Anticipated User Stereotypes Systematically Affect the Social Acceptability of Mobile Devices

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ABSTRACT

Understanding social perception is crucial when designing socially accepted mobile devices. Using the stereotype content model (SCM), recent work showed that mobile devices systematically attract stereotypical users' warmth and competence. It was concluded that the SCM can predict a device's social acceptability. There is, however, no empirical evidence for the assumption that the SCM can predict social acceptability and it also unclear what causes a device's stereotypical perception. In this paper, we first verify that the SCM's dimensions strongly correlate with social acceptance and show that social acceptance can be explained through stereotypical perception. In a second study, we independently asked participants to assess the warmth and competence of mobile devices, human stereotypes, and the probability that human stereotypes use the devices. We found that warmth and competence of anticipated stereotypical users predict a device's position in the SCM. The combined results of both studies show that the stereotypical perception of anticipated users can explain the social acceptability of mobile devices.

CCS CONCEPTS

• **Human-centered computing → HCI theory, concepts and models**; *Ubiquitous and mobile devices*; *Social engineering (social sciences).*

KEYWORDS

Stereotype content model, mobile devices, stereotypes, social acceptance, social objects

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1 INTRODUCTION

Using mobile devices in public settings is perceived and judged by other persons. Bystanders' judgments not only influence if and how we use a device but also how such a device is developed, designed, and presented. Thus, the social acceptance of mobile devices and interaction techniques has been extensively investigated to understand their adoption as well as their rejection. Research in human-computer interaction (HCI) focused on understanding the social acceptability of specific devices and interaction techniques but also devolved methods to quantify social acceptability. However, previous work found that social acceptability of devices also depends on their users. Smart glasses, for example, are socially more accepted when bystanders assume that the device is used by persons with disabilities [42] and potential users avoid using devices that "mark a person as being disabled" [51]. This suggests a connection between the assessment of other people and the assessment of devices' social acceptability.

Work from HCI typically considered social acceptance as an independent construct and explored factors that make a device socially acceptable. In contrast and inspired by Schwind et al. [48], our goal is to understand the cognitive process that causes devices' social acceptability. Our work is based on the assumption that assessing the social acceptability of a mobile device is caused by the cognitive process which is also used to determine a stranger's social group. Connecting the construct of social acceptability to well-understood cognitive processes would allow researchers to derive and test clear hypotheses based on a solid framework from social psychology.

The cognitive process of determining a person's social group is known as *stereotyping* and deeply rooted in human nature [3, 10, 17]. Stereotyping allows both quick assessments of the social group a person belongs to as well as predicting the person's future behavior. This is important as through perceiving similar or dissimilar characteristics of a person, humans assess if there is a competition for the same resources. From an evolutionary perspective, the process is beneficial as it simplifies one's worldview, and reduces the mental effort to deal with strangers. Although that overgeneralization of persons through stereotyping does not necessarily reflect the truth and can cause prejudices, the process is ubiquitous in everyday life. As all obvious qualities of a person are taken into account when stereotyping, mobile devices also became an essential aspect when assessing their user.

The stereotype content model (SCM) by Fiske et al. [17] suggests that the cognitive process of stereotyping assesses interpersonal impressions and groups stereotypes through peoples' intent and the capability to pursue it. Individuals not competing for the same pool of resources are considered as *warm* while individuals that can carry out their intentions are considered as *competent*. Along the orthogonal dimensions *warmth* and *competence* the following emotions towards a social group are predicted by each combination: paternalistic (high warmth, low competence), admirable (high warmth, high competence), contemptuous (low warmth, low competence), or envious (low warmth, high competence). It has been shown that the SCM is a robust and reliable model, applicable across cultures [10]. It not only allows predictions about human stereotypes but also about brands [30], consumer products [56], and even computing devices [48]. Schwind et al. [48] found that the SCM can be applied to mobile devices and that they are stereotypically perceived. They also found that mobile devices systematically attract the competence and warmth of their stereotypical users. While the authors conclude with the assumption that social acceptability is caused by stereotypical assessment, they left an empirical validation to future work. Thus, there is no empirical evidence for a connection between the dimensions of the SCM and social acceptability.

For designers and developers, it is crucial to understand when and why a device is socially accepted. Even if the warmth and competence of persons using a device can predict the device's social acceptability, it is still necessary to know what causes the assessment. If the assessment would be purely based on a device's features, designers could change these features to move the device's position within the SCM to increase its social acceptability. Work by Profita et al. and Antonetti et al. might provide a different explanation [5, 42]. Profita et al. showed that a device's user group can have an effect on the device's social acceptability. Antonetti et al. showed that the stereotypes attached to the users of a brand can have an effect on the perception of the brand [5]. These effects might provide an explanation for mobile devices' position in the SCM and thereby potentially also for their social acceptability. When assessing the warmth and competence of persons using a specific mobile device, assessors might anticipate stereotypical users. Consequently, the warmth and competence of these stereotypical users could cause the mobile device's position within the SCM.

In this paper, we investigate if the perceived warmth and competence of a device's anticipated users can predict the device's social acceptability. In the first study, we determine the warmth and competence of persons using twelve different mobile devices together with the devices' social acceptability. In the second study, we use three surveys to investigate what causes the warmth and competence of persons using a device. We simultaneously determined the warmth and competence of twelve human stereotypes, twelve mobile devices, as well as the probability that those human stereotypes use the mobile devices.

We show that the warmth and competence of a device's anticipated users predict the warmth and competence of persons using the device. Together, the studies show that the perceived warmth and competence of a device's anticipated stereotypical users can predict a device's social acceptability. This means that mobile devices can transfer the characteristics of stereotypical groups to other individuals. This transfer determines the social acceptance of a device and its user. We discuss implications for the design of mobile devices and provide directions for future work.

2 RELATED WORK

A growing body of work in HCI not only investigates the social acceptability of mobile devices and interaction techniques but also provides tools to assess social acceptability. Recent work in HCI and previous work from social psychology suggests that the SCM can be another helpful tool to assess and understand social acceptability.

2.1 Social Acceptability in HCI

Already in 1994, Nielsen named the social acceptability of users as one of the core factors for their system's acceptability [38]. More recently, Koelle et al. suggested that *"Social acceptability is becoming increasingly relevant to consider in holistic human-centric design"* [32]. Indeed, a growing corpus of work is concerned with the social acceptability of computing devices. Recent work especially looked at the social acceptability of mobile and wearable devices in general, interactions using gestures, as well as head-mounted displays in particular.

Williamson and Brewster as well as Väänänen et al. showed that the location and audience are important factors for users' willingness to perform gestures [45, 54]. They found that social acceptability increases with the familiarity of the audience. Assessing the social acceptability of different input modalities, Williamson and Brewster further highlight the importance of avoiding confusion about why users are gesturing or speaking as such actions might be misunderstood by spectators [44]. Looking specifically at on-body gestures, Profita et al. revealed that gender and cultural background have an effect on users' willingness to perform the gestures in public [43]. Montero et al. conclude that an important factor in determining social acceptance of gesture-based interaction techniques is the user's perception of others' ability to interpret the potential effect of a manipulation [37].

Guggenheimer et al. identified social acceptability as a core challenge for using head-mounted displays in shared and social spaces [20]. Koelle et al. found that social acceptability is a key factor that must be addressed when designing data glasses [31]. Häkkilä et al. highlight that effects on face-to-face interaction with other persons negatively affect the social acceptability of data glasses [22]. Similarly, Schwind et al. also found that the social acceptability of virtual reality head-mounted displays can be affected by the situation as well as the context in which they are being used [50]. Assessing the social acceptability of different devices, Profita et al. showed that it also depends on the stereotypical user if a device is considered socially acceptable [41, 42]. When smart glasses are worn by persons with disabilities, they become more socially acceptable.

An important factor that has been repeatedly identified is that people surrounding the head-mounted display user do not know what the user is doing with the device [22, 31, 50]. One proposed approach to increase the social acceptability of head-mounted display is to mirror the viewed scene on a display in front of the head-mounted display [21, 40]. Integrated cameras which raised particular concerns, as others do not know when they are recorded, also lead to proposals for novel designs [53]. Naturally, this is not limited to head-mounted displays but also applies to other wearable cameras [33].

2.2 Measuring Social Acceptability

The communities raising awareness for the importance of social acceptability led to increased efforts for developing standardized methods for assessing social acceptability [28, 41, 42, 45, 49]. Earlier work used different methods, including qualitative approaches [22, 31], asking to specify situations [45], ranking input techniques [44], or a single Likert item [53] to assess social acceptability. Profita et al. developed a first scale consisting of 13 Likert items to quantify social acceptability [41, 42]. Despite adapting the scale for their work [50], Schwind et al. still criticized the lack of a standardized method [49]. Indeed, over multiple iterations, Kelly developed the Wearable Acceptability Range (WEAR) scale [27–29] a questionnaire consisting of 14 Likert items. The WEAR scale is based on the assumption that social acceptability can be modeled by the two factors fulfillment of aspirational desires and absence of social fears. While the WEAR scale has not been widely adopted yet, it is the only validated quantitative way to assess the social acceptability of wearable devices available.

