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The Attendant Card Set: A Research and Design Tool to Consider Perspectives of Attendants versus Users When Co-Experiencing Technology

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Abstract: Although many of our interactions with technology nowadays take place in public places (e.g., using a mobile phone in public transportation), research and design on Human-Computer Interaction (HCI) has paid little attention to how this kind of technology usage affects others present—and vice versa. To illustrate the perspective of the attendant, i.e., a person who is not interacting with technology themselves but co-experiencing it as listener or viewer, we developed the so-called Attendant Card Set (ACS). In two studies, an expert survey and a student workshop, we tested its practical applicability and usefulness. It showed not only that experts assess the cards positively, i.e., helpful, informative, and relevant, but also that the cards can be used with laypersons for perspective-taking, creative ideation, and discussions. Thus, analyzing and/or comparing the experience of different types with the help of the ACS provides a unique approach to the consideration of the attendant perspective in the research and development process. Limitations of the present research and opportunities for future tool applications are discussed. In addition to establishing this concept in HCI, we also see potential in the transferability to other areas and contexts such as the design of public space or non-technological products.

Keywords: Human-Computer Interaction; technology experience; attendant; user; card set; research and design tool; public space; social context

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1. Introduction

Due to the rapid rate of innovation and widespread integration of technology, technical products are nowadays have become intertwined with our daily experiences. Interactions with technology have become an inherent part of numerous activities in the public space from moving around or working to communicating with people. Even when we are not users of the technology ourselves, i.e., we do not directly interact with the technology, we are, nonetheless, affected by its presence as passive viewers or listeners. Thus, it is important to recognize that designing only for the needs and preferences of users is insufficient. To truly enhance or shape public technology experiences in a positive way, a human-centered design approach is essential. This includes another group of stakeholders in public technology interactions: the attendants, i.e., individuals who are co-experiencing another user's interaction with technology [1].

The first launch of the Google Glass is a good example of how neglecting to consider the attendants' perspective can lead to design and product failures. Attendants reported issues such as privacy invasion and interference with social interactions [2,3]: "The Google Glass feature that (almost) no one is talking about is the experience—not of the user, but of everyone other than the user." [4]. The term "Glasshole" for users of this early AR glasses product spread quickly in public and in the media, underlining the importance of considering the perspective of those co-experiencing the use of a particular technological device.

Some even argue that attendants represent "the largest stakeholder group" [5] (p. 2377). Neglecting the perspective of a group that is affected by technology (interactions of users) to such an extent is concerning and calls for a critical reflection of the user-centered design practice in Human-Computer Interaction (HCI) research. The present research questions the popular design practice of only or mainly focusing on the needs and preferences of primary users by explicitly considering the attendant perspective. The overall aim is to enable positive experiences with/through technology for those (un-)voluntarily and (un-)apparently attending. To this end, a set of cards was developed to facilitate the description and analysis of attendant experience in the research and development process. The so-called Attendant Card Set (ACS) is supposed to stimulate critical thinking and encourage discussions and can thereby serve as a tool for design, evaluation, and ideation. We tested and optimized the ACS with the help of two studies: an online survey with experts and an in-person workshop with students. Results, such as the overall positive feedback of the experts and the fruitful discussions in the workshop, demonstrate the practical relevance and significance of the ACS. Ideas for further research directions are also presented. We start by explaining the importance of understanding and considering the attendant perspective in public technology interactions in the following chapter.

2. Theoretical Background

2.1. Attendant Role

First of all, why should we care about the attendant experience at all? To take up the example from the beginning, users reported how the experience of others present affected their own experience with the Google Glass: "Again and again, I made people very uncomfortable. That made me very uncomfortable." [6]. This is only one example of many illustrating an interdependency or connection of user and attendant experience. In fact, there are various studies showing that attendants both influence and are influenced by the user (technology interaction). For example, Gentile et al. [7] presented some insights on how others present can discourage users of public displays, and Von Terzi et al. [8] suggested that formerly public interactions with technology were experienced less positive when imagining the same interaction but without other persons present. Other authors investigated the effects of user interactions on attendants and revealed annoyance (e.g., [9,10]), disturbance (e.g., [11,12]) distraction (e.g., [13,14]), and embarrassment (e.g., [15,16]) as potential consequences.

So far, there is no systematic research on the attendant experience. HCI literature uses various terms for attendants of technology interactions, such as bystander (e.g., [17]), spectator (e.g., [18]), observer (e.g., [19]), passer-by (e.g., [20]), audience member (e.g., [7]), or Non-HMD (Head-Mounted Displays) user (e.g., [21]). Some authors, like Montero et al. [22], even utilize multiple terms within a single paper. The relatively few studies explicitly addressing the attendant perspective have a "narrow" research focus and can be grouped into two categories. The first category includes studies about the assessment and improvement of the technology or technology interaction, e.g., through social acceptability (e.g., [19,23]), but these are less about the attendant experience or its improvement. Those studies that explicitly address the attendant experience focus mainly on negative aspects, i.e., reducing or preventing violation of privacy (e.g., [5,24]). In the second category are studies concerned with turning attendants into users, i.e., by causing attraction or engagement (e.g., [25,26]). Indeed, previous research studies identified and tested various psychological effects in the context of user attraction and engagement [27], but what about those who cannot or do not want to participate, who cannot or do not want to be users?

We expand the focus of investigation and put the attendant in the center of our research work. For this, it is necessary to first understand who the attendants are in order to be able to better describe and analyze their experience in a next step.

