Disarming Prejudice: How Ease of Use Mitigates the Detrimental Effect of IT-Based Stereotype Threat on the IT Task Performance of Older Adults

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Completed Research Paper

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Abstract

We propose that although just an oversimplified picture, the stereotype that older adults cannot use IT turns into a real threat to older adults on IT tasks. We find in an experiment with 96 older adults on a municipality website that the stereotype of not being able to use IT creates a toxic cognitive load in the minds of older adults, which in turn significantly impairs their information search on the website. Based on cognitive load as a theoretical leverage point for an intervention against IT-based stereotype threat, our results furthermore highlight that increasing a website's ease of use effectively protects older adults against the stereotype about their inability in the IS domain. We offer in this paper a theoretically-grounded starting point for disarming prejudice in the digital transformation of societies.

Keywords: IT-based stereotype threat, older adults, task performance, e-government, social inclusion

Introduction

In a process known as the digital transformation (Rowe 2018), advances in information technology (IT) increasingly organize key social structures and activities around IT-enabled information networks (Castells 2000; Castells and Kreisler 2001). However, only 63 percent of the households headed by a person aged 65 and older have an internet subscription in the United States (Ryan and Lewis 2017) and 63 percent of those aged 65 and older use the internet in Germany (Federal Statistical Office 2018), for example, and the disparate use of IT continues to divide contemporary societies along age lines. To make matters worse, many Western societies bluntly expect older adults to fail when trying to use IT. In contemporary Western societies, the stereotype that older adults cannot use IT (Borjijin et al. 2015; Cuddy et al. 2005; Ogozalek 1991) puts older adults in an awkward situation: If they refrain from using IT, they risk to become excluded from an increasingly electronically networked society, and if they try using IT, they will fail anyway according to the prevailing stereotype.

To those who dare against all odds, the stereotype that older adults cannot use IT likely turns into a threat. Stereotype threat theory (Schmader et al. 2008; Steele and Aronson 1995) suggests that a negative stereotype about their IT ability creates for older adults the unnerving possibility of confirming the stereotype when using IT. In what we term in the following an IT-based stereotype threat (IT-BST), older adults start to fear to confirm the negative stereotype held of their age group. Although they aspire to do well on IT tasks in accordance with the fundamental human need to feel good about oneself (Steele 1988), the stereotype about their age group suggests that they will not (Schmader et al. 2008). The stereotype instills uncertainty into the situation, which older adults can try to reduce by monitoring if they indeed perform on the current IT task as poorly as the stereotype suggests or by attempting to suppress any negative stereotype-related thoughts that may come to their mind, for example. However, such coping strategies require attention to task progress or stereotype-related negative thoughts, and should thereby increase cognitive load over and above the cognitive demands already imposed by the IT task itself (Schmader et al. 2008; Schmader and Beilock 2012). When searching for information on a website, for instance, older adults may start to monitor the website sections they are visiting and begin to attend to additional interface cues in order to gauge if they are already searching within the correct section of the website. While promising to reduce uncertainty, such cognitive coping strategies tax the cognitive resources older adults rather need for task processing (Schmader et al. 2008; Schmader and Beilock 2012), and, as a result, their IT task performance should drop under IT-based stereotype threat.

The rationale that IT-based stereotype threat impairs the IT task performance of older adults by increasing cognitive load suggests that an effective intervention against IT-based stereotype threat has to free cognitive resources. Previous research has established that an easier to use interface reduces cognitive load on IT tasks (Hu et al. 2017; Oviatt 2006), which will leave older adults with more cognitive resources to effectively cope with IT-based stereotype threat. In addition, an easier to use interface facilitates task success (Chadwick-Dias et al. 2003; Dickinson et al. 2005) and older adults may come to realize that the stereotype about their IT ability does not apply in the given situation. The disconfirmed stereotype undermines the assumptions of larger society, restores balance with one's own aspirations, and thus leaves more cognitive resources for task processing.

In sum, theory suggests IT-based stereotype threat to impair the IT task performance of older adults by inducing additional cognitive load. This effect can likely be mitigated by providing older adults with an easier to use interface. We thus ask:

RQ1: Does IT-based stereotype threat impair the IT task performance of older adults by inducing cognitive load?

RQ2: Does ease of use mitigate the detrimental effect of IT-based stereotype threat on IT task performance for older adults?

Toward answering these questions, we conducted an experiment in which 96 older adults searched for e-government information on two versions of the same municipality website that varied in their ease of use. Our results provide the following three contributions. First, we hypothesize the stereotype that older adults cannot use IT to turn into a cognitively taxing threat to older adults, and find empirical evidence that, although just an oversimplified picture, an ability stereotype can have real detrimental performance consequences for stereotyped user groups by increasing cognitive load on IT tasks. Our results contribute a piece to the puzzle of how the cultural and social environment of older adults impact their use of IT (Shoemaker 2003; Tams et al. 2014). Second, our results empirically highlight ease of use as an effective means to mitigate the detrimental effect of IT-based stereotype threat. While stereotypes are hard to eliminate from society (Davies et al. 2002), increasing the ease of use of IT artifacts is a feasible and cost-effective technology-driven intervention. Third, by implementing this intervention on a municipality website, we demonstrate how an IT artifact that is both relevant to active aging (Curzon et al. 2005) and a key driver of the digital transformation (European Commission 2016) can reduce the detrimental effects of prejudice in the IS domain and contribute to equality among today's diverse user groups.

Background

To lay the foundations for an investigation of IT-based stereotype threat and an ease of use-based intervention against it, we first situate IT-based stereotype threat in related work on the determinants of

older adults' IT task performance, review IT-based stereotypes about older adults, and introduce the potentially detrimental effect of the IT ability stereotype on the IT task performance of older adults[1].