Schwind et al. recently suggested that the stereotype content model (SCM), a model from social psychology, can be used to explain what makes mobile devices socially acceptable [48]. The authors combined stereotypical users with mobile devices and revealed systematic effects of the devices on the stereotypical users' warmth and competence, the dimensions of the SCM. This implies that using a device changes how warm and competent stereotypical users are assessed. While the authors finally assume that social acceptability is simply the diagonal within the SCM, they left an empirical validation to future work. While the authors showed that mobile devices have a position within the SCM and can, therefore, be considered as social objects, it is still unclear where this position comes from.

2.3 Stereotypical Perception

If the stereotypical perception in general and the SCM in particular can help to understand social acceptability, it is important to understand stereotyping. Based on earlier work, Judd and Park provide a definition for the concept of stereotypes: *"A stereotype is an individual's set of beliefs about the characteristics or attributes of a group. Stereotypes need not be negative; the belief that accountants are good with numbers is certainly part of a stereotype. Stereotypes need not be inaccurate. [...] In general, stereotypic characteristics distinguish a particular group from other groups."* [25]. Research on stereotypes in social psychology can at least be traced back to the work by Katz and Braly [26] who studied racial stereotypes of college students in the 1930's. While stereotyping is related to prejudice, it neither necessarily cause prejudice nor it is necessary for prejudice [39]. As summarized by Fiske, people stereotype to simplify the task of social cognition and maximize scarce cognitive resources [16]. As such, stereotyping is a natural and common process [9, 16, 39]. Fiske, however, also highlights that this should not be misinterpreted as *"the social categorizer cannot easily do otherwise"* [16]. Indeed, studies found that people can inhibit the effects of automatic stereotype activation when the implications compete with goals to establish or maintain a nonprejudiced identity [11].

To examine stereotypes and explain the discrimination of social groups, Fiske et al. developed the SCM [17], a model which became an established theory in social psychology. The model is based on the assumption that, formed by evolution, people assess strangers using the two dimensions warmth and competence. People assess strangers' intent to either harm or help them (warmth) as well as their capacity to act on that perceived intention (competence). Strangers that are not perceived as a threat are considered warm and strangers that display status symbols are considered competent. It has been applied to different domains to understand, for example, racism [35], sexism [14], and ageism [8]. The stereotypical content or stereotypical groups are different for different groups or even individuals but the SCM reliably predicts stereotype content for different cultural contexts [10].

Previous work showed that the SCM can not only be applied to understand the stereotypical perception of mobile devices [48] but also the stereotypical perception of brands [24, 30] and other products [7, 56]. One the one hand, this seems not surprising as social psychology predicts that similar cognitive mechanisms are responsible to categorize people and to categorize objects [23]. On the other hand, it is unclear what causes an (stereotypical) objects' position within the SCM. While objects might be threatening, they cannot act and have no intention. The work by Schwind et al. [48] suggests that how an object modulates a persons' abilities defines the object's position within the SCM. If this is true, it would, however, still be unclear how a social categorizer assess how an object modulates a persons' abilities. The work on brand perception and desire to buy products by Antonetti and Maklan might offer a different explanation [5]. They suggest that stereotypical users of a brand have an effect on a person's desire to buy and own products of that brand. Applied to mobile devices, this could imply that the stereotypical users of a stereotypical mobile device define the device's position within the SCM.

2.4 Summary

There is an increasing awareness in HCI that social acceptability is important to understand the adoption of devices [20, 27, 32] and can also inspire novel ones (e.g. [21, 33, 40, 45, 53]). While we have increasingly reliable tools to measure social acceptability [27, 42], it is still unclear why one mobile or wearable device is more socially acceptable than another. Previous work revealed that a number of aspects, including the users' gender, the location, and the cultural background, affect social acceptability. Schwind et al. suggest that it can be explained by the SCM's two underlying factors warmth and competence. They argue that the SCM could help understanding social acceptability [48]. The authors even propose, without providing empirical evidence that the position within the SCM is the reason for a device's social acceptability. Even if this is true, it is currently unknown what causes a device's position within the SCM and, thereby, what causes its social acceptability. Work from psychology might provide an explanation by using the SCM to show that stereotypical users of a brand have an effect on the perception of the brand [5]. In conclusion, it is unclear if the SCM can actually predict social acceptability and it is also unclear what causes a device's position within the SCM.

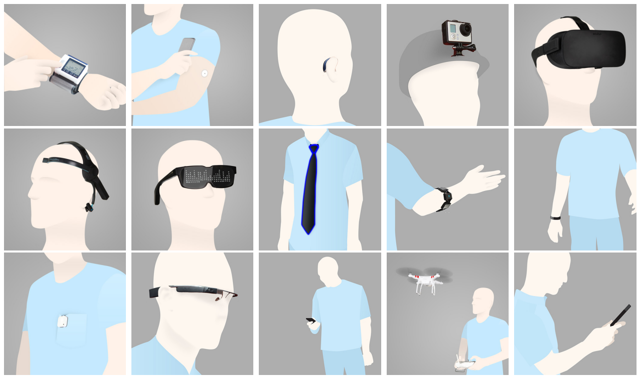

Figure 1: Illustrations of mobile devices used in our studies and provided by Schwind et al. [48]. From left-to-right and top-to-bottom: blood pressure monitors, blood glucose sensors, hearing aids, head-mounted action cameras, VR headsets, EEG headsets, quadcopters (with remote control), LED glasses, LED ties, gesture control armbands, fitness tracker, narrative clips, smart glasses, smartphone, and e-reader. The latter two devices were used in our second study instead of gesture control armbands and action cameras.

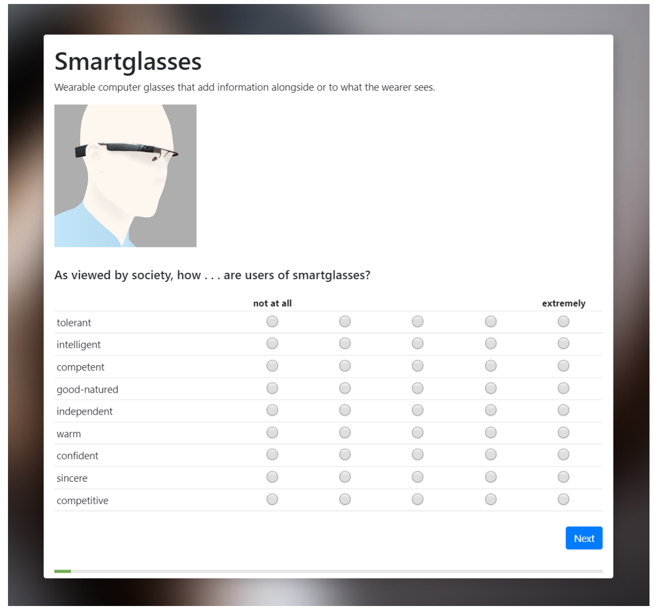

Figure 2: Screenshot from the first study's survey presenting a stimuli (here smart glasses) and the nine items of the SCM questionnaire.

3 STUDY 1: PREDICTING SOCIAL ACCEPTABILITY

Previous work suggests that ratings of warmth and competence can predict the social acceptability of mobile devices as such devices are stereotypically perceived [48]. Therefore, we conducted a study to empirically test this assumption. We hypothesize that the generally independent factors warmth and competence, when combined to a unified construct, predict how socially accepted a device is being considered. In the study, we asked participants how warm and competent they consider persons using mobile devices and simultaneously ask how socially acceptable they consider different devices.

3.1 Study Design

We used a within-subject design to determine the locations of 12 commercially available mobile devices in the SCM. At the same time, we determine the devices' social acceptability using the WEAR scale and three additional items directly asking to rate the devices' social acceptability. Device is the only independent variable and was utilized to modulate both social acceptability ratings as well as the corresponding locations within the SCM.

3.2 Stimuli

Illustrations of recent mobile devices provided in the work by Schwind et al. [48] were used to visualize the functionality and design of twelve devices. We selected the devices to evenly sample the space spanned by the SCM. Based on their locations in the SCM, we selected three medical devices (*blood pressure monitor*, *blood glucose sensor*, *hearing aid*), four head-worn devices (*head-mounted action camera*, *VR headset*, *EEG headset*), three devices generally used for leisure and fun (*quadcopter with remote control*, *LED glasses*, *LED tie*), two arm-worn devices (*gesture control armband* and *fitness tracker*), and two devices, which have been critically assessed due to privacy concerns [29, 41, 48], (*narrative clips*, *smart glasses*). Each stimuli had a brief description of the respective functionality (e.g. "Fitness tracker - Wearable device for monitoring and tracking of fitness- and health-related data"). Illustrations used in our first study are shown in Figure 1.