2.2. Attendant Typology

Through an iterative development process, we created the Attendant Typology (AT) for a more precise operationalization of the social context or the others present in public technology interactions [1]. The typology distinguishes four types of attendants by means of two criteria. The two criteria are voluntariness of attending the user interaction (forced vs. voluntary) and conspicuousness of attending the user interaction (secret vs. obvious). The criterion of voluntariness describes the degree of felt self-determination, i.e., whether watching and listening to the technology interaction is the attendant's choice or they feel like the interaction is forced upon them. The criterion of conspicuousness describes the level of attention that is given to the attendant, i.e., whether or not they believe they can be identified as an "observer" by the user while watching or listening in on the technology interaction. The resulting four types are lurker, spectator, bystander, and witness (see Figure 1).

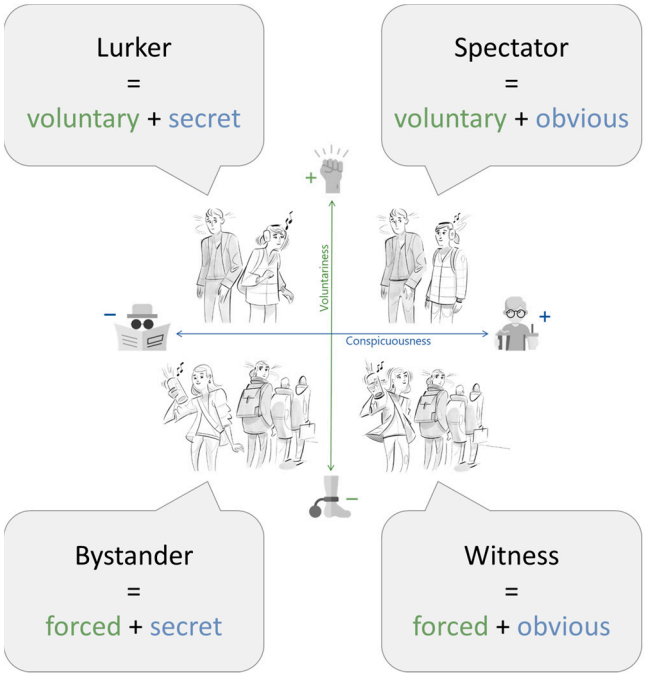

Figure 1. Overview of the four attendant types based on Von Terzi & Diefenbach [1].

In an online vignette study (N = 181) we ran a first experimental test of the typology. Participants were randomly assigned to one of four conditions or attendant types and were asked to evaluate their experiences in the imagined scenario. The study revealed notable differences in the experience patterns, emphasizing the need for design solutions that address the specific requirements of each attendant type [1]. Since we used a fictional use case in this first study, we were interested in whether the typology would also be applicable in the actual everyday experiences of people. Consequently, we conducted an explorative, qualitative interview study (N = 17) where we asked participants to recall a past attendant experience, followed by a few questions to help specify what aspects made this experience positive or negative. Lastly, each participant had to choose the attendant type that best described their role in the recalled experience. All four types were chosen multiple times (lurker: six, spectator: four, bystander: four, witness: three) underscoring the importance of differentiating the attendant perspective.

All in all, these studies not only provide valuable first insights into the attendant experience in public technology interactions but also stress the inadequacy of "one size fits all" design solutions. By recognizing and addressing the variations in experience patterns among different attendant types, researchers and designers can create technologies that meet the specific needs and preferences of individuals in different social contexts.

3. Attendant Card Set

As outlined in the previous chapter, considering the attendant perspective in contrast to the user perspective is an important topic in HCI research and practice. However, adequate tools and methods are still rare. To facilitate an easier and broader application of the developed attendant typology, we translated it into a card set (ACS, short for Attendant Card Set, see Figures A1–A4 in Appendix A for the final version). The card set is intended to enable the use of the typology in formats with greater practical orientation like workshops, focus groups, etc.

Card sets are an established, light-weight form of research and design tools in the HCI community. There are numerous types of card sets for different purposes and application domains, e.g., as repository tool or for participatory design (see literature reviews on design card sets of Aarts et al. [28] or Roy and Warren [29]). Many authors have commented on the value of such card sets, for example, Lucero et al. [30] naming them "tangible idea containers, triggers of combinatorial creativity, and collaboration enablers" (p. 92). As argued by Bekker and Antle [31], "[C]ard sets are a form of design tool that can be used to make conceptual information accessible to designers and can be used to support designers how they work in practice." (p. 2533). More specifically, they can inspire and enhance creativity in the design process [32]. They can encourage designers to take different perspectives, foster communication, empathy, and collaboration between designers and users, and can be used to solve a specific design issue [33].

The ACS (see Figure 2 for an example card) uses both, text and images, to illustrate the idea and characteristics of the attendant types so people can intuitively relate to the concepts. As with other card sets like Need Cards [34], PLEX Cards [30], Privacy Mediation Cards [35], or Wellbeing Determinant Cards [36], no specific professional or methodical know-how is needed to use the cards. Besides, the preparatory work is minimal, as participants can be introduced to the concept of AT with help of the introduction card (see Appendix A Figure A1). This can be done by a moderator or by the participants themselves. Our ACS bears a certain similarity to the method of personas, i.e., descriptions of prototypical users of a product through specific characters or profiles [37], which are frequently used in various fields such as marketing, product design, or software development. The difference is that in our case it is not about personality but role. To put it in the words of Ringfort-Felner et al. [38]: "While a personality describes general traits as they are, roles imply certain behaviors and conventions independent of the actual personality [. . .]. For example, mothers are expected to care, no matter whether they have a warm and caring personality or not; in the same way, a waiter is supposed to be friendly, no matter whether he is an introvert or has a bad day. Roles are more crucial to shape emerging relationships and expectations than personality." (p. 3).

