionally stable consumers tend to be more aware of Google Glass. Consumers who perceive the potential for high functional benefits and social conformity of smart glasses are more likely to adopt such wearables. The strength of these effects is moderated by consumers' individual personality, particularly by their levels of openness to experience, extraversion and neuroticism. This article concludes with a discussion of theoretical and managerial implications for research on technology adoption, and with suggestions for avenues for future research.

1. Introduction

Today, the Internet is a familiar part of life, at least for the so-called "Digital Natives" or "Millennials" (Li & Bernoff, 2011). However, this has not always been the case, as Table 1 shows. When the Internet became popular in the 1990s, it predominantly represented a uni-directional media; that is, the majority of users consumed content published by few people or organizations and they had no means of responding directly.

The second step in the evolution of the Internet, referred to as "Web 2.0" or "social media", draws on technologies that allow every user to create and publish content on the web (Kaplan & Haenlein, 2010). In this context, common social media technologies include popular social networking sites (such as Facebook), microblogging services (such as Twitter), or blogs. Mobile technologies, such as smart phones or tablets, enable users to access social media platforms everywhere and all the time. These developments were primarily driven by devices, developments in the technological infrastructure (e.g., UMTS or LTE networks), and applications with location-based functions (Barnes, 2002; Li & Bernoff, 2011; Ellison, 2007; Kaplan & Haenlein, 2010).

However, these (mobile) social media platforms currently still provide consumers with a second, "virtual" reality. For example, while browsing Facebook in their "social media world" users might experience feelings that are similar to the feelings they experience in their "physical world" while being offline. Indeed, the two worlds are linked, for instance when users take pictures in the "physical world" and post them in the "social media world". Yet, these two "worlds" remain distinct. For example, users cannot click a "Like" button for a product that they hold in their hand.

Hence, the next step in the evolution of Internet technologies aims to meld these two worlds, a concept termed augmented reality (AR; c.f. Table 1; Spreer & Kallweit, 2014). One of the most intensively discussed devices regarding AR are smart glasses, such as Google Glass, the first announced commercial product in this category of wearables. In short, these devices capture real world and digital information and integrate it on a prism in a user's view field, as shown in Fig. 1.

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0747-5632/

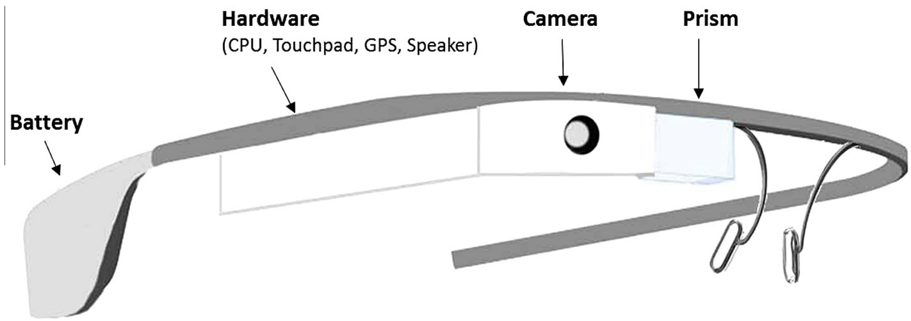

Fig. 1. Functionality of smart glasses, here: Google Glass. *Source*: Own illustration, based on information from Google Inc. and Martin Missfeld (CC-BY).

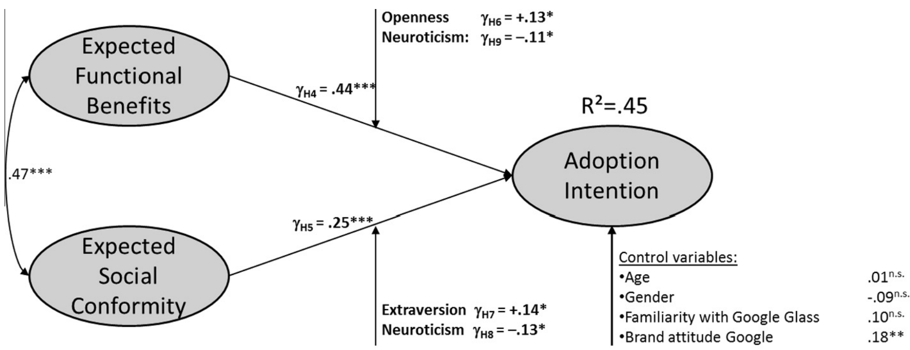

Fig. 2. Model (Study 2).

We define smart glasses as wearable computers with a mobile Internet connection that are worn like glasses or that mount on regular glasses to display information in the user's view field. A camera, a microphone, and a GPS receiver capture information from the physical world. A prism positioned in front of the user's right eye displays virtual information in the user's view field (Fig. 1).

In 2013, Google communicated the launch of Google Glass, the first commercial smart glass offered for personal use.[1] About one year later, in 2014, Google started distributing a limited number of Google Glass to selected people, such as developers and researchers in the U.S. Google announced that it would sell Google Glass in the U.S. in the summer/fall of 2014 (Google, 2014). Google Glass is based on the Android system and users can install a variety of applications (apps) on the device from the well-known and established Google Play Store. A recent study by Danova (2013) forecasts sales of 21 million units of Google Glass until 2018. Similarly, new start-ups have been founded that focus on developing apps for companies (Tilley, 2014). Commonly discussed applications are, for example, navigation systems, socializing tools, or apps that capture physical information, such as buildings, and provide the corresponding information from Wikipedia. At the same time, market research reports indicate barriers in the adoption of AR devices in general, such as individuals' privacy concerns (e.g., Denwagan, 2013; Juniper, 2013). Hence, research is needed to understand potential users and the underlying mechanisms that might influence the intended adoption of smart glasses.

To analyze the factors that influence the adoption of such technologies, we conduct two empirical studies. In Study 1, we investigate the extent to which personality explains the awareness of smart glasses by drawing on prior research on media usage and personality. We identify social and cognitive factors to determine the awareness of smart glasses. Using these findings, in Study 2, we investigate the interplay of personality, expected functional benefits, and of how "common" consumers expect smart glasses to be.

2. Prior research and theory

2.1. Prior research

Research that addressed the essential questions regarding smart glasses and its technology is still scarce, primarily because smart glasses are a new phenomenon and whether these devices are an (technical) invention or an innovation is yet to be proven. For the latter, the device must be novel and useful in a broader sense (Amabile, 1996; Baer, 2012), and must be successfully implemented in the market (Brem, 2008). For this, an adequate product advantage should be part of corporate strategy, and this should be perceived by the customers beyond the technological advantage (Gerhard, Brem, & Voigt, 2008).