3.3 Measures

We used the questionnaire by Fiske et al. to assess the stereotypical perception of persons using the devices, the WEAR scale to determine the devices' social acceptance, and three additional items to verify the reliability of the social acceptance measures [17, 28].

Stereotypical ratings of the SCM were asked with the question "As viewed by society, how are persons with [device *plural*]?" and nine corresponding items for perceived competence (*competent*, *confident*, *independent*, *competitive*, *intelligent*) and for perceived warmth (*tolerant*, *warm*, *good-natured*, *sincere*). Items were presented using 5-point scales ranging from *not at all* (1) to *extremely* (5). To assess social acceptance, we used the 14-item WEAR Scale by Kelly et al. [27]. SCM and WEAR Scale questionnaires were used as suggested in the original work [17, 27]. Thus, we randomized the items' order within the SCM and the WEAR scale questionnaires. Furthermore, we used three additional items to verify the social acceptability of each device. We asked participants to rate the extent to which they agree with the statements that "*owning*", "*using*", as well as "*wearing*" the device is socially accepted. The items were presented using 7-point Likert items ranging from "strongly

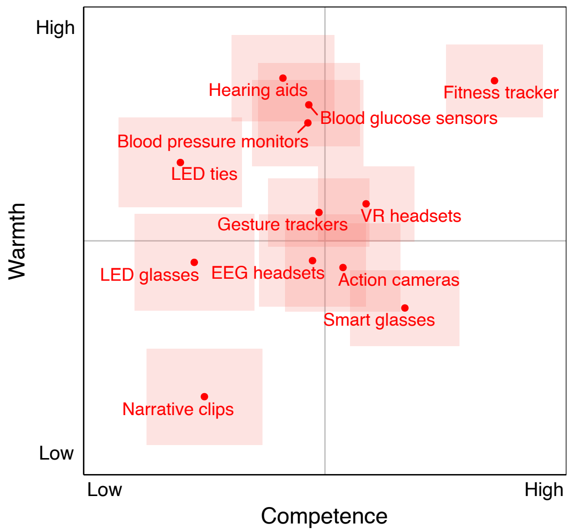

Figure 3: Average device locations within the dimensions of competence and warmth show the stereotypical perception of mobile devices. Rectangles show 95% confidence interval (CI).

disagree" (1) to "strongly agree" (7). In total, we used three questionnaires with 26 items. Each questionnaire was presented below the respective stimulus.

3.4 Procedure

The introducing survey page explained the purpose and goals of the study. After giving informed consent and proving demographic data (gender, age, occupation, highest degree, nationality) participants were presented one of the 12 conditions. We randomized the order of the conditions for each participant to avoid sequence effects. Questionnaires were presented one after another and below each stimulus. Figure 2 shows an example of the SCM questionnaire. After completing the survey, participants received a code for compensation.

3.5 Participants

We recruited 108 participants through our institution's mailing lists and Amazon Mechanical Turk (AMT). Thirteen participants did not complete the survey and were not considered in the analysis. Thus, 95 participants (41 female, 54 male) completed the survey. Participants from our institution were compensated with credit points for their study course, participants from AMT received \$ 2.50. On average, participants were 32.33 years old ($SD = 8.14$) ranging from 18 to 59 years. Fifteen participants came from Germany, 80 from the United States of America. Most had a background in engineering (16), management (17), health (8), sales (9), all remaining in other disciplines.

3.6 Results

To understand if findings from previous work are replicable and the SCM can be applied to mobile devices, we first determined the

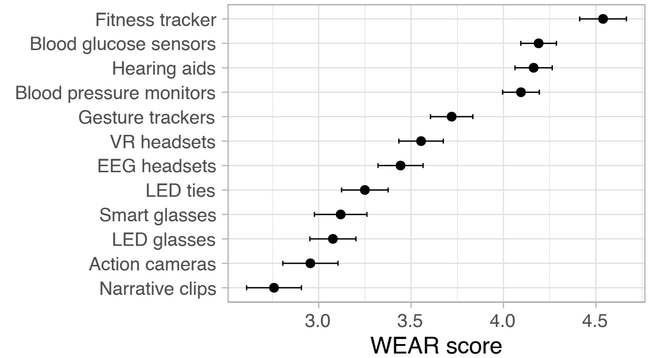

Figure 4: Average scores of the WEAR scale for all devices. Error bars show 95% CI.

devices' locations within the SCM's dimensions competence and warmth. We performed a one-way multivariate repeated measure (RM) analysis of variance (MANOVA) to determine the effects of Device on both measures. We found a statistically significant effect of Device on both measures, $F(11, 94) = 18.559$, $p < .001$, Pillai's trace = .330,$\eta_p^2 = .117$. Univariate RM-ANOVA revealed a significant effects on competence, $F(11, 93) = 11.41$, $p < .001$, and warmth, $F(11, 93) = 24.23$, $p < .001$. There was no significant difference between participants who completed the survey for credit points or via AMT, and we also found no effects of participants' gender ($p > 0.09$).

A MANOVA shows that warmth and competence are independent from each other and that mobile devices significantly affect both. The arrangement of the device locations (Figure 3) is similar to the results of the second study conducted by Schwind et al. [48]. For example, fitness trackers received high competence and warmth ratings. Medical devices received high warmth and medium competence ratings. LED glasses received low competence and low warmth ratings. Smart glasses received high competence but low warmth ratings.

Considering the four social acceptance measures, we found a statistically significant effect of Device, $F(11, 93) = 75.97$, $p < .001$, on the mean WEAR scores (Figure 4). Nonparametric ART-ANOVA also revealed significant effects on the items *owning a device*, $F(11, 93) = 54.242$, $p < .001$, *using a device*, $F(11, 93) = 75.66$, $p < .001$, and *wearing a device*, $F(11, 93) = 69.820$, $p < .001$.

To understand if perceived competence and warmth can predict ratings of social acceptability we determined the correlation between the diagonal of the SCM and the four measures of social acceptability. Means of the WEAR Scale were rounded to one digit to decrease the variance between the bins. Thus, ratings of device ownership, wearing the device, device usage, and the WEAR scale were compared with the stereotypical assessments within the SCM. The variance of this mapping is related to how often devices were rated with the respective score. All mappings between social acceptance ratings and perceived competence and warmth showed a linear increase along the equation fit. Equation fits for all measures were highly significant (all with $p < .001$), with adjusted coefficients of determination, $R^2 = .975$ for device ownership, $R^2 = .968$,

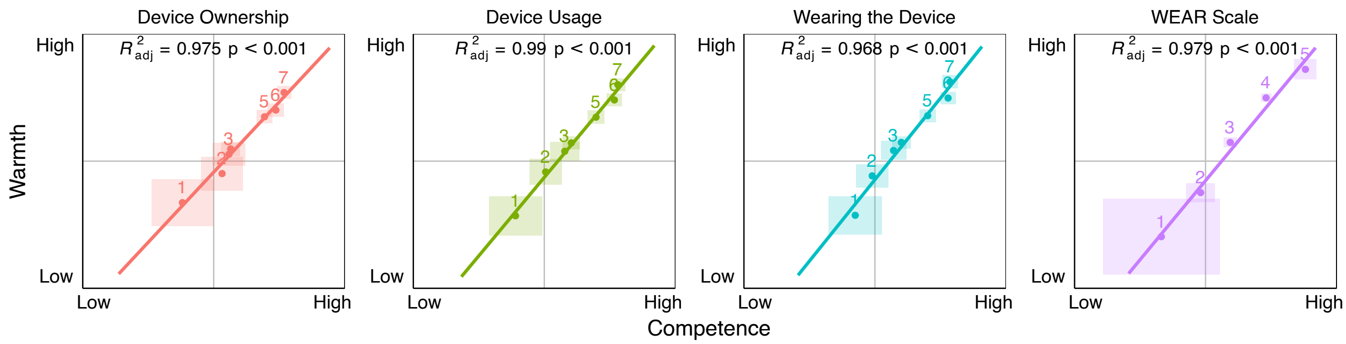

Figure 5: Social acceptance plots (from left to right): scores of device ownership, device usage, wearing a device, and the WEAR scale with their corresponding ratings of warmth and competence. The numbers show the respective social acceptance measure from low (not socially acceptable) to high (socially acceptable). The results indicate that all social acceptance indices of a device increase when warmth as well as competence increase, too. Rectangles show 95% CI.

for wearing the device, $R^2 = .990$ for device usage, and $R^2 = .979$, $p < .001$ using rounded scores of the WEAR scale. Social acceptance ratings within the SCM and 95% confidence interval are shown in Figure 5.