The ACS offers a practical tool for gaining a deeper understanding of the complexities of attendant roles and for incorporating the attendant perspective into the research and development process. Typical usage scenarios we have in mind are, for example, analyzing and comparing a public technology (interaction) from the perspective of the different attendant types, or exploring ways to improve or create innovative technological product ideas by considering the perspective of a specific attendant type. In other words, the ACS can serve as an evaluation, design, or ideation tool, promoting social and context-aware design solutions or technologies. Concrete examples of use cases for the cards include applying the ACS to design mobile technology interfaces that support or help to avoid the "participation" of attendants in the user interaction. Another example is using the ACS to inform users of public displays about the perspective of different attendants on their interaction and explore appropriate interaction forms to fulfill social needs for popularity or relatedness. Broadly, the ACS can be used in two ways:

1. explorative: e.g., by using the cards as impulses, to plunge into the attendant's world of experience, or to invent new product concepts based on attendant types not yet considered

2. directed: by starting from a specific technology (interaction) or usage scenario and exploring the solution or design space with the help of the cards

The ACS was developed in an iterative process in which we critically reviewed and improved its applicability with the help of two studies. These studies are described in more detail in the following.

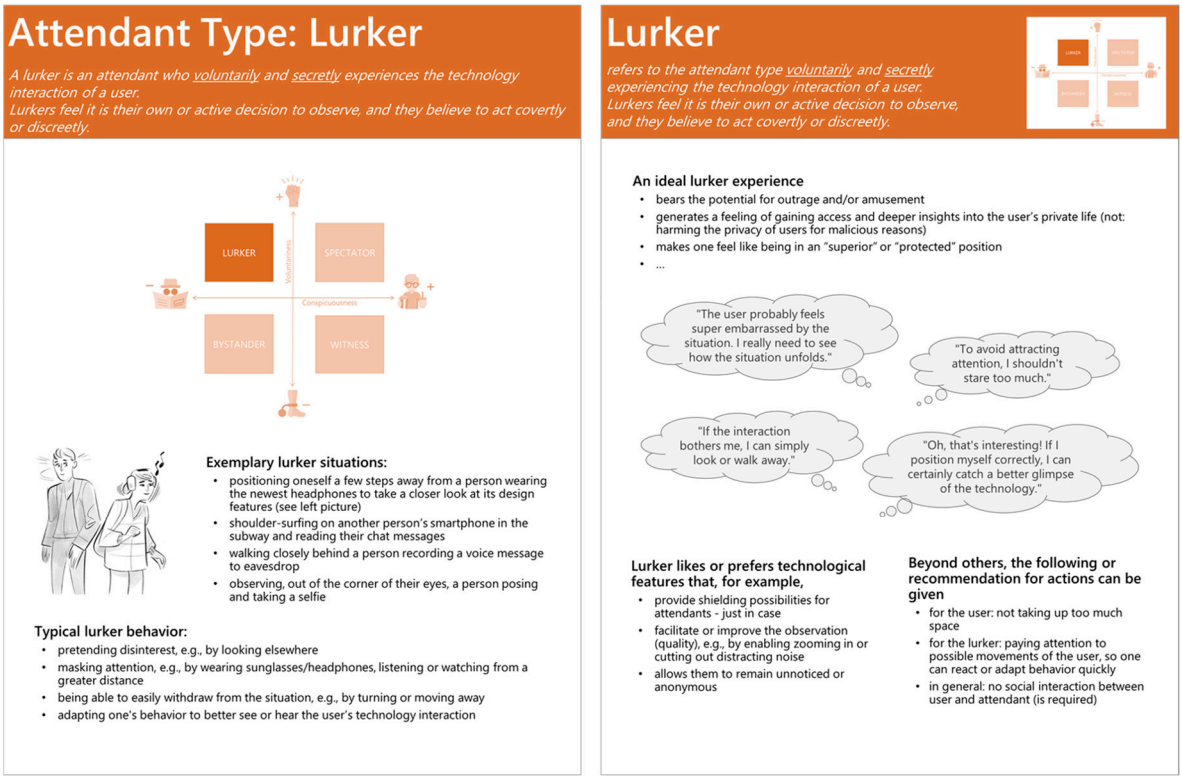

Figure 2. Front (**left**) and back (**right**) side of the lurker card.

4. Application and Refinement Studies

We first conducted an expert study (N = 11) to test and optimize the ACS, followed by a student workshop (N = 5) with the revised version of the ACS. In this chapter, we present the procedure and results of the two studies, i.e., discuss how the ACS was used and adapted.

4.1. Expert Survey

We structured the expert study into two parts: solving a specific research/design task (part A) and giving feedback on the card set (part B). With this structure, we hoped to not only gain a first impression of whether the card set would work and in which way it worked, but we also hoped to identify improvement potential and assess the practical relevance of our ACS.

4.1.1. Method

The questionnaire combined open (qualitative) and closed (quantitative) response formats. Except for the demographic question about gender, the closed format used a 5-point scale ranging from 1 (low/disagreement) to 5 (high/agreement). Thirteen participants were recruited via email, four males and nine females aged between 23 and 38 years (M = 29.62, SD = 4.33). These practitioners had experience and expertise in HCI (M = 4.31, SD = 0.95), psychology (M = 3.54, SD = 1.33), design (M = 3.31, SD = 1.25), and research (M = 4.38, SD = 0.65).

The study employed a randomized design wherein each participant was assigned to work with one type/card. The procedure consisted of two parts: part A involved testing and using the cards, while part B focused on gathering feedback related to the participants' user experience with the cards. More specifically, in part A the participants were instructed the make themselves familiar with their card and then reflect on how an ideal experience would look like, how they could satisfy or protect their interests in the role of that specific type, and which technological features and functions might enable a positive attendant experience. The expert feedback in part B included an assessment of the ACS quality on a 5-point scale, but also open-ended questions such as if and what information the participants did miss or which aspects of the cards they disliked or found difficult. Lastly, we asked participants to provide some demographic information. The complete questionnaire can be found in Supplementary Materials (see Table S1). The completion of the online questionnaire took the experts approximately 45 min.

