

Article

Investigating the Relationship between Personality and Technology Acceptance with a Focus on the Smartphone from a Gender Perspective: Results of an Exploratory Survey Study

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Abstract: Prior research found that user personality significantly affects technology acceptance perceptions and decisions. Yet, evidence on the moderating influence of user gender on the relationship between personality and technology acceptance is barely existent despite theoretical consideration. Considering this research gap, the present study reports the results of a survey in which we examined the relationships between personality and technology acceptance from a gender perspective. This study draws upon a sample of $N = 686$ participants ($n = 209$ men, $n = 477$ women) and applied the HEXACO Personality Inventory – Revised (<http://hexaco.org/>) along with established technology acceptance measures. The major result of this study is that we do not find significant influence of user gender on the relationship between personality and technology acceptance, except for one aspect of personality, namely altruism. We found a negative association between altruism and intention to use the smartphone in men, but a positive association in women. Consistent with this finding, we also found the same association pattern for altruism and predicted usage: a negative one in men and a positive one in women. Implications for research and practice are discussed, along with limitations of the present study and possible avenues for future research.

Keywords: HEXACO; personality; smartphone; technology acceptance model; TAM; gender

1. Introduction

1.1. General Introduction

The technology acceptance model (TAM) [1] is a theoretical framework which explains user acceptance of technology. In essence, this model explains that actual use of a technology is influenced by three core constructs: perceived ease of use of the technology, perceived usefulness of a technology to support task execution, and behavioral intention to use the technology. Moreover, perceived ease of use influences perceived usefulness, and both perceptual constructs influence behavioral intention. A wealth of survey research supports the explanative power of TAM (see, for example, meta-analyses and reviews by Lee, Kozar, and Larsen [2], Legris, Ingham, and Collette [3], or King and He [4]), and several TAM extensions and unifying frameworks were developed during the past decades (e.g., TAM2 [5,6], unified theory of acceptance and use of technology, UTAUT [7]). These extensions added

independent variables, as well as mediators and moderators, to increase the model's explanatory power. For example, a meta-analysis [8] revealed that a user's perception that most people who are important to him (her) think he (she) should, or should not, use the technology (referred to as "subjective norm") influences perceived usefulness, behavioral intention, and actual system use.

Because human perception and behavior in general, hence also users' technology perceptions and acceptance behavior, are influenced by personality, it is not surprising that researchers have also investigated the role of personality in technology acceptance (hereafter: TA). Personality is defined as people's "stable individual differences in cognitive, emotional and motivational aspects of mental states that result in stable behavioral action (especially emotional) tendencies [...]" [9] (p. 1). In fact, it has been found that personality affects technology perceptions and TA decisions [10–13].

Moreover, it is an established fact that significant gender differences exist in personality (see meta-analyses by Costa, Terracciano, and McCrae [14] and Feingold [15] as well as studies by Lee and Ashton [16] and Moshagen, Hilbig, and Zettler [17]). In addition, evidence indicates that computer usage decisions of women are more strongly influenced by perceived ease of use, whereas men's decisions are more strongly influenced by perceived usefulness [18]. Thus, gender affects TA decisions. This effect possibly has its root cause in gender differences that are related to personality. Specifically, women typically have less self-efficacy with regards to computers (computer self-efficacy) and higher levels of computer anxiety than men [7,18] making factors related to ease of use (e.g., interface usability) more salient to them. In contrast, men usually have more achievement needs and are more task-oriented than women, making factors related to usefulness (e.g., functions of a software tool) more salient to them (please also see consideration of user gender in early works of Venkatesh [7,18]).

However, the role of user gender in the personality-TA relationship, to the best of our knowledge, has not been empirically studied so far; except for one study which, however, only touches on the topic (see our discussion of Devaraj et al. [11] in the next section). A contribution to filling this research gap is not only important from an academic perspective. Rather, shedding light on the role of user gender in TA perceptions under consideration of personality is also critical for systems engineering in practice. Evidence [19–21] indicates that consideration of user gender in systems development (e.g., user interface design) may have beneficial effects on important outcome variables in human-technology interaction that are related to TA decisions, such as user satisfaction, trust, or sales in online shopping contexts. Thus, an answer to the question whether gender moderates the relationship between user personality and TA decisions is important. If a moderation effect exists, consideration of the interaction between users' personality and gender is critical in systems engineering and design. If a moderation effect does not exist, consideration of personality and gender in engineering and design does not become less important. However, what a missing moderation effect would indicate is that their joint consideration (i.e., personality and gender) is less complex because their influence on TA would be independent from each other.

Against the background of this research gap, we conducted a survey study with a large sample ($N = 686$) to investigate possible gender differences in the personality-TA relationship. The remainder of this paper is structured as follows. First, we discuss related work. This discussion is organized along the conceptual framework as shown in Figure 1. Afterwards, we describe the methods of our study. Next, we present our results and their discussion. What follows are the implications of our work for both research and practice, limitations, and possible avenues for future work. We close this paper with a conclusion.

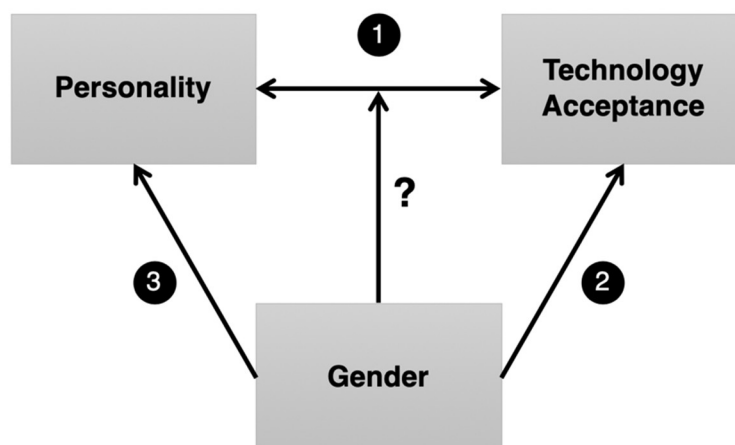


Figure 1. Conceptual Framework of Literature Review. 1: Research Stream 1 = personality and TA associations; 2: Research Stream 2 = gender differences in TA, 3: Research Stream 3 = gender differences in personality.