A large stream of prior research in the area of social media focused on the role of individual differences variables to explain how and why individuals use particular media. For example, uses and gratification theory (UGT) was extended to generally identify gratifications sought and obtained online (e.g., Lin, 2002) or through social media (Chen, 2011; Cheung, Chiu, & Lee, 2011; Lee & Ma, 2012; Park, Kee, & Valenzuela, 2009). Other researchers studied privacy concerns (Morgan, Snelson, & Elison-Bowers, 2010) or cultural differences (Acar, 2014; Jackson & Wang, 2013). Lastly, numerous studies were published that investigate the role of personality in predicting the use of new technologies such as the Internet (e.g., Amichai-Hamburger, Wainapel, & Fox, 2002) or, in particular, social media (e.g., Amichai-Hamburger, Lamdan, Madiel, & Hayat, 2008; Amichai-Hamburger & Vinitzky, 2010; Correa, Hinsley, & De Zuniga, 2010; Hughes, Rowe, Batey, & Lee,

[1] Similar smart glasses, such as Microsoft Hololens, Eye Tap or Golden-I do also exist, but their expected market entry will be after Google Glass, and furthermore, their presence in media is significantly lower than Google Glass.

2012; Moore & McElroy, 2012; Pagani, Hofacker, & Goldsmith, 2011; Rauschnabel, 2014; Ross et al., 2009; Ryan & Xenos, 2011, and others). Although these studies resulted in different findings (c.f., Rauschnabel, 2014 for a review), they gained increased attention as reflected by the large number of citations in a variety of disciplines. Some studies, such as Lin (2006), focused in particular on early adapters of new media channels and argued that an understanding of new media is important in the very early stages.

This study extends the personality-media research stream by looking at smart glasses. A particular contribution of this study is that it provides first findings before these new media are launched. Having this knowledge is important because the strength of the relationship between personality variables and usage behavior may differ over time. For example, openness to experiences is, arguably, important during the very early days but becomes less important after smart glasses are established. Furthermore, identifying the underlying psychological mechanisms related to smart glasses provides interesting and valuable insights for developers seeking to develop applications for smart glasses.

2.2. The Big Five Model of human personality and media use

Research in human personality is a major area of inquiry for many psychologists. In particular, trait theories have gained increased attention in media research. Such theories aim to describe the human personality on continuous dimensions.

Using research from Allport and Odbert (1936) on lexical approaches, the following five broad dimensions of human personality were developed: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (John & Srivastava, 1999; Costa & McCrae, 1992). Although some criticisms existed on the change in personality over time, such as by Specht, Egloff, and Schmukle (2011), those five dimensions were successfully replicated in numerous studies in several countries, cultures, and demographics (John & Srivastava, 1999). Hence, because prior research revealed their relevance in predicting individuals' behavior, we use the big five in our study.

Individuals who score high on openness to experience display intellectual curiosity, creativity or flexible thinking, sensitiveness to beauty, and the willingness to explore new ideas. However, people who score low tend to have more traditional interests and are less creative (Costa & McCrae, 1992; Digman, 1996; Digman & Takemoto-Chock, 1981).

Conscientiousness includes the degree of organization, motivation, and persistence in goal-directed behavior (Costa & McCrae, 1992). People who score high on conscientiousness are generally harder working, more self-disciplined, and more careful than low scorers.

People who score high on extraversion are sociable, person-oriented, talkative, optimistic, fun-loving, and affectionate (Costa & McCrae, 1992). Generally, these people have a stronger need for self-presentation and a need to create new interpersonal relationships. Extraverts also have higher self-esteem.

Agreeableness is a personality trait that describes the quality of one's interpersonal orientation. High scoring people are soft-hearted, altruistic, helpful, and trusting (John & Srivastava, 1999; Costa & McCrae, 1992). These individuals generally have greater abilities to maintain interpersonal relationships.

People who score low on neuroticism are generally calm and unemotional, whereas high scorers are worrying, nervous, and emotional (Costa & McCrae, 1992). Frequently, neurotics have problems forming and developing social relationships and are emotionally instable (John & Srivastava, 1999; Costa & McCrae, 1992).

Significant extant research focused on the role of personality in explaining Internet use or, in particular, social media. For example, a majority of prior research argued that personality predicts media use. For example, Amichai-Hamburger (2002, p. 6) concluded that personality is a "highly relevant factor in determining behavior on the Internet". Similarly, Rauschnabel (2014) reported more than fifty studies that investigated and identified the direct effects of personality on social media usage. However, psychologists claimed that looking at profiles rather than single personality traits are more effective in predicting behavior (Percy, 1976, p. 123), and Rauschnabel and Leischnig (2014) showed that this assumption is valid in predicting Facebook use.

Another stream of research, termed "Uses and Gratification" (U&G), argued that people use particular media to obtain specific gratification (Katz, 1959; Katz, Blumler, & Gurevitch, 1974). For example, they use social media to create new or to maintain existing social relationships (Kaye, 2007), to seek information (Park et al., 2009), or to be entertained (Park et al., 2009; Shao, 2009). However, Blumler and Katz and Blumler (1974) concluded that different people might use the same media for very different purposes, i.e., to gratify different needs. Hence, different motivations or gratifications sought were found to be associated with different consumers (e.g., Amiel & Sargent, 2004; Ross et al., 2009). That is, for example, open individuals tend to use particular media to get inspired or to receive new information, whereas other individuals, such as extraverts, use the same media to socialize with peers.

3. Study overview

We conducted two studies to investigate the role of individuals' personality in the adoption of Google Glass. In Study 1, we addressed the question of how personality traits explain consumer awareness of smart glasses. Data were collected from 146 German students and analyzed using structural equation modeling. Using the same theoretical assumption and the findings of Study 1, we identified the role of personality, expected social conformity, and functional benefits in Study 2. More precisely, we conducted a survey among 201 respondents in German shopping centers. The data was analyzed using moderated structural equation modeling, and we found empirical evidence for the moderating role of personality. Methodological details of both studies are presented in Appendix A.

4. Study 1

Drawing on the Big Five theory of human personality, this study aims to identify the personality traits associated with consumers' self-reported knowledge about Google Glass. The theoretical model of Study 1 is built on prior research and it argues that users' personality should predict their self-reported awareness (e.g., Amichai-Hamburger & Vinitzky, 2010; Amichai-Hamburger et al., 2008; Moore & McElroy, 2012; Ryan & Xenos, 2011).

