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Similarities and differences between genders in the usage of computer with different levels of technological complexity

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ABSTRACT

Research on technology usage and acceptance has demonstrated that women and men use technology differently, and also differ in their self-perception regarding technology (e.g., women see themselves as less capable). Gender role beliefs, according to which women are expected to be less interested in and less capable of using technologies than men, have been discussed as one major reason for these differences. Such differing attributions of women and men can induce negative experiences in terms of negative feelings and can reinforce the feelings of uncertainty experienced by women. We therefore assume that the usage of technology, especially with increasing complexity, may induce more negative experiences in women than in men. We conducted a 2 (male, female) x 3 (technological complexity) between-subjects lab experiment ($N = 148$) to examine the interaction between technological complexity and users' gender. The analyses revealed that women and men differ in the perception of their technological capabilities, but not in goal achievement. Additionally, we found slight gender differences concerning positive affect, but not concerning negative affect, depending on technologies' complexity.

1. Introduction

The ever-increasing digitalization in modern-day society represents a major challenge, and is capturing the attention of politics, industry and academia. The ubiquitous usage of technologies such as information communication technology (ICT) requires increasingly higher levels of technological skills in both the private and professional sphere. Studies have revealed that women and men differ regarding their interaction with technologies, for instance with women showing fewer capabilities and less interest in using computers compared to men (e.g., Hargittai & Shaw, 2015; Imhof, Vollmeyer, & Beierlein, 2007; Van Deursen, van Dijk, & ten Klooster, 2015).

In line with these findings, some scholars have reported that technology acceptance depends on the user's gender and on the interaction of gender with the characteristics of a technology, such as the ease with which it can be used to accomplish a given task (Venkatesh, Morris, Davis, & Davis, 2003). While previous studies have yielded highly valuable findings for theory development and for practitioners, one methodological concern is that most studies do not consider users' actual behavior, but rather take the form of survey studies which gather general information about intentions to use a technology. However, intention to use and actual usage are only weakly to moderately correlated with one another (Schepers & Wetzels, 2007; Venkatesh et al., 2003; Venkatesh, Thong, & Xu, 2016), making it difficult to derive assumptions about the actual interaction behavior of women and men. In this vein, various studies have revealed that men are more likely to use technology for fun and for exploration, while women strive more for facilitated task fulfillment, such as connecting with friends and family (Jackson, von Eye, Fitzgerald, Zhao, & Witt, 2010; Liu & Baumeister, 2016; Venkatesh & Morris, 2000). Possible explanations for these differences have been suggested to lie in gender role beliefs, according to which technology usage is inherent in the gender role of men, but not in the gender role of women (Morahan-Martin & Schumacher, 2007). In addition, moderating factors with respect to different self-perceptions, such as lower self-efficacy, lower computer self-efficacy, and more computer anxiety in women, have also been discussed (e.g., Busch, 1995; Jackson et al., 2010; Saleem, Beaudry, & Croteau, 2011).

In times of continuous technological advancement and female empowerment movements, we wish to examine whether gender differences in self-perception and actual technology usage still exist. Moreover, we aim to foster the understanding of the impact of technological complexity, which is widely neglected in research on human-technology interaction. Specifically, we examine its interaction with gender regarding the effect on the user's experience (e.g., feelings), which may

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be decisive for future interactions with technology.

2. Where do gender differences in technology acceptance and usage stem from?

A broad body of research on technology acceptance and usage has demonstrated that women and men can differ in their perceptions of technology. Acceptance of a technology refers to an early stage of technology introduction, in which users form an opinion, for example, about the usefulness of a technology. By contrast, technology usage reflects the result of a positive attitude toward a technology over time.

Over two decades ago, a meta-analysis demonstrated differences in computer-related behaviors between women and men (Whitley, 1997). Since then, it has often been debated whether such gender differences are decreasing (e.g., Van Deursen & Van Dijk, 2014), since there are studies that could not find a gender gap in technology usage (e.g., Shaw & Gant, 2002). On the other hand various studies have shown that the digital divide between women and men regarding technology-related behavior still exists (e.g., Cooper, 2006). A more recent meta-analysis confirmed the basic finding that men hold more favorable attitudes towards technology than do women (Cai, Fan, & Du, 2017), suggesting that women and men have different perceptions of technology. Such differences need to be examined regularly in order to ascertain whether the gap between men and women is decreasing.

One major reason for gender differences regarding technology has been suggested to lie in the differing socialization of women and men according to their gender roles. Gender role beliefs about women and men encompass views about what women and men are like and how they should behave (e.g., Prentice & Carranza, 2002), and can be equated with cognitive stereotypes which structure the knowledge about women and men (e.g., Aronson, Wilson, & Ackert, 2013). Acting against the inherent norms of gender roles can cause discrimination, which represents the behavioral component of stereotypes (Aronson, Wilson, & Akert, 2013). Discrimination can include different forms of sanction, such as punishment, harassment, or benevolent sexism (Aronson et al., 2013; Burgess & Borgida, 1999; Fehr & Fischbacher, 2004). Research findings indicate that the more a person acts against a norm, the more punishment is elicited (Fehr & Fischbacher, 2004).

Gender role beliefs about women and men are transferred from one generation to the next through socialization starting in early childhood (Freeman, 2007). Notably, such beliefs are not equally prevalent in individuals; while some people have very strong stereotypical beliefs, others do not (Devine, 1989). Gender role beliefs about women and men refer, for instance, to their personality traits, their competencies and their behavior. Accordingly, women are assumed to be caring, gentle, interpersonally oriented and submissive (e.g., Cuddy, Fiske, & Glick, 2008; Haines, Deaux, & Lofaro, 2016), while men are supposed to be logical, competitive, good in mathematics, assertive and task-oriented (e.g., Cuddy et al., 2008; Haines et al., 2016).

Moreover, from early childhood, girls and boys are expected to be interested in highly gender-typed domains, starting with gender-appropriate toys, subject interests and technology usage. For instance, boys are supposed to be interested in cars or action figures, while girls are supposed to prefer domestic items, dolls or cosmetics (e.g., Auster & Mansbach, 2012; Campenni, 1999; Freeman, 2007). In the domain of education, boys are assumed to be more interested in fields such as science, engineering, mathematics and technology compared to girls (e.g., Cvencek, Meltzoff, & Greenwald, 2011). Specifically with respect to technology usage, women are expected to use technologies more to stay in touch with others and foster relationships compared to men (Comunello, Fernández Ardèvol, Mulargia, & Belotti, 2017).