1.2. Conceptual Framework and Related Work

Figure 1 illustrates the conceptual framework which is used to structure the related work. Based on this framework, the research streams relevant to this paper become visible. First, we discuss research on the association between personality and TA (Research Stream 1). Second, we outline studies which indicate that gender differences in attitude toward and usage of information and communication technologies exist. Thus, TA decisions are influenced by user gender (Research Stream 2). Third, we summarize important insights on gender differences in personality (Research Stream 3). These three research streams together constitute the literature basis of the present study.

With respect to the possible moderating influence of gender on the personality-TA relationship, we only identified one finding in the scientific literature. In a study on the role of personality in TA decisions, Devaraj et al. [11] only write: “A one-way analysis of variance (ANOVA) of differences in responses between males and females in the sample supports the conclusion that gender does not play a significant part in our research model and results.” (p. 98). Further analyses (e.g., on an actual moderation effects of gender), results, or comments are not provided in the paper. What follows is that we know very little about the possible moderating influence of gender on the personality-TA relationship (see the question mark in Figure 1).

1.2.1. Research Stream 1: Personality and Technology Acceptance

Maier [22] comprehensively reviewed the academic literature to determine the role of personality in information systems research. In total, he identified 30 articles discussing personality in the top eight information systems journals (for details, see <https://aisnet.org/page/SeniorScholarBasket>). A total of 19 articles in some way “examine technology adoption behavior” [22] (p. 6), only five of which deal with higher-order traits (e.g., big five or cognitive style which describes the way an individual thinks, perceives, and remembers information). In the present article, we are interested in such higher-order traits. Hence, we analyzed the five studies in this domain in detail. Out of the five studies, only two [11,12] directly address personality in TA, while the other studies have a different focus, such as personality traits and effectiveness of presentation of product information in e-business systems [23–25].

Maier’s [22] literature review covered papers published until September 2011. Therefore, we also searched for more recent studies in Web of Science (last query: May 11, 2020; “personality” AND “technology acceptance”; focus: higher-order traits). In addition to the seminal papers by McElroy et al. [12] and Devaraj et al. [11] which were published before 2012, we identified two further key papers

[10,13]. In the following, we discuss these four studies which directly deal with the personality-TA relationship from a higher-order trait perspective.

McElroy et al. [12] tested the effect of personality and cognitive style on different measures of internet use. In essence, the study found that personality explained variation in internet use beyond the traditional measures of computer attitudes. Moreover, it was found that personality predicted internet use better than cognitive style. Further notable results from a personality perspective are reported in this paper. First, it was found that after controlling for computer anxiety, self-efficacy, and gender, personality significantly explained internet use variance in general, and online selling in particular. Second, openness was found to be a significant positive predictor of general internet use. Third, neuroticism was found to be a strong positive predictor of online selling. Altogether, these results provide evidence that personality (using the big five to measure it, but not based on cognitive style) might be an antecedent of internet use decisions. It is important to note that while gender was used as a control variable in this study, neither do the authors report the gender distribution in the sample nor are gender analyses described in the study.

Shortly after this 2007 study, Devaraj et al. [11] investigated the effect of user personality on both the perceived usefulness of technology and subjective norms toward the acceptance and use of technology. Major results of the study are: the relationship between perceived usefulness of technology and intentions to use the technology was stronger for individuals with higher (vs. lower) conscientiousness and the relationship between subjective norms and intentions to use the technology was stronger for individuals with higher (vs. lower) conscientiousness. Moreover, it was found that the relationship between subjective norms and intentions to use the technology was stronger for individuals with higher (vs. lower) extraversion, and the relationship between subjective norms and intentions to use the technology was stronger for individuals with higher (vs. lower) agreeableness. In addition, it was found that while neuroticism was negatively related to beliefs about the perceived usefulness of technology, agreeableness was positively related to beliefs about the perceived usefulness of technology. With respect to possible gender differences, the authors conclude that gender does not play a role in their research model and results. Further details on gender-specific analyses are not reported in the paper.

Svendsen et al. [13], drawing upon the two earlier papers, examined “the degree to which users’ assessments of the core constructs of TAM are influenced by their personality” [13] (p. 323). Major results of the study are: extraversion was positively related to behavioral intention to use a technology, and this effect was mediated by the TAM beliefs (perceived usefulness, perceived ease of use, and subjective norm). Conscientiousness was positively related to behavioral intention to use a technology for individuals interested in the application domain, and this effect was again mediated by the TAM beliefs. The positive association of emotional stability (opposite of neuroticism) with behavioral intention to use a technology was not mediated by the TAM beliefs. Finally, it was found that openness to experience was positively related to perceived ease of use. We emphasize that despite the fact that this study draws upon an impressive sample size ($N = 1004$ survey respondents) along with a mixed-gender sample, no gender analyses are reported in the study.

In the next recent paper in this research stream, Barnett et al. [10] argue that “[u]ntil recently [...] the role of personality in general, and the five-factor model (FFM) of personality in particular, had remained largely unexplored [and hence their] study takes an interactional psychology perspective, linking components of the FFM to the use of technology within the conceptual framework of the Unified Theory of Acceptance and Use of Technology” [10] (p. 374). Major results of this study are: conscientiousness was positively related to technology usage, both actual and perceived. Behavioral intention to use the technology partially mediated the relationship between conscientiousness and technology usage. Finally, it was found that neuroticism was negatively related to technology usage, both actual and perceived. Note that Barnett et al. [10] indicate that future research could investigate the role of gender in the personality-TA relationship. This statement also served as a motivation to conduct the present study.