Determinants of Older Adults' IT Task Performance

Existent research in cybernetics, information systems, and gerontology highlights a number of factors that determine how well older adults perform on IT tasks. These determinants can be roughly organized into individual differences and contextual factors.

In terms of individual differences, the fluid and crystallized abilities older adults have determine their performance on IT tasks. Fluid abilities enable older adults to solve problems without relying on prior knowledge or training (Drag and Bieliauskas 2010), of which processing speed, that is the ability to perform mental operations quickly, is a prime example (Echt et al. 1998). The term crystallized abilities subsumes stored factual knowledge (Drag and Bieliauskas 2010). Computer experience, which refers to the learning obtained from having used IT in the past, is a crystallized ability that has been repeatedly found to impact the IT task performance of older adults (Mead et al. 2000), for example. Beyond abilities, individual attitudes toward computers (Zandri and Charness 1989), beliefs such as perceived ease of use (Arning and Ziefle 2007), demographic factors like chronological age (Echt et al. 1998), gender, or education (Charness et al. 2001), and the problem solving strategies individual older adults employ (Stronge et al. 2006) influence their performance on IT tasks.

The contextual factors that determine the IT task performance of older adults are found in their technological as well as social context of use. Technological factors include hardware and software properties, for example the usability of input devices (Charness et al. 2004), the size of user interface elements such as fonts (Bernard et al. 2001) or acquisition targets (Kobayashi et al. 2011), the structure and design of menus (Zaphiris et al. 2003), and the topology of hypertext (Lin 2003). They also include properties of the task itself and (pre-)conditions of its execution, such as task difficulty (Dickinson et al. 2005) and the style of prior training (Mead and Fisk 1998). Less appears to be known about factors from the social context, though. Assistance provided by others (Hartley et al. 1984) and properties of the social learning environment (Zandri and Charness 1989) are two determinants of older adults' IT task performance that have been repeatedly identified in prior research.

Although transported by the media (e.g., Jones 2016) and experienced by older adults as a threat in their everyday life (Ivan and Schiau 2016), little appears to be known about the performance effects of the aging stereotypes that loom in older adults' social context. To the best of our knowledge, one study found in the special case of computer training that the stereotype of older adults as untrainable learners facilitated older adults IT task performance, an effect that may have occurred because older adults pushed harder under threat or could disconfirm the stereotype during training (Fritzsche et al. 2009). This finding is encouraging because it shows that the effects of negative aging stereotypes can be mitigated. However, it leaves open the mechanisms by which mitigation occurs. Ideally, in order to be applicable on a wide scale at low cost, such a mechanism should have little time and space requirements, and therefore directly modify the IT artifact that is used in the particular performance situation.

Next, we turn to theory on stereotypes toward identifying a theoretical leverage point for a technology-driven intervention on negative aging stereotypes in the IS domain.

IT-Based Stereotypes as a Form of Prejudice Against Older Adults

A stereotype is a set of beliefs about a group of people. These beliefs ascribe attributes to group members that are thought to be characteristic of their group and describe the extent to which group members have these attributes (Brauer et al. 2001). A stereotype is a view about members of a social group that can have positive or negative valence and is not necessarily accurate (Judd and Park 1993). In fact, stereotypes tend to be inaccurate (Brauer et al. 2001) and are thus a source for prejudice against members of the stereotyped group (Devine 1989). In the IS domain, stereotypes ascribe IT-related attributes to members of a particular user group. Such IT-based stereotypes include, for example, that women (Clayton et al. 2009) or blacks (Cain and Trauth 2013) struggle to succeed in the IS profession and that technically-

[1] Following the United Nations (2015), we refer to individuals aged 60 years and older as older adults.

oriented workers, so-called "nerds", are unathletic individuals who focus more on technology than people (Craig and Grover 2016).

Alike other user groups, older adults are targeted by numerous IT-based stereotypes in the IS domain. Older adults are said to be afraid of IT (Flandorfer 2012), to show little interest in IT (Arning and Ziefle 2009) and to be unwilling to use it (Borjijin et al. 2015). When trying to use it, older adults are stereotyped to have a hard time learning how to use IT (Lam and Lee 2006). In essence, older adults face the IT-based stereotype of not being able to use IT successfully (Borjijin et al. 2015; Cuddy et al. 2005; Flandorfer 2012; Ogozalek 1991).

IT-Based Stereotype Threat: When Prejudice Impairs IT Task Performance

For older adults, being said to struggle with IT is at odds with their human motive to feel good about themselves (Steele 1988). The IT-based stereotype denies older adults competence in the IS domain, and because of its reference to IT task performance, likely turns into a threat for older adults on IT tasks. The IT-based stereotype prejudges and devalues individual older adults by virtue of their group membership, which is an insidious allegation that is hard to defend against.

In general, when (1) a negative stereotype about a group is present, (2) an individual is (perceived as) a member of this group, and (3) the individual's behavior can lead to evaluative inference in the negatively stereotyped domain, the individual fears to behave in a way that confirms the negative stereotype. The individual experiences stereotype threat (Shapiro and Neuberg 2007; Steele and Aronson 1995). Under stereotype threat, individuals face the uncertainty of how their actions in a particular domain will play out.

With respect to their uncertain performance in an ability domain (e.g., education or sports), individuals under stereotype threat experience a triadic cognitive imbalance between their self-concept, the ability domain, and their social group. First, individuals expect to perform well in the ability domain because they are motivated to maintain a positive view of themselves (Steele 1988), and thereby establish a positive relation between their self-concept and the ability domain (Schmader et al. 2008). Second, individuals identify with the stereotyped group or are said to be one of its members (Shapiro and Neuberg 2007), which represents a second positive relation, one between their self-concept and the group (Schmader et al. 2008). However, the negative stereotype about their group suggests individuals to perform poorly in the ability domain (Brauer et al. 2001). The group and the ability domain are defined in opposition to each other, representing a negative relation (Schmader et al. 2008). For example, a female student may aspire to succeed on a math test, self-identify as a woman, but the negative stereotype of women's weaker math ability suggests her to perform poorly on the test.