Information is processed and interpreted differently depending on these beliefs (Bem, 1981). Gender role beliefs can have a recursive effect on women's and men's behavior as they seek to fit into their gender role. In one of the first studies in this area, Gefen and Straub (1997) concluded that women and men differ in their computer skills and usage due to their different socialization, suggesting that technology usage and acceptance are part of men's and not women's gender role. In this vein, Morahan-Martin and Schumacher (2007) stated that men more than women learn to perceive the computer as a toy and to use it for recreational proposes; the computer functions as a personal and cultural symbol of masculinity so that women stay away from it since it symbolized what they are not.

Moreover, Morahan-Martin and Schumacher (2007) suggested that women are more likely to become technophobes, which is linked to less technological expertise and lower comfort during interaction with technology, while men are more likely to become technophiles with high technology expertise.

In line with these reflections, Selwyn (2007) found that certain technologies are perceived as rather feminine or rather masculine: Emailing, e-learning and graphics are seen as feminine technologies, while online banking, laptops, digital cameras and digital music are perceived as masculine technologies.

Moreover, current discussions still reflect the perception that technology remains genderized and fits more into the gender role of men than of women (Comunello et al., 2017; Elsbach & Stigliani, 2019; Hacker, 2017; Pechtelidis, Kosma, & Chronaki, 2015). Pechtelidis et al. (2015) showed, for instance, that women are perceived rather as users of a technology while men are rather viewed as connoisseurs. Furthermore, Wynn and Correll (2017) showed that men working in the technology industry are more likely than women to believe that they match the affordances of a successful tech employee. In conclusion, it seems that women and men are socialized differently in terms of their appropriate involvement with technology.

3. Different perceptions of technology

In his seminal model of technology acceptance (TAM), Davis (1985) postulated several determining factors regarding why and under which circumstances people accept and use technology in occupational settings. The model distinguishes between different cognitive responses to a technology, such as *perceived usefulness* and *perceived ease of use*, which determine the *attitude toward using* (affective response) and *actual system use* (behavioral response). Davis found that *usefulness* is a strong predictor of technology use, while *ease of use* affects usage indirectly via usefulness. Subsequent research adopted the TAM and applied new theories to predict users' response to technology (for an overview see Venkatesh et al., 2003; Venkatesh, Thong, & Xu, 2012; 2016), confirming the importance of the determinants usefulness and ease of use (e.g., Kim, 2010; Terzis & Economides, 2011) and adding several other predictors. However, the TAM did not initially consider users' gender.

Gefen and Straub (1997) were among the first researchers to claim that the user's gender can be decisive for technology acceptance and use, suggesting direct effects of gender on usage, usefulness and ease of use. Although the authors were unable to confirm their hypotheses on gender-specific technology usage, their findings did reveal different perceptions of technology in women and men, with women rating usefulness as more decisive for their technology usage compared to men. In contrast, Venkatesh and Morris (2000) argued that men have more interest in using a technology for efficient goal accomplishment, because their gender role expects them to act in a more task-oriented manner. Women, by contrast, are assumed to more greatly appreciate ease of use compared to men, because they are assumed to lack ability and experience with technology. However, more recent studies have yielded mixed results in this regard: While some studies indicated that women value ease of use and usefulness with respect to their usage of mobile internet services (Khedhaouria & Beldi, 2014; Khedhaouria, Beldi, & Belbaly, 2013), others found that usefulness is valued more by men than by women (Okazaki & dos Santos, 2012).

In addition, Venkatesh and Morris (2000) suggested that *social influence* is more meaningful for women than for men. *Social influence* refers to the idea that important others (e.g., supervisors, friends) expect the user to use the system. Venkatesh et al. (2003) noted the term's similarity to concept of *social norms*, which are conceptualized within the Theory of Reasoned Action (see Venkatesh et al., 2003). Moreover, the authors stated that "While they [the terms] have different labels, each of these constructs contains the explicit or implicit notion that the individual's behavior is influenced by the way in which they believe others will view them as a result of having used the technology" (Venkatesh et al., 2003, p. 451). Referring to findings that men are less likely to accept majority opinions, are less compliant and more likely to oppose orders than women, Venkatesh and Morris suggested that social influence is a more pivotal predictor for women than for men, and their analyses confirmed this assumption. However, they also found that while social influence affected women's initial usage, this effect diminished over time. From these findings, the authors derived that the intention to use a technology, especially in men, is mostly driven by beliefs that conform to gender roles. In further studies, Venkatesh et al. (2003) and Venkatesh et al. (2012) confirmed their initial findings.

Notably, however, contradictory findings have also emerged in this area. For instance, in the educational context, Wang, Wu, and Wang (2009) found that social influence is more decisive for men than for women. The same pattern was demonstrated by Tai and Ku (2013), who investigated stock trading through technology. They argued that one reason for this may lie in the complexity of the technology, because more advanced skills are required to accomplish stock trading through technology and women may feel less attracted by such a complex technology. This in turn may lead to a lower probability that their peers influence them in using this technology.

In addition, Yu (2012) found that social influence is an important predictor of mobile banking usage but were unable to find any gender differences in the relation between social influence and usage.

Nevertheless, social influence does appear to be a predictor of technology usage and it seems reasonable to assume gender differences in the perception of technology.

4. Different usage of technology

The different perception of women and men may in turn affect attitudes towards technology and its usage. Calvert, Rideout, Woolard, Barr, and Strouse (2005) revealed that children's interest in computers becomes more differentiated by gender over time. The authors found that the interest in computers does not differ according to gender in very young children, but becomes gender-typed as they grow older, insofar as girls' interest diminishes. A recent meta-analysis confirmed the basic finding that men have more favorable attitudes towards technology than women (Cai et al., 2017).