Next to the already mentioned works, we could also find a paper on the association between the big five and TA with regard to the smartphone [26]. The study found that agreeableness and openness

were positively related to perceived ease of use, while neuroticism was negatively related to perceived usefulness.

1.2.2. Research Stream 2: Gender Differences in Attitude toward and Usage of Information and Communication Technologies

Cai, Fan, and Du [27] conducted a meta-analysis on gender and attitudes toward technology use ($N = 50$ articles published in the period between 1997 to 2014). The main finding of this study was that men held more favorable attitudes toward technology use than women, but this difference was characterized by a small effect size. Because attitude towards an object influences perception of that object and interaction behavior with that object, in the following we report research findings on gender differences in technology perception, behavioral intentions to use technology, and actual usage behavior.

Goswami and Dutta [28] reviewed gender differences in technology use and they structured their review along application areas. The major conclusion they draw is that “[f]rom the literature review, it can be observed that there are mixed results with respect to the influence of gender on technology adoption [...] while in few contexts, gender plays a significant role in determining the intention of accepting new technology, there are cases where gender differences cannot be discerned” [28] (p. 56). In a pioneering study, Venkatesh and Morris [18] examined sustained usage of technology in the workplace. Technology usage behavior was investigated over a five-month period among workers being introduced to a new software system. Results indicate that at all three points of measurement, compared to female users, the technology usage decisions of male users were more strongly influenced by their perceptions of the system’s usefulness for task execution. In contrast, female users were more strongly influenced by ease of use perceptions and subjective norm perceptions (note that the effect of subjective norm diminished over time). Similar results are reported in a recent study by Tarhini, Hone, and Liu [29], who studied acceptance of web-based learning systems. This study found that the influence of perceived ease of use and social norm on behavioral intention to use a system was stronger for women than for men. However, unlike Venkatesh and Morris [18], this study did not find a significant moderating effect of gender on the relationship between perceived usefulness and behavioral intention to use the system.

Gefen and Straub [30] empirically investigated gender differences with respect to beliefs and use of e-mail. Findings indicate that men and women differed in their perceptions, but not use, of e-mail (use was measured by the number of sent and received messages). A major implication of this finding is that managers “need to realize that the same mode of communication may be perceived differently by the sexes, suggesting that more favorable communications environments might be created, environments that take into account not only organizational contextual factors, but also the gender of users” [30] (p. 389).

1.2.3. Research Stream 3: Gender Differences in Personality

Gender differences in personality are long acknowledged and several studies report gender differences in various personality traits. Here, we focus on the most important studies.

Feingold published one of the most frequently cited meta-analyses about gender differences in personality [15]. Integrating the results of two decades of empirical research, he found that men scored higher than women in self-esteem and assertiveness, but lower in general anxiety.

In another study (published in the same paper), Feingold [15] investigated, among others, gender differences in norms of several personality inventories. Therefore, the scales of the different personality inventories were grouped into nine groups/factors, which were named based on facet scales of the NEO Personality Inventory – Revised (NEO-PI-R). Afterwards these nine groups/factors were analyzed with regard to gender differences. Feingold [15] found no gender differences in impulsiveness (facet of neuroticism), activity (facet of extraversion), ideas (facet of openness (to experience)), and order (facet of conscientiousness). However, women scored slightly higher in gregariousness (facet of extraversion), and higher in scales of anxiety (facet of neuroticism) and trust (facet of agreeableness), as well as much higher on tender-mindedness (facet of agreeableness),

whereas men scored higher (medium degree) on scales of assertiveness (facet of extraversion). However, Feingold [15] also stresses that moderating effects of the variable “inventory” have to be considered in result interpretation.

Another important meta-analysis in the field of gender differences in personality is the cross-cultural study by Costa, Terracciano, and McCrae [14]. In detail, this meta-analysis investigated gender differences in the big five personality traits with six more narrow sub-facets for each of the five factors as assessed using the NEO-PI-R [14]. The analysis was conducted in samples from 26 cultures excluding clinical and occupational selection samples. Across the samples from the different cultures, they found rather modest, but significant gender differences in all facets of neuroticism and agreeableness with women scoring higher than men. In addition, women scored higher than men in warmth, gregariousness, and positive emotions, but lower in assertiveness and excitement seeking in most cultures (sub-facets of extraversion). Additionally, women scored higher than men in openness to aesthetics, feelings, and actions, but lower in openness to ideas. For the other factors (especially conscientiousness) and corresponding sub-facets no pattern of significant gender differences could be observed across cultures. It has to be noted that some of the effect sizes differed between countries [14].

In addition to these important findings, especially gender differences in the HEXACO model of personality are of great importance for the present study. A recent study by Lee and Ashton [16] investigated the psychometric properties of the HEXACO-PI-R (100-item version) in a sample of more than 100,000 participants. This study also analyzed gender differences. Results indicate that gender differences were found in the scales assessing honesty–humility and emotionality with women scoring higher than men [16]. In a study based on German participants (using the 60-item HEXACO questionnaire, HEXACO-60), women scored not only higher than men in honesty–humility and emotionality (thereby replicating the results by Lee and Ashton), but also in agreeableness [17].

1.3. Summary

In the preceding sections, we described major results from three research streams which constitute the conceptual basis of the present paper: personality and TA (Stream 1), gender differences in attitude toward and usage of information and communication technologies (Stream 2), and gender differences in personality (Stream 3).