With two positive relations and one negative relation present, the outlined cognitive system is out of balance under stereotype threat (Schmader et al. 2008). In line with their fundamental desire for cognitive consistency (Festinger 1957; Heider 1958), threatened individuals try to restore balance and thus engage in a series of downstream coping strategies that tax two key cognitive resources individuals rather need for task processing (Schmader et al. 2008). To begin with, coping strategies take a heavy toll on working memory. Working memory refers to the capacity of an individual to attend to information in the pursuit of performance goals (Schmader et al. 2008). For successful task performance, task-relevant information has to receive attention in goal pursuit. However, under stereotype threat, task-irrelevant information enters working memory and depletes its capacity (Schmader et al. 2008). For example, individuals cope with stereotype threat by monitoring their performance and searching for cues that help them to restore cognitive balance. However, by devoting attention to cues, individuals get distracted from their actual task and their performance drops (Forbes et al. 2008; Schmader et al. 2008). In addition to depleting working memory, coping strategies also bring task processing from a more automated and reliable to a more conscious and effortful mode (Schmader et al. 2008). The use of a conscious problem solving strategy instead of intuition impairs, for example, the performance of threatened individuals (Koenig and Eagly 2005).

On IT tasks, the IT-based stereotype that older adults cannot use IT (Borjijin et al. 2015; Cuddy et al. 2005; Ogozalek 1991) challenges older adults in the IS domain and older adults start to fear to confirm the negative stereotype held of their age group, a phenomenon we term IT-based stereotype threat. Because working memory capacity declines with age (Park et al. 2002), older adults are sensitive to the working

memory demands of IT tasks in general and should thus become especially vulnerable to the performance effects of IT-based stereotype threat via working memory in particular. If IT-based stereotype threat increases cognitive load on IT tasks, the task performance of older adults should drop. Moreover, theorizing about the existence of such a harmful mechanism simultaneously informs intervention mechanisms on IT-based stereotype threat. It may, for example, well be that reducing cognitive load by providing older adults with an easier to use interface (Hu et al. 2017; Oviatt 2006) protects them against the detrimental performance effect of IT-based stereotype threat on IT tasks.

We thus set out in the following to investigate if IT-based stereotype threat impairs the performance of older adults on IT tasks by inducing cognitive load, and if ease of use can mitigate this detrimental effect. We integrate this investigation with established research on ease of use.

Hypotheses Development

To put the above theoretical considerations about IT-based stereotype threat into the practical context of the digital transformation of societies, we choose a municipality website as the IT artifact of our research. Municipality websites enable active aging in the information age, and their successful use is thus particularly relevant to both the everyday life of older adults as well as a sustainable digital transformation of societies. From the perspective of older adults, municipality websites help them to stay involved with their local community by providing information on their immediate surroundings (e.g., political or cultural events). Social contact and community participation are vital ingredients for healthy aging (Bath and Deeg 2005), and providing older adults with local government information accounts for the tendency of on average less mobile older adults to shift their social life to their immediate surroundings (Mollenkopf et al. 1997). From the perspective of the digital transformation of societies, European governments, among others, strive to offer public services over the internet by default (European Commission 2016) but at the same time have to walk the tightrope of serving all citizens equally well (Niehaves 2011). For a sustainable digital transformation of societies, older adults have to be able to use e-government services as well as other segments of the population. In the municipality setting of our research, we contextualize the dependent variable of our study, IT task performance, as information search performance, that is as how well older adults can find information on the municipality website.

Theory suggests that how well older adults can find information on a municipality website depends in part on stereotypes from their social context of use (Steele and Aronson 1995). The stereotype that older adults cannot use IT challenges older adults in their use of the municipality website by virtue of their group membership. Targeted by bad suspicion while ostensibly deprived of agency, older adults start to fear to confirm the stereotype during use and experience IT-based stereotype threat. Under threat, they aspire to find the required information on the municipality website in order to feel good about themselves (Steele 1988), but the stereotype about their group suggests that they will not (Schmader et al. 2008).

Toward resolving this cognitive imbalance, older adults engage in three coping strategies that increase cognitive load by taxing their working memory capacity (Schmader et al. 2008). First, older adults become vigilant to performance cues and start to monitor how well they perform in order to assess if the IT-based stereotype about their IT ability applies to them personally (Forbes et al. 2008; Schmader et al. 2008). For example, older adults can gauge if they get lost in their information search from the number of times they visit the same website node (Lin 2003) or they can assess how well the found information matches their search goal in order to gain confidence in their performance (Balijepally et al. 2009). Although performance monitoring promises to gain certainty and to resolve the cognitive imbalance induced by IT-based stereotype threat, it requires attention to interface cues such as older adults' current location on the municipality website and website content, which consumes working memory capacity (Beilock et al. 2007; Schmader et al. 2008).

Second, the fear of confirming the negative IT-based stereotype in their information search is likely a stressful experience for older adults (Schmader et al. 2008), and, just as other forms of social identity threat (Townsend et al. 2011) or stressful technology-related events (Riedl et al. 2012), should increase cortisol levels in older adults. The stress hormone cortisol is known to impair working memory function (Lupien et al. 1999), and will likely do so when older adults experience IT-based stereotype threat on the municipality website.