However, there may be domains in which this gap is reduced or shows the reverse pattern: Huang, Hood, and Yoo (2013) reported that women have more positive attitudes towards social networking sites than do men, but found no gender differences for wikis, blogs, immersive virtual environments, games and sharing videos online, indicating high attitudinal similarity between women and men.

The research findings regarding actual usage are also mixed. Jackson et al. (2010) found that boys play more video games than do girls, and Tondeur, Valcke, and Van Braak (2008) revealed that male teachers use computers more often in school compared to female teachers. Morahan-Martin and Schumacher (2007) found that men use twice as many cutting-edge applications or technology involving greater technological sophistication than women. Moreover, Li and Kirkup (2007) found that men use email and chat rooms and play video games to a greater extent than women. Jackson et al. (2010) reported that men go online more often and for longer periods of time, and that women are more likely to use the Internet to connect with family, while men are more likely to use it for commercial transactions. By contrast, Padilla-Meléndez, del Aguila-Obra, and Garrido-Moreno (2013) revealed that in a blended learning setting, behavioral patterns of system usage are fairly similar in women and men.

In terms of women and men's expertise, Cooper (2006) found that men attribute themselves with more skills than do women. In a survey study, Morahan-Martin and Schumacher (2007) asked participants to state which computer-related skills they possess (e.g. writing a computer program, changing cookie preferences), and found that men state that they have greater technological expertise.

In a valuable study assessing behavioral outcomes, Imhof et al. (2007) asked male and female students to complete a computer task (remastering of Power-Point slides), and found that male students outperformed female students on the task, while gender differences did not emerge with regard to aspects such as usage times and preferred activities. Kay (2006) found that self-reported gender differences in computer skills existed before undergoing training in a laptop program but not afterwards – with the exception of programming, in which men still scored higher. In addition, Scherer and Siddiq (2015) demonstrated self-reported differences in basic (e.g., emailing a file) and advanced (e.g., installing software) operational computer skills, with men scoring higher in both aspects. Given the different methods of assessing users' skills, it seems that self-reports and actual performance do not necessarily correlate perfectly. People who believe themselves to have sophisticated skills might perform weakly, while people who describe themselves as less skillful might perform well.

In summary, users' gender seems to have an impact on the usage of technology and on technological expertise. However, studies focusing on the actual performance of women and men are lacking.

4.1. Self-perception of users

From a psychological perspective, the question arises of whether other concepts inherent in the individual are responsible for or intertwined with these gender-specific perceptions and decision-making processes. For instance, Jackson et al. (2010) demonstrated that the self-concept, self-esteem and gender of young teenagers are related to technology usage. While their work used a more general approach to determine technology usage, we will focus on more specific, gender role-related and technology-related concepts.

According to Bandura (1982), self-efficacy can be described as the individual's beliefs about his/her ability to perform a particular task. Self-efficacy has been shown to predict an individual's decision about whether to engage in an activity, the amount of effort put into a task, and the level of perseverance demonstrated. Therefore, general self-efficacy beliefs might influence whether people decide to engage with technology and whether, and for how long, they try to solve a task and overcome problems (Galpin, Sanders, Turner, & Venter, 2003; He & Freeman, 2010). The concept has long been described as an important predictor for handling technology and was identified early on as a crucial variable that is prone to gender differences (Brosnan, 1998; Busch, 1995; Young, 2000), with findings that women score lower on self-efficacy than men.

Self-efficacy is a domain-unspecific concept, which represents a general personality disposition. To capture domain-specific efficacy, the concept of computer self-efficacy (CSE) has emerged (Compeau & Higgins, 1995). While CSE is often assessed in accordance with a specific computer task (e.g., installing software), "'general computer self-efficacy' (GCSE) refers to an individual's judgment of his or her ability to perform across multiple computer application domains" (Marakas, Johnson, & Clay, 2007, p. 17), which represents the result of all computer-related experience across the lifespan (for a review see Marakas et al., 2007). Furthermore, Scherer and Siddiq (2015) emphasized the need to assess CSE multidimensionally in order to capture beliefs regarding different dimensions of CSE, in contrast to the broad body of research, which captures CSE unidimensionally. The authors assumed that this procedure would better reflect CSE in terms of digital literacy. Indeed, studies have found differences as well as similarities in the sub-dimensions of CSE between women and men (Cooper, 2006; Scherer & Siddiq, 2015). Referring to a mostly unidimensional assessment, Cooper (2006) summarized that the differences between men's and women's self-efficacy regarding technology and computers is consistent across the world.

In conclusion, it seems that women and men perceive themselves in different ways when they are asked which skills they have and how confident they are in accomplishing a technology-related task.

Two other relevant concepts that have been identified as influencing the handling of technology are computer anxiety and locus of control. Here too, gender differences have long been described. Cooper (2006) reported that women's disadvantages regarding computer performance stem from their computer anxiety. Various studies have confirmed that there are gender differences concerning anxiety about computers in general (see a meta-analysis by Chua, Chen, & Wong, 1999) but also concerning anxiety about "potentially catastrophic computer failure" (Schottenbauer, Rodriguez, Glass, & Arnkoff, 2004, p. 78). Huang et al. (2013) revealed that compared to men, women show significantly more anxiety when using blogs, wikis, virtual environments and games.

The concept of locus of control, which stems from social learning theory, describes the extent to which an individual perceives him/herself as being in charge of his/her own actions, or believes that outcomes are controlled by external factors (Spector, 1988). Individuals learn the relation between actions and their consequences, and these consequences can be rewarding and reinforcing. The locus of control in human-computer interaction refers to a problem which cannot be immediately solved due to lacking resources, and represents an undesired state (Beier, 1999). In this context, it seems that women perceive themselves to be out of control when faced with a technology-related problem, while men perceive themselves to be in control. In view of all of these differences in self-perception, it is reasonable to assume that the user's actual experience during or after a technology-related action can fuel or mitigate future interactions based on implicit learning processes (Koch & Stahl, 2017). Referring to Koch and Stahl (2017), these learning processes have an incidental, inattentive and subliminal character, as opposed to explicit learning which is predominantly applied, for instance, in school (Koch & Stahl, 2017). Learning is the outcome of experience, which can be defined as any affective, cognitive or behavioral response elicited by a former stimulus, such as a particular task. Such experiences can have long-lasting effects on an individual's behavior (Koch & Stahl, 2017).