4.1. Hypotheses

Openness to experience is more likely associated with attempting new methods of communication (Correa et al., 2010; Ross et al., 2009). Open people generally trust computers more than their low-scoring counterparts, as reflected by lower levels of computer anxiety (Korzaan & Boswell, 2008). Similarly, McElroy, Hendrickson, Townsend, and DeMarie (2007) showed that open individuals use the Internet more intensely, and other research revealed open people's more intensive use of social media, such as blogs (Guadagno, Okdie, & Eno, 2008) or social networks (Butt & Philipps, 2008; Correa et al., 2010). Pagani et al. (2011) studied the role of innovativeness, a similar construct, and found a positive effect on the active and passive use of social media. Similarly, open people were found to provide more personal information in their social media profiles (Amichai-Hamburger & Vinitzky, 2010). Hence, we assume that openness to experiences should be positively related to the awareness of smart glasses (H1) because of the generally higher levels of innovativeness and curiosity, particularly in the context of new media and new technologies.

H1. Openness has a positive effect on the awareness of smart glasses.

Prior research showed that extraversion plays a significant role in predicting social media use. For example, Gosling, Augustine, Vazire, Holtzman, and Gaddis (2011) identified extraversion as the most predictive personality trait for Facebook. Several other studies also showed that extraverts tend to use social media and similar technologies more than introverts do (Correa et al., 2010; Zhou & Lu, 2011; Gosling et al., 2011) because extraverts like presenting themselves to others, and much of the new media enable users to extend their selves in these virtual environments. This concept is also in line with findings from the offline world that showed that extraversion was associated with higher levels of fashion consciousness (Casidy, 2012). Assuming that smart glasses are a way to present oneself to others (i.e., a kind of fashion), we hypothesize that extraverts should be more interested in these devices. We also assume that people who are interested in a particular technology should be more interested in learning about it. Additionally, extraverts generally have larger personal social networks and, thus, might receive information from their peers about new technologies.

H2. Extraversion has a positive effect on the awareness of smart glasses.

Neurotic people are generally more nervous and worrying than emotionally stable individuals and, by definition, display both anxiety and anger (Costa & McCrae, 1992). Hence, neurotic individuals have a general tendency to worry about everything that could go wrong. Therefore, neurotics generally show higher levels of computer anxiety (Korzaan & Boswell, 2008). For example, research on the use of social media showed that neurotic people do not use socializing tools, such as chat rooms or instant messaging, as intensely as their low-scoring counterparts do (Hamburger & Ben-Artzi, 2000; Ehrenberg, Juckes, White, & Walsh, 2008). Yet, neurotics tend to seek ways to *escape* from real life, or compensate interpersonal lacks of social relationships, through media (e.g., Correa et al., 2010). Hence, neurotics should be less interested in technologies that combine the physical world with the digital world, such as smart glasses, as they might integrate their fear from the physical world in their perceived social secure virtual world. The findings of Amichai-Hamburger and Vinitzky (2010) are in line with this assumption. They reported that neurotic people are less likely to post photos from real life on Facebook, and doing so can be viewed as a very first step in combining the physical and the digital world.

Finally, neurotics generally have fewer social relationships. Fewer relationships typically result in fewer opportunities to discuss technologies with peers. Hence, the odds of having heard of smart glasses are also lower among neurotics because of fewer interpersonal relationships. Thus, we develop the following hypothesis.

H3. Neuroticism has a negative effect on the awareness of smart glasses.

Age and gender were included as control variables in the model to assess its stability. Prior research showed that age (e.g., Correa et al., 2010) and gender (e.g., Correa et al., 2010; Moore & McElroy, 2012; He & Freeman, 2010) are likely to influence the interest and/or perception of new computer technologies.

4.2. Methodology and research design

Study 1 is based on a survey design. Students were randomly invited to a German university to voluntarily participate in a survey on brands and media. One hundred and forty-six usable questionnaires were collected (62.3% females; age: $m = 23.0$; SD = 2.36), and sweets were offered as incentives.

We measured respondents' awareness of Google Glass using an ordinal ad hoc scale, "Do you know Google's miniature computer Google Glass?" and the following answer options: 0 ("no, I have never heard of that"), 1 ("yes, but I just know the name and do not know what it is"), 2 ("yes, and I have a vague idea of what it is"), and 3 ("yes, and I know exactly what it is"). Personality was measured using the scale from John, Donahue, and Kentle (1991) with three items per dimensions. Appendix A provides all measurement items, descriptive statistics, and a correlation table.

First, we validated our measurement model by conducting confirmatory factor analyses using Mplus 7.11 (Muthén & Muthén, 2013). Overall, the results revealed acceptable levels of reliability and validity of the construct measures. Cronbach's alpha values ranged from .70 to .85 and thus exceeded the .70 suggestion by Nunnally (1978). Composite reliabilities (CR) and average variances extracted (AVE) were close to or exceeded the recommended cutoff values of .60 and .50, respectively. In addition, an assessment of discriminant validity using the suggestions of Fornell and Larcker (1981) revealed satisfactory discriminant validity between the construct measures. This assessment was given as the AVE—the values of each pair of latent variables were always higher as their squared correlation.

Because we relied on self-reported data, common method variance (CMV) might threaten our findings (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). To assess the magnitude of this potential threat, we conducted a Harman's single factor test. Therefore, we compared our basic model with a model in which all items load on a single factor. This single factor model ($\chi^2 = 198.46$; df = 53; CFI = .22; TLI = .04) was associated with a significantly worse model fit than the basic model (basic model: c.f., results section; comparison: $\Delta\ \chi^2 = 147.89$; Δ df = 10; $p < .001$). Thus, the results indicate the absence of substantial CMV.

4.3. Results

Covariance-based structural equation modeling (SEM) with an ordinal manifest dependent variable was applied using Mplus 7.11 (Muthén & Muthén, 2013). The overall model fit was excellent, as indicated by a non-significant χ^2 value ($\chi^2 = 50.57$; df = 43; $p = .20$) and fit indices close to one (CFI =.96; TLI = .94). Furthermore, an RMSEA value of .035 indicates the absence of substantial approximation errors.

4.3.1. Hypotheses

In line with H1, openness was found to be positively related to awareness ($\gamma_{H1} = .24$; $p = .03$). However, no empirical support was identified for H2 because extraversion did not achieve significance ($\gamma_{H2} = .00$; $p = .98$). However, a negative effect was identified for neuroticism ($\gamma_{H3} = -.27$; $p = .02$), which supports H3. Among the control variables, age was insignificant ($\gamma_{age} = .02$; $p = .80$) and gender was positively related (0 = female; 1 = male; $\gamma_{gender} = .29$; $p < .01$). In summary, all three personality measures and the control variables explained 28.5% of the variance of the awareness (*R*-squared).