Our analyses of the scientific literature also revealed that no paper in our specific study context (including personality, gender, their interaction, and TAM) examined the smartphone as technology (but note that several papers exist at the nexus of technology acceptance and smartphone as technological device, such as the works by Cho and Park [31], Joo and Sang [32], and Kim [33]). However, because the smartphone has become the most important technology in the economy and in society in general, we used this major technology as study context in the present examination. In 2019, the number of worldwide smartphone users reached the 3.2 billion threshold, and this number is expected to grow further in the next years [34]. One major explanation why the smartphone has become a ubiquitous device is that it provides the user with various different applications, both for personal and business use.

In conclusion, evidence indicates that (1) personality is associated with TA, (2) gender influences TA, and (3) gender influences personality. However, only one paper touches on the possible moderation effect of gender [11] but reports, without any further descriptions, that gender did not play a role in the model. What follows is that personality and gender seem to independently exert their influences on TA perceptions and decisions. Thus, despite the fact that the present study is exploratory in nature, based on the little existing evidence there is reason to assume that H_0 (“gender does not moderate the personality-TA relationship”) is more likely than H_1 (“gender moderates the personality-TA relationship.”). With regards to potential associations between personality and/or gender and TA we point towards the scarce previous literature on these associations with a focus on the smartphone. Consecutively, we do also not formulate hypotheses for these associations.

2. Materials and Methods

2.1. Sample

In total, $N = 702$ participants took part in the present online survey. A monetary incentive was paid for participation. Of note, the sample is part of the Ulm Gene Brain Behavior Project. Therefore, the present sample partly overlaps with samples reported in other scientific papers using samples from this project. In course of the Ulm Gene Brain Behavior Project, participants first fill in various online questionnaires for different research objectives and have the possibility to also provide genetic samples (not of interest for the present research endeavor). Therefore, the data of the present study are derived from an online survey. Advertisement for participation and recruitment was mostly implemented at Ulm University, Ulm, Germany. Please note that part of the HEXACO-PI-R data has been investigated in context of a Serbian-German cross-cultural project investigating the Affective Neuroscience Personality Scales, earlier [35].

After exclusion of all participants who gave incomplete information, a sample of $N = 686$ participants ($n = 209$ men, $n = 477$ women; age: $M=23.71$ years, $SD=6.10$ years, range: 18–75 years) remained for final analyses. When asked about their highest educational degree, most participants in the final sample stated A-level (German: Abitur; $n = 473$) or a university degree (German: Hochschulabschluss; $n = 157$) as their highest educational degree. Most participants were single ($n = 593$). These socio-demographic characteristics of the sample reflect the fact that data collection was implemented at a (German) university. We can therefore assume that most of the participants were students.

All participants provided informed consent electronically prior to participation. The study was approved by the local ethics committee of Ulm University, Ulm, Germany.

Please note that we are not allowed to upload data of this project at scientific platforms such as the Open Science Framework (as this was not part of the Institutional Review Board approval; for newer projects we always aim to upload the data online [36,37]). Therefore, the data of the present project is available from the authors only upon reasonable request.

2.2. Self-Report Measures

2.2.1. Demographics

First, participants filled in demographic variables about their age, gender, and their highest educational degree.

2.2.2. HEXACO-PI-R

Afterwards and among other questionnaires (see also information above), which are not of interest for the present research endeavor, participants filled in the German version of the HEXACO-PI-R questionnaire consisting of 100 items [16]. The questionnaire assesses the six factors honesty–humility, emotionality, extraversion, agreeableness, conscientiousness, and openness (to experience) with 16 items each, as well as an interstitial additional scale called Altruism (4 items). Each item is answered on a 5-point Likert-scale. Internal consistency estimates (using Cronbach’s alpha) for the broad six factors were: honesty–humility: 0.84, emotionality: 0.86, extraversion: 0.85, agreeableness: 0.82, conscientiousness: 0.82, and openness: 0.78. The internal consistency of the altruism scale was 0.65.

2.2.3. Technology Acceptance

Self-reported perceived usefulness (PU), perceived ease of use (PeU), as well as intention to use (ITU) and predicted usage (PUs) with regard to smartphone use were assessed in light of two purposes: for personal and for business use. In detail, participants filled in 9 items to assess PU (e.g., “using a smartphone saves time.”), 9 items for PeU (e.g., “It is easy to learn how to use a smartphone”), 2 items for ITU (e.g., “assuming I had access to a smartphone, I would use it”), and 4

items for PUs (e.g., “In future situations in which I have to fulfill [business / personal] tasks and have the free decision, I would use a smartphone as technology”), for both personal and business use of the smartphone. The items to assess PU, PeU, and ITUs were translated and reformulated for the present research endeavor based on Chin, Johnson, and Schwarz [38]. The items to assess ITU were translated and reformulated based on Venkatesh and Davis [5]. These instruments constitute established instruments developed and validated by world-wide leading scholars in the field of TA research. Moreover, three additional items were included in the PU and PeU scales. Each item was answered on a 6-point Likert-scale (we opted for a 6-point scale to avoid a tendency toward the middle option; note that the original measures used 7-point scales). For interested researchers, the German items to assess the TA scales as used in the present study are available from the authors upon request. Internal consistency estimates (using Cronbach’s alpha) for the scales were: smartphone business: 0.88 (PU), 0.86 (PeU), 0.88 (ITU), and 0.95 (PUs); smartphone personal: 0.88 (PU), 0.89 (PeU), 0.89 (ITU), and 0.94 (PUs). Because the associations between personality and TA scales did not differ meaningfully between the personal and business use scales (see Appendix), we combined both PU, both PeU, both ITU, and both PUs scales (personal and business use) into one scale, respectively. This leads to one total PU, one total PeU, one total ITU, and one total PUs scale. Our strategy makes sense: Without meaningful differences in correlation patterns between personality and TAM for personal and business area, we focus the main body of the paper on general smartphone acceptance in everyday life. Nevertheless, the investigation of individual differences in technology acceptance of the smartphone in both personal and business areas without doubt can provide researchers with additional important insights. Therefore, we also provide information on personality-TAM correlations in the personal and business sectors in the Appendix. For the interested researchers the data are available upon reasonable request.