4.1.2. Results

The analysis of the qualitative data collected in part A provided some valuable insight. First, all participants were able to solve all tasks or answer all three questions with the help of the cards (i.e., no missing data). Second, the content of the participants' answers differed between the conditions. For example, participants working with the card of an obvious attendant type, witness, emphasized that being recognized was ideal because it allowed them to directly interact with the technology user in question: "[. . .] I did not have to intervene explicitly by saying that she is really loud and asking her to calm her voice. [. . .] she understood the way I looked at her". Participants in the lurker condition, on the other hand, emphasized that remaining unnoticed was of central importance when asked about an ideal experience: "[. . .] I would be much more comfortable, not worrying about the need to explain myself [. . .]". This shows that the cards provide diverse insights into the attendant perspective and thus emphasizes that a nuanced distinction between the other participants in the technology interaction is necessary. Since the participants' answers to the three open questions also provided deeper insights into the attendant experience, they were consequently used as inspiration for improving the ACS. For example, we included participant ideas regarding technical features that would enable a positive attendant experience in the revised version of the ACS.

Analyses of the qualitative and quantitative data from part B of the questionnaire showed an overall positive experts' assessment of the ACS. All of eight items capturing the cards' utility received mean scores of $\geq$3 on a 5-point Likert scale ranging from 1 (strongly disagree/not at all) to 5 (strongly agree/extremely). This shows that the experts liked the cards, see Figure 3.

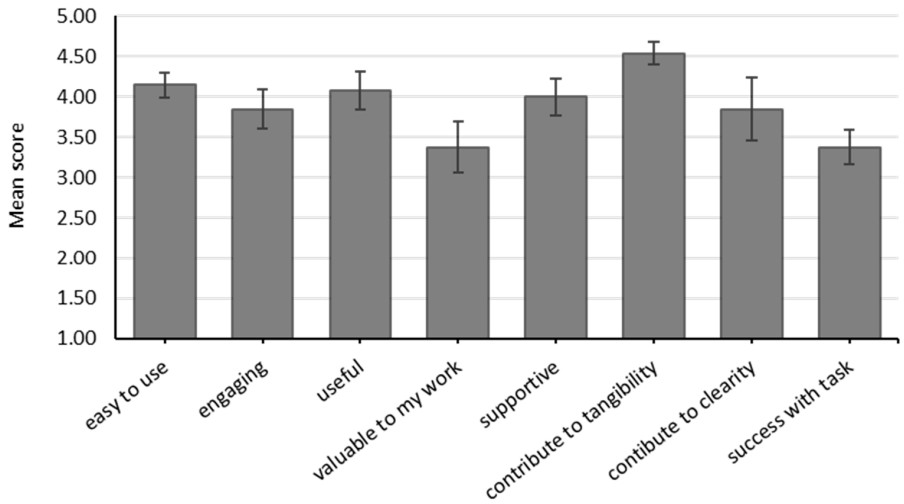

Figure 3. Mean scores of all eight items to show the quality of the ACS. Error bars show standard errors.

This impression is further reinforced by participants' answers to the open questions regarding what they found particularly helpful, missed, or disliked in the cards. Experts stated, for example, that they especially appreciated the sketches, the overview of the types, the background information regarding the typology, the concrete and non-obvious example situations, as well as the quotes. Eight of the thirteen participants found nothing amiss when using the cards. The input of the other five experts corresponded to their responses when asked about possibilities for improvement and the features they disliked or found difficult. For example, one participant missed the perspective of the primary user and suggested to include their perspective. Another expert asked for sample scenarios in virtual environments. Most of the experts' improvement suggestions related to visual or design aspects like less text, reducing the quantity of information, a more aesthetic font, or an alternative arrangement of the elements on the card.

For the revision of our card set, we did not only include the explicit suggestions for improvement but also examined all participant responses from part B carefully and applied them as far as considered reasonable. In the end, the following changes were made to improve design and ease of use: (1) information on the front and back side of each card, (2) a clearer layout, and (3) additional information. To improve the layout of the cards, we changed the font and rearranged the sketches, quotes, and text blocks. The newly added information included, for example, an instruction card that gives an overview of all four types and explains how to use the ACS and textual descriptions of the sketches.

Further interesting insights relate to the experts' experience with similar tools. Eight participants have worked with a card set before, for example, in the context of design thinking, collaboration, creative imagination, scrum process, or card-sorting tasks. These experts had used card sets like Need Cards [34], Interaction Vocabulary Cards [39], or the digital card set "Laws of UX" (User Experience) [40]. However, none of the experts knew a tool to capture the social context in (public) technology interactions. Furthermore, when asked about work situations where they might use the cards in the future, nearly all experts could think of potential use cases like evaluation of a product idea or UX of a technology, prototyping, user testing, interviews, categorization of user groups, in ideation process for architects or designer, or game design—just to name a few. One expert suggested that the ACS not only can be used to take and understand the perspective of the attendant but also to assess a technology/interaction from a user perspective when a specific attendant type is present.

4.2. Student Workshop

The student workshop was designed with the aim of testing the cards' applicability in a face-to-face setting with people who have no specific practical know-how, i.e., under conditions that we consider typical and realistic in practice.

4.2.1. Method

The five participants of the workshop (four females, one male; aged between 22 and 38 years, M = 26.20, SD = 6.65) were all psychology students in a master's program and had no design or research expertise. The workshop lasted for about 75 min and was divided into the following phases: warm-up, theoretical input, and practical tasks.

In the beginning, participants were asked to report and reflect on their most memorable experiences in an attendant role, i.e., when they listened to or watched the technical interaction of a stranger and why. In doing so, participants were expected to become acquainted with the topic and aware of differences in the attendant perspectives. Following the warm-up, we explained the idea of the AT and ACS to the participants. Then, each of the participants was assigned to one specific attendant type and given some time to familiarize themselves with the corresponding card.