We assume that having pleasant experiences, for instance in the form of positive affect, during or after accomplishing a task using certain software, may increase women's self-perception, for instance, concerning her computer-related skills.

This is also in line with women's and men's socialization processes, within which men gather more (positive) experiences with technology. By contrast, having a negative experience, failing on a task, or encountering unforeseen technology-related problems, might have a reinforcing effect in terms of avoiding technology-related actions in the future. Such negative experiences might exert their effect in terms of self-affirmation (not being able to handle technology). To provide more information about experiences in response to technology usage, it is essential to capture actual users' reactions.

4.2. Hypotheses and research questions

In sum, research indicates that women and men differ in terms of their acceptance and usage of technology. To determine whether this gender gap is closing, it seems to be important to first review previous findings concerning well-researched variables, which refer to perceptions of technology, self-perception and usage of technology.

According to various research findings (e.g., Venkatesh et al., 2012; Venkatesh & Morris, 2000), social influence is more important for women than for men. Thus, we state the following hypotheses:

H1. Women score higher on social influence than men.

In addition, there are several differences in the self-perceptions of women and men, especially regarding technology usage and technological capabilities (Cooper, 2006; Scherer & Siddiq, 2015). First, women seem to experience more anxiety regarding technology than men. Second, women may experience less control over their technology-related actions.

Moreover, women report less general self-efficacy than do men (e.g., Busch, 1995), rendering them less confident in their ability to perform a technology-related action, for instance solving a specific task. Scherer and Siddiq (2015) reported that men have higher computer self-efficacy in basic and advanced operational skills compared to women. These lower self-attributed skills in women might reduce their self-confidence in solving a technology-related task and fuel their impressions of incompetence. Therefore, we assume the following hypotheses:

H2. Women show more computer anxiety than do men.

H3. Women show a more external locus of control than do men.

H4. Women score lower on self-efficacy than do men.

H5. Women report lower a) general computer self-efficacy, b) basic operational skills and c) advanced operational skills than do men.

Furthermore, based on the aforementioned findings that women perceive themselves to lack technology-related competencies, it is conceivable that women avoid technology-related actions, if they have the chance to do so. For this reason, we assume that the complexity of a technology (e.g., the number of functions, design, difficulty to use) might be important for decision-making. If a task can be accomplished by using less complex technology in contrast to using sophisticated technology, women might be more likely than men to choose the less technologically complex method. We therefore assume the following hypotheses:

H6. Women will accomplish a technology-related task less often than men.

H7. Women will decide less often to use a more complex technology to accomplish a given task compared to men.

Given that women show lower self-confidence in their technology-related competencies compared to men, we assume that:

H8. Increasing technological complexity will lead to more negative experiences in women than in men.

In addition, we wish to examine which factor (specified in H1-H5 plus technological complexity) is the strongest determinant of user's experiences. Therefore, we ask the following research question:

RQ1. What is the strongest predictor of user's experiences when using technology to accomplish a given task?

5. Method

5.1. Study design

To examine our hypotheses and research question, we conducted a lab experiment with a 2 (participants' gender) x 3 (technological complexity) between-subject design ($N = 148$, 83 women, 65 men) after it was approved by the local ethics committee. Referring to Field (2013) and Miles and Shevlin (2001), the interdependence of predictors and the number of participants allows for the detection of a medium or strong effect size.

Approximately half of the participants ($n = 79$) were free to choose the technology (varying in complexity) with which they completed the experimental task, while the other half ($n = 69$) were randomly assigned to one technology (classic mail/paper, email, online system, more details below). This allowed us to address the question of whether women avoid more complex technology, and also to calculate the effects of the differing technologies independently of freedom of choice. To be able to collapse the data, we conducted MANOVAs with freedom of choice as independent variable and all dependent variables; the analysis showed no significant main effects of freedom of choice.

5.2. Procedure

The experiment took place in a lab at a large German university. Participants were recruited personally online and offline, and advertisements were also placed in various newspapers. The experiment comprised three parts: completing a pre-questionnaire, completing the experimental task (simulation of a job application) and completing a post-questionnaire.

After welcoming participants to the lab, the experimenter instructed them to complete a first questionnaire, in which we asked for their informed consent and measured some trait variables, such as self-efficacy, on a laptop. Next, they were instructed on the display to complete a task (applying for a job) on another computer workstation. When they had finished the application task, they returned to the laptop to complete the second part of the questionnaire (see experimental set-up in Fig. 1). All participants were left alone for the trial but were able to contact the experimenter in person at any time if problems occurred. At the end of the experiment, participants were debriefed, thanked and either remunerated with course credits (if they were students at the university) or 10 Euros. The total duration of the experiment was approximately 35–50 min.

5.3. Experimental manipulation

5.3.1. Technological complexity

To create as realistic a situation as possible in terms of technology usage in the job context, participants were told to imagine that they wished to change job and now had the opportunity to apply for a new job. Therefore, we prepared the customary job application documents (letter of interest, CV, diplomas, employer references), which were placed on desktop computer and had to be edited (e.g., filling in their name and place of residence) and finished by the participants. To vary the complexity of the technology, three types of application were used: a) classic mail/paper, b) email and c) online system. Complexity increased according to more steps (sub-tasks), which had to be completed on the computer to accomplish the task.

The application via classic mail comprised editing the application documents, printing them out, labeling the application and placing the completed application in a provided mailbox. In the email condition, participants had to edit the documents, convert them into one PDF document and send the PDF document as an attachment using a preinstalled email program or their own email account to a given address. In the online condition, participants had to edit the documents, convert them into a PDF document, fill in their personal data (e.g., address, former employers, duration of employment) in the online system, and upload the PDF document to the online system in order to finally send the application by pressing the send button.

5.4. Instruments/Measurements

5.4.1. Social influence

Referring to social influence of the unified theory of acceptance and usage of technology 2 (UTAUT 2; Venkatesh et al., 2012), we measured the perceived importance of digital job applications. Some items were adapted in order to maintain the authenticity of the experiment (e.g., "I think that it is expected [by the organization] to apply for a job digitally" or "I think it makes the best impression [at the organization] to apply digitally"), as the original items by Venkatesh (e.g., "People who are important to me think that I should use the system") do not fit the experimental setting. Items were rated on a 7-point scale (1 = *do not agree*; 7 = *totally agree*; α = 0.70).