2.3. Statistical Analyses

The statistical analyses were implemented using the SPSS Statistics software of IBM. Age and the ITU scale showed a skewness and kurtosis of greater than ± 1 ; age even above 3 (skewness) and 19 (kurtosis). In accordance with the criteria by Miles and Shevlin [39], this might constitute a problem for the assumption of a normal distribution, which is a prerequisite for some statistical tests. Nevertheless, given the large sample size, we decided to use parametric tests (note that the main results do not differ much depending on whether parametric or the respective non-parametric tests are used).

Thereon, associations with age and gender of all self-report scales of interest were calculated by means of Pearson correlations and t-tests (Welch’s t-tests whenever necessary). Associations with age were calculated to include age as covariate in further analyses, if necessary. These analyses were implemented because evidence indicates that age might influence the scores in the HEXACO-PI-R scales [40], and the age range of the sample of the present study was 18 to 75 years, hence, possible confounding effects of age can be investigated. Gender differences were investigated in light of Research Streams 2 and 3.

Next, the associations between the HEXACO-PI-R scales and the scales assessing TA were calculated based on partial Pearson correlations (corrected for age) in the total sample (Research Stream 1) and moderating effects of gender on these associations were investigated by use of the PROCESS Macro in SPSS. Tests for significances were implemented two-tailed.

3. Results

3.1. Associations with Age (a potential Covariate)

Age correlated significantly ($p < 0.05$) with the PeU ($r = -0.18$, $p < 0.001$) and ITU ($r = -0.08$, $p = 0.042$) scales. Additionally, age correlated significantly with the honesty–humility scale ($r = 0.12$, $p = 0.002$), the emotionality scale ($r = -0.13$, $p < 0.0001$), and the openness scale ($r = 0.14$, $p < 0.001$) of the HEXACO-PI-R.

3.2. Research Streams 2 and 3: Effects of Gender on TAM and Personality Scales

Significant ($p < 0.05$) gender differences were found in several of the variables of interest in the context of Research Stream 2 (gender $\rightarrow$ TA) and Research Stream 3 (gender $\rightarrow$ personality).

Regarding the influence of gender on TAM variables, we found that men scored higher in the PUs scale assessing TA with regard to the smartphone compared to women. Moreover, several gender differences in the HEXACO-PI-R scales were found. Please see Table 1 for descriptive statistics and results of the respective t-tests.

Importantly, when strictly correcting for multiple testing issues by manually adjusting the alpha-level (e.g. $0.05/11 = 0.0045$; divided by 11 because we investigated gender differences on 11 scales), the differences in honesty–humility, emotionality, agreeableness, conscientiousness, and altruism would remain significant.

Table 1. Mean values and standard deviations (SDs) of all scales of interest separately for men and women as well as results of t-tests on differences between genders.

	<i>M (SD)</i> Men (<i>n</i> = 209)	<i>M (SD)</i> Women (<i>n</i> = 477)	<i>t</i>	<i>df</i>	<i>p</i>	Hedge's <i>g</i>
Smartphone TA						
PU	4.06 (0.98)	3.94 (0.84)	1.48	347.43	0.141	0.130
PeU	4.39 (0.86)	4.28 (0.78)	1.65	684	0.099	0.137
ITU	4.86 (1.10)	4.92 (1.05)	−0.64	684	0.522	−0.053
PU _s	3.50 (1.35)	3.27 (1.11)	2.18	334.76	0.030	0.196
HEXACO-PI-R						
Honesty–Humility	3.15 (0.63)	3.44 (0.53)	−5.84	344.03	<0.001	−0.517
Emotionality	2.81 (0.56)	3.50 (0.47)	−15.63	340.60	<0.001	−1.391
Extraversion	3.47 (0.56)	3.43 (0.55)	0.92	684	0.359	0.076
Agreeableness	3.18 (0.54)	3.05 (0.49)	3.01	684	0.003	0.250
Conscientiousness	3.43 (0.53)	3.56 (0.48)	−3.23	684	0.001	−0.268
Openness	3.25 (0.56)	3.28 (0.53)	−0.79	684	0.432	−0.065
Altruism	3.34 (0.69)	3.85 (0.54)	−9.55	322.16	<0.001	−0.873

Note: PU = perceived usefulness, PeU = perceived ease of use, ITU = intention to use, PU_s = predicted usage.

3.3. Research Stream 1: Associations between Personality and TAM Scales and Moderation Effects of Gender

Regarding Research Stream 1 (personality & TA), we present our results in Table 2. As can be seen in Table 2, honesty–humility is negatively related to all TAM scales. Moreover, extraversion is positively related to all TAM scales. The other HEXACO-PI-R scales reveal only some significant associations with different TAM scales.

Table 2. Partial Pearson correlations between the HEXACO-PI-R and technology acceptance model (TAM) scales.