Third, older adults receive a number of cues from their performance monitoring, their experience of stress, and their state of cognitive imbalance. A negative appraisal of such cues triggers negative thoughts and emotions in the mind of older adults, which are inconsistent with their aspiration to perform well in their information search (Schmader et al. 2008). For example, after having returned to the same website node for the third time in a row, older adults start to doubt their own ability (Steele and Aronson 1995) and feel anxious (Bosson et al. 2004). Older adults try to suppress their anxiety because it interferes with their goal of performing well (Schmader et al. 2008). However, suppression requires attention and thereby consumes working memory capacity (Johns et al. 2008).

So far, we have established that IT-based stereotype threat theoretically increases the cognitive load of older adults by increasing working memory demands. Increased working memory demands should in turn translate into decreased performance and thereby mediate the effect of IT-based stereotype threat on information search performance. Working memory capacity is a key component of human cognitive ability that affects fundamental processes such as reasoning or task processing (Süß et al. 2002), and reduced working memory capacity has been found to directly affect the IT task performance of older adults (Echt et al. 1998; Morrell et al. 2000). Cognitive load should thus have a negative effect on older adult's information search performance on the municipality website.

Connecting IT-based stereotype threat's positive influence on cognitive load and cognitive load's negative influence on the IT task performance of older adults, we hypothesize a negative indirect effect of IT-based stereotype threat on information search performance via cognitive load.

H1a: IT-based stereotype threat has a detrimental indirect effect on the information search performance of older adults on a municipality website via cognitive load.

Although not the theoretical focus of this paper, IT-based stereotype threat may also impair the information search performance of older adults by mechanisms other than creating cognitive load. Alternative theoretical accounts suggest that IT-based stereotype threat impairs performance by shifting effortful attention to otherwise automated and efficient activities (Schmader et al. 2008), such as operating input devices, or by lowering performance expectations in line with the stereotype (Cadinu et al. 2003). For the purpose of answering RQ1 in a mediation analysis, we subsume alternative accounts in a direct effect of IT-based stereotype threat on information search performance.

H1b: IT-based stereotype threat has a detrimental direct effect on the information search performance of older adults on a municipality website.

Ease of use is the category of a website's usability that explicitly focusses on "the cognitive effort required in using a web site" (Agarwal and Venkatesh 2002, p. 171), and thus represents a usability category that fits the present paper's cognitive perspective on IT-based stereotype threat and IT task performance.

Existent research points to a number of cognitive abilities that enable older adults to find information on a website. The quicker older adults can process information and the more computer experience they can draw on (Chadwick-Dias et al. 2003), for example, the better they find information on a website. This suggests that lowering the cognitive ability demands of the municipality website by increasing its ease of use should improve older adult's information search performance. On an easier to use municipality website, older adults will have to bring less cognitive ability to the table in order to find the information they are looking for. In line with empirical results on personal digital assistants (Arning and Ziefle 2007), we thus hypothesize that an easier to use municipality website will increase older adult's chances to find target information.

H2: An easier to use municipality website version facilitates the information search performance of older adults on a municipality website.

An easier to use municipality website will furthermore require less effort from its users and thus promises to reduce older adult's cognitive load during information search. Easier to use websites tend to consist of fewer interface elements (e.g., less buttons and input fields), leading to less hesitation among older adults during use (Dickinson et al. 2005). Looked at from the perspective of working memory, fewer interface elements mean less elements that can enter working memory and compete for attention. Older adults have a harder time suppressing irrelevant cues (Kane et al. 1994), which are in turn free to enter working memory (Darowski et al. 2008) and start to distract older adults from processing the information search task at hand.

Empirical evidence on the negative relationship between usability (Oviatt 2006) or the closely-related concept of navigability (Hu et al. 2017) and cognitive load lends further empirical support for ease of use to decrease the cognitive load of older adults on the municipality website.

H3: An easier to use municipality website version reduces the cognitive load of older adults during information search on a municipality website.

Finally, an easier to use municipality website holds the potential to moderate the detrimental effect of IT-based stereotype threat on the information search performance of older adults. One way to do so is by moderating the indirect effect (H1a). When searching for information on the easier to use website, ease of use reduces the likelihood of setbacks and gives older adults the opportunity to disconfirm the ability stereotype about their group during use. The stereotype likely becomes less of a concern to older adults, which allows them to restore cognitive balance by establishing a positive relation between their group and the municipality website (Schmader et al. 2008). Cognitive balance obviates the need for effortful coping strategies (cf. H1a), and thereby should reduce cognitive load and improve performance.

H4a: An easier to use municipality website version positively moderates the detrimental indirect effect of IT-based stereotype threat on the information search performance of older adults on a municipality website via cognitive load.

Another way of how an easier to use municipality website can moderate the detrimental effect of IT-based stereotype threat on the information search performance of older adults is by moderating the direct effect (H1b). In our model, the direct effect of IT-based stereotype threat on performance subsumes approaches unrelated to cognitive load, which are likely to be influenced by stereotype disconfirmation as well. Stereotype disconfirmation should, for example, put the operation of input devices back to a more automatic and reliable mode (Schmader et al. 2008), and reduce negative expectations (Cadinu et al. 2003).

H4b: An easier to use municipality website version positively moderates the detrimental direct effect of IT-based stereotype threat on the information search performance of older adults on a municipality website.

We also control for age, gender, and education to account for potential performance differences between older age groups (Echt et al. 1998), gender differences in technology adoption and use (Venkatesh et al. 2003), and differences in cognitive reserve (Jefferson et al. 2011). Figure 1 depicts our research model.