The last phase of the workshop consisted of several practical tasks which the participants performed individually. First, we asked the participants to take the perspective of their assigned attendant type and think about how a user interaction with a smartphone

might be experienced from this perspective. The scenario could be fictional or a situation from their own experience. Each participant created a sketch of this experience and later explained it to the group. This allowed us to make sure that all participants had read their cards carefully. For the second task, participants had to analyze which psychological needs (i.e., autonomy, competence, meaning, popularity, relatedness, security, stimulation) would be most important for their attendant type and why. They had a few minutes to make some notes and then, one by one, put sticky dots on a flipchart after the corresponding needs and were asked to explain their reasoning. The third task was related to user behavior and contact. We asked participants to reflect on (a) how a user would behave in a scenario where they were surrounded by their attendant type, (b) the conceivable user-attendant contact, and (c) how the specific type should behave so that their behavior would be experienced as positive or pleasant for primary users. Last but not least, participants assessed the relevance of Civil Inattention (CI) for their respective type; CI being the practice of signaling people that you have noticed them but are not particularly interested in them or what they are doing in order to keep a polite distance [41].

After each task, participants were instructed to discuss their impressions and ideas. By comparing the four types in a group discussion, participants explored differences and similarities in the attendant types regarding needs, desired level of user contact, and socially acceptable attendant behavior.

4.2.2. Results

Task 1 was aimed at immersion into the perspective of the respective types to appreciate possible thoughts and behavior. On this base, participants created sketches of a user interaction with a smartphone from the perspective of their type using the assigned cards. For example, one participant described their sketch to the group as a situation where they sit on the train and were happy to secretly read the "spicy messages" of another person.

In task 2 and task 3, participants first analyzed the perspective and experience of their type individually, and afterwards engaged in a group discussion to compare the different types. This allowed them to identify differences and similarities in the scenario of attending a user's smartphone interaction in public. In task 2, participants determined the needs relevant to their attendant type. For example, participants in the lurker condition stated that, for their type, competence is the most relevant need and could be satisfied by secretly gathering information about the user, thereby gaining a sort of knowledge advantage. For the spectator, in addition to autonomy and stimulation, one of the participants mentioned relatedness as a relevant need. In their opinion, the observation situation felt like a shared experience, something that the user and attendant experienced together. As bystander, the need for security can play an important role. Since most usage situations seem unpredictable to them, gathering information through secret observation was seen as a way to assess the user and enable an appropriate reaction. In addition to the satisfaction of the need for stimulation and relatedness, participants explained that autonomy is important. According to them, as a bystander, the need for autonomy is violated because one cannot freely decide what one sees or hears. The participant in the witness condition declared relatedness, stimulation, and security as relevant needs. The need for security, was explained as being certain of not doing something unwanted when observing the user or their interaction since the user was aware of the witness's observation and could just adapt the technology interaction accordingly. The group discussion on the participants' choices revealed that some of the need-type assignments were considered critical. For example, regarding the need for relatedness, the participants concluded that for the secret types, lurker and bystander, it is rather a kind of one-way relatedness. In such situations, since the user is unaware that the attendant acquired private knowledge about them, the feeling of relatedness cannot be mutual. Regarding the need for stimulation, participants discussed that this aspect mainly motivates the voluntary types whereas, for forced types, stimulation only plays a role in making the situation more bearable.

In Task 3, participants reflected on user behavior and contact and described with the help of their card what socially acceptable attendant behavior might look like. The group discussion revealed user attitude to be one of the most important differences in user behavior towards the four types. For example, participants discussed that the user would act "clueless" in a lurker situation, whereas, in a spectator situation, the user simply might not care enough to hide or change their behavior. Furthermore, participants agreed that even with forced attendant types, the users often don't act with a bad intention of imposing themselves or their technology interaction but, for example, "do not pay attention to what the others present are doing" (witness) or "do their thing" (bystander). Participants suggested that depending on the attendant situation, the user might actively ignore any witnesses, as opposed to simply being too absorbed to notice any bystanders. Regarding user contact, participants agreed that even though interaction with secret types would be rare, attendants would be open to step in, if necessary. For obvious types, eye contact was deemed the most common form of interaction between user and attendant. In the discussion on socially acceptable attendant behavior, participants identified some differences between types but also similarities. For example, as spectator, it would be important not to act too intrusively and to give the other person enough space, i.e., to signal openness for social contact only through facial expressions and gestures. Similarly, as witness, one should not stare too much. In case the user or their technology is disturbing, the witness might communicate it to the user while keeping this social interaction as short as possible. For both obvious types, it seems to be important not to take up too much of the user's time and space. The question of which party could or should initiate the verbal contact was answered differently for each type. While it was deemed okay for a witness to approach the user directly, a spectator should wait for the user to make the first move. In case of a bystander, the user should not be disturbed in their technology interaction and even eye contact should be avoided. For lurkers, participants stressed the importance of the attendant apologizing and explaining if caught observing. Lastly, participants discussed the relevance of CI for the different types and concluded that signaling to the user "I see, but I am not watching you" might be helpful or important for all types except the spectator. For instance, one participant suggested that lurkers might be more successful in observing a user, i.e., following their technology interaction undisturbed, by pretending not to be interested. For the witness, CI is relevant for another reason. By making brief eye contact with the user and (mutually) confirming that one has noticed the other, witnesses can ensure that contact is possible in case necessary, e.g., if the technology interaction became disturbing.

5. Discussion and Future Work

The results of the application and refinement studies show that the ACS provides a valuable approach to exploring the attendant perspective. Its value and usefulness are not only affirmed by the overall positive feedback (mean scores ≥ 3) of the experts on the ACS but also by their creative ideas on ideal experiences, attendant (re-)action possibilities, as well as technological features and functions. The results of the workshop show that the cards can be used for imagining the perspective of an attendant (type) and, thereby, analyze type-specific characteristics and preferences. They can also be used for comparing types to uncover similarities and differences, e.g., with regard to needs, social acceptability, etc. That way, the ACS can serve both as a design tool and a research tool. As a design tool it might serve as inspiration or to help ensure the explicit consideration of the attendant experience(s) in the design of a technology or technology interaction. As a research tool, it enables reflection on the role and perspective of attendants in technology interactions.