5.4.2. Self-efficacy

General self-efficacy was assessed using the Generalized Self-Efficacy Scale by Jerusalem and Schwarzer (1999), with items rated on a 4-point scale (1 = *not at all*; 4 = *absolutely*; α = 0.87). A sum score was calculated, with high scores representing high self-efficacy and low scores representing low-self-efficacy.

5.4.3. Computer-self-efficacy

Computer-self-efficacy was measured by means of different scales. First, we employed the General Computer Self-Efficacy Scale by Marakas et al. (2007), which consists of six items (e.g., "I believe I have the ability to describe how a computer works"). Items are rated on a 10-point scale (1 = *not at all confident*; 10 = *totally confident*; α = 0.83). Second, we captured advanced and basic operational skills by adapting the scales of Scherer and Siddiq (2015). The advanced skills scale comprised four items (e.g., "I can collaborate with others using shared resources such as [Google Docs]"); we added two items to the advanced scale due to their topicality ("I'm capable of creating a blog" and "I'm capable of creating pictures and videos and making them available on the Internet, for instance on Instagram"; α = 0.76). The basic skills scale included five items (e.g., "I can store digital photos on a computer; α = 0.73). All items were rated on a 10-point scale (1 = *not at all confident*; 10 = *totally confident*).

5.4.4. Anxiety

In line with previous research, for instance by Venkatesh et al. (2003), we measured anxiety using three items (e.g., "I would use a technology if I were not afraid of making mistakes I cannot correct"). Items were rated on 7-point scales (1 = *do not agree*; 7 = *totally agree*; α = 0.91).

5.4.5. Locus of control concerning technology

We used the scale by Beier (1999) to measure the locus of control concerning the usage of technology, with six items (e.g., "When I solve a technical problem, it usually happens because I got lucky") rated on a 5-point scale (1 = *do not agree*; 5 = *totally agree*; α = 0.86).

5.4.6. Experiences

Affect. To capture participants' experiences, we measured affect and time. Using the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), we measured positive and negative affect after the application task (e.g., "How active do you feel?"; "How angry do you feel?"). Items were rated on a 5-point scale (1 = *not at all*; 5 = *absolutely*). Good reliability values were found for the subscales (positive affect α = 0.90; negative affect α = 0.80).

Time needed. In addition, we recorded screen activity at the workstation on which participants had to complete the application task. We captured the time which they needed to accomplish the application in seconds.

Goal Achievement. We coded whether or not participants accomplished the application task. The task was seen as accomplished when participants posted the mail, sent the email, or submitted data to the online system, respectively.

5.4.7. Sociodemographic variables

Participants' sociodemographic characteristics (gender, age, level of education) were recorded.

5.4.8. Familiarity

We assessed the participants' level of familiarity with each type of application on a 7-point scale (1 = *not at all familiar*; 7 = *very familiar*).

5.4.9. Access to ICT

Access to ICT was measured using the ad-hoc items "How many Internet-ready devices do you have?" and "How many years of experience do you have with the Internet?".

5.4.10. Immersion in test situation

To examine whether the test situation was realistic and whether participants immersed themselves in the test situation, we asked "How well were you able to place yourself in this test situation?", which was answered on a 7-point scale (1 = *not at all*; 7 = *very well*).

5.5. Sample

The initial sample comprised 187 participants, 39 of whom had to be excluded for the following reasons: One participant detected the screen recording, eight participants were excluded due to technical problems (e.g., the screen recording failed, the laptop broke down) and 30 participants ($n_{Paper} = 5$, $n_{Email} = 25$; $n_{OnlSyst} = 5$) did not follow the instructions correctly, i.e. they were instructed to apply via email, but instead applied via classic mail/paper or the online system or both. The excluded participants did not differ from the final sample in terms of sociodemographic characteristics (e.g., gender, age). However, they showed slightly lower scores on self-efficacy, general computer self-efficacy, basic operational skills, advanced operational skills, anxiety and locus of control.

The final sample thus comprised 148 participants (83 females, 65 males). Their age ranged from 18 to 67 years ($M = 25.11$, $SD = 9.35$). In terms of highest educational attainment, 20% held a university degree (e.g., Bachelor or higher), 77% had a university entrance-level certificate, and 5% named other qualification (e.g. graduated from a medium-track school at end of tenth grade). On average, participants possessed 3.7 Internet-enabled devices ($M = 3.70$; $SD = 2.12$) and had been using the Internet for 12 years ($M = 11.76$; $SD = 4.54$).

Participants were, on average, moderately familiar with job applications via classic mail/paper ($M = 3.98$; $SD = 2.08$), email ($M = 4.94$; $SD = 1.81$) and an online system ($M = 4.28$; $SD = 2.08$). In addition, participants stated that they were able to immerse themselves in the test situation fairly well ($M = 4.94$; $SD = 1.47$).

Nineteen women completed the job application via classic mail, 25 via email and the remaining 39 via the online tool. Seventeen men completed the classic mail application, 27 applied via email and 21 completed the online tool.

6. Results

In order to examine H1–H5, considering simple effects of participants' gender, we conducted a MANOVA with gender as independent variable and the following dependent variables: social influence, self-efficacy, general computer self-efficacy, basic operational skills, advanced operational skills, anxiety and locus of control (Table 1).

The analysis revealed that women scored lower on social influence (contradicting H1), self-efficacy (confirming H4), general computer self-efficacy (confirming H5a) and advanced operational skills (confirming H5c). In addition, women scored higher on locus of control, indicating an external attribution (confirming H3). H5b and H2, which referred to gender differences in basic operational skills and anxiety, were rejected.

To address H6, referring to whether women accomplish applications less often with increasing technological complexity, we conducted a Chi^2 test ($n = 148$). The analysis revealed no significant difference in women's and men's goal achievement, $\chi^2(1) = 0.00$, $p = 1.000$, $\varphi = 0.00$.