3.7 Discussion

The study asked participants to assess the warmth and competence of people using twelve mobile devices. Participants also rated the devices' social acceptability using the WEAR scale by Kelly [27–29] as well as three items asking how socially acceptable it is to own, wear, and use a device. Responses by 95 participants show that the twelve devices cover a wide spectrum of the SCM and the four measures of social acceptability. The analysis revealed a very high correlation between the dimensions of the SCM and the four measures of social acceptability including the WEAR scale ($R^2 > .96$ for all measures).

In line with Schwind et al. [48], the study shows that a person with a device has a position in the SCM. By simultaneously measuring warmth, competence, and social acceptability, we show that the position in the SCM can predict the social acceptability of the mobile devices. Social acceptance of a mobile device increases along the diagonal in the SCM from contempt (low warmth, low competence) to admiration (high warmth, high competence). One might argue that correlation does not necessarily imply causation. There are several reasons why we are certain that we did not observe a spurious correlation. As the underlying assumption has been independently formulated in previous work, the study has been conducted based on a clear hypothesis we tested. Furthermore, the robustness of the SCM has been shown numerous times. The WEAR scale is a validated questionnaire for social acceptability and we used three additional items measuring social acceptability to increase the internal validity. The devices cover a broad spectrum of the SCM and the WEAR scale. The results are also in line with previous work on brand perception [30]. Popular brands receive high ratings on both dimensions and troubled brands (such as Goldman Sachs directly after the financial crisis of 2007-2008) receive low ratings on both dimensions. Thus, we conclude that the warmth and competence of a person using a device can indeed predict a device's social acceptability.

One explanation for the formation of the warmth and competence of persons with a device is that the device modulates the persons' abilities. Following this explanation, persons with a fitness tracker would be considered warm and competent because the device increases the capacity to carry out their intentions and enable them to help but not harming others. Persons with LED glasses would be considered neither warm nor competent because the device reduces the capacity to carry out intentions and enable to harm but not help others. Following Antonetti and Maklan [5], however, makes another explanation more likely. Just as stereotypical users of a brand affect the perception of that brand, stereotypical users of a mobile device could affect the stereotypical perception of the device. If this is true, a device's position in the SCM and, therefore, also a device's social acceptability is caused by the device's stereotypical users. As it is assumed that a device is typically used by persons that are warm and competent, it is concluded that a specific person using a device is also warm and competent. Consequently, a device would be socially acceptable if we believe that it is typically used by persons we admire that have a high status and do not compete with us. A device would not be socially acceptable if we believe that it is typically used by persons who compete with us that we consider contemptuous and low status. If this would indeed be the case, it would require radically different approaches to increase devices' social acceptability. Instead of changing the features that modulate a user's ability, developers would have to find designs that suggest typical users who are warm and competent.

4 STUDY 2: ANTICIPATED USER STEREOTYPES

We conducted a second study to learn if a device's position in the SCM and therefore also a device's social acceptability is caused by the human stereotypes that are anticipated to use the device. Therefore, we conducted three surveys to determine if the assumed probability that human stereotypes use a mobile device can predict the stereotypical perception of the device.

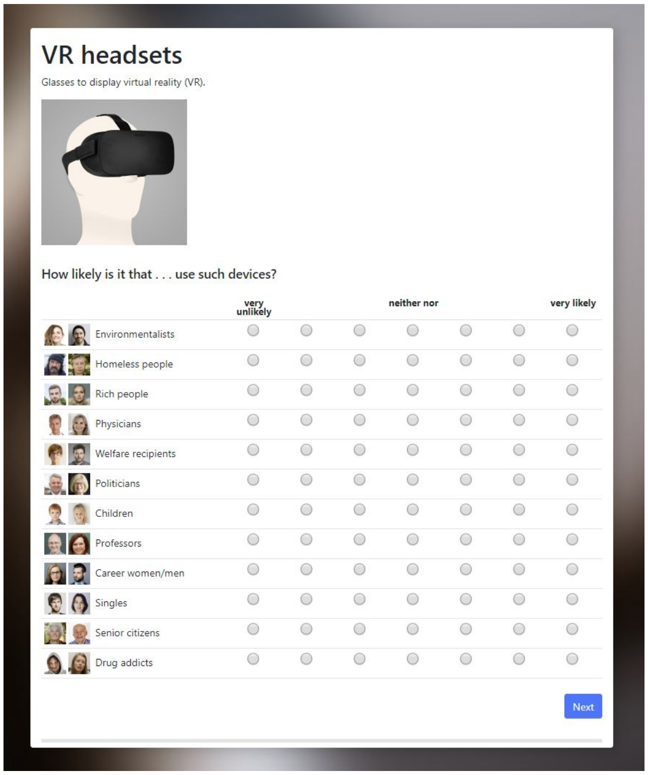

Figure 6: Screenshot of the survey asking for the perceived probability that each of the twelve stereotypical users uses a device (here a VR headset).

4.1 Study Design

In the first of the three surveys, we asked participants to assess the warmth and competence of twelve known Human Stereotypes. We used the SCM questionnaire as suggested in the original work [17] and presented the stereotypes in random order. In the second survey, we asked participants to assess the warmth and competence of persons with twelve Mobile Devices. Again, we used the SCM questionnaire as suggested in the original work [17] and presented the devices in random order. In the third survey, we determined the Anticipated Users of mobile devices by asking participants to assess the probability that each of the twelve Mobile Devices is used by each of the twelve Human Stereotypes. For each mobile device, we asked participants to assess "How likely is it that [stereotype *pl.*] use such devices?" (from 1 "very unlikely" to 7 "very likely") by presenting a list of the Human Stereotypes (see Figure 6). We randomized the order of conditions. The three surveys were conducted concurrently and each participant was assigned to only one of them. We ensured that each participant could only contribute to a single survey.

4.2 Stimuli

Twelve human stereotypes, which were already investigated by previous work, were used to determine the location of different user groups [12, 13, 18, 19, 48]. We used exemplary photos of male

Figure 7: Stimuli pairs of female and male persons used as human stereotypes in our second study (from left to right, from top to bottom): career women/men, homeless people, environmentalists, rich people, senior citizens, singles, welfare recipients, physicians, politicians, professors, children, and drug addicts.

and female persons (see Figure 7) as used by Schwind et al. [48] and obtained from shuttstock.com and adobestock.com. As our study relies on an even and stable distribution of human stereotypes, we added drug addicts, professors, children, and politicians, as they were already investigated and found to be in each of the four quadrants within the SCM [12, 13, 18, 19]. Illustrations of devices from the first study were also used in our second study. Instead of gesture control armbands and action cameras, we used illustrations of smartphones and e-readers to investigate the perception of more ubiquitous devices. Thus, we had also twelve conditions in Mobile Devices. Every stimulus had a brief textual description.

4.3 Procedure

As the three surveys were distributed concurrently, participants who received the link to the study were randomly assigned to one of them. The three surveys basically followed the procedure of our first study. In all surveys, participants started on a page explaining the purpose and goals of the study. They also received an informed consent form. After providing informed consent, participants continued with a demographic questionnaire and were then assigned to the first of the twelve randomly ordered conditions. The individual questionnaires were presented one after another and below each stimulus. After completing the survey, participants received a code for compensation.

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4.4 Participants

All participants were recruited via AMT and received $1.80 as compensation for their participation. In total, 207 participants took part in the study and 189 completed their assigned survey. Only completed surveys were considered in the analysis to enable a full factorial study design. Participants' average age was 35.05 years (SD = 9.85) and ranged from 21 to 68 years. The survey investigating Human Stereotypes was completed by 60 participants (24

Table 1: Probability provided by participants by rating how likely each of the twelve human stereotypes uses a device. The assessments were used to predict warmth and competence (see Figure 8) based on the corresponding human stereotypes' locations in the SCM.