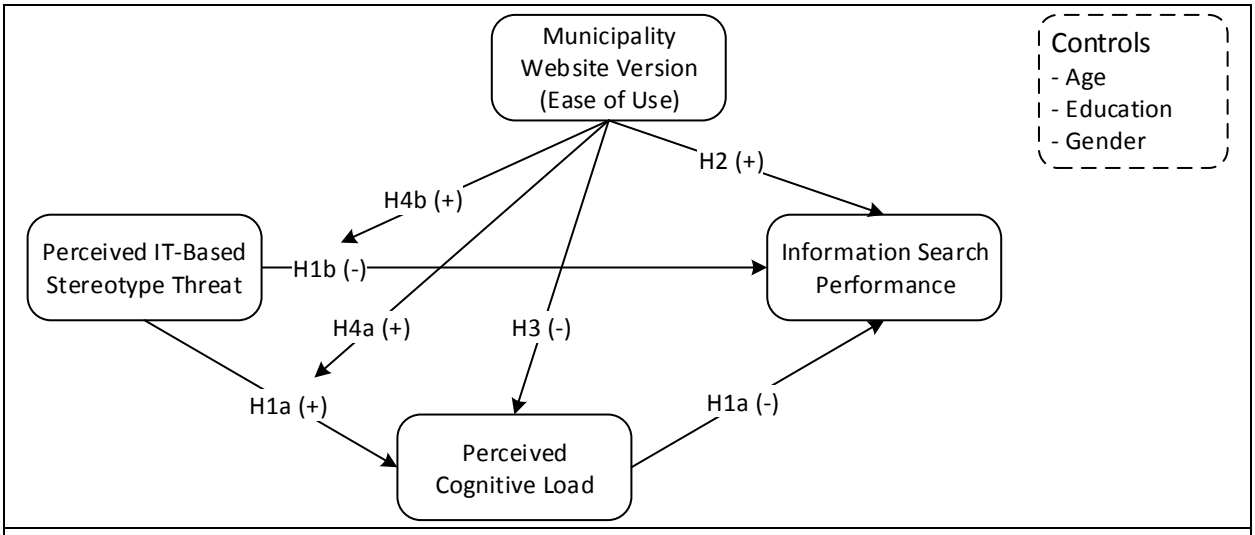

Figure 1. Research Model

Methodology

We designed an experiment in which we varied the ease of use of a municipality website and invited older adults to solve information search tasks on the website in order to test our research model.

Website Versions: Ease of Use Treatment

We developed two versions of the same municipality website that provided older adults with local e-government information about the fictitious town of Neustadt (English: "New Town"). The content of the Neustadt Website included information about the public services offered by the Neustadt administration, community events, and local medical services.

In order to experimentally vary ease of use, we modeled the control version of the municipality website after a real world example in terms of both layout and content, an approach that allowed to combine realism with a stable technological environment across experiment trials (Laberge and Scialfa 2005). The improved (i.e. age-aware) version of the website was created by applying ease of use interventions from existent research on age-aware website design to the control website, thereby creating an easier to use version of the control website. However, while our ease of use treatment had to be effective, we simultaneously exercised great care to keep the website versions within realistic boundaries. Figure 2a outlines the control version of the website, Figure 2b the easier to use, age-aware version.

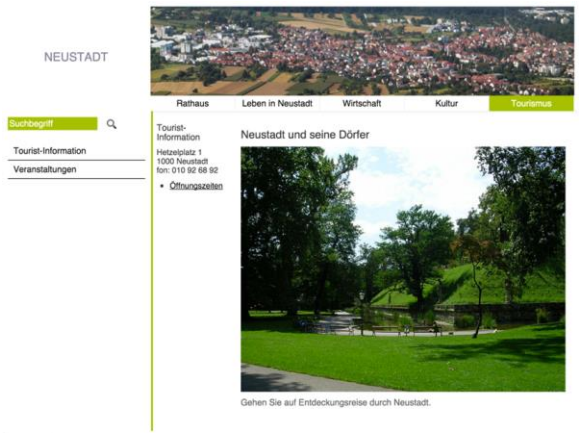

Figure 2a. Control Version of the Website

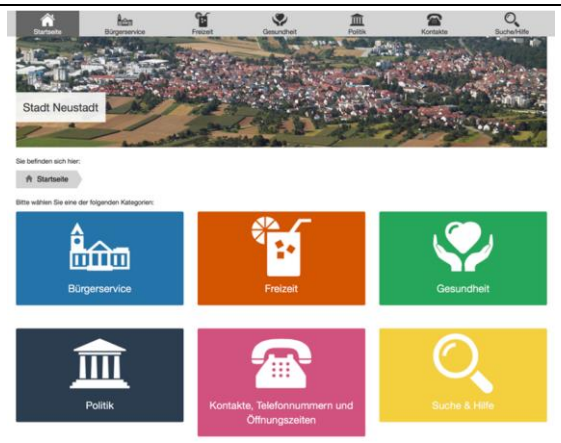

Figure 2b. Age-Aware Version of the Website

The applied ease of use interventions can be grouped into three themes: website structure, location-awareness, and content presentation. To successfully navigate the municipality website, older adults have to easily comprehend the website's structure. This can be achieved by simplifying the mental model older adults have to build of the website. Because a hierarchical topology allows only for simultaneously navigating one level up or one level down the hierarchy, it requires less connections between single website nodes and thereby simplifies the mental model older adults have to comprehend and keep in mind (Lin 2003). A strictly hierarchical website structure is moreover linear in the sense that older adults consume information on pre-defined navigation paths, just as older adults are already used to from navigating more traditional media such as newspapers or books. A hierarchical structure thus enables older adults to draw on well-learned habitual navigation styles (Castilla et al. 2016). The age-aware website version thus followed a strictly hierarchical structure. After having identified their target in a navigation menu structure, older adults still have to successfully click on it. Clicking accuracy was facilitated in the age-aware website version by closely aligning navigation menu items (Ketcham and Stelmach 2004) and increasing their size (Jochems et al. 2013) in a tile layout.