To assess H7, which assumed that women are less likely than men to choose a technologically complex method of application, we conducted a Chi^2 test for the subsample ($n = 79$) of participants who were able to freely choose their application method. The analysis revealed no significant difference in women's and men's choice of application method, $\chi^2(2) = 2.61$, $p = .271$, $\varphi = 0.18$.

H8 referred to the interaction between participants' gender and technological complexity with respect to their positive or negative experience. To examine our assumptions, we conducted a MANOVA with gender and technology as independent variables and both affect scales as dependent variables. Starting with positive affect, the analysis showed no significant main effects for gender, $F(1, 142) = 0.09$, $p = .765$, $_{partial}\eta^2 = .001$, or technological complexity, $F(1, 142) = 0.08$, $p = .925$, $_{partial}\eta^2 = .001$, but the interaction between the two was significant, $F(2, 142) = 3.13$, $p = .047$, $_{partial}\eta^2 = 0.042$, indicating that women experienced most positive affect after applying via paper ($M_{Paper} = 3.35$; $SD = 0.69$) followed by email ($M_{Email} = 3.04$, $SD = 0.76$), and the online system ($M_{OnSyst} = 3.03$, $SD = 0.78$) (see Fig. 2). In contrast, men experienced most positive affect when applying via the online system ($M_{OnSyst} = 3.35$, $SD = 0.91$), followed by the email application ($M_{Email} = 3.28$, $SD = 0.62$) and the paper application ($M_{Paper} = 2.91$, $SD = 0.82$).

Furthermore, negative affect was not influenced by gender, $F(1, 142) = 2.85$, $p = .094$, $_{partial}\eta^2 = .020$, technological complexity, $F(1, 142) = 1.37$, $p = .259$, $_{partial}\eta^2 = .019$, or the interaction between these variables, $F(2, 142) = 0.15$, $p = .863$, $_{partial}\eta^2 = 0.002$.

In addition, we conducted another ANOVA with gender and technological complexity as independent variables and the time needed to complete the application (in seconds) as dependent variable. The analysis revealed a significant effect for technological complexity, $F(1, 142) = 8.24$, $p < .001$, $_{partial}\ \eta^2 = .104$, indicating that those applying via email needed more time ($M = 1746$, SD 581) for the application than those applying via classic mail ($M = 1290$, $SD = 316$) and the online system ($M = 1367$, $SD = 657$). There were no significant effects for gender, $F(1, 142) = 0.064$, $p = .800$, $_{partial}\ \eta^2 = .000$, or for the interaction of gender and technological complexity, $F(2, 142) = 1.11$, $p = 332$, $_{partial}\ \eta^2 = .015$.

To examine which variables are the strongest predictors of participants' experiences (RQ1), we conducted multilinear regressions. To this aim, we coded dummy variables for technological complexity and created interaction variables for gender and technological complexity. We used the paper-based condition as the base category. In the first step, gender was included in the regression, followed by technological complexity (second step), the interaction of gender and technological complexity (third step), and social influence, self-efficacy, computer self-efficacy, anxiety and locus of control (fourth step). The final model for positive affect was not significant, $F(12, 147) = 0.95$, $p = .502$, $r^2 = 0.078$. The model for negative affect was statistically significant, $F(12, 147) = 2.18$, $p = .016$, $r^2 = 0.162$; however, none of the coefficients reached significance. The model for time required to accomplish the task was marginally significant, $F(12, 147) = 1.73$, $p = .067$, $r^2 = 0.133$. The coefficients show that the contrast between the paper-based application and the email condition was the only significant predictor, $b = 0.38$, $t(135) = 2.49$, $p < .014$, CI [97.46, 846.62]).

7. Discussion

The current study aimed to examine gender differences, the impact of technological complexity, and the interaction between gender and technological complexity on participants' experience, under the assumption that the experience may be important in terms of reinforcing normative gender role beliefs.

First, we found further evidence that women and men perceive technology differently. However, in contrast to previous findings by Venkatesh and Morris (2000) and Venkatesh et al. (2012) that due to their gender role-congruent socialization, women are more prone to follow rules and are more concerned about the opinion of others than men, we found the reverse pattern of results. In the present study, the men attributed social influence with greater importance than did women.

One may argue that the reason for this difference may lie in the fact that we did not use exactly the same items as Venkatesh et al. (2003), and rather adapted the items for our experimental setting. However, Wang et al. (2009), who used the same general items as Venkatesh et al. (2003), also found the reverse pattern of results. Therefore, it is unlikely that this difference is merely attributable to the adaptation of items.

Wang et al. (2009) argued that women are less familiar with advanced technology, making them more resilient to social influence, as the obstacle they would have to overcome by using the technology is too high. Taking our findings concerning self-perception into consideration, for instance that women attribute themselves with lower general computer self-efficacy, this could provide a reasonable explanation for our results. Moreover, the study by Tai and Ku (2013) also yielded the same pattern of findings as in the present study. As an explanation for their findings, the authors reasoned that handling a technology could have been too complex and that much more advanced skills would have been needed, thus hindering women from using the technology.

Another explanation may lie in the genderized perception of technologies (Selwyn, 2007). The used technologies could have been perceived as more "masculine", meaning that men were more aware of their gender role and the inherent expectations of being able to deal with technologies. This, in turn, could have led them to answer in a manner more congruent with such expectations.

However, we can only speculate about what elicited this result, and merely note that the perception of social influence differs between the genders. Future studies could focus on the question of under which circumstances women and men rate the importance of social influence in technology usage differently, for instance by varying the technology domain, its complexity, or the context of technology usage (e.g., private setting, job setting, peers vs. supervisors).

Furthermore, our findings revealed differences in self-perceptions of women and men. In line with previous studies (e.g., Busch, 1995; Cooper, 2006; Huang et al., 2013; Scherer & Siddiq, 2015), the present analyses showed that women attribute themselves with lower self-efficacy, lower general computer self-efficacy, less advanced operational skills, and less control over technology usage than do men. Concerning self-efficacy captured as a trait variable, it should be noted that the average ratings for women and men in our sample are comparable with the norm values for the German population (Hinz, Schumacher, Albani, Schmid, & Bräher, 2006). On the one hand, this points in favor of the general representative power of our sample, and on the other hand, the norm values suggest that a general difference between women and men will emerge when using this particular self-efficacy scale.