Device	Drug addicts	Homeless people	Welfare recipients	Children	Senior citizens	Politicians	Rich people	Environ-mentalists	Singles	Career wo-men/men	Professors	Physicians
Fitness tracker	25,8%	20,3%	35,7%	42,0%	56,3%	64,9%	81,8%	66,5%	76,0%	77,3%	70,6%	77,7%
E-Reader	31,6%	22,9%	37,7%	64,5%	57,4%	72,3%	79,4%	66,2%	73,6%	78,1%	84,8%	76,8%
Quadcopters	24,9%	19,3%	26,0%	66,9%	27,7%	41,8%	79,0%	57,8%	64,1%	56,7%	54,8%	43,9%
VR headsets	28,4%	20,3%	28,8%	76,6%	28,1%	40,9%	79,0%	48,3%	69,7%	55,0%	52,6%	48,9%
Smart glasses	22,5%	18,8%	24,9%	37,2%	25,5%	49,6%	78,4%	47,0%	55,8%	60,6%	61,7%	58,2%
Narrative clips	24,5%	20,6%	29,2%	36,1%	32,3%	51,3%	64,1%	51,7%	49,8%	57,4%	57,1%	54,5%
Blood glucose sensors	33,8%	26,0%	37,2%	37,2%	81,6%	50,0%	56,3%	47,8%	48,3%	51,9%	51,3%	58,7%
Blood pressure monitors	33,8%	23,6%	35,7%	30,3%	84,2%	58,4%	58,0%	48,9%	46,5%	54,5%	54,5%	69,5%
Hearing aids	34,6%	29,7%	39,6%	39,2%	86,8%	51,7%	51,9%	44,8%	46,8%	46,3%	49,8%	49,6%
LED ties	24,5%	20,6%	26,0%	40,9%	29,4%	34,6%	49,8%	34,6%	48,3%	42,6%	40,3%	34,8%
LED glasses	27,5%	19,5%	25,5%	55,4%	25,8%	33,5%	58,2%	37,0%	53,2%	39,2%	37,0%	35,3%
Smartphones	71,6%	45,2%	72,7%	70,8%	69,3%	92,0%	93,9%	87,9%	92,2%	93,9%	92,6%	94,2%

female, 35 male, one did not want to specify), the survey for Mobile Devices was completed by 63 participants (25 female, 38 male), and the Anticipated Users survey was completed by 66 participants (27 female, 38 male, 1 other). All participants came from the United States of America.

4.5 Results

The results of the surveys asking about the position of the Human Stereotypes and the Mobile Devices within the SCM are shown along with the devices' predicted positions in Figure 8. The probabilities that the Human Stereotypes use the Mobile Devices are shown in Table 1. The analysis to determine effects of the Human Stereotypes and the Mobile Devices is in line with Schwind et al. [48]. Using a RM-ANOVA, we found that Human Stereotypes, $F(11, 59) = 138.2$, $p < .001$, as well as Mobile Devices, $F(11, 62) = 11.95$, $p < .001$, have a significant effect on competence. Using a RM-ANOVA, we also found significant effects of Human Stereotypes, $F(11, 59) = 65.02$, $p < .001$, and Mobile Devices, $F(11, 62) = 11.95$, $p < .001$ on warmth. The third survey with Anticipated Users as independent variable had twelve measures supposed to be independent from each other, which could be confirmed using a RM-MANOVA , $F(132, 7854) = 12.983$, $p < .001$, Pillai's trace = 1.970, $\eta_p^2 = .148$.

We developed the simplest possible model to predict a device's location in the SCM based on the assumption that anticipated stereotypical users are responsible for the social perception of mobile devices. To predict the warmth and competence of a device, we determine the device's location in the SCM from stereotypes' warmth and competence combined with the probability that the stereotypes use the device. We used the Human Stereotypes' average position in the SCM and weighted them linearly with the corresponding probability determined through the Anticipated Users survey. We first determined for each Mobile Device how likely it is, according to participants' believes, that the device is used by each Human Stereotype. The resulting probability is used as a weighting factor when predicting the devices' warmth and competence. For each device, we used Equation 1 to predict the device's warmth and competence. We sum up the warmth and competence of the twelve Human Stereotypes' and weight them using the respective probability.

$$\binom{w}{c}'_d = \frac{\sum\limits_{s \in S} p_{ds} \binom{w}{c}_s}{\sum\limits_{s \in S} p_{ds}} \tag{1}$$

In Equation 1, (w, c) is a position within the SCM composed of warmth and competence, d is a Mobile Device from the set of all Mobile Devices, s is a Human Stereotype from the set of all Human Stereotypes S, and p_{ds} is the probability that Mobile Device d is used by Human Stereotype s. The result is $(w, c)'$ a device's position which is purely derived from Human Stereotypes' and the assumed likelihood that they use the device.

We computed warmth and competence for all devices to assess the similarity of the prediction and the directly measured warmth and competence for each Mobile Device. We use Spearman's rank correlation [52] to determine if the predicted and the measured device locations correlate. Spearman's correlation analysis between the devices' measured and predicted locations revealed a strong and significant correlation for warmth, $r_s = .755$, $p < .001$, and a very strong and significant correlation for competence, $r_s = .83$, $p < .001$. We use Welch's approximation test of equivalence (TOST) [34] to determine if the predicted and the measured device locations are equivalent. TOST for warmth (df = 12.88, $\delta = -.278$) and competence (df = 14.476, $\delta = -.334$) were significant (both with $\epsilon = 1$, $p < .001$) indicating that a null hypothesis of statistical difference between predicted and direct measures can be rejected.

4.6 Discussion

In the second study, three surveys were conducted to understand if anticipated user stereotypes can predict mobile devices' position in the SCM and thereby their social acceptability. In the first survey, we determined the warmth and competence ratings of known human stereotypes. The results are in line with previous work [12, 13, 18, 19, 48]. Based on the second survey, we found that mobile devices are perceived stereotypically and received distinct locations within the SCM that are in line with our first study and were predicted by Schwind et al. [48]. In the third survey, we determined the devices'

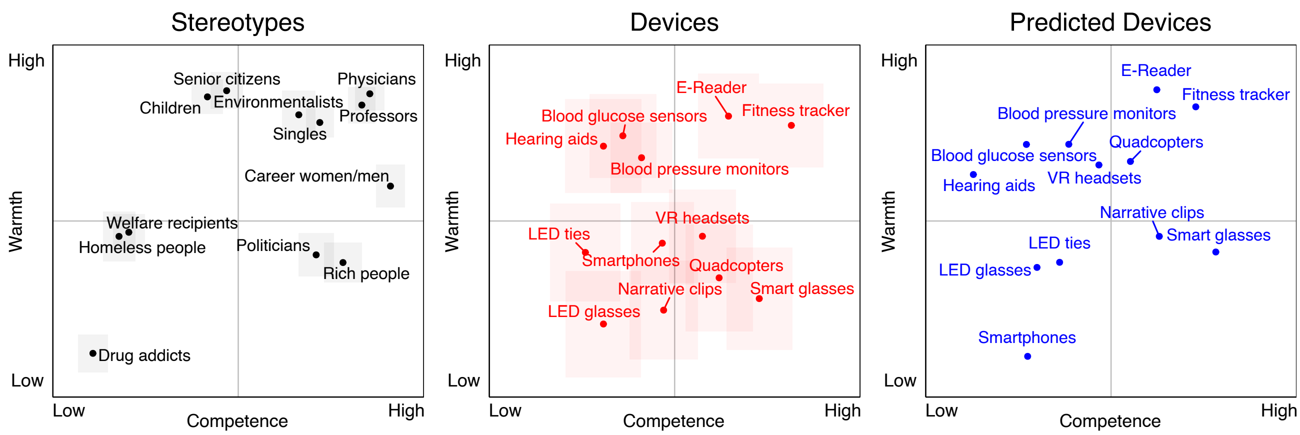

Figure 8: Results of the three surveys from our second study: Average ratings of the first survey (left) show the perceived warmth and competence ratings of twelve known human stereotypes. In the second survey (middle), "warmth and competence ratings of 'any person"' with a mobile device. Device locations in our third study (right) are predicted by combining the perceived probability (see Table 1) that a human stereotype uses a device with the corresponding warmth and competence from the human stereotypes (left). Rectangles show 95% CI.

Anticipated Users by asking how likely it is that the Human Stereotypes use the Mobile Device.

By weighting the warmth and competence of the human stereotypes based on the probability that they use the devices, we predict the devices' position in the SCM. We found a strong ($r_s = .755$) correlation between the predicted warmth and the warmth directly rated by participants. We found a very strong ($r_s = .83$) correlation between the predicted competence and the competence directly rated by participants. Equivalence tests indicate that the null hypothesis of statistical difference between the direct ratings and predictions can be rejected. Thus, our findings support the hypothesis that the warmth and competence of persons using a mobile device is the result of the warmth and competence of the device's anticipated users. Thus, a device's position in the SCM is not inherently caused by the device itself but through the device's stereotypical users. Combined with the results of our first study, we conclude, that a device's social acceptability is, at least partially, caused by the device's stereotypical users.

Predicted warmth and competence of mobile devices determined through the weighting of anticipated user stereotypes do not perfectly match with the directly assessed warmth and competence ratings of mobile devices. While competence ratings showed a very strong correlation between the predicted and the measured scores, warmth ratings showed "only" a strong correlation. We also investigate smartphones as a ubiquitous and widely used type of mobile device. The position relative to the other devices predicted for smartphones clearly deviates from the position directly provided by participants. Smartphones received higher warmth and competence ratings than predicted. This deviation is the main reason for the imperfect overall correlation between the predictions and participants' ratings for all devices. Participants anticipated that all human stereotypes provided in the study use smartphones. This includes the contemptuous stereotypes which are considered unlikely to use the other devices. Therefore, smartphones' location is attracted by ratings of human stereotypes that are considered to have very low competence and warmth. We assume that the concept of a smartphone contains a broad and less differentiated spectrum of mobile devices and, more importantly, a less differentiated view on the anticipated user stereotypes used in our study. It is further conceivable that smartphones do have a special status in terms of social acceptance. Even the direct warmth and competence ratings are low considering their ubiquitous nature. These low ratings are also evident in the second study by Schwind et al. [48].