4.3.2. Additional analyses and robustness tests

To assess the stability of the findings, we also included in the model the non-hypothesized personality traits of agreeableness and conscientiousness. As expected, both traits were insignificant and did not affect our findings. Furthermore, we ran an additional model that treated the dependent variable as a metric. The results were identical, indicating the stability of our findings (these additional results are available from the first author on request).

Because smart glasses are still a very new technology, some descriptive results might provide an additional contribution. Hence, we focused on the distribution of the dependent variable. The results show that Google Glass is still an unfamiliar technology. Of the surveyed students, 66.9% stated that they had never heard of Google Glass, 10.8% recognized just the name, 15.3% knew something about what it is, and only 7.0% stated that they knew exactly what Google Glass is.

4.4. Discussion

This study provides us with first findings on the awareness of smart glasses. In particular, this study shows that the awareness of Google Glass among German students is still low but that personality traits can explain a significant amount of the variance in awareness levels. People who know Google Glass are characterized by higher levels of openness and lower levels of neuroticism. From a theoretical perspective, this finding indicates that—in the current stage—Google Glass is an application for emotionally stable, innovative, and curious people. Contrary to our expectations, extraversion was not found to be related to the awareness of Google Glass. This result is surprising because communicative and talkative people are expected to realize a significant benefit from having such a device; we assume that higher perceived self-presentation benefits should be correlated with knowledge. One explanation could be that the absolute level of awareness among our surveyed respondents is still weak, as the descriptive results indicate. That is, even among extraverts, the likelihood of discussing smart glasses is low because of a general lack of knowledge among students.

However, although the results reflect knowledge about Google Glass, which may be interpreted as a proxy for interest, we have yet to identify the factors that should influence the adoption intention of Google Glass. We address this point in Study 2.

5. Study 2

In Study 1, we showed that open and emotionally stable individuals are more aware of Google Glass. In the hypotheses section, we argued that this finding results from more functional and more social aspects. In this study, we shed additional light on these underlying mechanisms by exploring the extent to which expected functional and social factors influence the anticipated adoption intention of consumers.

5.1. Hypotheses

Based on the logic of Study 1, we assume that social and functional aspects should influence adoption intention (direct effects). However, our second assumption is that not all individuals' behavior is determined by the same antecedents in the same way. Hence, we draw on the Big Five Model of personality and assume that different personalities are intended to adopt smart glasses for different reasons (moderating effects).

5.1.1. Direct effects

We apply the widely replicated finding that consumers are more likely to adapt a new product when it is associated with functional benefits (Davis, 1985; King & He, 2006; Venkatesh & Davis, 2000). In this study, we define the expected functional benefits as the degree to which a user believes that using smart glasses enhances his or her performance in everyday life (syn: perceived usefulness; c.f., Davis, 1985). In particular, smart glasses are predestined to help consumers by making their lives more efficient. For example, a GPS navigation system may provide users with particular online information through a single device. Thus, sightseeing becomes much easier using direct navigation from place to place and weather and traffic information at hand. Hence, we argue that consumers who perceive Google Glass to be associated with functional benefits are more likely to adopt the device.

H4. Expected functional benefits have a positive effect on the adoption intention of smart glasses.

In Study 1, we argued that social aspects should play an important role in the use of smart glasses, as hypothesized by neuroticism and extraversion. In Study 2, we use a more direct measure and focus on individuals' expected social conformity. We define expected social conformity as individuals' perception of how common and popular these users expect a technology to be among their peers. In particular, we postulate that individuals who perceive Google Glass as conforming socially are more likely to adopt smart glasses. The rationale for this postulation is as follows.

Smart glasses worn and used are visible to other consumers; furthermore, they look completely different from extant media or other IT devices, and other wearables like shoes or clothing. As the Guardian reports, an Indian start-up is working on shoes that are linked with Google Maps to guide the wearer when walking (Gibbs, 2014). Noting people's response will be interesting when such devices are brought to market. Usually, measuring such responses is accomplished through a self-assessment of the technology and its potential usage on the basis of personal backgrounds and influences.

Using a meta-analysis of the construct validity of self-assessments of knowledge in education and workplace training, Sitzmann, Ely, Brown, and Bauer (2010) stated evidence that the accuracy of self-assessments is primarily inaccurate: more than 30% of reports use self-assessment knowledge as an indicator of learning, even though 80% of such studies concluded that these learners' self-assessments are inaccurate.

Therefore, self-assessments might change if individuals receive additional information during a certain period. A self-assessment typically changes when the individual is able to compare his or her own performance with the performance of others—assuming that the person receives individual feedback from others regarding his or her abilities (Kipnis, 1961). Therefore, perceptions of new products such as wearables, which are strongly subjective, might change over time on the basis of feedback.

Hence, when people do not believe that other people in their social environment also use these devices in public, they might perceive a high social risk. In contrast, social risk is proposed as being lower when an individual's peers are also using these devices. Moreover, popularity might also be associated with lower functional risks given that a large number of other users might increase the credibility of smart glasses.

H5. Expected social conformity has a positive effect on the adoption intention of smart glasses.

5.1.2. Moderating effects

Note that we assume that these effects are not equal for all consumers. Drawing on the findings of Study 1, we assume that a consumer's personality should explain whether these effects are particularly strong or weak. Hence, we include consumers' personality as a moderator in the hypothesized main effects.

Following the logic of Study 1, that open people have stronger knowledge of (and, thus, interest in) smart glasses, we assume that openness should moderate the effect hypothesized in H4. In particular, we assume that the expected functional benefits should be more important for people scoring high on the openness dimension compared with their low-scoring counterparts. In other words, when open individuals perceive that Google Glass is associated with high levels of functional benefits, the hypothesis is that these individuals are more likely to adopt Google Glass than their low-scoring counterparts.

H6. The effect from the expected functional benefits of the adoption intention of Google Glass as hypothesized in H4 is stronger (versus weaker) when consumers score higher (versus lower) on openness.

We also assume that extraverts tend to have a stronger preference for popular media than introverts, for several reasons. First, and particularly with respect to the role of augmented reality, we assume that Google Glass users, in general, might be perceived as a community of people, especially when the product is popular. Henceforth, we assume that, among extraverts, expected popularity and the opportunity to meet and/or interact with other users should be stronger relative to adoption intention among extraverts compared with introverts. Second, extraverts tend to focus strongly on how they present themselves to others because the use of specific products is a common way for a person to define and express his or her individual character (Sirgy, 1982). For fashion products (McCracken, 1986), new media might help achieve such individuality by creating meaning.

