Foregrounding Algorithms: Preparing Users for Co-design with Sensitizing Activities

OSCAR ALVARADO, Department of Computer Science, KU Leuven, Belgium
ELIAS STORMS, Mintlab, Faculty of Social Sciences, KU Leuven, Belgium
DAVID GEERTS, Mintlab, Faculty of Social Sciences, KU Leuven, Belgium
KATRIEN VERBERT, Department of Computer Science, KU Leuven, Belgium

Algorithms are present in many of our everyday activities. However, there is generally low awareness of their presence among users, and there are various conceptualizations to define them. Additionally, algorithms are often both complex and opaque. These characteristics raise challenges when applying co-design activities to the interaction design of algorithms. We argue that researchers can overcome these challenges by developing *sensitizing activities*: activities that foreground the presence of algorithms, thus raising algorithmic awareness and a shared understanding, without influencing their initial experiences and expectations. We share how we applied sensitizing activities in two case studies: sensitizing interviews, and diary studies together with two-phase workshops. We share our experiences applying these techniques to overcome the challenges of low algorithmic awareness and multiple algorithmic understandings of participants. Finally, we offer recommendations for researchers and practitioners when applying sensitizing activities in this design context and invite further methodological discussion on this challenging topic.

CCS Concepts: • **Human-centered computing** → *Interaction design*; *HCI design and evaluation methods*; *Participatory design*.

Additional Key Words and Phrases: sensitizing activities; co-design; algorithms; interaction design

1 INTRODUCTION

Algorithms are involved in most of our daily activities and decisions [32], becoming publicly [12] and academically relevant because of the power they exert over users and societies [3]. Unfortunately, previous research has reported various ethical issues related to algorithms such as unjustified actions, opacity, bias, discrimination, challenges to user autonomy, and privacy [20].

Human-centered design in general and co-design in particular promote the active involvement of users in design [25, 26]. This approach could be applied in the research process to explore opportunities to reduce these issues and improve the interaction with algorithms. However, applying the principles of co-design to involve users in the interaction design for algorithms actively presents at least two main challenges: the low algorithmic awareness in the general population [10, 14, 15] and the multiplicity of understandings of the term "algorithm" [9, 13, 27].

We propose to explore "sensitizing activities" to overcome these challenges in the context of co-design for the interaction with algorithmic systems. We also present two case studies in which we applied two sensitizing activities: *sensitizing interviews* and sensitizing diary studies with two-phase workshops.

We reflect on these experiences and provide suggestions for researchers and practitioners who wish to apply a co-design approach to inform the interaction design of algorithms. Finally, we make a call for further research on methodological approaches to address the co-design of algorithmic interfaces. We hope this paper helps to highlight some of these pressing challenges in HCI and provides a departure point for further exploration of methods to engage users in this design context.

2 RESEARCHING ALGORITHMS VIA CO-DESIGN

2.1 Algorithmic systems as a research topic

Various areas of academic research have underscored the relevance of the investigation of algorithms and their impact on users and societies. Gillespie [12], for instance, discusses *public relevance algorithms* that select or exclude information, infer or anticipate user information, define what is relevant or legitimate knowledge, flaunt impartiality without human mediation, provoke changes in the behavior and practices of users, and produce calculated publics. Similarly, other researchers have advocated the study of those algorithms that semi-autonomously exert power without supervision from human counterparts [3, 32]. Other academic efforts have drafted extensive lists of the ethical issues associated with algorithmic systems, such as unjustified actions, opacity, bias, discrimination, challenges to user autonomy, privacy, and moral responsibility [20].

Because of their ubiquity and their social and political implications, research on algorithms and their interaction are highly relevant for both designers and academics. Fortunately, the field of Human-Computer Interaction presents various ways to confront this challenge, one of which is the active involvement of users during design activities.

2.2 Involving users through co-design activities

In HCI [26], and the social sciences [7], the idea of "co-creation" has gained traction over the past decades: people that used to be subjects of study are now active participants. Whether we call them users, citizens, consumers, or laypersons, researchers are now increasingly incorporating their voices and their experiences in the whole research process.

In both design research and design practice, this paradigmatic shift manifests itself in the evolution from a user-centered approach in general to a focus on co-designing in particular [26]. Here, co-design refers to "the creativity of designers and people not trained in design, working together in the design development process" [26, p. 6]. Sanders and Stappers [25, 26] situate co-design within a "participatory mindset", which sees users as partners and involves them as active co-creators throughout the design process. This viewpoint is opposed to the classical "expert mindset" which considers users as subjects, consumers, and reactive informers. In co-design, by contrast, users are considered "experts of [their own] experiences" who can be actively involved in the design process when given tools for expression and ideation [26]. While this brief introduction glosses over varieties and tensions within the broader field of human-centered design [29], here we want to use the term co-design to refer a "process of joint inquiry and imagination" [30] in which non-designers are actively involved in the design process.