Our results might suggest while smartphones' are widely used, this not necessarily imply that they are socially accepted. One explanation is that they are also used by contemptuous user stereotypes. As smartphones can be found everywhere in today's modern cultures, it is conceivable that negative associations with less accepted human stereotype are being ignored or tolerated while using those devices oneself. Another explanation for the mismatch is that due to their ubiquitous nature, the term smartphone is not sufficient to characterize a mobile device. The price range for current smartphones comprises more than one order of magnitude and they are used even with clearly visible defects [47]. It might be assumed that smartphones at the low end of the price range or with visible defects are perceived very different from smartphones at the far end of the price spectrum and in mint conditions.

When predicting devices' warmth and competence, we linearly combined the weighted warmth and competence of all human stereotypes. Some anticipated stereotypical users might, however, be more important or prominent when assessing mobile devices than others. We used human stereotypes that all have been used in previous work [12, 13, 18, 19, 48]. Stereotype content, however, differs between cultures [10] and consequently also changes over time. Probably more important, stereotypes used to assess strangers might differ from the stereotypes used to assess mobile devices.

5 GENERAL DISCUSSION

In two studies, we investigated if anticipated user stereotypes affect the social acceptability of mobile devices. In the first study, we asked participants to assess the warmth, competence and social acceptability of mobile devices. We showed that combined competence-warmth ratings highly correlate with measures of social acceptance. We concluded that the warmth and competence of a person using a device can indeed predict a device's social acceptability. The results of the study indicate that the construct of social acceptability can also be described and composed using the outcome of stereotyping. Thus, social acceptance of a mobile device can be considered as the result of a cognitive process assessing peoples' intent and the capability to pursue it. In the second study, participants were independently asked to assess (1) the warmth and competence of user stereotypes, (2) mobile devices, and (3) how likely it is that a human stereotype uses a device. We show that the anticipated probability that a human stereotype uses a device, predict the device's perceived warmth and competence. Thus, we conclude that the anticipated users of a mobile device affect the device's social acceptability. We further conclude that mobile devices are not inherently stereotypically perceived but convey the perception about people, who are assumed to use the device.

Our results confirm previous work by Schwind et al. [48]. Our first study confirms the assumption that there is indeed a relationship between social acceptance and the dimensions of the SCM. The device positions within the SCM of both studies are in line with the second study reported by Schwind et al. [48] which shows the robustness of using the SCM to assess the social perception of mobile devices. Our second study explains and thereby also confirms earlier findings [48]. They found that equipping stereotypical users with mobile devices systematically changes their position in the SCM. Our second study suggests that this shift is caused by the anticipated users of devices. Thus, using a fitness tracker, for example, the user becomes associated with the typical or anticipated user of fitness trackers.

Our conclusion might seem defeatist for designers and developers. If a device is assumed to have users who are admired by society, the device becomes socially acceptable. Some devices are connected to certain stereotypical user groups. Stigmatization can prevent the adoption of hearing aids [15, 55], blood glucose sensors [36, 46] and other assistive technologies [51]. As the probability of hearing loss and diabetes increases with age, such devices' anticipated users are foremost senior citizen. As senior citizen are stereotypically perceived to have lower competence this affects the perception of the corresponding devices. The prevalent answer seems to showcase such devices with young apparently healthy persons full of power and energy. Clearly, this is what advertisers often try by presenting products with fictitious stereotypes from the SCM's admirable quadrant. Previous work showed that if brands are perceived as both, warm and competent, it increases consumers' desire to buy products from that brand [1]. Previous work even suggested ways to cultivate admiration of brands to land in what the authors call the *"golden quadrant"* of the SCM [2].

We believe that designers and developers of mobile devices still have a say in social acceptability. Using the SCM's dimension of warmth and competence is more actionable than a single social acceptability score. For example, for a prototype with high competence and low warmth ratings, designers can further increase a device's social acceptability by increasing the perceived warmth. To design socially accepted devices, they can deliberately create designs that suggest socially accepted stereotypical users. This would be in line with suggestions for the acceptance of assistive devices [4, 6]. Advertising smart glasses by presenting them used by admirable stereotypes is likely not sufficient. The device's characteristics might suggest a stereotypical user that intends to invade our privacy and thereby harms us. Consequently, designers can integrate or highlight product features that suggest stereotypical users that are considered socially acceptable. E-readers, for example, make their wearers competent and warm because they are associated with intellectually-skilled people who educate (themselves) through reading. Similarly, fitness trackers are associated with health-conscious stereotypes. Equipping smart glasses with features that support reading and highlighting advanced educational content for VR headsets could increase their social acceptability because such properties can increase the likelihood that the devices are associated with admirable stereotypes. Regarding assistive devices, we suggest, in line with Shinohara and Wobbrock [51], that accessibility should be built into mainstream technologies.

Our results show that the conclusion that anticipated user stereotypes systematically affect devices' social acceptability only tells one part of the story. There is still variance that cannot be explained through the stereotypical perception of anticipated users. This implies that there are additional factors that developers can influence. Most importantly, a device can modulate persons' abilities. An e-reader can provide access to information, a fitness tracker can enable a healthier life, and hearing aids can improve one's ability to communicate. We believe that considering how devices modulate persons' abilities can explain some of the unsystematic variance we observed. This is supported by Schwind et al. who paired mobile devices with human stereotypes [48]. They discuss that some devices, such as tablets, VR headsets, and quadcopters, have a larger effect on senior citizens' perceived competence than on perceived warmth. The effect is also different compared to the effect on other human stereotypes. While it might not be anticipated that senior citizen use such devices, if they do, it increases their ability to pursue their intent.

The study asked participants to assess persons with a device without providing additional context. As highlighted by previous work, the social acceptability of using a device can be affected by the environment in which the usage takes place [45, 50, 57]. This is important to predict if a user would use a device in a certain context. We intentionally focused on the devices' social acceptability without specifying this context and left the context to participants' imagination. This is important for predicting if a mobile device will be acquired but it might not reliably predict if a device is used afterward. Stereotypical perception is still important when predicting if a potential user uses a device in a specific context and how socially accepted bystanders consider it. We believe that mobile devices are just one aspect of a users' context. Just as any other context their assessment is shaped by stereotypical groups connected to this context.

6 CONCLUSION & FUTURE WORK

In this paper, we presented two studies to increase our understanding of the mechanism resulting in the social acceptability of mobile devices. Through the first study, we show that the warmth and competence of a person using a device can predict the device's social acceptability. Through the second study, we show that the warmth and competence of a person using a device can be predicted using the warmth and competence of the device's anticipated users. In conclusion, social acceptance can be explained through stereotypical perception and the stereotypical perception of anticipated users can explain the social acceptability of mobile devices.

Future work should explore the mechanisms that are responsible for anticipating a device's users. For some devices, such as hearing aids and blood pressure monitors, this might seem obvious but for others, such as fitness trackers and VR glasses, it is certainly less obvious. This is especially important for novel devices and interaction techniques that have no established user group yet. Furthermore, future work has to explore additional factors that affect devices' social acceptability. How devices modulate a user's perceived warmth and competence is one direction worth pursuing.

Our work only considered who is using a device but left when and where the device is used to participants' imagination. As shown by previous work, these factors can affect devices' and interaction techniques' social acceptability and are therefore important to predict if a device is used in a specific context. Consequently, future work should investigate the relationship between stereotyping, mobile devices and context. We assume that different contexts could have individual positions in the SCM just as mobile devices have a position in the SCM. If this is indeed the case, it would be interesting to find unexpected interaction effects when mobile devices are used in specific contexts by different stereotypical users.

REFERENCES

[1] Jennifer Aaker, Kathleen D. Vohs, and Cassie Mogilner. 2010. Nonprofits Are Seen as Warm and For-Profits as Competent: Firm Stereotypes Matter. *Journal of Consumer Research* 37, 2 (02 2010), 224–237. https://doi.org/10.1086/651566 arXiv:http://oup.prod.sis.lan/jcr/article-pdf/37/2/224/17930260/37-2-224.pdf

[2] Jennifer L. Aaker, Emily N. Garbinsky, and Kathleen D. Vohs. 2012. Cultivating admiration in brands: Warmth, competence, and landing in the golden quadrant. *Journal of Consumer Psychology* 22, 2 (2012), 191–194. https://doi.org/10.1016/j.jcps.2011.11.012

[3] Gordon W. Allport, Kenneth Clark, and Thomas Pettigrew. 1954. *The Nature of Prejudice.* Addison-Wesley Reading, MA.