	PU	PeU	ITU	PU _s
Total (N = 686)				
Honesty–Humility	$r = -0.25, p < 0.001$	$r = -0.16, p < 0.001$	$r = -0.17, p < 0.001$	$r = -0.18, p < 0.001$
Emotionality	$r = 0.01, p = 0.894$	$r = -0.10, p = 0.011$	$r = 0.05, p = 0.173$	$r = 0.02, p = 0.638$
Extraversion	$r = 0.15, p < 0.001$	$r = 0.18, p < 0.001$	$r = 0.14, p < 0.001$	$r = 0.12, p = 0.002$
Agreeableness	$r = -0.05, p = 0.201$	$r = 0.04, p = 0.322$	$r = -0.09, p = 0.013$	$r = -0.01, p = 0.830$
Conscientiousness	$r = 0.06, p = 0.132$	$r = 0.09, p = 0.014$	$r = 0.01, p = 0.854$	$r = 0.01, p = 0.721$
Openness	$r = -0.12, p = 0.002$	$r = -0.06, p = 0.146$	$r = -0.06, p = 0.093$	$r = -0.07, p = 0.067$
Altruism	$r = -0.05, p = 0.233$	$r = -0.03, p = 0.496$	$r = 0.01, p = 0.832$	$r = -0.07, p = 0.062$

Note: r = (partial) Pearson correlations; all correlations are corrected for age; p -values are derived from two-sided testing.

With regard to the main research question, namely whether gender would be a moderator for the relation between personality and TAM constructs, moderation analyses revealed nearly no significant interaction effects of personality with gender on the TAM constructs. However, the interaction between gender and altruism on ITU (controlled for age; all variables z-standardized) ($B=0.23$, $SE=0.08$; $F(1,681)=7.63$, $p=0.006$) was significant and revealed a negative association between altruism and ITU in men but a positive association in women. Additionally, the interaction between altruism and gender on the PUs scale (controlled for age; all variables z-standardized) was significant ($B=0.16$, $SE=0.08$, $F(1,681)=3.92$, $p=0.048$). Again, a negative association was found between PUs and altruism in men but a positive in women. All other interaction effects were non-significant (all p 's > 0.158). Additionally, when separately calculating the Pearson partial correlations (corrected for age) between ITU and altruism and PUs and altruism in men and women, only the association between ITU and altruism in men ($r=-0.14$, $p=0.048$) turned out to be significant.

4. Discussion

The present study aimed at investigating the associations between personality and TAM constructs with a special focus on the potential moderating effect of gender. A result of our study is that men scored higher in the PUs scale assessing TA with regard to the smartphone compared to women (Table 1). This result is consistent with prior evidence which we discussed under Research Stream 2 in the related work section. Cai et al. [27], who conducted a meta-analysis on gender and attitudes toward technology use, report that men hold more favorable attitudes toward technology use than women, and this might explain why men, in contrast to women, score higher on predicted usage.

Moreover, we found several gender differences in personality (Table 1). Specifically, we found significant differences in honesty–humility, emotionality, agreeableness, conscientiousness, and altruism. These differences are mostly in line with results of prior research which we discussed under Research Stream 3 in the related work section [16,17].

As can be seen in Table 2 (corrected for age), honesty–humility was negatively related to all TAM scales. Individuals with high scores on the honesty–humility scale “avoid manipulating others for personal gain, feel little temptation to break rules, are uninterested in lavish wealth and luxuries, and feel no special entitlement to elevated social status” (<http://hexaco.org/scaledescriptions>). Thus, people with lower scores in honesty–humility seem to indicate higher levels of TA indicators (PU, PeU, ITU, PUs) in this survey study. Individuals with high scores on honesty–humility are likely to be more honest regarding their usage of technological devices, because they might not see smartphones as luxury articles, but as a device to accomplish goals in the job or private social life (in so far, they might also be more humble). Because prior studies in the context of personality and TA did not measure honesty–humility (see the discussion under Research Stream 1 in the related work section), it is not possible to compare our results to such earlier studies.

Moreover, extraversion was positively related to all TAM scales (see Table 2). Individuals with high scores on the extraversion scale “feel positively about themselves, feel confident when leading or addressing groups of people, enjoy social gatherings and interactions, and experience positive feelings of enthusiasm and energy” (<http://hexaco.org/scaledescriptions>). This result confirms prior evidence which showed that extraversion is significantly positively related to intention to use [13]. This is also in line with other works showing that people using social media technologies, which can be accessed via the smartphone, are more extraverted than those who are refraining to use such technologies [36]. Moreover, such person groups might even show more intense use in terms of durations on platforms such as WhatsApp [41]. In sum, technologies fulfilling the stronger social needs of extraverted individuals should also be more embraced by such a user group.

Individuals with high scores on the openness (to experience) scale “become absorbed in the beauty of art and nature, are inquisitive about various domains of knowledge, use their imagination freely in everyday life, and take an interest in unusual ideas or people” (<http://hexaco.org/scaledescriptions>). We found that openness was significantly negatively correlated with perceived usefulness. Svendsen et al. [13] found that openness (to experience) is positively

correlated with perceived usefulness. Thus, our data do not confirm this prior result. A possible explanation of this finding could be that Svendsen et al. [13] investigated a “software tool designed to take care of digital contents like images, music, and files” (p. 328). Thus, this technology is high in hedonic value, which could explain the positive relationship between openness (to experience) and perceived usefulness. However, it is interesting to note that Devaraj et al. [11] could not confirm their hypothesis that openness (to experience) would be positively associated with beliefs about the perceived usefulness of technology (a collaborative technology which supported project management, and hence a non-hedonic technology, was investigated, $r = -0.04$). It follows that the data of the present study confirm the finding of Devaraj et al. [11].