Engaging users in the design process can be done in many different ways and at multiple stages in the design process. To illustrate these possibilities, we share three methods used by Lucero and Mattelmäki [19]. The first way is through a probes study. Design probes are tools for collecting user data based on the self-documentation of their experiences and needs. By giving them tasks

such as diaries and open questionnaires, researchers involve users in a collaborative exploration of solutions to the design problem. This technique can help to find "inspiration for ideas that were rooted in the real needs of a specific user group" [19]. The second way is to engage users more actively via co-design workshops, where they participate in design activities and exercises. Lucero and Mattelmäki argue that this method has multiple benefits: it creates an opportunity to analyze the previous design probes together with participants, it shows the technological possibilities of the participants to solve the design problem, and it invites them to co-design applications to provide a solution. The authors report that the "co-design sessions were successful in generating ideas that combine the needs of users, the intentions of the researchers, and the possibilities offered by the technology" [19]. The third way consists of prototype evaluations. Lucero and Mattelmäki used these to test a design iteration and gauge whether their solution was relevant to the users [19]. These evaluations consist of an introduction, a task, and a semi-structured interview to gather user impressions.

Active involvement of users in research and design depends on activities like the ones discussed above. When it comes to designing interaction with algorithmic systems, however, additional challenges emerge. In the next section, we discuss at least two main challenges that researchers and practitioners need to consider when starting a co-design process in this context.

3 THE CHALLENGE OF A CO-DESIGN APPROACH IN THE CONTEXT OF ALGORITHMS

Involving users in research on and interaction design of algorithms is not a straightforward endeavor for at least two reasons. First, the limited awareness of algorithmic intervention among the general population could hinder participants when engaging in co-design activities, and thus limit proposed solutions. Second, the multitude of ways in which the concept of "algorithm" is understood and used, even among technical experts, which could prevent a shared and unified notion of the design goal. This variety adds uncertainties and potential misunderstandings among those involved in co-design exercises. We further explore these challenges in the paragraphs below.

3.1 Limited awareness of algorithms

Recent work has highlighted the importance of studying how users experience and understand algorithms. Hargittai et al. [15], for example, call for more empirical studies into how users approach algorithmic systems and the extent to which they possess "algorithm skills". One challenge, they note, is "that there is not necessarily a ground truth to which researchers themselves are privy" [15, p. 3], as such systems are proprietary and rarely made public. Such limitations make it challenging to establish possible measurements of skills.

Previous research has tentatively measured the awareness of the existence of algorithms on social media platforms. In 2014, Hamilton et al. [14] assessed that less than 25% of regular Facebook users were aware of an algorithm curating their news feeds. Similarly, Eslami et al. [10] reported that less than 37.5% of participants in their experiments were aware of algorithmic filtering of their news feed. Furthermore, these researchers noticed that becoming aware of algorithmic intervention provoked feelings of anger, betrayal, and discomfort among participants. Other research has noticed that, when people are conscious of hidden algorithmic processes, this awareness often has an impact on how they behave online [5, 23]. While the precise level of "algorithmic awareness" is difficult to establish [15] and seems to vary considerably among populations [11], a necessary conclusion is that researchers and designers cannot take such awareness for granted.

3.2 The multiple meanings of "algorithm"

Besides a varied but generally low level of algorithmic awareness, previous research into algorithmic systems has also highlighted a particular challenge with this research topic: properly defining what an algorithm is in order to "fully grasp their influences and consequences" [3]. Gillespie [13], for example, has distinguished different understandings and uses of the concept of "algorithm". For instance, the algorithm can be a concept used by computer programmers to refer to a model that overcomes a particular goal, a synecdoche that refers to its broader socio-technical implications, a "talisman" when companies use it towards the public to avoid responsibility, or an adjective to describe a type of phenomenon such as "algorithmic journalism" or "algorithmic experience". These varied uses of the concept point out that "the algorithm" can have different meanings for different kinds of groups.

A variety of conceptualizations of algorithms also exist among technicians. In this context, Paul Dourish [9] argues that researchers should study algorithms in relation to their "others", including technical components such as automation, code, and system architecture. He advocates focusing on "algorithm" as a "term of technical art" used by members of a specific profession, and to explore how these actors use it. Responding to this call, anthropologist Nick Seaver [27] points out that even among technical experts and practitioners, the algorithm multiplies: it is not a single object but is rather enacted in many different ways, causing "the algorithm" to become "multiple" [cf. 21]. He notes that even at the level of engineering, "the algorithm" is everywhere and nowhere simultaneously. Algorithms, Seaver concludes, are "composed of collective human practices" and thus do not "heed a strong distinction between technical and non-technical concerns" [27, p. 5].