[4] Leonardo Angelini, Maurizio Caon, Stefano Carrino, Luc Bergeron, Nathalie Nyffeler, Mélanie Jean-Mairet, and Elena Mugellini. 2013. Designing a Desirable Smart Bracelet for Older Adults. In *Proceedings of the 2013 ACM Conference on Pervasive and Ubiquitous Computing Adjunct Publication* (Zurich, Switzerland) *(UbiComp '13 Adjunct)*. Association for Computing Machinery, New York, NY, USA, 425–434. https://doi.org/10.1145/2494091.2495974

[5] Paolo Antonetti and Stan Maklan. 2016. Hippies, greenies, and tree huggers: How the "warmth" stereotype hinders the adoption of responsible brands. *Psychology & Marketing* 33, 10 (2016), 796–813.

[6] Aimée K. Bright and Lynne Coventry. 2013. Assistive Technology for Older Adults: Psychological and Socio-Emotional Design Requirements. In *Proceedings of the 6th International Conference on PErvasive Technologies Related to Assistive Environments* (Rhodes, Greece) *(PETRA '13)*. Association for Computing Machinery, New York, NY, USA, Article 9, 4 pages. https://doi.org/10.1145/2504335.2504344

[7] Michael Chattalas. 2015. National stereotype effects on consumer expectations and purchase likelihood: competent versus warm countries of origin. *Journal of Business and Retail Management Research* 10, 1 (2015).

[8] Amy J.C. Cuddy and Susan T. Fiske. 2002. Doddering but dear: Process, content, and function in stereotyping of older persons. *Ageism: Stereotyping and prejudice against older persons* 3 (2002), 26.

[9] Amy J.C. Cuddy, Susan T. Fiske, and Peter Glick. 2008. Warmth and Competence as Universal Dimensions of Social Perception: The Stereotype Content Model and the BIAS Map. *Advances in Experimental Social Psychology* 40 (2008), 61–149. https://doi.org/10.1016/S0065-2601(07)00002-0

[10] Amy J.C. Cuddy, Susan T. Fiske, Virginia S.Y. Kwan, Peter Glick, Stephanie Demoulin, Jacques-Philippe Leyens, Michael Harris Bond, Jean-Claude Croizet, Naomi Ellemers, Ed Sleebos, et al. 2009. Stereotype content model across cultures: Towards universal similarities and some differences. *British Journal of Social Psychology* 48, 1 (2009), 1–33.

[11] Patricia G. Devine. 1989. Stereotypes and prejudice: Their automatic and controlled components. *Journal of personality and social psychology* 56, 1 (1989), 5.

[12] Federica Durante, Susan T. Fiske, Michele J. Gelfand, Franca Crippa, Chiara Suttora, Amelia Stillwell, Frank Asbrock, Zeynep Aycan, Hege H. Bye, Rickard Carlsson, Fredrik Björklund, Munqith Dagher, Armando Geller, Christian Albrekt Larsen, Abdel-Hamid Abdel Latif, Tuuli Anna Mähönen, Inga Jasinskaja-Lahti, and Ali Teymoori. 2017. Ambivalent stereotypes link to peace, conflict, and inequality across 38 nations. *Proceedings of the National Academy of Sciences* 114, 4 (2017), 669–674. https://doi.org/10.1073/pnas.1611874114 arXiv:https://www.pnas.org/content/114/4/669.full.pdf

[13] Federica Durante, Susan T. Fiske, Nicolas Kervyn, Amy J.C. Cuddy, Adebowale Debo Akande, Bolanle E. Adetoun, Modupe F. Adewuyi, Magdeline M. Tserere, Ananthi Al Ramiah, Khairul Anwar Mastor, et al. 2018. Nations' income inequality predicts ambivalence in stereotype content: How societies mind the gap. In *Social Cognition.* Routledge, 246–268.

[14] Thomas Eckes. 2002. Paternalistic and envious gender stereotypes: Testing predictions from the stereotype content model. *Sex Roles* 47, 3-4 (2002), 99–114.

[15] Susan F. Erler and Dean C. Garstecki. 2002. Hearing Loss-and Hearing Aid-Related Stigma. *American Journal of Audiology* (2002). https://doi.org/10.1044/1059-0889(2002/020)

[16] Susan T. Fiske. 1989. Examining the role of intent: Toward understanding its role in stereotyping and prejudice. *Unintended thought* 253 (1989), 253–283.

[17] Susan T. Fiske, Amy J.C. Cuddy, Peter Glick, and Jun Xu. 2002. A model of (often mixed) stereotype content: competence and warmth respectively follow from perceived status and competition. *Journal of personality and social psychology* 82, 6 (jun 2002), 878–902. http://www.ncbi.nlm.nih.gov/pubmed/12051578

[18] Susan T. Fiske and Cydney Dupree. 2014. Gaining trust as well as respect in communicating to motivated audiences about science topics. *Proceedings of the National Academy of Sciences* 111, Supplement 4 (2014), 13593–13597. https://doi.org/10.1073/pnas.1317505111

[19] Susan T. Fiske and Federica Durante. 2014. Never trust a politician? Collective distrust, relational accountability, and voter response. In *Power, politics, and paranoia: Why people are suspicious of their leaders.* Cambridge University Press Cambridge, UK, 91–105.

[20] Jan Gugenheimer, Christian Mai, Mark McGill, Julie Williamson, Frank Steinicke, and Ken Perlin. 2019. Challenges Using Head-Mounted Displays in Shared and Social Spaces. In *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI EA '19)*. ACM, New York, NY, USA, Article W19, 8 pages. https://doi.org/10.1145/3290607.3299028

[21] Jan Gugenheimer, Evgeny Stemasov, Harpreet Sareen, and Enrico Rukzio. 2018. FaceDisplay: Towards Asymmetric Multi-User Interaction for Nomadic Virtual Reality. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI '18)*. ACM, New York, NY, USA, Article 54, 13 pages. https://doi.org/10.1145/3173574.3173628

[22] Jonna Häkkilä, Farnaz Vahabpour, Ashley Colley, Jani Väyrynen, and Timo Koskela. 2015. Design Probes Study on User Perceptions of a Smart Glasses Concept. In *Proceedings of the 14th International Conference on Mobile and Ubiquitous Multimedia* (Linz, Austria) *(MUM '15)*. ACM, New York, NY, USA, 223–233. https://doi.org/10.1145/2836041.2836064

[23] Stevan Harnad. 2017. To Cognize is to Categorize: Cognition is Categorization. In *Handbook of Categorization in Cognitive Science (Second Edition)* (second edition ed.), Henri Cohen and Claire Lefebvre (Eds.). Elsevier, San Diego, 21 – 54. https://doi.org/10.1016/B978-0-08-101107-2.00002-6

[24] Bjoern S. Ivens, Alexander Leischnig, Brigitte Muller, and Katharina Valta. 2015. On the role of brand stereotypes in shaping consumer response toward brands: An empirical examination of direct and mediating effects of warmth and competence. *Psychology & Marketing* 32, 8 (2015), 808–820.

[25] Charles M. Judd and Bernadette Park. 1993. Definition and assessment of accuracy in social stereotypes. *Psychological review* 100, 1 (1993), 109. https://doi.org/10.1037/0033-295X.100.1.109

[26] Daniel Katz and Kenneth Braly. 1933. Racial stereotypes of one hundred college students. *The Journal of Abnormal and Social Psychology* 28, 3 (1933), 280. https://doi.org/10.1037/h0074049

[27] Norene Kelly. 2017. All the World's a Stage: What Makes a Wearable Socially Acceptable. *Interactions* 24, 6 (Oct. 2017), 56–60. https://doi.org/10.1145/3137093

[28] Norene Kelly and Stephen Gilbert. 2016. The WEAR Scale: Developing a Measure of the Social Acceptability of a Wearable Device. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI EA '16)*. ACM, New York, NY, USA, 2864–2871. https://doi.org/10.1145/2851581.2892331

[29] Norene Kelly and Stephen B. Gilbert. 2018. The Wearer, the Device, and Its Use: Advances in Understanding the Social Acceptability of Wearables. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 62, 1 (2018), 1027–1031. https://doi.org/10.1177/1541931218621237

[30] Nicolas Kervyn, Susan T. Fiske, and Chris Malone. 2012. Brands as intentional agents framework: How perceived intentions and ability can map brand perception. *Journal of Consumer Psychology* 22, 2 (2012), 166–176. https://doi.org/10.1016/j.jcps.2011.09.006 arXiv:https://onlinelibrary.wiley.com/doi/pdf/10.1016/j.jcps.2011.09.006

[31] Marion Koelle, Matthias Kranz, and Andreas Möller. 2015. Don't look at me that way! – Understanding User Attitudes Towards Data Glasses Usage. In *Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services* (Copenhagen, Denmark) *(MobileHCI '15)*. ACM, New York, NY, USA, 362–372. https://doi.org/10.1145/2785830.2785842