The ACS can be used by both experts and laypersons for assessing, improving, or creating public technology experiences. For example, in the expert survey, participants not only reported that it was engaging and easy to use but also that it allowed them to successfully complete the design/research tasks. No difficulties were observed when the card set was used by the laypeople in the workshop.

We suggest that the ACS offers a unique approach to mapping the social context or other people present as none of our experts knew about a similar (design) tool. Moreover, they suggested a couple of example scenarios for how they could use the ACS in their everyday work—beyond the use cases we described in the online study. The analysis of the quantitative data also shows that the experts think of the ACS as useful, supportive, and informative.

When talking about the opportunities to enhance the design and use of design cards, Hsieh et al. [42] stated that "[. . .] we need to explore ways to better communicate the value of design cards and lower barriers for using these cards." (p. 13). Therefore, we consider the fact that the value and contribution of the ACS to the HCI community is precisely described in this work as well as on the instruction card a major strength of our ACS. Besides, the cards are not only engaging and easy to use (see expert study), they also require no prior knowledge (ACS was used in workshops by laypersons without any problems). Lastly, using the ACS needs minimal preparatory work. For instance, it took less than 10 min to introduce the idea of the ACS to the workshop participants. In the expert study, a brief written introduction was sufficient.

This research comes with a few limitations that need to be addressed. First, we used relatively small sample sizes in our application and refinement studies as we followed a qualitative (workshop) and mixed (expert survey) approach. However, this is not uncommon, nor are large sample sizes considered critical for such formats, see [43]. A suggestion for an experimental study with a larger sample size could be to explore statistically significant group differences between the four attendant types. For example, by instructing participants to take the perspective of a specific type with the help of the ACS and assess a technological product with the help of quantitative measures, such a study could show if a technology is more or less "suitable" for particular types. Furthermore, the focus on European participants with higher educational levels may limit the generalizability of the results. Thus, conducting studies with a more diverse sample of individuals with varying backgrounds and experiences (e.g., engineers or marketing experts) and exploring how the ACS can support the later design stages (e.g., prototyping and implementation) would be logical next steps. Future research could also explore the application of the ACS in diverse cultural contexts, and thereby assess if cross-cultural differences exist or if modifications or supplemental types/cards would be needed for other cultures. Moreover it is very likely that in the real world, attendants will not only find themselves in the role of one single type but could be expected to transition from one type to another (see e.g., "roles are dynamic" [38]). Therefore, field experiments or observations investigating the transition from one type to another and its impact on the attendant experience are an interesting future research direction. Last but not least, we do not address interdependencies between attendants and users in our ACS. Future studies exploring user perception and emotions regarding a specific type of attendant are needed to allow an integration and expansion of the ACS with user-attendant dynamics. Moreover, experimental and observational studies should also explore more complex usage situations with multi-user and/or multi-attendant situations in the future as interdependencies might change or differ when there are multiple stakeholders.

We see great potential in the ACS, for two main reasons: (1) the systematic implementation of the attendant construct into HCI theory and practice and (2) the transferability of the ACS to/in other fields; from which we derive further recommendations for future research directions. First, a wider application of the ACS would support successfully establishing the construct in HCI. For example, future studies could integration and combine the ACS in and with other design methods (e.g., design thinking or role-play) or tools (e.g., need cards). Furthermore, the ACS can be extended by additional types/cards in accordance with the typology (see [1]). Following Aarts et al. [28] suggesting the creation of open-ended card sets, the possibility to expand the ACS in line with new research insights enables continuing flexibility and progress. Second, the transfer of the ACS to other fields, such as hybrid collaboration or urban planning, presents exciting opportunities. For example, one could

consider the attendant as an additional stakeholder (next to users) when developing video conference systems, or one might explore the role and perspective of attendants in smart cities or Pervasive Computing Environments (PCEs). Analyzing the attendant experience in such environments might lead to, e.g., new insights regarding non-use or techno-stress in physical spaces.

Since we focus exclusively on technology, testing the applicability of ACS for non-technical interactions, such as the act of riding a bike, could be an interesting distinction in user versus attendant perspective. By considering non-technical interactions and acknowledging the user-attendant dynamics within them, a more comprehensive understanding of public experiences with products of all kinds could be achieved.

6. Conclusions

People co-experiencing, i.e., watching or listening, both influence and are influenced by the user interaction with technology. As technology becomes increasingly embedded in public spaces, it is essential to adopt a human-centered design approach that also acknowledges the role and experience of the attendants in public technology interactions. This research has presented the so-called Attendant Card Set as a valuable tool for stimulating conscious reflection and consideration of the attendant perspective in the research and design process. Results of the application and refinement studies show, for example, overall positive feedback from experts regarding the ACS and its use. The card set also facilitated fruitful discussions and interactions between laypersons in an in-person workshop. More specifically, experts not only rated the ACS as, inter alia, easy to use and supportive. They also saw the potential of using the cards for their work and suggested a couple of interesting future use cases for the cards. Furthermore, the ACS enabled students to take and compare the perspectives of the four attendants, thereby identifying similarities and differences, e.g., regarding need satisfaction or socially acceptable attendant behavior. The present work challenges how we currently design technology in HCI. However, it can only be the first step. Future studies, on the one hand, should focus on the establishment in HCI theory and practice, e.g., by using the ACS in experimental studies with greater sample sizes or prototyping sessions in companies. On the other hand, the transferability and application of the ACS in other domains and contexts, e.g., urban planning or multi-user workspaces, are promising research directions. Considering the attendant perspective will lead to more holistic and inclusive design practices—in all kinds of areas.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/mti7110107/s1, Table S1: All Items of the expert survey.