The central research question of this study is whether gender moderates the personality-TA relationship. Our analyses revealed nearly no significant moderation effects. Yet, we found a negative association between altruism and ITU in men, but a positive association in women. In line with this result, we further found a negative association between PUs and altruism in men, but a positive one in women. Altruism refers to “a tendency to be sympathetic and soft-hearted toward others. High scorers avoid causing harm and react with generosity toward those who are weak or in need of help, whereas low scorers are not upset by the prospect of hurting others and may be seen as hard-hearted” (<http://hexaco.org/scaledescriptions>). What follows is that in men, when altruism is high, intention to use the smartphone, and predicted usage of the smartphone, is low. In contrast, in women, when altruism is high, intention to use the smartphone, and predicted usage of the smartphone, is high. Although this moderation effect is interesting, we clearly do not want to over-interpret it. It is noteworthy that it was the only moderation effect that we observed regarding gender on the personality-TA relationship and it is also of importance that it was only observed on one facet of personality. Hence, in the absence of a directed hypothesis and the need to correct for multiple testing, it is questionable if this finding is robust. Moreover, the effect size is weak as well. This all said, and if such a finding would be replicated in other samples, it could mean that in men and women prosocial behavior in the context of technology use might take other directions.

When interpreting our results, one has to consider the following limitations, which should deserve attention in future research. In our study, we did not measure actual usage behavior in a specific usage scenario. Rather, we asked our study participants about their general perceptions of smartphone acceptance with reference to two application scenarios of this technology, namely business and personal. This approach is similar to the methodological approach used in McElroy et al. [12]. However, in the study by Devaraj et al. [11] subjects actually used a collaborative technology which supported project management activities and actual usage of this technology was measured based on activity log files. The other TAM constructs such as perceived usefulness and perceived ease of use were collected via survey. A similar approach was used by Barnett et al. [10]. Here, the instructors of a business class invited students to use a web-based course management system and subjects could use the system as often as desired and use was voluntary. The TAM constructs were measured via survey; yet, actual usage was measured via “actual logged system usage data for each student” [10] (p. 381). Another approach was used in the study by Svendsen et al. [13]. They collected data online and when the subjects went to the specific website of the study they had to read a description of the technology (“software tool designed to take care of digital contents like images, music, and files” (p. 328)), [13] and afterwards they completed the survey. It follows that while the subjects were confronted with a real-life usage scenario, actual usage did neither take place nor was actual usage measured via log files. Considering these differences in data collection approaches across the different studies, two factors become evident. First, these methodological differences may, at least partly, explain differences in research findings. Second, future studies should confront a mixed-gender sample with an actual usage situation and should also measure actual usage via log files (like Barnett et al. [10] and Devaraj et al. [11] did).

In this realm, it should also be mentioned that a new research discipline called psycho-informatics deals with the question of how psychological variables are linked to online-behavior or interactions with the Internet of Things [42–44]. Here, a growing body of research already demonstrated robust links between smartphone and smartphone application use and personality

[45–48], something to be supplemented by TAM variables in the near future. Of note, adding this layer is of high relevance as certain smartphone variables are not accurately reported via self-report [49,50]. This said, we are also convinced that self-report variables will always provide information beyond recorded data, because assessing what's going on in the inner mind of a person including the subjective assessments of one's own person (here personality or attitudes), will always rely to some extent on self-report [44]. This said, digital phenotyping or mobile sensing in the realm of psycho-informatics represents an interesting new research area where tracked variables of the smartphone could already be linked to both brain imaging variables [51] and molecular genetic variables [52] in the recent past. See also for new developments in neuro-psychopharmacology the work by Smith [53]. For privacy and ethical concerns in the age of surveillance capitalism [54] please see the works by Dagum and Montag [55] and Montag, Sindermann, and Baumeister [56].

Another limitation of our study is the imbalance in the number of men ($n = 209$) and women ($n = 477$). It follows that while we believe that our male sample size with more than two hundred subjects is large (at least if compared to most of the related work described above: McElroy et al. [12]: $N_{\text{men+women}} = 132$, Devaraj et al. [11]: $N_{\text{men+women}} = 180$, Barnett et al. [10]: $N_{\text{men+women}} = 382$), we cannot completely rule out that some moderations were not statistically significant in the present study as a consequence of this imbalance. In other words, it is possible (yet not very likely) that a large male sample size would have made some of the moderation effects of gender on the personality-TAM relations statistically significant (but clearly the effect size of such a moderation seems to be weak according to our data). Thus, we make a call for future studies with large sample sizes and a balance with respect to male and female subjects. The study by Svendsen et al. [13] may serve as a positive example with respect to this property because their sample consisted of 1004 respondents of which 499 were men and 505 were women.

Moreover, the present study did not explicitly ask whether participants owned a smartphone. However, we can assume that the majority of participants did own a smartphone.

Additionally, it needs to be mentioned that next to personality and gender, also other variables might influence TA. In this realm, future studies should aim at (additionally) investigating variables such as income, schooling, and occupation. These variables have not been assessed in the present study but are likely to be similar across participants given the German university context for data assessment. This leads to a further limitation: the present study's sample mostly consists of young individuals, which are likely to be students. Thus, results should not be generalized to other populations. Considering this, we make a call for future studies to replicate the present investigation based on different age groups.

Moreover, in the TA literature, it is reported that an interaction exists between gender and age. Specifically, Venkatesh, Morris, Davis, and Davis [7] found that perceived usefulness was more salient to younger users, particularly men. Moreover, they found that perceived ease of use was more salient to older users, particularly women. Because the sample of the present study has little variance in age ($M=23.71$ with $SD=6.10$ years), in our analyses we controlled for age, but did not statistically calculate the interaction of age and gender. Therefore, future studies should recruit a sample with a much larger variance in age, thereby establishing a precondition for statistical computation of interaction terms.

Another avenue for future research concerns the abstraction with which personality traits are studied. Based on the HEXACO-PI-R, in the present study we investigated higher-order traits (just as all prior studies which used the big five of personality, see Research Stream 1 in the related work section). As reported, except for altruism, we did not find significant influence of user gender on the personality-TA relationship. However, it is possible that investigation of personality via more narrow traits (e.g., computer anxiety as a specific manifestation of neuroticism [22]), may reveal significant influence of gender on the personality-TA relationship. Thus, we make a call for future studies which replicate our findings based on HEXACO factors and the big five, but also see value in future studies with a focus on more narrow traits.