This diffuseness and heterogeneity of algorithms, even when technical experts use the term, adds to the challenge of involving participants in co-design activities that focus on the interaction design of algorithms. This difficulty needs to be taken into account for all research into algorithmic systems but poses a particular challenge for co-design workshops and related activities.

4 ADDRESSING THIS GAP WITH "SENSITIZING ACTIVITIES"

Both the limited and varied levels of algorithmic awareness among users and the multitude of meanings of the concept of "algorithm", pose challenges to the active involvement of participants. At the same time, it is precisely these varied stances and experiences that can be valuable for designers and researchers during the co-design of interaction with these systems. We, therefore, argue that it is crucial to find ways to subtly guide the attention of users in the preparation of co-design activities that inform the interaction design of algorithms. Researchers need to do this preparation without directly affecting the personal experiences and understandings of users with these systems.

In this context, the notion of "sensitizing" can help us develop such strategies. The idea is used here in a similar fashion to what sociologist Herbert Blumer presented as *sensitizing concepts*, a notion he proposed in the context of social theory. For Blumer, theoretical concepts first and foremost guide the attention of researchers, a quality he referred to with the term "sensitizing". These "sensitizing concepts" do not provide direct descriptions of phenomena, but "merely suggest directions along which to look" [4, p. 7]. His approach to theoretical concepts has been very influential in qualitative methodologies in the social sciences.

Within HCI, researchers have used "sensitizing" to refer to concepts that can foster attitudes and sensibilities in researchers and practitioners. Researchers have deployed "sensitizing concepts" to consider the consequences of proxemics in interaction design [16], to inform the design of systems that promote playful interactions with children [24], or to help designers consider the diversity of human needs when conducting user experience research [17].

Other HCI researchers have used the term "sensitizing" to define activities that involve specialists and end-users in the design process. In this context, researchers devise role-playing scenarios to sensitize and introduce different design teams to complex theories about museology [31], deploy "sensitizing techniques" to involve children in the design of serious games [28], or use sensitizing terms to guide those who experience, evaluate, and report on open-ended interactive art [22].

Based on these examples, we use the word "sensitizing" to denote a similar concept. In the scope of algorithmic systems in our everyday lives, we use *sensitizing activities* to refer to the *subtle efforts and exercises* via which researchers can sensitize participants to the existence of these algorithmic systems, and suggest a more unified understanding of what the algorithm is for the design context. Such activities prepare participants for more elaborate reflection on their own experiences and more direct engagement with "the algorithm" in subsequent co-design activities.

For our purposes, *sensitizing* does not entail theoretical concepts meant for researchers. It refers to hands-on activities meant for participants. Nevertheless, our use of *sensitizing* remains close to the way Blumer [4] used it: sensitizing refers to an observer becoming receptive to particular phenomena and their specific qualities. Sensitizing activities, then, are small tasks, and exercises participants carry out during or in preparation of co-design, to prepare them for further reflection on their experiences.

To the best of our knowledge, there are no published accounts of *sensitizing activities* in the context of the co-design of algorithmic systems, although there are academic examples that try to achieve similar results with preparatory exercises with their participants. For instance, in the context of algorithmic curation on Facebook, Alvarado and Waern [2] included "priming tutorials" in a co-design workshop. This tutorial explained to participants "how algorithms are used in several common apps", with a focus on Facebook. It seems that this explanation improved the understanding of the participants on how algorithms produce recommendations and select specific information, facilitating subsequent co-design workshops. A follow-up study also applied a similar technique[1].

While these priming tutorials can increase the knowledge of the participants, the directness of this approach increases the risk of directly influencing their original insights and experiences. Researchers and practitioners need to reduce this influence, mainly when we consider that the everyday experiences of participants are a crucial ingredient for fruitful co-design exercises [26].

A major methodological challenge currently unsolved, then, can be formulated as follows: *How can participants be subtly sensitized to the existence of algorithmic systems, so that their experiences can inform co-design activities for the interaction design with these systems?* In the remainder of this paper, we share our experiences addressing this challenge. We do so by discussing two different case studies, one on algorithmic news recommendations and another on algorithmic video recommendations. Without claiming a definitive methodological solution for these challenges, we hope that these insights provide a starting point for further reflection and methodological discussion on the topic.