H7. The effect from expected social conformity on the adoption intention of Google Glass as hypothesized in H5 is stronger (versus weaker) when consumers are more (versus less) extraverted.

In H8, we hypothesize a moderating effect of neuroticism on the relationship from expected social conformity on adoption intention. However, two alternative explanations are formulated in H8a and H8b.

First, in H8a, we hypothesize that neuroticism should *positively* moderate the effect of expected social conformity on adoption intention. We argue that using smart glasses might provide a way for people to assimilate with other consumers. That is, neurotics who perceive that their peers will likely use Google Glass should be more inclined to adopt them because they perceive the product to be new and innovative. Thus, new and innovative products may give consumers a way to assimilate with their peers.

In contrast, in H8b, we hypothesize that neuroticism should *negatively* moderate the effect of expected social conformity on adoption intention. This moderation is based on the finding that neurotic people tend to worry a lot and might be frightened by potential data insecurity, or that the device does not work a situation in which they have to rely on it. Another argument is that these people fear that permanent stress is created through the omnipresence of information from such devices; hence, they do not want to use them. Finally, even the mentioned argument of assimilation could be viewed the other way around. Because Google has negative aspects to its image, e.g., from the process of obtaining information for Google StreetView, neuroticism may lead to a fear of being assimilated with Google as a company.

H8a. The effect from expected social conformity on the adoption intention of Google Glass as hypothesized in H5 is stronger (versus weaker) when consumers score higher (versus lower) on neuroticism.

H8b. The effect from expected social conformity on the adoption intention of Google Glass as hypothesized in H5 is stronger (versus weaker) when consumers score lower (versus higher) on neuroticism.

Finally, we know from prior research that, generally, neurotics are perceived as being controlled and influenced by computers (Johnson, Marakas, & Palmer, 2008) and that, generally, neurotics do not trust new technologies as much (Zhou & Lu, 2011). As stated in H1, smart glasses are associated with functional benefits for users, such as providing them with recommendations or information needed to make profound decisions. However, we assume that neurotics perceive smart glasses less as a recommendation and more as influencing or having control over the world. Hence, this assumption leads us to the conclusion that an increase in functionality and influence in the offline world should lead to a negative likelihood to adapt smart glasses.

H9. The effect of expected functional benefits on the adoption intention of Google Glass as hypothesized in H5 is stronger (versus weaker) when consumers score lower (versus higher) on neuroticism.

5.1.3. Control variables

Furthermore, we extend our model using various control variables. As in Study 1, we include age and gender as controls. Following the logic of Study 1, we assume that existing knowledge about smart glasses should affect their interest and adoption intentions. Hence, we also control for such knowledge about Google Glass. Finally, Google is a highly polarizing brand, with some people greatly admiring it and others criticizing its strategy. To parcel out variances that relate to the brand (rather than to Google Glass), we add brand attitude as a control. Furthermore, expected social conformity and expected functional benefits may share some common variances. In particular, expected social conformity may influence expected functional benefits given that the acceptance of many people might increase an individual's perceived trust in a technology. Alternatively, if consumers believe that a product has a high level of functional benefits, they are more likely to expect that large audiences will accept Google Glass. Thus, we model a correlation between these two exogenous variables.

5.2. Methodology and research design

A survey was conducted among German respondents who were randomly invited in shopping centers to participate in a survey on "brand and new media". Surveys were conducted on laptop computers and sweets were offered as incentives for participation.

As in Study 1, we used the John et al. (1991) scale to measure personality traits, extraversion, openness, and neuroticism, with three items per dimension. We adapted items from Thompson, Higgins, and Howell (1994) and Lu, Yao, and Yu (2005) to measure the expected functional benefits. To measures expected social conformity, we adapted and modified items from the literature on brand popularity and social norms (Lu et al., 2005; Mishra, Umesh, & Stem, 1993; Venkatesh, Morris, Davis, & Davis, 1996). To measure knowledge of Google Glass, we presented a brief, neutral description of Google Glass at the beginning of the survey. This description consisted of several technical features and pictures (see Appendix A). We then asked the respondents to what extent were they aware of such information. They responded using a semantic differential scale anchored from 1 ["this information was completely new to me"] to 7 ["I was already aware of this information"].

The final survey instrument was then discussed and slightly refined using an expert from a consulting company with a specialization in augmented reality. Furthermore, the instrument was discussed with potential consumers. These discussions led to some minor changes in the wording of a few items. All measurement items, descriptive statistics, and a correlation table are presented in Appendix A.

As in Study 1, we start by establishing the measurement model. Again, confirmatory factor analyses using Mplus 7.11 were applied. The measurement model revealed adequate psychometric characteristics, as reflected by high reliability coefficients, such as Cronbach's alpha, CR, and AVE. The detailed results are listed in Appendix A. We used the recommended procedure of Fornell and Larcker (1981) to reveal satisfactory discriminant validity between the construct measures. We also checked for common method bias, as in Study 1 (Podsakoff et al., 2003), and again identified no concerns.

5.3. Results

Having established the measurement model, we now focus on an analysis of the path model. We applied a ML estimator in Mplus (Muthén & Muthén, 2013) and tested the basic model—the hypothesized model including all control variables. All fit indices revealed a satisfactory model fit (CFI = .94; TLI = .92; SRMR = .07; RMSEA = .08; (χ^2 = 185.4; df = 80). The results of the hypotheses testing are presented in Fig. 2.

5.3.1. Main effects (H4–H5)

In line with our hypothesized main effects, both expected functional benefits (γ_{H4} = .44; $p < .001$) and expected social conformity (γ_{H5} = .25; p = .002) were positively related to the adoption intention of Google Glass. Hence, H4 and H5 are empirically supported. The independent variables and the control variables explain approximately 56% of the variance of the dependent variable adoption intention.

5.3.2. Moderation effects (H6–H8)

We now focus on analyses of the moderating effects. Therefore, we apply the LMS latent moderating estimation procedure as recommended by Klein and Moosbrugger (2000) using Mplus 7.11. We include in the model the beta effects from the independent variable (i.e., expected functional benefits or expected social norms), the moderators (i.e., openness, extraversion, or neuroticism), and the latent interactions (i.e., for example, expected social conformity $\times$ neuroticism). A moderation effect is established when the latent interaction term is significant. The results are presented in Table 2.

In line with H9, openness was found to moderate the effect from the expected functional benefits on the adoption intention, as reflected by a significant interaction (γ_{H9} = .13; p = .02). H7 postulates that extraverts should favor smart glasses because of their social benefits. In line with this assumption, we identified a positive and significant interaction (γ_{H7} = .14; p = .01), thus supporting H7.