Finally, the smartphone is a multipurpose device allowing various apps to be used. Therefore, future studies should aim at investigating TA for separate applications. Even if the present study did

not reveal differences in associations with personality between personal and business use of the smartphone, this might be true for TA of different apps.

5. Conclusions

Technology acceptance research is of critical importance, especially in today's society where technologies such as the smartphone gain increasing importance. Prior research revealed that user personality may significantly affect technology acceptance perceptions and decisions. However, prior evidence on the moderating influence of user gender on the relationship between personality and technology acceptance is hardly available. Against this background, we conducted a survey study in which we examined the relationship between personality and technology acceptance from a gender perspective. Applying the HEXACO-PI-R (<http://hexaco.org/>) along with established technology acceptance measures, we found that honesty–humility was negatively related to all TAM constructs, whereas extraversion was positively related to all TAM constructs. Moreover, we did not find significant influence of user gender on the relationship between personality and technology acceptance, except for one notable aspect of personality, namely altruism. We recommend that future research replicates our exploratory findings, based on actual technology usage data (that complement our self-reported data) and with a focus on more narrow personality traits (this could eventually lead to identification of possible moderator effects of gender in the personality-TA relationship). In this way, it is possible to shed further light on influential variables of the acceptance of technologies such as the smartphone.

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Appendix

Partial Correlations Between the HEXACO-PI-R Scales and the Scales to Assess Technology Acceptance

Smartphone Business

In Table A1, all partial Pearson correlations (corrected for age) between the HEXACO-PI-R scales and the scales assessing TA with regard to the use of a smartphone for business purposes are presented for the total sample. As can be seen in Table A1, especially the HEXACO-PI-R scale honesty–humility is significantly ($p < 0.05$) negatively associated with the TA scales. Additionally, extraversion is significantly positively associated with all of the TA scales. Moreover, some other HEXACO-PI-R scales exhibit some correlations with some of the TA scales. When strictly correcting for multiple testing issues by manually adjusting the alpha-level (e.g., $0.05/28 = 0.0018$; divided by 28 because we investigated 7×4 correlations), only a few of the correlations would remain significant.

Table A1. Partial Pearson correlations (corrected for age) between the HEXACO-PI-R scales and the scales assessing TA with regard to smartphone use for business purposes.

	PU	PeU	ITU	PU _s
Total (N = 686)				
Honesty–Humility	r=−0.26, p<0.001	r=−0.17, p<0.001	r=−0.19, p<0.001	r=−0.19, p<0.001
Emotionality	r=−0.05, p=0.235	r=−0.13, p<0.001	r=−0.00, p=0.976	r=−0.07, p=0.055
Extraversion	r=0.16, p<0.001	r=0.19, p<0.001	r=0.14, p<0.001	r=0.10, p=0.007
Agreeableness	r=−0.04, p=0.280	r=0.04, p=0.286	r=−0.08, p=0.033	r=0.01, p=0.878
Conscientiousness	r=0.02, p=0.663	r=0.08, p=0.033	r=−0.03, p=0.403	r=−0.02, p=0.571
Openness	r=−0.12, p=0.002	r=−0.05, p=0.198	r=−0.05, p=0.214	r=−0.08, p=0.048
Altruism	r=−0.08, p=0.038	r=−0.04, p=0.259	r=−0.01, p=0.696	r=−0.14, p<0.001

Note: r = (partial) Pearson correlations (corrected for age); PU = perceived usefulness, PeU = perceived ease of use, ITU = intention to use, PU_s = predicted usage; p-values are derived from two-sided testing.

Smartphone Personal

In Table A2, all partial Pearson correlations (corrected for age) between the HEXACO-PI-R scales and the scales assessing TA with regard to the use of a smartphone for personal purposes are presented for the total sample. Again, the honesty–humility scale is significantly negatively associated with all TA scales, whereas extraversion is significantly positively related to all TA scales. The other HEXACO-PI-R scales also exhibit some significant associations with some TA scales. When strictly correcting for multiple testing issues by manually adjusting the alpha-level (e.g., $0.05/28=0.0018$; divided by 28 because we investigated 7×4 correlations), only a few of the correlations would remain significant.

Table A2. Partial Pearson correlations (corrected for age) between the HEXACO-PI-R scales and the scales assessing TA with regard to smartphone use for personal purposes.

	PU	PeU	ITU	PU _s
Total (N = 686)				
Honesty–Humility	r=−0.21, p<0.001	r=−0.15, p<0.001	r=−0.12, p=0.001	r=−0.12, p=0.001
Emotionality	r=0.06, p=0.145	r=−0.06, p=0.101	r=0.10, p=0.008	r=0.10, p=0.007
Extraversion	r=0.13, p<0.001	r=0.17, p<0.001	r=0.11, p=0.004	r=0.10, p=0.006
Agreeableness	r=−0.05, p=0.177	r=0.03, p=0.388	r=−0.10, p=0.012	r=−0.02, p=0.601
Conscientiousness	r=0.09, p=0.015	r=0.10, p=0.009	r=0.05, p=0.213	r=0.04, p=0.241
Openness	r=−0.10, p=0.007	r=−0.06, p=0.124	r=−0.07, p=0.057	r=−0.05, p=0.210
Altruism	r=−0.01, p=0.862	r=−0.01, p=0.832	r=0.03, p=0.409	r=0.01, p=0.737

Note: r = (partial) Pearson correlations corrected for age; PU = perceived usefulness, PeU = perceived ease of use, ITU = intention to use, PU_s = predicted usage; p-values are derived from two-sided testing.

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