On the whole, our findings indicate that women perceive themselves as less competent concerning their interaction with technology. However, the results also show that women do not experience more anxiety than men and do not differ from men with respect to basic operational skills. This could point to a slow narrowing of the gender gap, as suggested by Cai et al. (2017). Nonetheless, the differences in self-perception found in the present study give reason to assume that gender role beliefs induce the mindset of lower competence of women regarding technology. Furthermore, we suggest that this is further underpinned by the non-significant differences between men and women concerning behavioral factors in our study.

Contrary to our expectation that women would be less likely to choose a more complex technology to accomplish a given task than men, we found no such gender difference: Women were just as likely as men to choose to complete the task using email or the online system. In addition, we found no gender difference regarding task accomplishment, with women and men performing equally well in completing the given task. This is in contrast to our assumption as well as the findings by Imhof et al. (2007), who observed that men outperformed women in a Power-Point task. We assume that the current task was even more difficult than the task employed by Imhof et al. (2007), because it comprised more single steps with different technologies, whereas participants in the latter study used one single program (Microsoft Power Point) and had to reconstruct the format and style of four printed slides, which took them approximately 15 min.

In the current study, participants had to switch programs, and were required to replace placeholders within a word processing program (Microsoft Word) with their personal details, to save changes, and to use a printer, a PDF creator, an email system, or complete an online form and upload PDFs. Given that women perceive themselves as less competent in technology-related constructs than men, the present findings are interesting. We see several potential reasons for the different findings: 1) Imhof et al. (2007) had a much smaller sample ($N = 48$), predominantly consisting of students; 2) although their participants had to accomplish a less complicated task dealing with one particular program/technology, this may have been problematic for participants with less experience in using this specific program. Moreover, 3) the study by Imhof et al. (2007) was conducted over 10 years before the present study, and handling Microsoft Word or presentation programs may have become a more trivial undertaking for users in the interim.

Nevertheless, our results suggest that women and men have gender role-congruent beliefs, according to which both genders judge themselves, although their equal performance would allow for a different attribution. Referring to research on stereotypes and prejudices by Devine (1989), this might indicate that the responsible processes are subliminal and do not necessarily drive participants' behavior but are deeply rooted in the individual. Future studies should address this issue by implicitly measuring gender role beliefs concerning technology competence and usage and relate them to actual interaction behavior.

The finding that women and men do not differ in their performance and that women do not avoid more complex technology points to a behavioral change in women, indicating a slowly narrowing gender gap. It appears that in order to fully close the gender gap, women have to be further empowered in terms of fostering their self-perception.

In addition, the study examined the experiences of women and men concerning actual interaction behavior, which may potentially have recursive/reinforcing effects on a person's gender role beliefs and future behavior.

First, as mentioned above, women did not perform worse than men. Thus, a reinforcing effect stemming from failure can be ruled out for women. However, we captured experienced affect and time needed for task accomplishment, and assumed that with increasing technological complexity, women would have more negative experiences than men. The analyses demonstrated that women did not need more time to accomplish the task, and did not experience more negative affect, irrespective of the technological complexity. Thus, it appears that a reinforcing effect of gender role beliefs, caused by increased negative affect or more required time, can be neglected at this point.

However, we found an interaction effect between technological complexity and gender with respect to positive affect, insofar as women experienced more positive affect when accomplishing the task via the classic mail/paper method as compared to the other two methods (email and online system). The reverse pattern emerged in men, who experienced the most positive affect when accomplishing the task using the online system, directly followed by the email method and the classic mail/paper method. This result is generally in line with gender role beliefs, specifically that technology is inherent in men's gender role but not inherent in women's gender role (e.g., Morahan-Martin & Schumacher, 2007).

Moreover, this finding also seems to correspond to previous study findings that enjoyment is a more decisive factor in men than in women when it comes to the behavioral intention to use a technology (e.g., Jackson et al., 2010; Khedhaouria & Beldi, 2014; Venkatesh et al., 2012; Venkatesh & Morris, 2000). However, we can only speculate about an underlying link between enjoyment and pleasant feelings, as we did not measure enjoyment in the present study. Future studies should therefore investigate this potential association.

In terms of the difference between men and women regarding the technology used, it should be noted that ratings on the positive affect scale were in the moderate range, thus suggesting only minor differences. It may therefore be argued that this moderate level of positive affect was unlikely to reinforce gender role beliefs, such as beliefs that women cannot handle technology while men are more competent in doing so. Nevertheless, although the differences are small, they do fit with the assumptions of gender roles. For this reason, we suggest that future studies should focus further on technological complexity and its interaction with participants' gender in order to provide more insights into this relation. Future studies should first attempt to replicate our findings, before addressing whether and how an individual's self-concept is altered in the short and long term.

We suggest that more research on actual performance of women and men, as well as elicited emotional, cognitive and behavioral reactions, is needed to gain a better understanding of potentially recursive effects on women's and men's technology-related behavior. The finding that the women in our study did not perform worse than men, but seemed to be harder on themselves concerning their self-perceptions, gives rise to the assumption that gender role beliefs are deeply rooted in our participants.

Our study demonstrates, in line with previous research, that women and men perceive technology-related concepts differently, but that no gender differences emerge when it comes to performance. As an implication for daily life, it appears that women still need to be empowered in terms of improving their self-perception. Moreover, our findings emphasize that although women may rate themselves as less skilled, which may affect the way in which they describe themselves, for instance in job interviews or in other job-related discussions, they probably will not perform worse on the job. Therefore, it may be useful to provide women with support, for instance by specifically addressing them in job advertisements or by employing gender quotas in technology jobs, at least in Germany, in order to contribute to a society that treats women and men equally.