In order to design their navigation strategy, older adults have to know their current location on the municipality website, from which node they came from, and where they can go to next. The age-aware website version tried to visualize these aspects in form of a so-called breadcrumb trail (Laberge and Scialfa 2005) and by employing expressive button labels (Park et al. 2002) as well as semantically-

matching pictures (Karanam et al. 2012). The age-aware website version had furthermore to present its content in a manner that is easier to understand for older adults. It thus featured slightly more readable sentences, that is sentences with lower word difficulty and of shorter length (Lukaitis and Davey 2012), for example. These were also written in a marginally larger font (Bernard et al. 2001). In order to prevent older adults from getting distracted by irrelevant cues (Darowski et al. 2008), the age aware website version avoided distracting stimuli.

Experiment Procedure

Participants were welcomed and told in the experiment's introduction that we are interested in how well older adults can find important information on the internet. In line with existent research on stereotype threat (Steele and Aronson 1995), we thereby offered a subtle cue from which older adults could potentially infer the IT-based stereotype that older adults cannot use IT (Fritzsche et al. 2009). The instruction referred to the three conditions that are necessary for IT-based stereotype threat to arise, and thus simulated a situation that older adults encounter in everyday life (Ivan and Schiau 2016). Participants were moreover informed that they will work on the website of the town of Neustadt as part of the study. After the introduction, participants (1) reported their expectations about the study in a brief pre-questionnaire, (2) were alternately asked to explore one version of the website and reflected on their experience in a second intermediate-questionnaire, (3) worked on the five information search tasks of the study on the same website version as before and filled in a post-questionnaire, (4) filled in a demographic questionnaire, and (5) were finally debriefed and thanked for their participation.

The five information search tasks of the study were information retrieval tasks on the municipality website. More specifically, participants first read a task instruction that asked them to find specific information on the Neustadt website. They subsequently clicked on a "start next task" button on an overlay menu and began to search for the information on the website. Participants were instructed to note down found information in a paper-based workbook after having clicked the "end task button" on the overlay and to spend maximum five minutes per task.

We captured self-report as well as objective measures of our constructs. Measurement items for perceived IT-based stereotype threat (Chasteen et al. 2005; Steele and Aronson 1995), cognitive load (Hu et al. 2017), age (Fedorowicz et al. 2010), education (Lammi et al. 1989), and gender (Venkatesh and Morris 2000) were adapted from existing research. The latter three constructs were included in the demographic questionnaire, the first was part of the pre-questionnaire and the second was included in the post-questionnaire. How many information search tasks a participant solved correctly within five minutes each served as an index of a participant's information search performance (Webster and Ahuja 2006). This index of efficiency allowed us to consider output and input at the same time in one measure of performance (Beal et al. 2003). Table A1 in the Appendix provides an overview of the construct operationalizations.

Table 1. Information Search Tasks on the Municipality Website

Task Number	Instruction
1	Find the opening hours of the "Brunnen" pharmacy.
2	When does the Christmas concert of the Neustadt gospel choir take place?
3	Find any dentist in Neustadt and note down his/her name.
4	When does the next mayoral election take place?
5	You are planning on modifying your house and are required to request a permit. Inform yourself on the website of the city of Neustadt how many signed copies of your application need to be submitted.

Data Collection and Analysis

Data collection took place in Germany, a Western country in which older adults face the IT-based stereotype that they cannot use IT (Bergsdorf et al. 2010). Older adults aged 60 years and over were invited to take part in our study, whom we recruited at retirement homes and senior centers. The

organizations advertised the study on bulletin boards and older adults could sign up for the study with a representative of the respective organization. Participants were provided with beverages and snacks during our study toward creating a welcoming atmosphere, and were furthermore offered € 10 in appreciation of their time. The study was conducted in quiet rooms at the premises of the cooperating organizations, and the organizations scheduled the participants while being blind to the subsequent experiment procedures. 102 older adults initially engaged with the municipality website but we had to remove six from the sample. One participant who had a hard time using the mouse gave up after the exploration phase, two participants aborted task processing after respectively the second and the fourth municipality website task, two more participants were not assigned to a website version in an alternating fashion, and a sixth participant specified to be 59 years old, leaving us with 96 participants for the final sample.

For data analysis, we used the partial least squares approach to structural equation modeling (PLS-SEM) (Chin 1998). PLS-SEM allowed us to test a comprehensive research model, including mediation and moderation, with a relatively small sample size (Ringle et al. 2012), thereby accommodating for the fact that older adults are usually harder to recruit as participants in hands-on computer experiments. Because theorizing on the interplay between stereotypes and ease of use is at an early stage in the IS domain, PLS-SEM enabled us to explore new theory and to identify key determinants (Hair et al. 2011). To estimate the significance of relationships, we ran a bootstrapping with 5,000 subsamples (Hair et al. 2011). Data analysis was conducted in SmartPLS version 3.2.7 (Ringle et al. 2015).

Results

The 96 participants of our study were between 60 and 98 years old, and had an average age of 76.65 years (SD 8.22). They had attended school for 10.30 years on average (SD 2.26), with 36.46 percent having tertiary education. The sample consisted of 40 men, 55 women, and one individual who did not specify a gender. As a manipulation check of our experimental ease of use treatment, we asked participants after task completion if they find the website of the city of Neustadt easy to use (1 = "totally disagree" to 7 = "totally agree"). The difference between users of both website versions was significant in the hypothesized direction ($Mean_{Control} = 5.49$, $Mean_{Age\text{-}Aware} = 6.15$, $p < 0.001$), thereby confirming the effectiveness of the experimental treatment. The users of both website versions did not differ significantly in computer skills, as indicated by their computer experience ("I use the computer frequently", 1 = "totally disagree" to 7 = "totally agree", $Mean_{Control} = 4.43$, $Mean_{Age\text{-}Aware} = 4.64$, $p > 0.1$).