The results support H8b (and not H8a), as reflected by the negative significant interaction ($\gamma_{H8} = -.13$, p = .02). Furthermore, in line with our expectations, highly neurotic individuals are less influenced by expected functional benefits ($\gamma_{H9} = -.11$, p = .01), thus supporting H9.

5.3.3. Additional analyses and robustness tests

5.3.3.1. Robustness tests. To validate our theorizing and to assess stability, we conducted the following ex post analyses. First, we also tested the extent to which the personality traits moderate the non-hypothesized effects, such as the extent to which openness moderates the influence of the expected functional benefits on adoption intention. We identified no substantial effects. Furthermore, we applied methodological replications, such as multi-group analyses and moderated regression analyses. The results were similar, indicating the stability of our findings (these results can be provided by the first author on request).

Furthermore, because this study is the first on smart glasses, additional exploratory analyses provide additional contributions. Hence, we also tested the moderating effects of the non-hypothesized personality traits of agreeableness and conscientiousness. Both traits were not found to moderate any of the proposed main effects.

5.3.3.2. Alternative model. Additionally, we ran an alternative model. In particular, we applied a common methodology in media research on established media platforms (as compared to new technologies, as in this study) that argues that personality traits should directly influence usage behavior (e.g., Moore & McElroy, 2012). Therefore, we ran an additional SEM using all five personality traits as independent variables and adoption intention as the dependent variable. Furthermore, we included the same control variables as in the main model. A moderate model fit was detected (CFI = .91; NFI = .89; SRMR = .07; χ^2 = .420.90; DF = 224; $p < .001$). The independent variables and the control variables explain approximately 17.3% of the variance in adoption intention. Conscientiousness ($\gamma_{consc} = -.18$; p = .02) was the only significantly related personality variable (all other personality variables were associated with p-values of 15% and higher).

5.4. Discussion

The results of this study show that, generally, both expected social conformity and functional benefits influence consumers' intention to adopt Google Glass. However, the importance of these two antecedents is moderated by consumers' individual characteristics, particularly their personality.

Our results show that open individuals intend to buy Google Glass for its functional benefits. However, extraverts tend to be interested in adopting smart glasses because of expected social conformity. Extraverts who expect Google Glass to be accepted by their peers tend to perceive smart glasses as a way to assimilate with others. This perception is in line with the general characteristics of extraverts and their ongoing need to create interpersonal relationships (Costa & McCrae, 1992; John, 2011).

In contrast, neuroticism was found to moderate both the expected effects of social conformity and the functional benefits of adoption intention, in a manner that weakened both effects when neuroticism increased. Regarding the expected functional benefits, this observation is interpreted by neurotics' fear of being controlled by technology and is supported by the direct, negative effect of neuroticism (c.f., Table 2) and prior research (c.f., for example, Galinsky, Gruenfeld, & Magee, 2003). Our results of the moderator analyses show that neurotics tend to be particularly averse of smart glasses when they believe that this technology has a strong effect on their lives. Similarly, neurotics tend to be less likely to adopt smart glasses when they expect the glasses to conform among peers in the future. This finding suggests that neurotics might prefer smart glasses more when they expect the devices to help present them as unique.

6. General discussion

To the best of the authors' knowledge, this study is the first to investigate augmented reality devices, such as smart glasses, in a personal context. By doing so, this study extends prior research on other AR-applications (e.g., Spreer & Kallweit, 2014) and provides groundwork for future research. Using Google Glass—the most prominent example of such devices—we studied the

Table 1
Development of Internet technologies over time.

Internet phase	Pre-Web Era	Web 1.0	Web 2.0	Mobile Web	Augmented Reality
Offline Role	Pure offline life	Online information for the offline life	Managing from offline to sharing online information	Offline content (e.g., videos, pictures, GPS) is transferred to the offline world everywhere and every time	Online and offline information are integrated and can be simultaneously used and shared.
Online Role	Not yet existing	Storage of professional content	Storage of professional and user-generated content; more production of content than consumption	Storage of professional and user-generated content; content is available everywhere and anytime	
Typical usage Behaviors	n/a	Information seeking	Searching and providing information	Affective and cognitive sharing of information sharing	Crosslinked information searching, saving, and sharing, everywhere and for everybody.
Typical Applications	Videotex, BTX	(static) Websites, chat rooms; bulletin board system	Social media, such as blogs, instant messaging (e.g., ICQ, Skype). Social networking sites, content sharing platforms	Cloud app ecosystems (Android, iOS, Windows)	Augmented reality supporting social media apps in combination with hardware
Typical Devices	Telephone/ Fax	Desktop computers, pagers	First-generation mobile devices, such as laptops, cell phones, smartphones	Second generation mobile devices, such as smartphones and tablets	Wearable Augmented Reality devices, such as smart glasses
Technological Drivers and Infrastructure	Cable	Telephone networks (voice), analog (modem) or digital (ISDN) Internet connections, one-way radio systems (e.g., pager)	Fast wired Internet connections (WiFi), digital cameras in phones	Fast mobile Internet, HD cameras, GPS, NFC	High-speed Internet everywhere (LTE), machine-to-machine communication, micro-computers
Limitations		Modem speed, web space, technical complexity (lack of usability of many services)	Speed of wireless connections, social and privacy concerns	Speed of mobile Internet connections (UMTS), battery power; social and privacy concerns	Social and privacy concerns of users and non-users
Research on user personality (examples)		Brenner (1997); Amichai-Hamburger and Ben-Artzi (2003)	Ross et al. (2009); Correa et al. (2010); Hughes et al. (2012); Moore & McElroy, (2012); Ryan & Xenos (2011); Amichai-Hamburger & Vinitzky (2010); Amichai-Hamburger et al. (2008)	Lane and Manner (2011); Aldás-Manzano et al. (2009); Kim et al. (2015)	***This study***
Time	1980s and earlier	1990s	2000s	2010s	2015 – ...

Table 2
Moderation analysis.

H	IV	Moderator	Beta (IV)	Beta (Mod)	Beta (Interakt)	Mod?
H6	EFB	Openness	.34, $p < .001$	.10; $p = .11$	.13; $p = .02$	✓
H7	ESC	Extraversion	.18; $p = .02$	.09; $p = .11$	.14; $p = .01$	✓
H8	ESC	Neuroticism	.23, $p < .01$	−.15; $p = .02$	−.13, $p = .02$	✓
H9	EFB	Neuroticism	.35, $p < .001$	−.15; $p = .02$	−.11; $p = .01$	✓

ESC: expected social conformity; EFB: expected functional benefits.

proposition that both functional and social aspects explain consumers' perception and adoption behavior of smart glasses.