5 EXPERIENCES FROM TWO CASE STUDIES

5.1 Sensitizing via interviews

In our first case study, our research group explored how middle-aged consumers of YouTube videos understand their video recommendations and which interactive solutions they would suggest in such an interface. The study took place in January 2019. After recruiting participants via social media and mailing lists, we interviewed 18 participants with a mean age of 43.88 (SD=7.04). Twelve participants were between 37 and 43 years old, three participants were between 47 or 50, and the remaining three participants were older than 50. The oldest participant in the sample was 60 years old. Since this selection of participants belongs to a generation that did not grow up with these

technologies, they possess a high risk of low algorithmic awareness. Therefore, we attempted to sensitize the participants before trying to address the research goals.

To this end, we opted to start our research with what we called a "sensitizing interview" with each participant individually. These sensitizing interviews consisted of common questions about the YouTube interface to trigger some reflection and awareness of the video recommendation system in the participants, such as: "Do you know you have video recommendations on YouTube?"; "Do you watch the recommended videos that appear on the landing page?"; "To which extent do you feel you understand why specific videos are included in your recommendations, and others are not?"; and "How much control do you think you have over the content that appears on your YouTube recommendations?".

After this sensitizing interview, we continued with a co-design exercise to determine design suggestions to improve the interface of the video recommender system. Given the scope of this paper, we will only briefly discuss this subsequent phase. The co-design exercise consisted of giving users some pens, markers, and other creative materials so they could draw their "improved version" of the interface, mostly centered on their concerns about the recommender system.

We allowed participants to visit YouTube during the entire exercise: during the sensitizing interview, the semi-structured interviews, and the co-design exercise. We consider that this is a suitable strategy to ensure that participants can remember or confirm their impressions about the algorithmic system during the process.

This sensitizing interview proved useful for the rest of the research project. It ensured algorithmic awareness among participants, helped to provide a more unified notion of the "algorithm" during the study, and thus improved our data collection process. During the co-design exercise, participants felt secure and willing to provide their notions about algorithms without restrictions. They even expressed their questions, criticisms, and doubts about the system. More details on suggestions and conclusions for this sensitizing technique will be shared later in the paper.

5.2   Sensitizing via a diary study and two-phase workshops

In 2019, our research group worked on an interdisciplinary research project about algorithmic news recommendations. Together with legal scholars, we set out to (a) empirically investigate transparency and accountability of news recommender algorithms, and (b) co-design an interface prototype that could make such algorithms more understandable to everyday users. In the context of this paper, we will focus on the second goal. We then organized co-design workshops where we invited users to reflect on their experiences and ideate new interface elements that could help increase transparency and legibility of algorithmic news curation.

As research suggests that only a minority of users are conscious of the algorithmic curation in social media feeds, we decided to take extra efforts to sensitize the participants. To this end, we (1) opted to split the co-design activities over two workshops with the same participants, and (2) created a diary exercise for participants in preparation for the first workshop.

Participants were recruited via a paid advertisement on Facebook and received a gift voucher as compensation for their time and efforts. We made sure to avoid technical terms such as "algorithms" or "recommender systems" during the recruitment process because we wanted to that recognition of this term would influence participation. Instead, we explained that we were looking for participants in a study that focused on increasing transparency on how news spreads on social media. In total, 11 people with various professional backgrounds (from finance, IT, engineering, and the cultural & social sector) and from different age groups (from 18 to 65 years old) participated in the workshops.

Diary study. In the five days leading up to the first workshop, the moderator assigned participants a diary exercise. This activity aimed to sensitize participants to the algorithmic curation system in their news feeds.

During this diary exercise, we asked them to take note of the news they encountered in their Facebook feeds. For the first five items they saw in their feeds, participants filled out a brief questionnaire via Google Forms. These questionnaires asked the participants to note the position of each item in the feed, how old it was, whether friends had previously interacted with it via likes or comments, and how well it connected to their interests. This approach was inspired by previous literature that explained how people became aware of their algorithmic selection and ranking on Facebook by noticing that items were not in chronological order [10]. By asking users to look at both the time of publication of an item and its position in the news feed, we subtly encouraged participants to reflect on the order in which items appear.

Feedback from the participants showed that we were successful in this regard. Afterward, we sent out a short survey to learn from their experiences. Overall, participants found the diary exercise useful and informative. One participant mentioned that it caused them to "think more consciously, for once" about what they encountered on Facebook. Another stated that it was "interesting to focus on which news appeared on Facebook and why [it appeared] in this particular order." Other participants also expressed that it helped them to prepare better for the subsequent workshop.