[32] Marion Koelle, Thomas Olsson, Robb Mitchell, Julie Williamson, and Susanne Boll. 2019. What is (Un)Acceptable?: Thoughts on Social Acceptability in HCI Research. *Interactions* 26, 3 (April 2019), 36–40. https://doi.org/10.1145/3319073

[33] Marion Koelle, Katrin Wolf, and Susanne Boll. 2018. Beyond LED Status Lights - Design Requirements of Privacy Notices for Body-worn Cameras. In *Proceedings of the Twelfth International Conference on Tangible, Embedded, and Embodied Interaction* (Stockholm, Sweden) *(TEI '18)*. ACM, New York, NY, USA, 177–187. https://doi.org/10.1145/3173225.3173234

[34] Daniel Lakens. 2017. Equivalence Tests: A Practical Primer for t Tests, Correlations, and Meta-Analyses. *Social Psychological and Personality Science* 8, 4 (2017), 355–362. https://doi.org/10.1177/1948550617697177 arXiv:https://doi.org/10.1177/1948550617697177

[35] Monica H. Lin, Virginia S.Y. Kwan, Anna Cheung, and Susan T. Fiske. 2005. Stereotype content model explains prejudice for an envied outgroup: Scale of anti-Asian American stereotypes. *Personality and Social Psychology Bulletin* 31, 1 (2005), 34–47.

[36] Nancy F. Liu, Adam S. Brown, Alexandra E. Folias, Michael F. Younge, Susan J. Guzman, Kelly L. Close, and Richard Wood. 2017. Stigma in people with type 1 or type 2 diabetes. *Clinical Diabetes* 35, 1 (2017), 27–34. https://doi.org/10.2337/cd16-0020

[37] Calkin S. Montero, Jason Alexander, Mark T. Marshall, and Sriram Subramanian. 2010. Would You Do That? – Understanding Social Acceptance of Gestural Interfaces. In *Proceedings of the 12th International Conference on Human Computer Interaction with Mobile Devices and Services* (Lisbon, Portugal) *(MobileHCI '10)*. ACM, New York, NY, USA, 275–278. https://doi.org/10.1145/1851600.1851647

[38] Jakob Nielsen. 1994. *Usability engineering*. Morgan Kaufmann, San Diego.

[39] Scott Plous. 2003. The psychology of prejudice, sterotyping, and discrimination: An overview. In *Understanding prejudice and discrimination*. McGraw-Hill, New York, NY, US, 3–48.

[40] Daniel Pohl and Carlos F. de Tejada Quemada. 2016. See what I see: Concepts to improve the social acceptance of HMDs. In *2016 IEEE Virtual Reality (VR)*. 267–268. https://doi.org/10.1109/VR.2016.7504756

[41] Halley P. Profita. 2017. *Designing Wearable Assistive Computing Devices to Support Social Acceptability and Personal Expression*. Ph.D. Dissertation. University of Colorado Boulder. https://scholar.colorado.edu/csci_gradetds/138/

[42] Halley P. Profita, Reem Albaghli, Leah Findlater, Paul Jaeger, and Shaun K. Kane. 2016. The AT Effect: How Disability Affects the Perceived Social Acceptability of Head-Mounted Display Use. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI '16)*. ACM, New York, NY, USA, 4884–4895. https://doi.org/10.1145/2858036.2858130

[43] Halley P. Profita, James Clawson, Scott Gilliland, Clint Zeagler, Thad Starner, Jim Budd, and Ellen Yi-Luen Do. 2013. Don't Mind Me Touching My Wrist: A Case Study of Interacting with On-body Technology in Public. In *Proceedings of the 2013 International Symposium on Wearable Computers* (Zurich, Switzerland) *(ISWC '13)*. ACM, New York, NY, USA, 89–96. https://doi.org/10.1145/2493988.2494331

[44] Julie Rico and Stephen Brewster. 2010. Gesture and Voice Prototyping for Early Evaluations of Social Acceptability in Multimodal Interfaces. In *International Conference on Multimodal Interfaces and the Workshop on Machine Learning for Multimodal Interaction* (Beijing, China) *(ICMI-MLMI '10)*. ACM, New York, NY, USA, Article 16, 9 pages. https://doi.org/10.1145/1891903.1891925

[45] Julie Rico and Stephen Brewster. 2010. Usable Gestures for Mobile Interfaces: Evaluating Social Acceptability. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Atlanta, Georgia, USA) *(CHI '10)*. ACM, New York, NY, USA, 887–896. https://doi.org/10.1145/1753326.1753458

[46] Jasmin Schabert, Jessica L. Browne, Kylie Mosely, and Jane Speight. 2013. Social stigma in diabetes. *The Patient-Patient-Centered Outcomes Research* 6, 1 (2013), 1–10. https://doi.org/10.1007/s40271-012-0001-0

[47] Florian Schaub, Julian Seifert, Frank Honold, Michael Müller, Enrico Rukzio, and Michael Weber. 2014. Broken Display = Broken Interface? The Impact of Display Damage on Smartphone Interaction. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Toronto, Ontario, Canada) *(CHI '14)*. ACM, New York, NY, USA, 2337–2346. https://doi.org/10.1145/2556288.2557067

[48] Valentin Schwind, Niklas Deierlein, Romina Poguntke, and Niels Henze. 2019. Understanding the Social Acceptability of Mobile Devices Using the Stereotype Content Model. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. ACM, New York, NY, USA, Article 361, 12 pages. https://doi.org/10.1145/3290605.3300591

[49] Valentin Schwind, Jens Reinhardt, Rufat Rzayev, Niels Henze, and Katrin Wolf. 2018. On the Need for Standardized Methods to Study the Social Acceptability of Emerging Technologies. In *CHI'18 Workshop on (Un) Acceptable!?!-Re-thinking the Social Acceptability of Emerging Technologies*. 6. https://socialacceptabilityworkshop.uol.de/2018/proceedings/CHI18-SociallyAcceptableCHI-schwind.pdf

[50] Valentin Schwind, Jens Reinhardt, Rufat Rzayev, Niels Henze, and Katrin Wolf. 2018. Virtual Reality on the Go?: A Study on Social Acceptance of VR Glasses. In *Proceedings of the 20th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct* (Barcelona, Spain) *(MobileHCI '18)*. ACM, New York, NY, USA, 111–118. https://doi.org/10.1145/3236112.3236127

[51] Kristen Shinohara and Jacob O. Wobbrock. 2011. In the Shadow of Misperception: Assistive Technology Use and Social Interactions. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Vancouver, BC, Canada) *(CHI '11)*. Association for Computing Machinery, New York, NY, USA, 705–714. https://doi.org/10.1145/1978942.1979044

[52] Charles Spearman. 1904. The Proof and Measurement of Association between Two Things. *The American Journal of Psychology* 15, 1 (1904), 72–101. https://doi.org/10.2307/1412159

[53] Julian Steil, Marion Koelle, Wilko Heuten, Susanne Boll, and Andreas Bulling. 2019. PrivacEye: Privacy-preserving Head-mounted Eye Tracking Using Egocentric Scene Image and Eye Movement Features. In *Proceedings of the 11th ACM Symposium on Eye Tracking Research & Applications* (Denver, Colorado) *(ETRA '19)*. ACM, New York, NY, USA, Article 26, 10 pages. https://doi.org/10.1145/3314111.3319913

[54] Kaisa Väänänen-Vainio-Mattila, Thomas Olsson, and Jari Laaksonen. 2012. An Exploratory Study of User-generated Spatial Gestures with Social Mobile Devices. In *Proceedings of the 11th International Conference on Mobile and Ubiquitous Multimedia* (Ulm, Germany) *(MUM '12)*. ACM, New York, NY, USA, Article 11, 4 pages. https://doi.org/10.1145/2406367.2406381

[55] Margaret I. Wallhagen. 2009. The Stigma of Hearing Loss. *The Gerontologist* 50, 1 (07 2009), 66–75. https://doi.org/10.1093/geront/gnp107 arXiv:http://oup.prod.sis.lan/gerontologist/article-pdf/50/1/66/2034590/gnp107.pdf

[56] Katherine White and Darren W. Dahl. 2006. To Be or Not Be? The Influence of Dissociative Reference Groups on Consumer Preferences. *Journal of Consumer Psychology* 16, 4 (2006), 404 – 414. https://doi.org/10.1207/s15327663jcp1604_11

[57] Julie R. Williamson, Andrew Crossan, and Stephen Brewster. 2011. Multimodal Mobile Interactions: Usability Studies in Real World Settings. In *Proceedings of the 13th International Conference on Multimodal Interfaces* (Alicante, Spain) *(ICMI '11)*. ACM, New York, NY, USA, 361–368. https://doi.org/10.1145/2070481.2070551