6.1. Theoretical contribution

First, our study introduced smart glasses to human–computer research. We view smart glasses (and other personal AR wearable devices) as a further development of (mobile) social media. These media do not only establish a link between virtual and physical reality—they combine both "worlds". Because they represent a major evolution as compared to prior technologies, insights into the psychological mechanisms that lead to the adoption (or not) of this technology are of interest to academics and practitioners alike. We addressed this issue by focusing on the role of personality traits and, by doing so, extend prior research in the previous domains of technology development, as shown in Table 1 (e.g., Amichai-Hamburger & Vinitzky, 2010; Amichai-Hamburger et al., 2008; Moore & McElroy, 2012; Ryan & Xenos, 2011, and others).

Our study provides first findings on the interplay between personality traits (particularly extraversion, openness, and neuroticisms) and expectations concerning smart glasses (expected social conformity and expected functional benefits). In particular, our findings are as follows.

Openness was found be to an important personality trait in predicting smart glasses use. Open people show higher levels of knowledge of Google Glass (Study 1), which is the result of their generally higher level of curiosity. In line with this finding, we showed that open people are more likely to adopt smart glasses when they expect that Google Glass helps increase the efficiency of their lives. This finding suggests that openness is not a purposeless trait but is linked to concrete challenges in peoples' lives.

Moreover, high levels of neuroticism are negatively related to smart glass adoption. In Study 1, we showed that neurotic consumers have less knowledge about Google Glass compared with their high-scoring counterparts. Similarly, in Study 2, our results show that neurotics who perceive smart glasses as functionally valuable tend to have a lower probability of adapting them. This is in line with prior research (Kim & McGill, 2011; Bargh, Raymond, Pryor, & Strack, 1995; Fast, Gruenfeld, Sivanathan, & Galinsky, 2009; Galinsky et al., 2003), that found that individuals with stable personalities often experience higher levels fear of and aversion to being controlled and manipulated by technologies). Moreover, Study 2 showed that neurotics are also less likely to adopt smart glasses when they do not perceive that the benefits that they receive from such devices are unique. This concept was established based on the finding that neurotics who do not expect that a majority of their peers will use smart glasses are more likely to purchase Google Glass. In contrast, neurotics who expect Google Glass to be an established technology are less interested in adopting it.

Finally, extraverts do not have more knowledge about Google Glass than introverts, as Study 1 shows. However, extraverts tend to see smart glasses as a way to increase social assimilation. This assumption received empirical support in Study 2, which showed that extraverts are more likely to adopt Google Glass when they perceive that its usage is also common among their peers.

These findings provide insights into the relationship between individual personality traits and the adoption of smart glasses. It thus contributes to the emerging literature on consumers' use of smart glasses. More importantly, our findings complete the extant stream of research on the impact of personality on the adoption of inventions. This leads to the question to what extend these findings are also valid for other technological inventions in general. According to our theorizing, it is not just the novelty of the technology that characterizes our findings – it is also the fact that smart glasses are visible for others, and are likely to influence other users by recognizing, identifying, and recording them. Thus, expected peer evaluations of the use of the technology are much for likely to influence individuals' smart glass use, as compared to the use of less visible wearable technologies, such as smart watches or cell phones. Beyond these theoretical contributions, our studies have implications for management practice.

6.2. Managerial contribution

Our study also provided important implications for managers. For manufacturers of smart glasses, reducing uncertainty is important. For example, because neurotic people particularly fear external control (e.g. through functionalities integrated into smart glasses), manufacturers may highlight the value of their supportive function rather than their controlling function for promotion purposes.

The development of applications that enable social contact with other people, such as dating apps, might be promising for attracting smart glasses to individuals that lack interpersonal relationship abilities, such as highly neurotic people. For example, a dating app might provide information about other singles who are also using this app and who have similar profiles. Thus, these users might get to know each other in their augmented reality and meet in real life. Similarly, these apps can help extraverts satisfy their need for new relationships.

Because open people are aware of smart glasses (c.f., Study 1) and tend to prefer these devices for of their functional benefits (c.f., Study 2), providing information through media that are typically used by open individuals seems promising. Manufacturers or developers of smart glasses applications might also ask these users in open innovation approaches to provide ideas for applications and usage scenarios.

On a strategic level, corporate top management should be aware of the necessity to proactive manage technological adoption. Especially in technology-driven companies this view is not always implemented on the strategic level, thinking that the product "sells itself" just because of its technical features. Moreover, tools for early customer involvement should be taken into consideration as well.

6.3. Limitations and future research

Since smart glasses are an emerging technology, research is still scarce. Although our studies provide insights into issues related to smart glasses that are of interest from both, a marketing and an innovation management vantage point, as all empirical research our research design presents certain limitations. These provide direct avenues for future research as much as the field of smart glasses generally calls for increased scholarly interest and inquiry.

One such limitation of this study is its focus on intended behavior with respect to a less well-known product. However, knowledge about (potential) early adopters is important (Lin, 2006), as this knowledge helps companies to develop and refine their market entry strategies. From a manufacturer's position, this knowledge is important to increase their success in a market that is forecasted to be particularly profitable (e.g., Danova, 2013; Juniper, 2013). However, future research is needed to understand the development of smart glasses after their launch.

Furthermore, the focus on one cultural context with data collected solely in Germany and a student sample in Study 1 may limit our findings. Future studies should address these limitations by studying intercultural issues and comparing different countries and even continents. Moreover, socio-demographic characteristics of sample members may also influence our outcome variable. Although we account for some of these characteristics as control variables, a more differentiated consideration of their role would be of interest. Hence, e.g. analyzing other age groups may offer additional insights.

In Study 2, we ran an alternative model that analyzed the effects of the big five personality traits on the adoption intention of smart glasses. In Study 2, we showed that personality traits are less likely to directly explain the intention to adopt smart glasses. This finding is interesting because a large stream of research showed that personality has a direct effect on technology use (e.g., Amichai-Hamburger & Vinitzky, 2010; Amichai-Hamburger et al., 2008; Moore & McElroy, 2012; Ryan & Xenos, 2011). However, most of these studies were conducted after such technologies were established. In line with this phenomenon, Rauschnabel (2014) showed that personality traits better explain media usage when consumers have strong interest and experience in a particular medium. One may draw on this finding and assume that personality traits' direct explanatory power might increase over time. However, different studies should validate and address this assumption in detail. In line with that approach, meta analyses that investigate the role of personality in media research could be useful.