First Workshop. We paid additional attention to sensitizing during the first workshop. We first handed out printed versions of the own diaries entries of every participant and asked them to pick three items that stood out because of their position in the news feed. Next, a moderator mentioned that Facebook has a ranking system that determines how items appear. We did not go into detail and only mentioned that there is a system taking many factors into account, in order to come to a "relevancy score" for each item. For this part, the moderator used simple visuals from the Facebook press website.[1]

The workshop continued with a brainstorming exercise in break-out groups, during which the moderator instructed the participants to reflect on their news feeds and write down factors that Facebook might take into account when ranking the items. The participants later combined these insights into a single diagram via a collaborative affinity mapping activity [cf. 18]. During this exercise, the moderator invited the participants to make comments and reflect on the ranking factors they thought were influential. This exercise served as a complementary sensitizing activity and explored the "algorithmic imaginaries" [cf. 5] of the participants. The resulting insights were used later in the co-design activities during the second workshop.

Second Workshop and Co-design Exercise. In this phase, which we will only discuss briefly given the scope of the current paper, the moderator gave the participants co-design exercises. In small break-out groups, the participants collaboratively ideated suggestions of possible interface elements that could lead to an improvement in the transparency of personalized news recommender systems. At the end of this workshop, they presented their designs, shared and discussed goals and motivations, and voted on their ideas. In a later phase in the research project, these ideas served as input for low-fidelity prototypes which were qualitatively evaluated together with potential users.

In the end, the earlier sensitizing activities proved fruitful to make these co-design exercises work. By including a short diary study and a collective brainstorming exercise during the first workshop, we were able to let participants reflect on the algorithmic curation of their news feeds without

---

[1]We used screenshots from a video from the Facebook Newsroom, titled *News Feed Ranking in Three Minutes Flat*: https://newsroom.fb.com/news/2018/05/inside-feed-news-feed-ranking/ (last accessed on 4 May 2020). The screenshots did not show any of the factors taken into account but only suggested that a "relevancy score" is generated for each item.

asking them directly about their opinions. These activities helped to foreground the algorithms from the daily experiences of the participants in a subtle manner to not steer their opinions.

6 DISCUSSION AND CONCLUSIONS

In this final section we provide general insights for developing sensitizing activities. First, we reflect on the sensitizing activities in our case studies. We then share some points of attention for practitioners and researchers that are interested in applying sensitizing activities in future design processes. Finally, we provide an invitation to the HCI community to reflect on and share their own experiences when dealing with these challenges in developing co-design activities around the topic of algorithms.

6.1 Learning from our experiences

The power of sensitizing, we argue, is that it combines users' situated experiences and a general understanding of the presence of the hidden, more technical aspects of computing. In the context of algorithms, people develop "intuitive theories" [23] and "folk theories" [8], which implies that any reflexive exercises can influence the original perceptions of algorithmic systems in the participants. Therefore, sensitizing activities and similar techniques require careful deliberation by the researchers: they need to be subtle and not directly influence the original "algorithmic imaginaries" [6] of the participants. The focus needs to be on guiding attention without direct interference.

In the context of video recommendations, the sensitizing interviews we conducted resulted in an effective method to introduce an "algorithmic mindset" among participants, with questions that triggered their own and previously hidden experiences and understandings of the algorithmic system. After the study, participants expressed their appreciation of the interviews, as the technique focused their attention on the "recommender systems they encountered almost every day" and encouraged conscious reflection on these encounters. The sensitizing interviews also seem adequate to prepare participants for design exercises later in the study. Additionally, the sensitizing interviews helped us attain the research goals: to understand how middle-aged consumers of YouTube videos understand their video recommendations and to explore how they prefer to interact with such a system.

In contrast with the effort of organizing a diary study and two-phase workshops, sensitizing interviews require less preparation and are both more comfortable and faster to organize. As Hargittai et al. [15] remark, in-depth discussions, and interviews with users can also be useful to assess the understandings and awareness of algorithms in users. We, therefore, consider sensitizing interviews a useful, light-weight approach when it is more convenient to meet participants individually.

Adding diary exercise and splitting workshops into two phases, by comparison, is more time consuming, but seems to offer a more controlled and guided process to achieve the subtle sensitizing effects. Asking participants to keep a diary and answer short questions daily about their interactions with the system allowed them to pay close and unified attention to their own experiences. Through independent but guided reflection, these sensitizing activities prepared the participants for an active contribution during later co-design activities.