7.1. Limitations

Some limitations of the present study need to be mentioned. First, none of our variables significantly predicted any of the outcome variables (time and affect). One reason for this may be that variables other than those included in the study were responsible for positive and negative affect and for the time required to accomplish the task. Moreover, our sample may have been too small to detect small effects. Referring to Field (2013) and Miles and Shevlin (2001), our sample size allows for the detection of medium and large effects; to detect small effects, we would have needed to observe more than 800 participants. The recruitment of such a large number of participants would have necessitated an online experiment. However, since we wanted to provide high internal and external validity, we decided on a lab experiment, accepting the consequence of probably missing small effects. In a future study, an online experiment should be conducted to test for small effects, while ensuring that experimental conditions, especially participants' environmental influences, are controlled for and that a realistic and complex computer task is implemented in terms of capturing actual interaction behavior.

Moreover, unfortunately, we had to exclude several participants who did not follow the instructions. This suggests that leaving the participants alone in the lab to accomplish the computer task, with instructions provided via monitor, may have induced high feelings of uncertainty in the participants, resulting in inappropriate handling of the task. Indeed, the descriptive analysis of participants' characteristics revealed that the excluded individuals scored lower on, for instance, CSE. To prevent such situations in the future, an experimenter could instruct participants at different phases of the experiment or could be present in the lab at all times.

In addition, we did not capture the perceived complexity or difficulty of the different technological methods to accomplish the given task. Therefore, there is a possibility that task accomplishment via email and online system may not have been sufficiently distinct from one another, or that the email condition was actually more complex than the online system condition. However, even if this had been the case, it would not necessarily change the interpretations of the study findings. Indeed, the only significant interaction of gender and technological complexity emerged regarding positive affect, indicating that the pivotal difference in positive affect exists in classic mail usage in contrast to email and online system usage. Nonetheless, perceived complexity should be captured in future research.

A further potential limitation refers to the composition of the sample, as we may have included too many student participants, as Akçayır, Dündar, and Akçayır (2016) demonstrated that students' technological skills increase year on year. However, we made a great effort to avoid solely recruiting from a student sample. To foster the representativeness of our participants, we approached people with diverse educational (e.g., graduating from a medium-track school) and professional backgrounds (e.g., transportation, agriculture, media). In future studies, we aim to reduce the number of highly educated people even more. This should also increase the average age of participants, making the sample more representative of the German (working) population, since our sample was 25 years old on average.

A further advancement might be to capture participants' actual gender role beliefs in general to ensure that our interpretations are in line with participants' actual beliefs. In addition, more attention should be paid to self-perception concerning gender role beliefs, i.e. whether participants attribute more purportedly 'feminine' or 'masculine' characteristics to themselves. In the current study, we focused on a sample fitting into a binary gender categorization. However, referring to identity research, it would make sense to capture gender identity more extensively and in this regard to recruit from a more diverse sample (e.g., an LGBTQ sample).

7.2. Conclusion

In sum, the current study revealed that gender differences emerge in terms of differing perceptions of technology usage and self-perception. Women perceive themselves to have lower general computer self-efficacy and less advanced skills compared to men. However, they choose complex technology as often as men and accomplish the given task equally as proficiently as men. This indicates that there are differences in the self-concept of women and men, which seem to be rooted in gender role beliefs. These, however, do not play out in worse task performance or in more negative affect related to the task.

It seems that women accept the challenge of using complex technology and accomplish this challenge, but that this does not lead to self-enhancement in terms of their beliefs about their ability to master technology. Our results suggest that while the behavioral gender gap is closing, stereotypical beliefs and differences in self-perceptions still persist. To further examine which variables can have recursive effects on gender role beliefs concerning technology usage and acceptance, future studies could focus on affective reactions and problem-solving strategies when facing, for instance, failure in technology usage.

APPENDIX

Fig. 1. Experimental setting. *Note.* Right picture shows the workstation at which the application task was completed; left picture shows both workstations (left application task; right questionnaires) and the intended red mailbox.

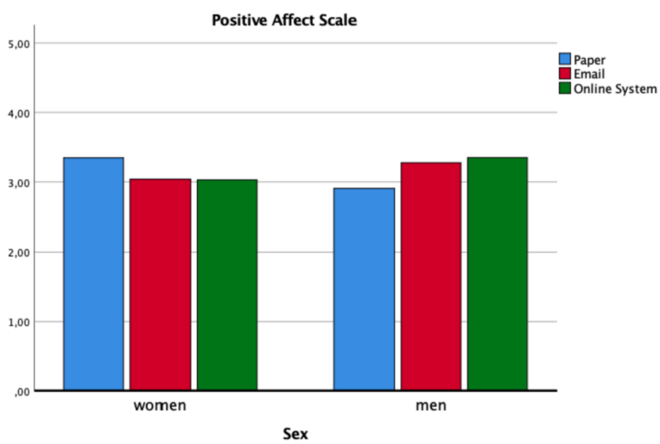

Fig. 2. Interaction Effect of Gender*Technological Complexity on Positive Affect (N = 148). ***Note***. Items were rated on a 5-point scale (1 = not at all positive; 5 = very positive).

Table 1
Simple Effects of Gender (women n = 83; men n = 65).

	df	df error	F	$_p\eta^2$	Women		Women		Men		Men	
					M	SD	CI[LB]	CI[UB]	M	SD	CI[LB]	CI[UB]
BOS	1	147	1.34	.009	9.42	0.85	9.25	29.56	9.60	0.78	9.38	9.78
AOS	1	147	5.72*	.038	8.11	1.44	7.81	8.41	8.66	1.32	8.32	9.00
GCSE	1	147	23.21**	.137	7.73	1.50	7.42	8.05	8.89	1.38	8.54	9.25
SE	1	147	5.67*	.037	28.48	4.62	27.40	29.56	30.45	5.40	29.23	31.67
ANX	1	147	2.63	.018	5.34	1.57	4.96	5.72	4.87	1.95	4.44	5.30
LOC	1	147	16.52**	.102	2.20	0.79	2.04	2.36	1.71	0.63	1.54	1.89
SI	1	147	3.96*	.026	5.30	1.25	5.06	5.55	5.67	0.94	5.40	5.95

Note: BOS = Basic Operational Skills, AOS = Advanced Operational Skills, GCSE = General Computer Self-Efficacy, SE = Self-Efficacy, ANX = Anxiety, LOC = Locus of Control , SI = Social Influence; p < .001 = **, p <.050 = *, CI [95%], LB = Lower Bound; UB = Upper Bound.

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