Another potential limitation of this study is the use of self-reported behavior for the dependent variables rather than observed objective data (c.f. Goodhue, Klein, & March, 2000). However, for a study conducted in a pre-market-entry situation, self-reported data are appropriate because observational data do not exist. Hence, following the suggestions of Amichai-Hamburger and Vinitzky (2010) and Moore and McElroy (2012), future studies could compare the personality structure of users versus non-users after an official market launch. Furthermore, analysis of particular usage patterns might increase the understanding of smart glasses in the context of everyday life. For example, who will use dating apps: on smart glasses? Are these neurotics, in order to cope with social deficits in real life? Or extraverts, who extend their social abilities through AR? Both assumptions are plausible, as shown in prior research on social media (Rauschnabel & Leischnig, 2014; Zywica & Danowski, 2008).

Finally, scholars should investigate the role of smart glasses as data collection tools for future research. For example, to what extent can smart glasses be used for surveys that cover both situational data (e.g., location, pictures of the environment) and display questionnaires in the view field? Such a research method might be interesting in a variety of disciplines, including psychology or marketing (e.g., consumer behavior at the point of sale), and may extend other innovative data collection methods, such as for smartphones (Dufau et al., 2011). It may increase, at the same time, reliability, validity, and cost efficiency of data collection in consumer research situations. However, given that wearing glasses is not a habitual purchasing situation for many consumers, it may bias observed behaviors. Hence, scholars should contribute to the clarification of the question whether smart glasses represent useful and usable market research tools. Finally, future research might look into approaches to generalize our findings to other wearables as well.

Overall, smart glasses offer a wealth of avenues for future research to academic inquiry. We encourage scholars to dedicate increased effort to a deepened understanding of their role in the realm of marketing.

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Measure for knowledge about Google Glass (single item): pictures were taken from newsider.de, Wikimedia.com futuristspeaker.com, mashable.com.

Google Glass is the name of a miniature computer that is worn on a user's head (syn: data glasses), It is mounted on a spectacle frame and displays information in a user's view field. Generally speaking, this device is like a smartphone, that can make pictures, use Google maps (or other apps), send message or record videos, controlled by a user's voice commands.

We'd like to know from you, how familiar you are with the content of this text. Did you know this before?

[bipolar scale, ranging from: −3: These information were completely new to me ... +3 I already knew all of these information]

Appendix B. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.chb.2015.03.003.

Appendix A. Measurement models

Study 1

Extraversion	Openness	Neuroticism
Reserved [R]	Has an active imagination	Worries a lot
Tends to be quiet [R]	Values artistic, esthetic experiences	Is relaxed, handles stress well
Communicative, talkative	Is original, comes up with new ideas	Gets nervous easily
α = .85	α = .75	α = .70
CR = .86	CR = .76	CR = .73
AVE = .68	AVE = .54	AVE = .47

Study 2

Extraversion	Openness	Neuroticism	Attitude toward Google
Reserved [R]	Has an active imagination	Worries a lot	I find the brand Google good.
Tends to be quiet [R]	Values artistic, esthetic experiences	Is relaxed, handles stress well	I like the brand Google.
Communicative, talkative	Is original, comes up with new ideas	Gets nervous easily	I have a positive attitude toward Google.
α = .76	α = .78	α = .76	α = .95
CR = .76	CR = .78	CR = .77	CR = .89
AVE = .60	AVE = .62	AVE = .61	AVE = .75

Expected social conformity	Functional benefits	Adoption intention
My friends like Google Glass	With Google Glass, I can make many daily things better	I'll be one of the first who will use Google Glass
Using Google Glass will be very common in my personal environment	With Google Glass, I can make many daily things faster	Certainly, I will use Google Glass
A majority of my friends will also be using Google Glass	Generally speaking, Google Glass is useful for me	I am interested in buying Google Glass
α = .84	α = .91	α = .88
CR = .85	CR = .89	CR = .95
AVE = .75	AVE = .75	AVE = .86

Note: The personality measures are based on the conceptualization by John et al. (1991). Items were taken from an established German scale (c.f., Gerlitz & Schupp, 2005).

Correlations tables

Study 1

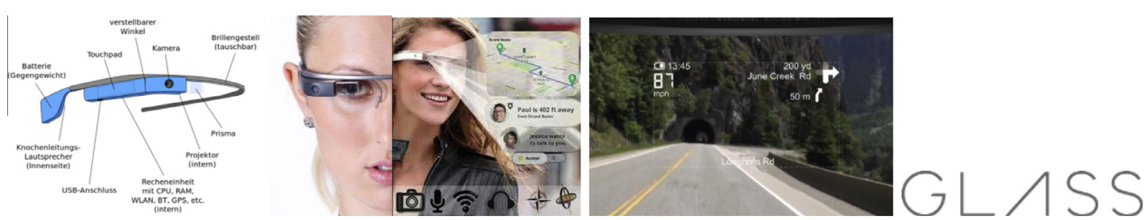
	M	SD	*O*	*E*	*N*	Awareness	Age
Openness	4.66	1.23					
Extraversion	4.63	1.30	.25**				
Neuroticism	4.09	1.22	−.04	−.15			
Awareness	1.64	.99	.22**	.09	−.29**		
Age	22.96	2.36	.02	−.06	−.02	.04	
Gender (1 = female)[a]	.62%	n/a	−.07	.03	.29**	−.35**	−.10

*** $p < .001$, ** $p < .01$, * $p < .05$, T $p < .10$.
[a] Represents the amount of females (%); SD is not available for binary variables.

Study 2

	M	SD	*O*	*E*	*N*	EFB	ESC	AI	Know	BA	*A*
Openness	4.94	1.30									
Extraversion	4.71	1.28	.16*								
Neuroticism	4.06	1.39	−.03	−.22**							
Expected functional benefits	2.75	1.61	−.03	−.08	.05						
Expected social conformity	1.93	1.12	−.01	.04	−.03	.44**					
Adoption Intention	1.93	1.39	.01	.08	−.13	.56**	.45**				
Knowledge	4.54	2.24	.24**	.09	−.31**	.15*	.05	.19**			
Brand Attitude (Google)	4.96	1.74	.03	−.02	.16*	.16*	.10	.23**	−.16*		
Age	31.82	13.14	−.11	−.11	−.11	−.23**	.06	−.08	−.04	−.13	
Gender (1 = female)[a]	59%	n/a	.06	.14*	.24**	−.15*	−.06	−.14	−.27**	.17*	−.08

*** $p < .001$, ** $p < .01$, * $p < .05$, T $p < .10$.
[a] Value represents the amount of females (%); SD is not available for binary variables.



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