Likewise, organizing two workshops with the same participants provides additional time to sensitize participants to their everyday algorithmic interactions and experiences. For instance, in our first workshop, participants shared their experiences, while the second focused on the co-design activities aimed at the ideation of new interface elements. The two weeks separating the two workshops proved fruitful for the subsequent co-design activities: letting participants reflect during their usual consumption of the platform and encouraging them to share their experiences both during the co-design activities and during presentation and discussion of their designs. Moreover, we

wanted to uncover algorithmic imaginaries of participants, which required that we did not directly "explain" how the Facebook ranking algorithm works (assuming that we would, hypothetically, be able to do so), but rather provide cues of its presence so that participants could reflect from their personal experience. This dual focus ensured that our sensitizing activities were subtle and provided enough room for participants to reflect and deliberate on their own experience

We consider that both techniques, sensitizing interviews, and diary studies together with two-stage workshops, are approaches that deserve more exploration and application. These, and similar techniques or methods, require further evaluation to assess their effectiveness of foregrounding algorithms without affecting the initial understandings about algorithms of users.

6.2 Some Suggestions for Researchers and Practitioners

Based on our experiences with these case studies and further reflection on challenges and literature, we would like to share some points of attention when applying sensitizing activities in the context of the interaction design with algorithms.

The challenges of "already sensitized" participants. Some researchers might prefer not to apply sensitizing activities and instead recruit participants that already know about algorithms. This approach could be particularly helpful when researchers can easily find the opinions of users about algorithms and their implications in digital platforms or databases. For instance, previous studies have found interviewees who were already aware of the algorithms in Facebook [5] or Twitter [8], making them easier to be contacted and involve them later in the research.

We argue, however, that even when participants have already expressed some level of algorithmic awareness, applying sensitizing activities can still be necessary. As explained earlier, the multiplicity of concepts that the word "algorithm" encompasses could still entail some problems when engaging the participants actively for design solutions. Therefore, we consider it essential to make sure that participants also gain an understanding of what the algorithm is in terms of the research and design goals.

Be aware of potential biasing. Even if people might not be aware of algorithmic systems around them, it is very probable that they regularly encounter and engage with them in their daily lives. Likely, they have already heard about algorithms in the context of scandals about platforms collecting data, the ethical dilemmas with self-driving cars, or other related topics. Depending on the research and design goals, it might be essential to avoid influencing (and especially enlarging) such preconceptions as much as possible. We want to emphasize that sensitizing activities foreground the "algorithmic experiences" of participants, and they should not steer them towards a specific way of understanding algorithms. At the same time, misconceptions can hinder participation in co-design activities. Such challenges can be addressed at the start of the co-design workshop, rather than during preparatory sensitizing activities. The sensitizing activities themselves should focus on heightening the sensibilities of the participants without interfering with their conceptions of algorithmic systems.

Avoid the term "algorithm" during recruitment to focus on the experiences of the participants. As the term "algorithm" is fraught with connotations, mainly because of its full application and increased media attention, it can be a good idea to avoid using it during the recruitment process. Including this concept in the recruitment call, for example, might attract overly critical participants and can bias their ideas about the topic (as discussed above). Moreover, the goal of the co-design activities is often not "the algorithm" itself, but rather ways in which users engage and interact with algorithmic systems. It is crucial, then, that the sensitizing activities focus on the experiences of the participants, rather than on the possible preconceptions they might have. We, therefore, recommend avoiding

the term in all communications with possible participants, such as emails, posters, or other types of recruitment calls.

Attune the level of sensitizing to the research goal. The required level of sensitizing will depend on the goal of the research or design project in question. When the goal is, for example, to explore existing "algorithmic imaginaries" [5] or "folk theories" [8] and use these in design activities, sensitizing should merely guide the attention of the participants to their experience of automated systems. To be clear, in some conditions, researchers might even need to avoid any sensitizing activity explicitly. When evaluating an interface from a behavioral perspective, for instance, any form of priming participants, including sensitizing, is out of the question. If, on the other hand, researchers require the participants to engage directly with algorithmic systems during co-design activities, or when they are required to actively reflect on previous experiences so that they can provide inputs, sensitizing activities can play an essential preparatory role.

Be Creative. Since there are little formal methodological guidelines to follow when "sensitizing" participants, we encourage researchers and practitioners to explore and develop different alternatives, taking the above study cases as examples.

Developing sensitizing activities implies a reflection during which researchers and practitioners think of ways to make participants sensitive to their own experiences, thus foregrounding algorithms in preparation for further participation. The development of sensitizing activities, then, is inherently creative. We hope that more researchers will share their experiences creating such activities.

6.3   A call to further methodological discussion and reflection

Our exploration of the challenges involved in doing co-design in the context of algorithms and their interaction led to an important question: *How can we subtly prepare non-designers for active participation in co-design and research activities that can inform the interaction design of algorithms?* While we suggest using the notion of "sensitizing activities" to talk about such preparatory tasks and activities, we do not claim to provide a definitive answer to this methodological challenge. On the contrary: its methodological nature implies that HCI and related fields can only overcome this challenge through continued reflection and conversation between researchers. We hope to contribute to this ongoing discussion and invite scholars in design, HCI, communication science, and other related fields to share their methodological experiences with these challenges.