Measurement Model Validation

We followed PLS-SEM guidelines to validate the measurement of our constructs. Measurement items exhibited loadings of at least 0.7 to their corresponding construct, with the exception of PITBST1. Because removing PITBST1 did not lead to an increase in the corresponding construct's composite reliability (CR) above the 0.7 CR threshold, we retained the measurement item in accordance with established guidelines (Hair et al. 2011; Henseler et al. 2009). The constructs of our model further showed sufficient convergent validity and internal consistency reliability, as indicated by average variance extracted (AVE) values above 0.5 and CR values higher than 0.7 for all constructs (Hair et al. 2011; Henseler et al. 2009). According to the heterotrait-monotrait ratio of correlations (HTMT) (Henseler et al. 2014), the constructs also turned out to be empirically distinct. The ratios of measurement item correlations across constructs relative to measurement item correlations within constructs were all below the conservative 0.85 threshold. Table A2 in the Appendix summarizes the measurement model validation.

Structural Model Estimation

Turning to the estimation of the structural model, the indirect effect of perceived IT-based stereotype threat on information search performance via perceived cognitive load was negative ($\beta = -0.115$) and significant ($p < 0.01$), which supports H1a. Perceived IT-based stereotype threat moreover turned out to have a marginally significant negative effect on information search performance ($\beta = -0.147$, $p < 0.1$), lending insufficient support for H1b. Taken together, results on H1a and H1b point to an indirect-only (full) mediation (Zhao et al. 2010).

The municipality website version had a positive significant effect on information search performance (β = 0.293, p < 0.001) in that the age-aware version, which offered higher ease of use, facilitated performance. We accept H2. Likewise, we accept H3 because the ease of use treatment (i.e. age-aware municipality website) showed a significant negative effect on perceived cognitive load (β = -0.253, p < 0.01). There was also an indirect effect of municipality website version on information search performance via perceived cognitive load, which turned out to be positive (β =0.097) and significant (p < 0.05). In terms of moderations, we do not find support for H4a. The ease of use treatment did not moderate the indirect effect of IT-based stereotype threat on information search performance via cognitive load (β = 0.039, p > 0.1). We find, however, support for a significant positive moderation of IT-based stereotype threat's direct effect on information search performance (β = 0.201, p < 0.05) and thus accept H4b. Additional simple slope analysis shows a marked improvement in performance when the easier to use website was used. The effects of the control variables age (β = -0.097, p > 0.05), education (β = 0.042, p > 0.05), and gender (β = -0.102, p > 0.05) did not reach significance in our experiment.

Our research model explained 14.2 percent in perceived cognitive load and 41.3 percent in information search performance. Figure 3 depicts the results of the structural model estimation.

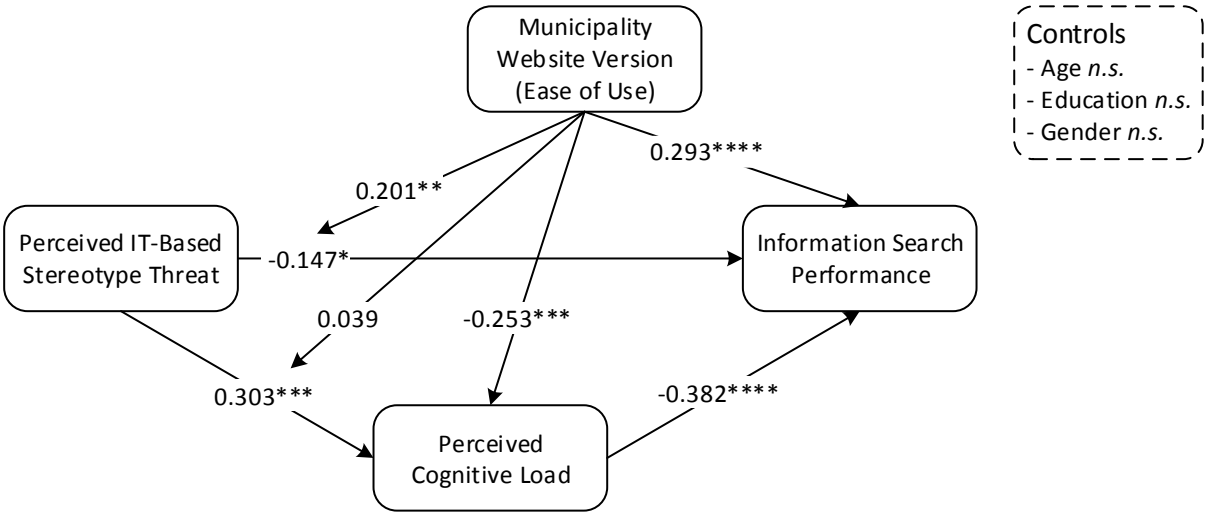

Figure 3. Results of the Structural Model Estimation

Discussion and Conclusion

Although just an oversimplified picture at first sight, the IT-based stereotype that older adults cannot use IT turns into a real threat to older adults on IT tasks. We find in an experiment with 96 older adults on a municipality website that the stereotype of not being able to use IT creates a toxic cognitive load in the minds of older adults, which in turn significantly impairs their information search on the website (H1a). The significant indirect effect highlights IT-based stereotype threat as a stumbling block for older adults outside of computer training environments (cf. Fritzsche et al. 2009; Ivan and Schiau 2016), which needs to be removed toward increasing the chances of older adults to successfully partake in an increasingly digital society. When taking alternative theoretical explanations into account (H1b), our data indicates an indirect-only mediation of IT-based stereotype threat's effect by cognitive load. However, while our data strongly supports cognitive load as one mediator of IT-based stereotype threat, we caution against ruling out other explanations of IT-based stereotype threat's effect in light of the close empirical results. Our findings also contribute to usability research in IS more generally. While existent research traditionally posits that elements from the technological subsystem (e.g., user interface elements) influence cognitive load (e.g., Oviatt 2006), our work adds using the example of IT-based stereotype threat that cognitive load

can also originate from the social subsystem. This highlights the need to more thoroughly consider a particular user's social environment toward reducing cognitive load and improving task performance.