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Appendix A

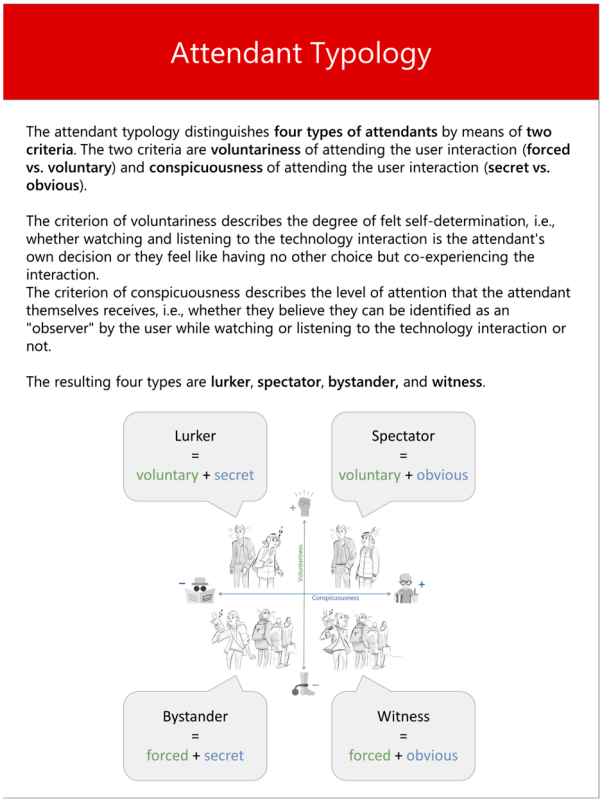

Figure A1. Introduction card of the ACS.

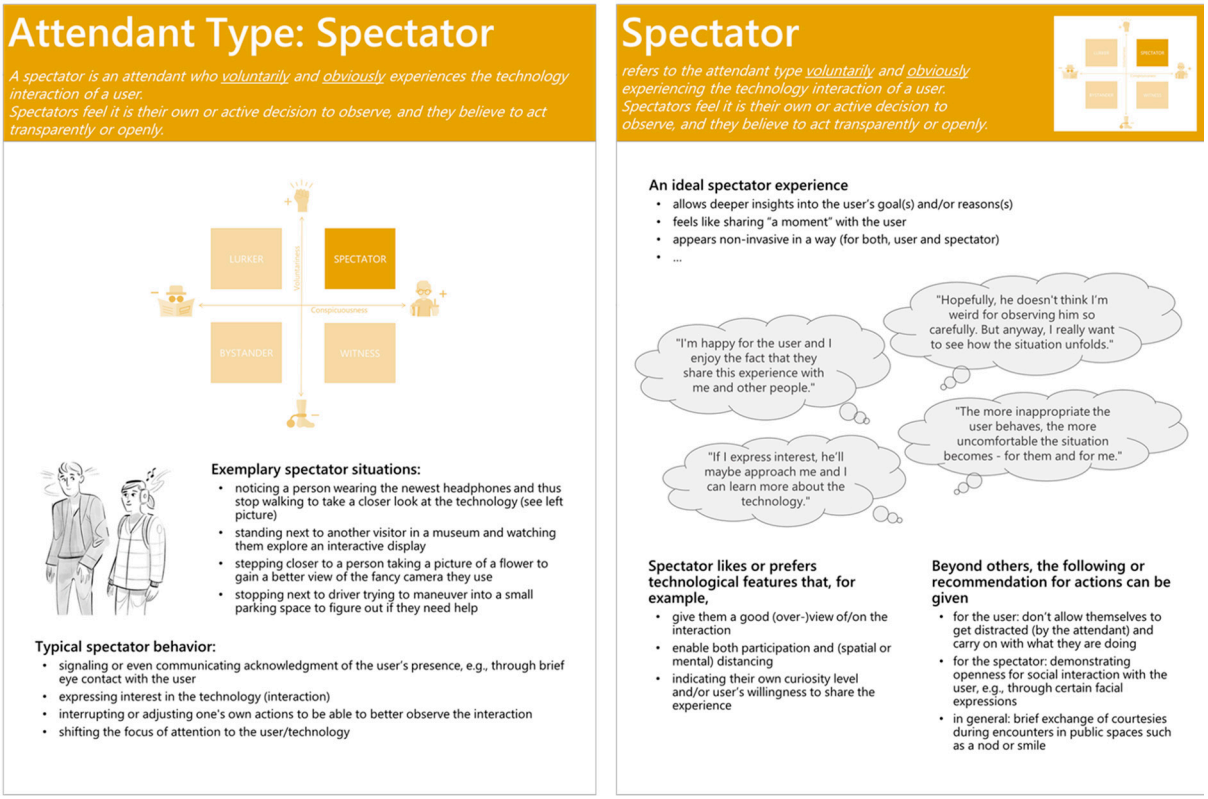

Figure A2. Front (**left**) and back (**right**) side of the spectator card.