REFERENCES

[1] Oscar Alvarado, Vero Vanden Abeele, David Geerts, and Katrien Verbert. 2019. "I Really Don't Know What 'Thumbs Up' Means": Algorithmic Experience in Movie Recommender Algorithms. In *Human-Computer Interaction – INTERACT 2019. INTERACT 2019. Lecture Notes in Computer Science, vol 11748. Springer, Cham*, Lamas D., Loizides F., Nacke L., Petrie H., Winckler M., and Zaphiris P. (Eds.). Springer, Cham, 521–541. https://doi.org/10.1007/978-3-030-29387-1_30

[2] Oscar Alvarado and Annika Waern. 2018. Towards Algorithmic Experience. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems - CHI '18*. ACM Press, Montreal, Canada, 1–9. https://doi.org/10.1145/3173574.3173860

[3] David Beer. 2017. The social power of algorithms. *Information, Communication & Society* 20, 1 (2017), 1–13. https://doi.org/10.1080/1369118X.2016.1216147

[4] Herbert Blumer. 1954. What Is Wrong with Social Theory? *American Sociological Review* 19, 1 (1954), 3–10.

[5] Taina Bucher. 2017. The algorithmic imaginary: exploring the ordinary affects of Facebook algorithms. *Information, Communication & Society* 20, April (2017), 30–44. https://doi.org/10.1080/1369118X.2016.1154086

[6] Taina Bucher. 2017. 'Machines don't have instincts': Articulating the computational in journalism. *New Media and Society* 19, 6 (2017), 918–933. https://doi.org/10.1177/1461444815624182

[7] Dries Coertjens, Marlies Verhaegen, Bert Morrens, Anne Bergmans, and Ilse Loots. 2018. Cocreatie van kennis en beleid in complexe milieudossiers: welke rollen voor de (publieke) milieusociologie? In *Wetenschappers in actie: een publiek-sociologische benadering*, Frédéric Vandermoere, Ilse Loots, Anne Bergmans, and Peter Raeymaeckers (Eds.). Acco, 25–42.

[8] Michael A. DeVito, Darren Gergle, and Jeremy Birnholtz. 2017. Algorithms ruin everything: RIPTwitter, Folk Theories, and Resistance to Algorithmic Change in Social Media. *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems - CHI '17* (2017), 3163–3174. https://doi.org/10.1145/3025453.3025659

[9] Paul Dourish. 2016. Algorithms and their others: Algorithmic culture in context. *Big Data & Society* 3, 2 (2016), 1–11. https://doi.org/10.1177/2053951716665128

[10] Motahhare Eslami, Aimee Rickman, Kristen Vaccaro, Amirhossein Aleyasen, Andy Vuong, Karrie Karahalios, Kevin Hamilton, and Christian Sandvig. 2015. "I always assumed that I wasn't really that close to [her]". In *Proceedings of the 2015 CHI Conference on Human Factors in Computing Systems - CHI '15*. Seoul, 153–162. https://doi.org/10.1145/2702123.2702556

[11] Richard Fletcher and Rasmus Kleis Nielsen. 2018. Generalised scepticism: how people navigate news on social media. *Information, Communication & Society* 22, 12 (2018), 1751–1769. https://doi.org/10.1080/1369118x.2018.1450887

[12] Tarleton Gillespie. 2014. The relevance of algorithms. In *Media Technologies: Essays on Communication, Materiality, and Society*, Tarleton Gillespie, Pablo Boczkowski, and Kirsten Foot (Eds.). MIT Press, 167–194. https://doi.org/10.7551/mitpress/9780262525374.003.0009 arXiv:arXiv:1011.1669v3

[13] Tarleton Gillespie. 2016. Algorithm. In *Digital Keywords: A Vocabulary of Information Society and Culture*, Ben Peters (Ed.). Princeton University Press, Chapter 2, 18–30. http://culturedigitally.org/wp-content/uploads/2016/07/Gillespie-2016-Algorithm-Digital-Keywords-Peters-ed.pdf

[14] Kevin Hamilton, Karrie Karahalios, Christian Sandvig, and Motahhare Eslami. 2014. A path to understanding the effects of algorithm awareness. In *Proceedings of the extended abstracts of ACM conference on Human factors in computing systems - CHI EA '14*. 631–642. https://doi.org/10.1145/2559206.2578883

[15] Eszter Hargittai, Jonathan Gruber, Teodora Djukaric, Jaelle Fuchs, and Lisa Brombach. 2020. Black box measures? How to study people's algorithm skills. *Information, Communication & Society* (2020), 1–12. https://doi.org/10.1080/1369118X.2020.1713846