Based on cognitive load as a theoretical leverage point for an intervention against IT-based stereotype threat, our results moreover highlight that increasing a website's ease of use effectively protects older adults against the IT-based stereotype about their ability. A higher ease of use frees cognitive resources (H3), leaving older adults with more resources to cope with IT-based stereotype threat. Our data did, however, not confirm ease of use as a moderator of IT-based stereotype threat's indirect effect on information search performance via cognitive load (H4a). Future research may want to explore a continuous measurement of cognitive load toward a better understanding of the underlying dynamics. Although not in the theoretical focus of this paper, our data supports ease of use as a moderator of IT-based stereotype threat's direct effect on performance (H4b). This may have occurred because unlike cognitive balance (H4a), expectations can turn into positive and spark a virtuous motivational cycle. However, this rationale clearly awaits further research.

Our research has to be viewed in light of its limitations. With stereotypes being a societal phenomenon, the generalizability of our results depends on culture and may also be limited in that we did not recruit older adults staying at home. It is also worth noting that PLS-SEM cannot provide a measure of goodness of model fit nor rule out biased parameter estimates (Hair et al. 2011). The present study moreover focuses on how to mitigate threat effects among older adults to whom the stereotype is relevant, and therefore manipulates the intervention (i.e. ease of use). Future work may want to manipulate IT-based stereotype threat, too, and continuously measure cognitive load toward a more detailed account of the dynamics involved. We are currently enhancing the design of future experiments in this regard.

In general, our results hold two major theoretical implications for future research. First, our findings support the notion that the cultural context of older adults impacts their use of IT (Shoemaker 2003; Tams et al. 2014) and invites future research to consider the theoretical concepts of IT-based stereotypes and IT-based stereotype threat toward an inclusive digital transformation of societies that leaves no user group behind. Second, by theoretically identifying and empirically confirming the mechanism by which IT-based stereotype threat impairs the IT task performance of old adults on IT tasks, we offer a leverage point that future research can connect to in order to develop interventions on ability-related IT-based stereotype threat.

We hope that our findings encourage practitioners, especially those working on (local) e-government initiatives and those taking a stand for older adults in the digital transformation of societies, to combat the detrimental effects of ageist IT-based stereotypes. Although eliminating the stereotypes from larger society may be an unattainable goal, our research shows that we can understand the way stereotypes operate in the IS domain. By highlighting the importance of ease of use in this context and effectively mitigating the detrimental effect of IT-based stereotype threat with the help of technology, we offer a technology-based and cost-effective intervention as a starting point for practice.

Appendix

Table A1. Construct Operationalizations

Construct (based on)	Item ID	Acquisition / Treatment / Wording
Age (Fedorowicz et al. 2010)	AGE	How old are you? _____ years
Education (Lammi et al. 1989)	EDU	How many years did you attend school? _____ years
Gender (Venkatesh and Morris 2000)	GDR	Please specify your gender: □ male / □ female
Information Search Performance (Webster and Ahuja 2006)	ISP	The number of information search tasks solved correctly within five minutes each.

Municipality Website Version (Ease of Use) (Agarwal and Venkatesh 2002)	MWV	Two versions of the same municipality website that vary in their ease of use, that is the extent to which their use requires cognitive effort. Ease of use was varied based on research on age-aware website design (e.g., Jochems et al. 2013; Laberge and Scialfa 2005; Lin 2003). Coding: 1 = control, 2 = age-aware website
Perceived Cognitive Load (Hu et al. 2017)	PCL1	Working with the website was very demanding for me.
	PCL2	I had to make a big effort to find my way around the website.
	PCL3	I had to concentrate hard to find what I was looking for.
Perceived IT-Based Stereotype Threat (Chasteen et al. 2005; Steele and Aronson 1995)	PITBST1	Based on my age, people often underestimate my computer skills.
	PITBST2	The experimenter expects me to do poorly on the computer tasks because of my age.
	PITBST3	On computer tasks people my age often face biased evaluations.

Note: Perceived IT-based stereotype threat and perceived cognitive load were assessed on 7-point Likert-type scales.

Table A2. Measurement Model Validation

Con-struct	**Item**	**Loadings**	**AVE**	**CR**	**HTMT**						
					AGE	EDU	GDR	ISP	MWV	PCL	PITBST
AGE	AGE	Single item	Single item	Single item							
EDU	EDU	Single item	Single item	Single item	0.058						
GDR	GDR	Single item	Single item	Single item	0.005	0.105					
ISP	ISP	Single item	Single item	Single item	0.246	0.087	0.164				
MWV	MWV	Single item	Single item	Single item	0.058	0.000	0.100	0.363			
PCL	PCL1	0.849	0.814	0.929	0.317	0.164	0.058	0.545	0.230		
	PCL2	0.947									
	PCL3	0.907									
PITBST	PITBST1	0.644	0.607	0.820	0.342	0.211	0.080	0.300	0.145	0.325	
	PITBST2	0.810									
	PITBST3	0.865									

Note: AGE = age, EDU = education, GDR = gender, ISP = information search performance, MWV = municipality website version (1 = control, 2 = age-aware), PCL = perceived cognitive load, PITBST = perceived IT-based stereotype threat

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