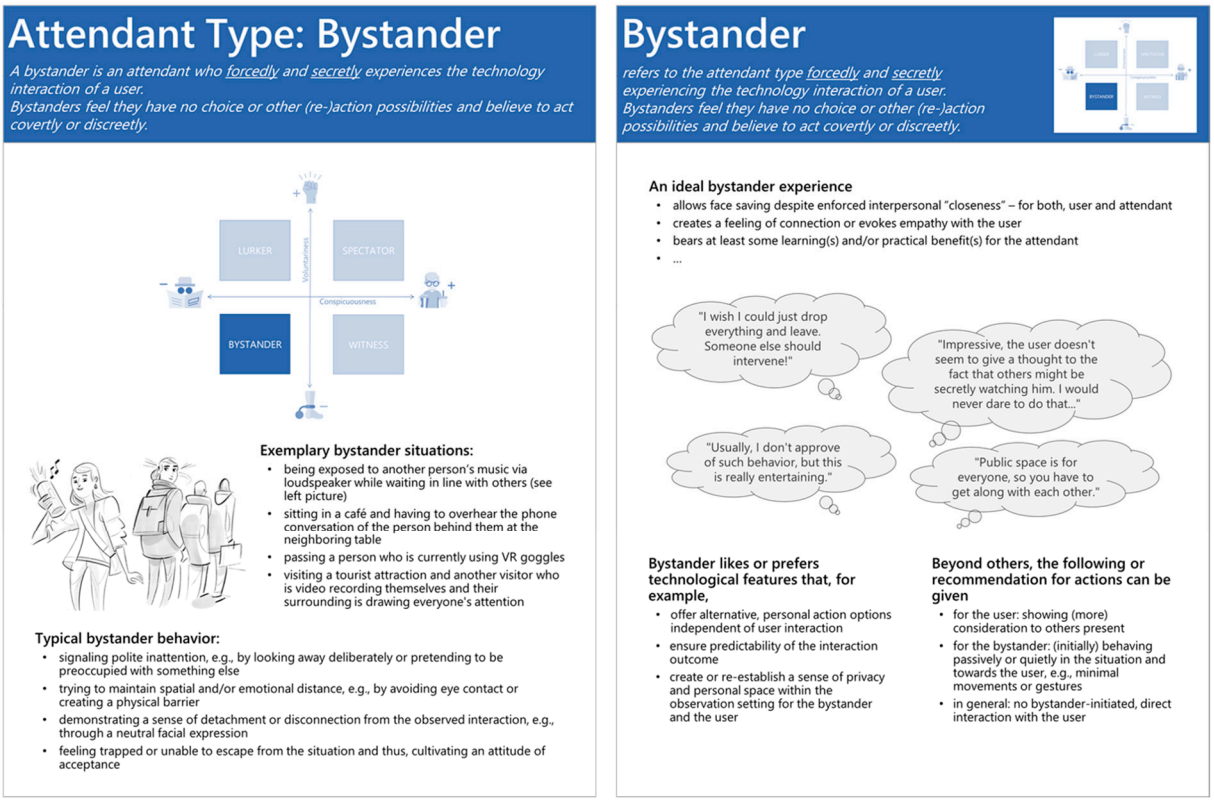

Figure A3. Front (**left**) and back (**right**) side of the bystander card.

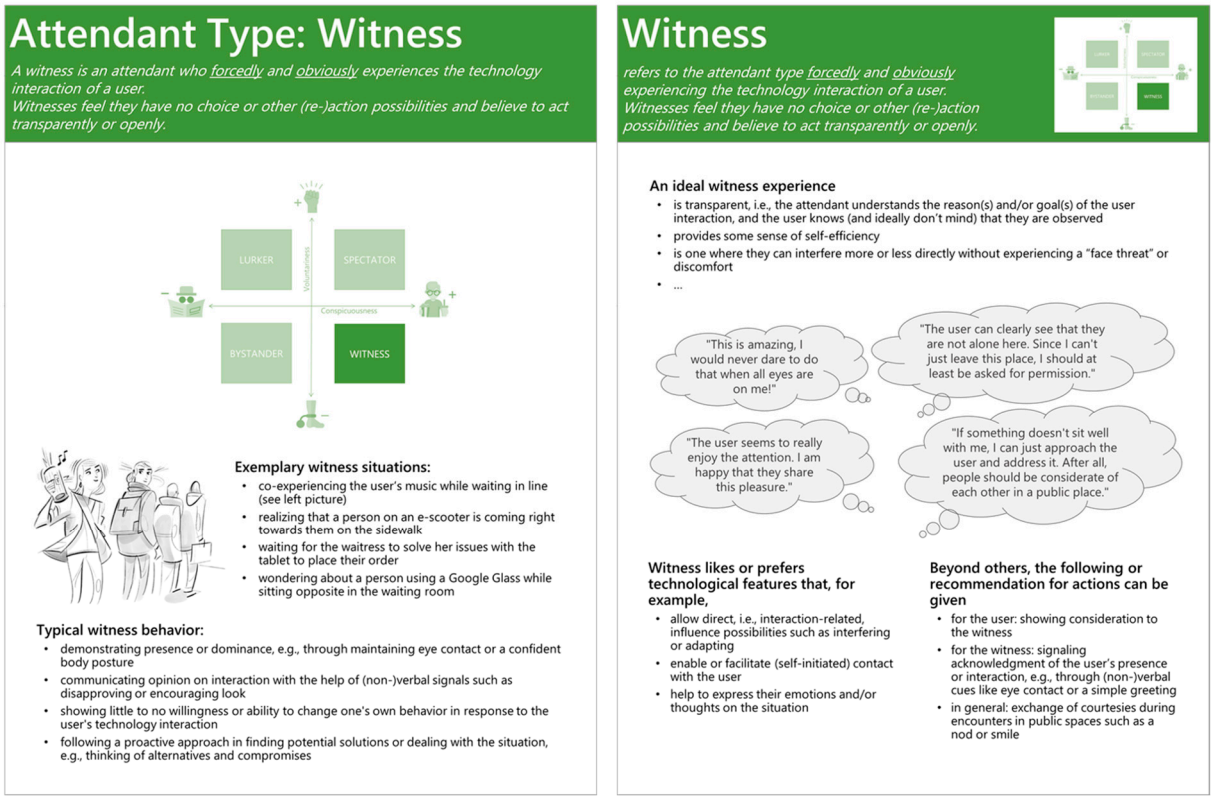

Figure A4. Front (**left**) and back (**right**) side of the witness card.

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