[16] Peter Gall Krogh, Marianne Graves Petersen, Kenton O'Hara, and Jens Emil Groenbaek. 2017. Sensitizing Concepts for Socio-Spatial Literacy in HCI. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (Denver, Colorado, USA) *(CHI '17)*. Association for Computing Machinery, New York, NY, USA, 6449–6460. https://doi.org/10.1145/3025453.3025756

[17] Anne Elisabeth Krüger, Sebastian Kurowski, Kathrin Pollmann, Nora Fronemann, and Matthias Peissner. 2017. Needs Profile: Sensitising Approach for User Experience Research. In *Proceedings of the 29th Australian Conference on Computer-Human Interaction* (Brisbane, Queensland, Australia) *(OZCHI '17)*. Association for Computing Machinery, New York, NY, USA, 41–48. https://doi.org/10.1145/3152771.3152776

[18] Andrés Lucero. 2015. Using Affinity Diagrams to Evaluate Interactive Prototypes. In *Human-Computer Interaction - INTERACT 2015*. 231–248. https://doi.org/10.1007/978-3-319-22668-2_19

[19] Andrés Lucero and Tuuli Mattelmäki. 2011. Good to see you again: Engaging users in design. In *DPPI'11 - Designing Pleasurable Products and Interfaces, Proceedings*. ACM Press, New York, New York, USA, 1. https://doi.org/10.1145/2347504.2347517

[20] Brent Daniel Mittelstadt, Patrick Allo, Mariarosaria Taddeo, Sandra Wachter, and Luciano Floridi. 2016. The ethics of algorithms: Mapping the debate. *Big Data & Society* 3, 2 (dec 2016), 1–21. https://doi.org/10.1177/2053951716679679

[21] Annemarie Mol. 2002. *The Body Multiple. Ontology in Medical Practice*. Duke University Press.

[22] Ann Morrison, Stephen Viller, and Peta Mitchell. 2011. Building Sensitising Terms to Understand Free-Play in Open-Ended Interactive Art Environments. 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, 2335–2344. https://doi.org/10.1145/1978942.1979285

[23] Emilee Rader and Rebecca Gray. 2015. Understanding User Beliefs About Algorithmic Curation in the Facebook News Feed. *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems - CHI '15* (2015), 173–182. https://doi.org/10.1145/2702123.2702174

[24] Stefan Rennick Egglestone, Brendan Walker, Joe Marshall, Steve Benford, and Derek McAuley. 2011. Analysing the Playground: Sensitizing Concepts to Inform Systems That Promote Playful Interaction. In *Human-Computer Interaction – INTERACT 2011*, Pedro Campos, Nicholas Graham, Joaquim Jorge, Nuno Nunes, Philippe Palanque, and Marco Winckler (Eds.). Springer Berlin Heidelberg, Berlin, Heidelberg, 452–469.

[25] Elizabeth Sanders and Pieter Jan Stappers. 2012. *Convivial Design Toolbox: Generative Research for the Front End of Design.* BIS, Amsterdam.

[26] Elizabeth B.-N. Sanders and Pieter Jan Stappers. 2008. Co-Creation and the New Landscapes of Design. *CoDesign* 4, 1 (2008), 5–18.

[27] Nick Seaver. 2017. Algorithms as culture: Some tactics for the ethnography of algorithmic systems. *Big Data & Society* 4, 2 (2017), 1–12. https://doi.org/10.1177/2053951717738104

[28] Gavin Sim, Matthew Horton, and Janet C. Read. 2016. Sensitizing: Helping Children Design Serious Games for a Surrogate Population. In *Serious Games, Interaction, and Simulation*, Carlos Vaz de Carvalho, Paula Escudeiro, and António Coelho (Eds.). Springer International Publishing, Cham, 58–65.

[29] Marc Steen. 2011. Tensions in human-centred design. *CoDesign* 7, 1 (2011), 45–60. https://doi.org/10.1080/15710882.2011.563314

[30] Marc Steen. 2013. Co-Design as a Process of Joint Inquiry and Imagination. *Design Issues* 29, 2 (2013), 16–28. https://doi.org/10.1162/desi_a_00207

[31] Annika Waern, Paulina Rajkowska, Karin B. Johansson, Jon Bac, Jocelyn Spence, and Anders Sundnes Løvlie. 2020. Sensitizing Scenarios: Sensitizing Designer Teams to Theory. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3313831.3376620

[32] Michele Willson. 2017. Algorithms (and the) everyday. *Information Communication and Society* 20, 1 (2017), 137–150. https://doi.org/10.1080/1369118X.2016.1200645